UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

Upper Canada
Planning &
Engineering Ltd.
3-30 Hannover Drive
St. Catharines, ON
L2W 1A3
Phone 905-688-9400
Fax 905-688-5274

UCC File: 2201

FUNCTIONAL SERVICING REPORT

450 RICE ROAD

CITY OF WELLAND
October 2024

INTRODUCTION

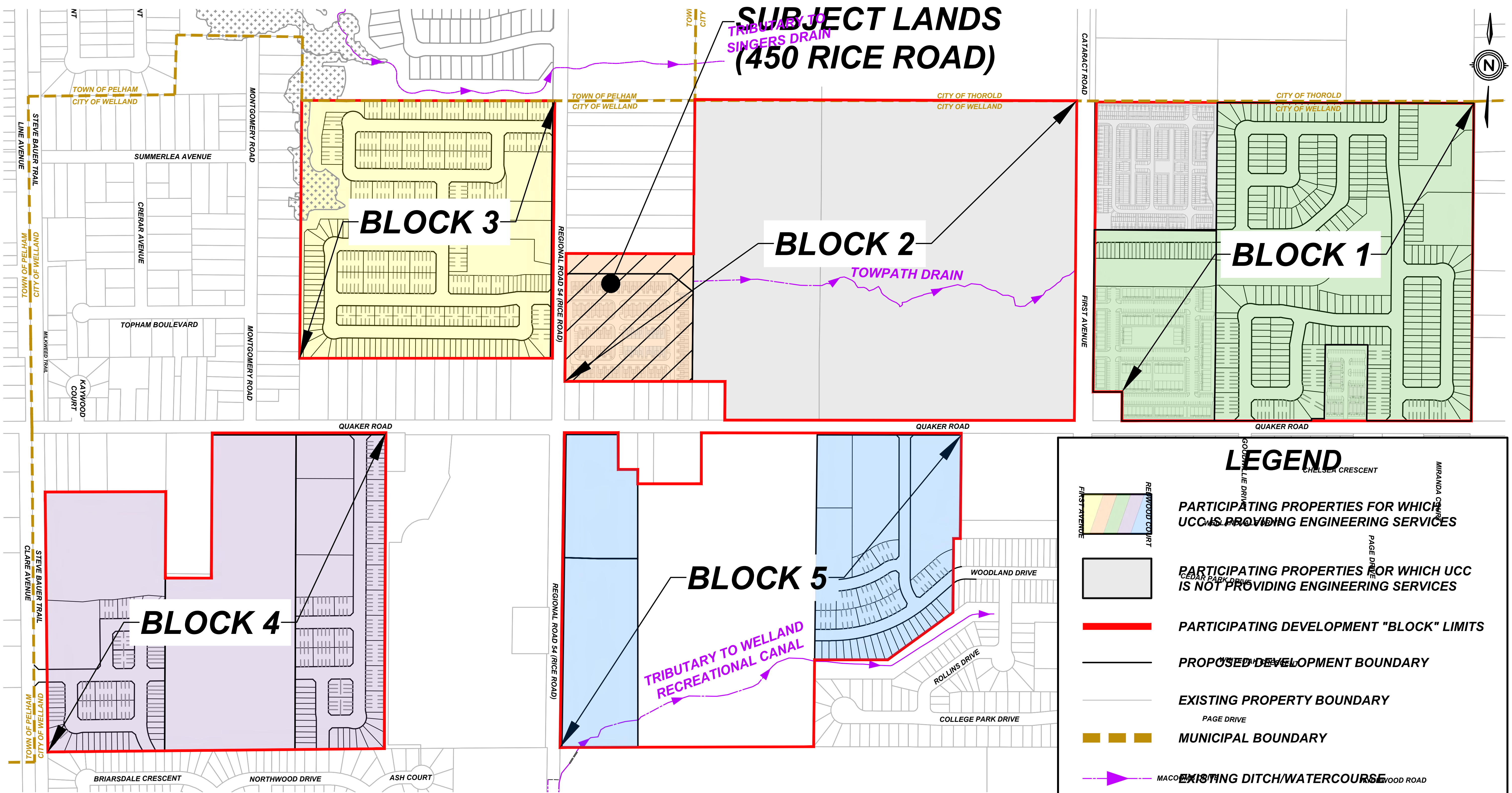
The purpose of this Functional Servicing Report (FSR) is to address the municipal servicing requirements for the proposed residential condominium development located at 450 Rice Road in the north-central portion of the Northwest Welland Secondary Plan (NWWSP) Area in the City of Welland, north of Quaker Road, west of First Avenue, east of Rice Road, and south of the municipal boundary with the Town of Pelham. The location of the subject lands within the NWWSP Area has been shown in Figure 1.

The development area is approximately 3.32 hectares and will consist of private residential townhouse condominiums. The subject lands will be developed to include associated asphalt roadways, concrete curb, catch basins, storm sewers, sanitary sewers, and watermain.

The objectives of this report are as follows:

1. Identify domestic and fire protection water servicing needs for the site;
2. Identify sanitary servicing needs for the site; and,
3. Identify stormwater management needs for the site.

As part of the Northwest Welland Secondary Plan (NWWSP), a Conceptual Municipal Servicing Design Report was prepared by Associated Engineering on behalf of the City of Welland This design report assessed the existing municipal infrastructure (water, sanitary, and storm) to service the Secondary Plan Area, and provided a conceptual framework to identify the locations where new or upgraded infrastructure will be required to support future development. The updated report (June 2024) has been included in Appendix A.



UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

NORTHWEST WELLAND SECONDARY PLAN

CITY OF WELLAND

SITE LOCATION PLAN - 450 RICE ROAD

DATE	2024-10-17
SCALE	1:6000 m
REF No.	-
DWG No.	FIGURE 1

WATER SERVICING

There is an existing 150mm diameter municipal watermain located on Quaker Road, in front of the subject lands and no existing watermain on First Avenue.

The Conceptual Municipal Servicing Design Report assessed the City of Welland watermain model to determine the required watermain sizes to provide adequate domestic water supply and fire protection to a minimum fire flow of 133 L/s within the Secondary Plan Area.

It was determined in the Design Report that a new 250mm diameter trunk watermain would be required within the subject lands and on First Avenue, extending from the existing 300mm watermain on Quaker Road and connecting to the existing 150mm diameter watermain on Montgomery Road and looping internally through the future development lands at 469 & 509 Rice Road, on the west side of Rice Road adjacent to the subject lands.

It was shown that a small 150mm diameter watermain would be extended through the subject lands from the proposed 250mm diameter trunk on Rice Road and a 300mm diameter trunk watermain loop within additional future development lands to the immediate east of the site. However, as the subject lands will be developed as a private condominium, it will not be permitted to provide two watermain connections for the subject lands. Therefore, the local 150mm diameter watermain will not connect between Rice Road and the easterly development lands.

Smaller diameter mains connecting the new 250mm diameter trunk watermains were determined to be able to provide domestic water supply and fire protection within the proposed local roads.

A Watermain Distribution Plan has been prepared by Upper Canada Consultants which shows the proposed watermain locations on Rice Road and within the westerly adjacent future development lands (which share the same owner as the subject lands) and is enclosed in Appendix B. As shown in this Plan:

- An upsized 300mm diameter trunk watermain loop is proposed on Rice Road and within the westerly development lands, connecting to the existing 300mm diameter watermain on Quaker Road and existing 150mm diameter watermain on Montgomery Road;
- An internal 300mm diameter watermain loop will be provided internally within the westerly development lands;
- The local internal streets will be serviced with local 150mm and 200mm diameter watermains; and,
- A single 300mm diameter water service has been preliminarily proposed for the subject lands, from the proposed 300mm diameter watermain on Rice Road.

Per discussions with City of Welland Staff, the overall watermain servicing within the NWWSP Area will be reviewed through the City of Welland watermain model as development applications are submitted within the area to determine the actual required watermain sizes for domestic water supply and fire protections.

The estimated peak domestic water demands have been summarized in Table 1 below for the proposed 139 townhouse dwellings, using an average residential flow rate of 270 L/capita/day. Peaking factors for the maximum daily demand and maximum hourly demand were taken from the Table 3-3 of the Ministry of Environment Design Guidelines for Drinking Water Systems.

The peaking factors shown in Table 1 below have been interpolated from the values shown in Table 3-3 of the MECP Guidelines. The peak demands will be confirmed as part of the detailed engineering design.

Table 1. Estimated Peak Domestic Water Demand	
Average Domestic Demand *270 L/cap/day; 306 persons*	**0.96 L/s**
Maximum Day Peaking Factor	3.1
Maximum Day Domestic Demand	**2.98 L/s**
Peak Hour Peaking Factor	4.7
Peak Hour Domestic Demand	**4.51 L/s**

Private fire hydrants will be provided within the development site to provide fire protection for the proposed dwellings. The spacing and location of the proposed fire hydrants will be provided in accordance with the City of Welland design standards and Ontario Building Code requirements as part of the detailed engineering design.

Therefore, there is expected to be adequate capacity to provide domestic water supply and fire protection within the subject lands and adjacent development lands upon confirmation from the City of Welland watermain model.

SANITARY SERVICING

There is presently a 600mm diameter Regional trunk sanitary sewer flowing southerly on Rice Road to the existing 750mm diameter Regional trunk sanitary sewer flowing easterly on Quaker Road, which ultimately outlets to Towpath Road Sanitary Pumping Station.

A Sanitary Drainage Area Plan has been prepared for the proposed developments at 450 Rice Road and 469 & 509 Rice Road, and is enclosed in Appendix C. As shown in the enclosed Drainage Area Plan, a total sanitary drainage area of 3.34 ha and a population of 306 persons has been allocated for the subject lands, which will convey flows to the existing 600mm diameter Regional trunk sanitary sewer on Rice Road with a single private 200mm diameter sanitary service.

The existing 600mm diameter Regional trunk sanitary sewer on Quaker Road in front of the subject lands has a full flow capacity of 452.94 L/s. The future peak sanitary flow from the subject lands will is calculated to be 4.64 L/s, which will occupy 1.0% of the full flow capacity in the existing 600mm diameter sanitary sewer on Rice Road. With the addition of the adjacent 469 & 509 Rice Road properties, the full build-out of the development area will occupy 3.9% of the full flow capacity in the 60mm diameter sanitary seer on Rice Road.

Therefore, the receiving sanitary sewer system is expected to have adequate capacity to receive future sanitary flows from the subject lands. The sanitary sewer design is attached in Appendix C for reference.

The Conceptual Municipal Servicing Design Report assessed the City of Welland InfoSWMM sanitary sewer model and the available capacities in the Towpath SPS and associated forcemain and the Welland WWTP.

Per the conclusions in the Design Report, there is expected to be adequate capacity in the existing Towpath SPS and associated forcemain following upgrades planned to this infrastructure by the Niagara Region, and Welland WWTP without upgrades for the entire NWWSP Area. The Design Report indicates that the capacity in the downstream sanitary sewer system will need to be re-evaluated as part of detailed engineering design, prior to build-out of the NWWSP Area.

Therefore, there is expected to be adequate capacity in the receiving sanitary network for the subject lands.

STORMWATER MANAGEMENT

It is proposed to collect and convey all future stormwater flows generated within the subject lands to the Towpath Drain, which flows easterly along the northern limit of the subject lands.

A proposed storm sewer outlet will be constructed at the north eastern limit of the subject lands to convey minor stormwater flows to the watercourse and the major overland flow route will be conveyed to the same location.

A separate Stormwater Management Brief has been prepared by Upper Canada Consultants (UCC) which includes all detailed calculations for the subject land sand has been enclosed in Appendix D for reference. The following are the summarized conclusions from the enclosed Brief:

1. Stormwater quantity controls are not required on-site as the upstream adjacent lands (owned by the same owner) will provide adequate over-control to ensure future peak stormwater flows in the Towpath Drain are maintained to below existing levels.

2. The major overland route will convey stormwater flows northerly to the Towpath Drain.

3. Stormwater quality protection is being provided by a Hydroworks HD 12 stormwater oil/grit separator or approved equivalent in the proposed development.

CONCLUSIONS AND RECOMMENDATIONS

Therefore, based on the above comments and design calculations provided for this site, the following summarizes the servicing for this site:

1. The existing municipal watermain system is expected to have adequate capacity to provide both domestic and fire protection water supply for the subject lands.

2. The receiving 600mm diameter Regional sanitary sewer on Rice Road, the Towpath SPS and associated forcemain, and Welland WWTP are expected to have adequate capacity for the subject lands upon full build-out of the NWWSP Area.

3. Detailed calculations, conclusions, and recommendations regarding Stormwater Management can be found in the Stormwater Management Plan found in Appendix C.

Based on the above and the accompanying calculations, there exists adequate municipal infrastructure for this development. We trust the above comments and enclosed calculations are satisfactory for approval. If you have any questions or require additional information, please do not hesitate to contact our office.

Respectfully Submitted,

Reviewed By:

B. Kapteyn

LICENSED PROFESSIONAL ENGINEER
B. J. KAPTEYN
100509155
PROVINCE OF ONTARIO

Brendan Kapteyn, P.Eng.

APPENDICES

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX A

NW Welland Secondary Plan Municipal Servicing Conceptual Design Report (Associated Engineering, June 2024)

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

REPORT

City of Welland

Northwest Welland Secondary Plan
Municipal Servicing
Conceptual Design Report

JUNE 2024

carbon neutral since 2009

CANADA BEST MANAGED COMPANIES Platinum member

REVISIONS PAGE

Northwest Welland Secondary Plan Municipal Servicing Conceptual Design Report	
Client:	Engineer:
Upper Canada Consultants	Associated Engineering (Ont.) Ltd.

Revision/ Issue	Date	Description	Prepared by/ Reviewed by	Client Review
1	2023-11-22	Municipal Servicing Report_v1	AL & BB/ RC & MG	
3	2024-03-26	Municipal Servicing Report_v3	AL & BB/ RC & MG	
5	2024-06-24	Municipal Servicing Report_v5	AL & BB/ RC & MG	
	Click or tap to enter a date.			
	Click or tap to enter a date.			

TABLE OF CONTENTS

SECTION PAGE NO.

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

The City of Welland identified the development of the Northwest Secondary Plan as a priority to provide for detailed land use planning policies for a mix of uses, including policies that address infrastructure requirements, and natural and cultural heritage considerations. The Northwest Welland Secondary Plan (NWSP) will guide future growth and development within the study area. This report (previously issued May 2021) reviews background information and provides capacity analysis for existing water, sanitary, and storm sewer servicing in the study area. In addition, an initial assessment was completed for proposed conceptual water, sanitary, and storm servicing. These analyses were used to develop general recommendations for municipal water, sanitary, and storm servicing requirements in the Secondary Area.

1.1 Study Area

The study area (Figure 1-1) includes the land within the urban area boundary of Welland that is bounded by Clare Avenue to the west, Niagara Street to the east, land on the south side of Quaker Road to a depth of approximately 500m to the south and 500m to the north and comprises approximately 190ha. Quaker Road bisects through the Study Area and is identified as an arterial road and all other streets are considered local roads.

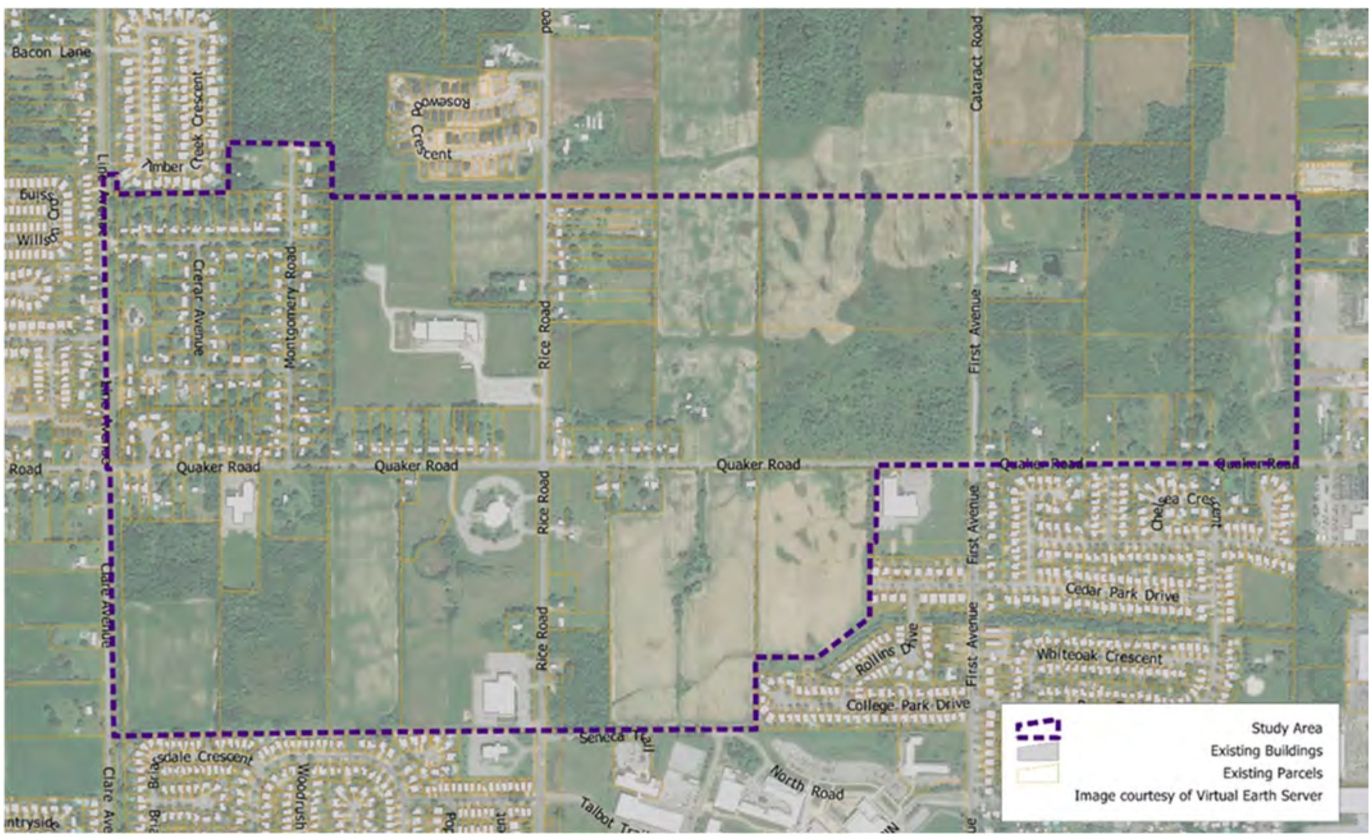


Figure 1-1: Northwest Welland Secondary Plan Study Area

Existing land uses are primarily residential, institutional, agricultural, and open space. Currently, municipal services for water, sanitary and storm exist in parts of the NWSP area, which will be leveraged to accommodate the NWSP area.

1.2 Proposed Secondary Plan

Figure 1-2 shows the proposed NWSP layout provided by Upper Canada Consultants (September 2023). Based on the proposed layout, population and unit numbers for each development block were also provided by Upper Canada Consultants. Projected units and populations are summarized in Table 1-1.

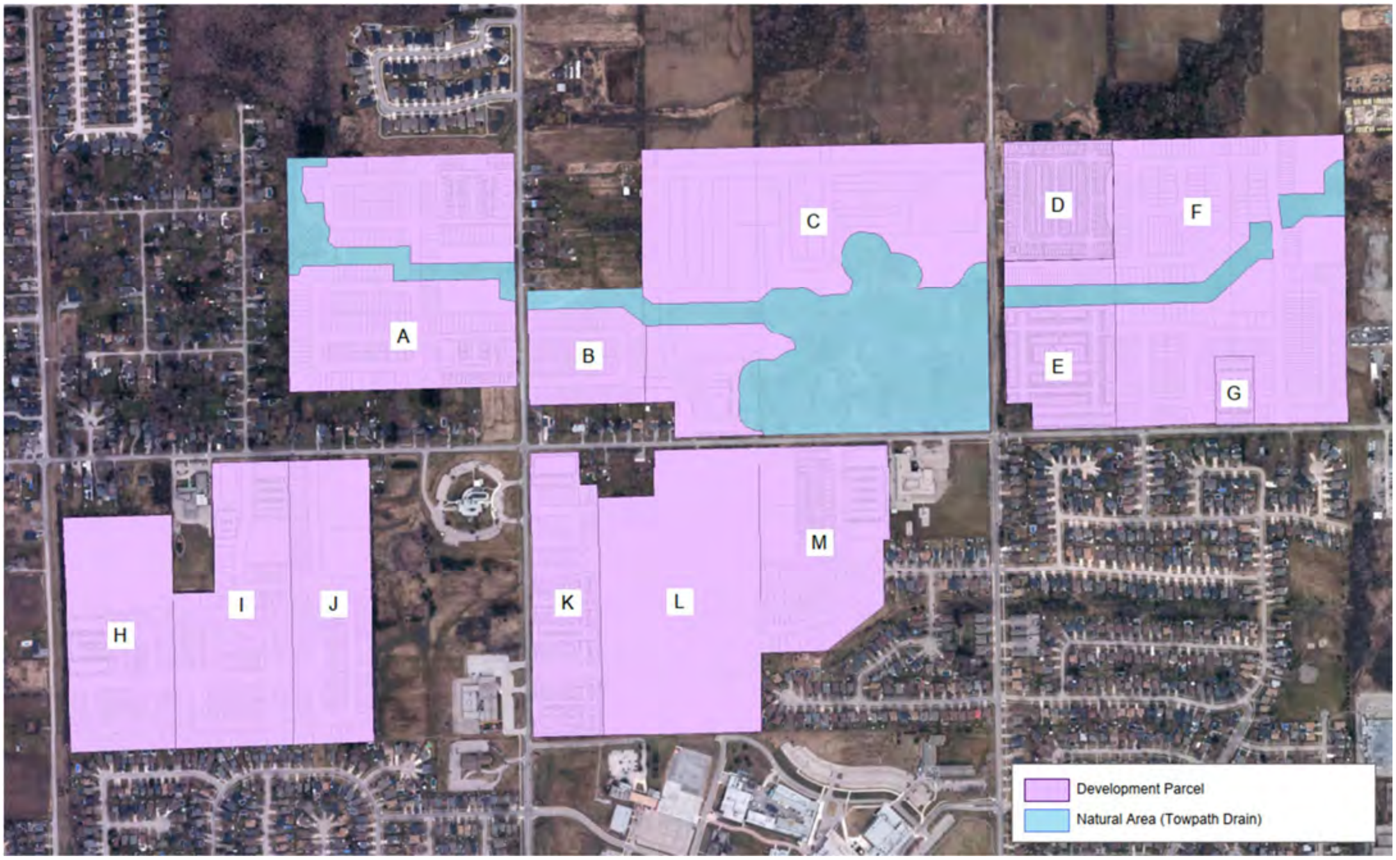


Figure 1-2: NWSP Proposed Population and Unit Plan

Table 1-1: NWSP Population and Unit Numbers

Block Number	Area (ha)	Units	Population (+/-)
A	13.25	386	1,081
B	3.36	114	319
C	18.15	800	2,240
D	4.05	360	1,008
E	4.77	401	1,123
F	17.71	403	1,128
G	0.80	96	269

Block Number	Area (ha)	Units	Population (+/-)
H	8.40	226	633
I	8.79	227	636
J	7.04	162	454
K	5.73	439	1,229
L	13.02	500	1,400
M	7.05	236	661

2 BACKGROUND INFORMATION

2.1 Sources

Table 2-1 provides a list of sources used to aid in completing the analysis of water, wastewater, and stormwater servicing for the NWSP area.

Table 2-1: Water, Sanitary and Storm Data Sources

System	Description	File Type(s)	Author(s)
All	City of Welland Northwest Area Planning and Servicing Study Municipal Class EA	PDF	Earth Tech
All	1m Elevation Contours	SHP	City of Welland
All	City of Welland GIS Data	GIS	City of Welland
All	City of Welland Official Plan	PDF	Dillon Consulting
All	Key Directions Report for the Northwest Welland Secondary Plan Area	PDF	SGL
All	City of Welland Municipal Standards, 2013	PDF	City of Welland
Water/Wastewater	2016 Water and Wastewater Master Servicing Plan Update Hydraulic Model for City of Welland, May 2017	PDF	GM Blue Plan
Water	Welland Water Model (part of the Niagara Region Water Model for the 2017 Niagara Region Master Servicing Plan), 2017	InfoWater	Niagara Region
*Water	City of Welland All Pipe Water Model	InfoWater	City of Welland
Water	Design Guidelines for Drinking-Water Systems, 2008	PDF	MECP
Water	City of Welland Fire Flow Requirements – By Building Zone	PDF	AE

System	Description	File Type(s)	Author(s)
*Wastewater	Welland All Pipe Wastewater Model	InfoSWMM	City of Welland/ Niagara Region
*Wastewater	City of Welland Pollution Prevention Control Plan Update & Wastewater Master Servicing Plan, 2020	PDF	GM Blue Plan
*Storm	Northwest Welland Stormwater Management Implementation Plan, 2022	PDF	Upper Canada Consultants

*additional/updated data sources since May 2021 Report

2.2 Data Gaps

Data gaps are presented in Table 2-2, which summarizes missing, relevant information that would provide a clearer picture of the existing and future needs of the systems in future steps of this process (i.e. confirmation of criteria to be used in future design of systems).

Table 2-2: Data Gaps

System	Data Gaps	Justification
All	Detailed topographic survey	To confirm elevations for servicing

3 WATER

Water servicing in the Niagara Region is a two-tiered approach; Niagara Region has jurisdiction over the drinking water supply for homes and businesses throughout the Region and is responsible for treatment, storage, pumping, and trunk watermains. The City of Welland is responsible for the local distribution system.

Currently, the area surrounding the proposed development is pipe fed from the Welland Water Treatment Plant (WTP) to the Shoalt's Drive Reservoir and surrounding area. During periods where the WTP is offline, the area is predominately supplied by gravity from the Shoalt's Reservoir. The Welland system also has an elevated storage tank (Bemis) located in the southern portion of the distribution system.

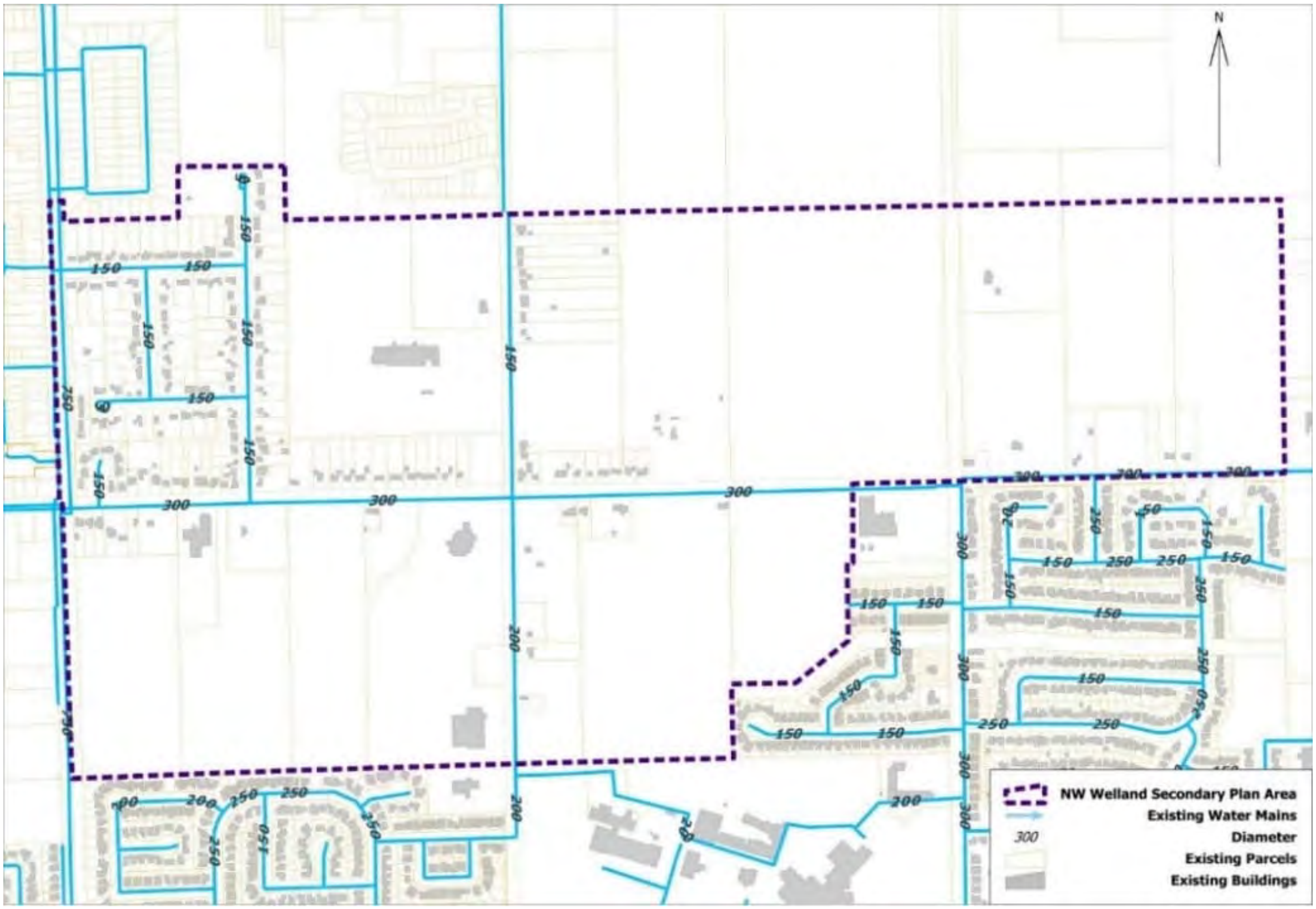


Figure 3-1: Existing Watermains Configuration in Study Area

The existing system configuration within the study area, including existing pipe diameters, is shown in

Figure 3-1. Within this area there is a small existing development east of Line Avenue and north of Quaker Road. This area, which was built in 2002, consists of 150mm PVC watermain connecting to both the 750mm CPP on Line Avenue to the west and the 300mm CI on Quaker Road to the south. In addition, there is a 150mm existing main on Rice Road (north of Quaker Road) which appears to serve few properties. There are also existing properties along Quaker Road, which are serviced off the 300mm main.

3.1 Design Criteria

The design criteria used for the analysis of the water distribution system includes the following:

- Target normal operating pressures:
  - Preferred system pressure between 350 kPa to 550 kPa (50 to 80 psi)
  - Minimum system pressure to be greater than 275 kPa (40 psi)
  - Maximum system pressure to be less than 700 kPa (100 psi)
- Fire flow requirements during MDD with 140 kPa (20 psi) residual system pressure:

- Parks: 67 L/s
- Low Density Residential (Single Family Residential): 67 L/s
- Medium Density Residential (Townhomes): 133 L/s
- Multi-Use: 133 L/s

- Per capita demand: 240 L/cap-day (Based on City design criteria)
- Peaking factors as per the City of Welland Model, as follows:
  - Maximum Day Demand peaking factor: 1.5
  - Peak Hour Demand peaking factor: 1.87 (2.81 x Average Day Demand)
- ADD and MDD demand patterns as per City of Welland Model
- C-Factor for new pipes: 135 (Based on the City design standard)

3.1.1 Water Demands

Table 3-1 summarizes the new demands assigned within the model for the NWSP area. These demands were calculated based on the newly proposed populations/units previously identified in Table 1-1 and design criteria noted in Section 3.1.

Table 3-1: New NWSP Demands

Junction ID	ADD (L/s)	MDD (L/s)	PHD (L/s)
814	0.89	1.33	2.49
951	3.89	5.83	10.93
1700	0.75	1.12	2.10
3952	1.76	2.64	4.94
8338	1.50	2.25	4.22
8622	3.41	5.12	9.59
8623	2.07	3.11	5.83
J-FUT-47	2.80	4.20	7.87
J_NWSP_4	1.26	1.89	3.55
J_NWSP_6	1.50	2.25	4.22
J_NWSP_8	2.07	3.11	5.83
J_NWSP_9	2.07	3.11	5.83
J_NWSP_10	3.12	4.68	8.77
J_NWSP_15	1.84	2.76	5.16
J_NWSP_20	3.13	4.70	8.81
J-FUT-49	1.77	2.65	4.97

Junction ID	ADD (L/s)	MDD (L/s)	PHD (L/s)
Total Demand	33.84	50.77	95.11

3.2 Model Updates and Existing System Conditions

An InfoWater Model (WELLAND_WATER_2023, dated October 23, 2023) provided by the City was used for the analysis. The City's model includes both existing and future Average Day Demand (ADD) and Maximum Day Demand (MDD) extended period simulation scenarios. Model data sets suggest that the existing demand scenarios in the model were last reviewed and updated in 2022. The earlier study completed for this development reviewed and commented on the Niagara Region & City of Welland InfoWater models for their future development growth, providing an insight into the future development areas of the region. It has been assumed that this information still applies despite the time passed since that report.

During the development of this study, City noted that there were two errors in the existing model scenarios that should be rectified and therefore, the analysis was updated with the following changes/corrections.

- The size of the watermain, dead end on Montogomery Road where hydrant was connected, was changed from 50mm to 150mm pipe.
- The connection to the intersection of the Regional trunk main at Line Avenue and Summerlea Avenue was opened in the model.
- Recent discussions with the City indicated that the watermain along Quaker Road from Clare Avenue to Rice Road is currently being replaced with a new 300mm watermain and therefore, this portion of pipe was upsized and a C-factor of 135 was assigned in the model to reflect the upgrade.
- The connection (IW pipe ID – 2377) between the 750mm Region trunk main on Clare Avenue N and the 300mm watermain on Quaker Road was opened in the model.

Other than the above noted model updates, no quality control checks were conducted on the City's model; it was assumed that the model is sufficiently calibrated for the purpose of this analysis and is indicative of the current system.

Figures for this section can be found in Appendix A. Table 3-2 shows the existing and current future pumping schemes from the City's model (on/off settings) at the WTP for both ADD and MDD scenarios. No changes were made to these settings for the development analysis.

Table 3-2: Existing and Future WTP Pump Settings – City's InfoWater Model

Pump	Existing ADD	Existing MDD	Future ADD	Future MDD
Low Flow Pump #1	On at 0:00 Off at 6:00	Off at 0:00	Off at 0:00 On at 11:00	Off at 0:00 On at 20:00 Off at 22:00
Low Flow Pump #2	Off at 0:00	Off at 0:00	Off at 0:00 On at 20:00	Off at 0:00

Pump	Existing ADD	Existing MDD	Future ADD	Future MDD
High Flow Pump #1	Off at 0:00 On at 13:00	On at 0:00 Off at 7:00	On at 0:00	On at 0:00 Off at 2:00 On at 5:00
High Flow Pump #2	Off at 0:00	Off at 0:00 On at 12:00	On at 0:00 Off at 3:00 On at 6:00 Off at 20:00	On at 0:00 Off at 2:00 On at 5:00

3.2.1 Current Hydraulic Conditions

A hydraulic analysis of the existing system was completed to provide a baseline level of service to compare to the future development scenarios.

Figures A-1 and A-2 show the minimum pressure during existing ADD and MDD in the study limits and surrounding area. At certain locations within the study area, pressures are lower than the required minimum pressure of 275 kPa (40 psi). These low-pressure nodes are in proximity to the Shoalt's reservoir and occur during peak periods; simulation time 11am to 12 noon for ADD and 10am to 11am for MDD. The observed minimum pressures in this portion of the study area for ADD and MDD are 239 kPa and 234 kPa respectively and are thought to be due to high ground elevations (maximum of 193m) and fluctuations of the Shoalt's Drive Reservoir head (between 217.5m and 219.0m). As to be expected during higher demands, more low-pressure nodes were observed in the surrounding study area during MDD scenario than ADD. There were also few low-pressure nodes observed in the other future growth areas of the system.

Figure A-3 shows the available fire flow during MDD at a residual pressure of 140 kPa (20 psi). Certain portions of the study area, specifically watermains along the Rice Road and Topham Boulevard have available fire flows less than 67 L/s (the City standard for single family residential). However, the new 300mm watermain upgrade along Quaker Road (from Clare Avenue to Rice Road) improves fire flows along Quaker Road, Montgomery Road and in Summerlea Avenue. The dead ends of the watermains in this portion of the area still indicated low fire flows (< 67 L/s).

The low availability of fire flows is due to both the high ground elevation and the size of the watermains supplying these hydrants.

3.2.2 Future Conditions without NWSP Development

In the existing model from the City, it was observed that the future model scenario included NWSP infrastructure and demands based on the previous study. A total of 48.7 L/s for future ADD and 73.1 L/s for future MDD was allocated in the NWSP region at the model junctions summarized below in Table 3-3.

Table 3-3: Identified Previous NWSP Demands from the City's Model

Junction ID	Future ADD (L/s)	Future MDD (L/s)
3952	1.00	1.07
567	3.15	4.72
812	2.52	3.77
815	3.86	5.79
818	4.01	6.02
8622	1.18	1.77
8623	5.35	8.03
J-FUT-47	10.10	15.16
J-FUT-48	2.14	3.21
J-FUT-49	5.58	8.37
J-FUT-50	6.08	9.12
J-FUT-51	4.03	6.05
Total Demand	49.00	73.08

To prevent "doubling up" on NWSP demands, the previously proposed infrastructure for NWSP has been removed from the future analysis.

Figures A-4 and A-5 show the minimum pressure during future ADD and MDD, without the NWSP development. As these figures show, a significant improvement in pressures was noted in the surrounding study area when compared to the existing scenarios, with only a small number of low-pressure nodes noted. This is due to the change in the pumping procedure at the WTP for the future scenario.

Figures 3-2 and 3-3 below show the hydraulic grade (HG) for Shoalt's and Bemis tanks for the existing and future MDD Scenarios. The pumping operating procedure at the WTP for the existing scenario shuts down the pumps mid-morning, coinciding with periods of higher system demand. During this mid-morning WTP shutdown, both the Shoalt's Drive Reservoir and the Bemis Elevated Tank levels are drawn down; this draw down is sharp and reaches its lowest hydraulic grade level (HG) around noon. However, with the current future pumping scheme at WTP, the HG at Shoalt's and Bemis shows a sustained hydraulic head after 6 am showing improved pressures in the surrounding study area.

The future pumping schemes in the model for ADD and MDD scenarios showed improved pressures surrounding the study area which appeared to resolve most of the low-pressure nodes that were highlighted in existing scenarios. A few low-pressure nodes (250 kPa to 261kPa) still persisted surrounding the study area particularly nodes close to the Shoalt's reservoir.

An attempt was made to assess the future system by changing the current future pumping scheme for MDD scenario by altering the pumping hours at pump H-1 (On at 0:00 and Off at 2:00) which showed improved pressures in the reservoir area but not completely eliminated. As modification of pumping schemes is outside of the scope of this analysis, this would need to be confirmed by the City when adjusting the overall system configuration and settings.

Figure A-6 shows the available fire flow during future MDD prior to the proposed development. Parts of the surrounding study area on the south and east sides showed sufficient fire flows as required for multi-family residential housing (133 L/s) however, the nodes on the Rice Road watermain have less than the design standard of 133 L/s. Most of the Shoalt's reservoir area showed adequate fire flows with the new 300mm watermain upgrade in Quaker Road and by opening the 750mm Region trunk main interconnection in Clare Avenue N with the exception of the dead-end locations.

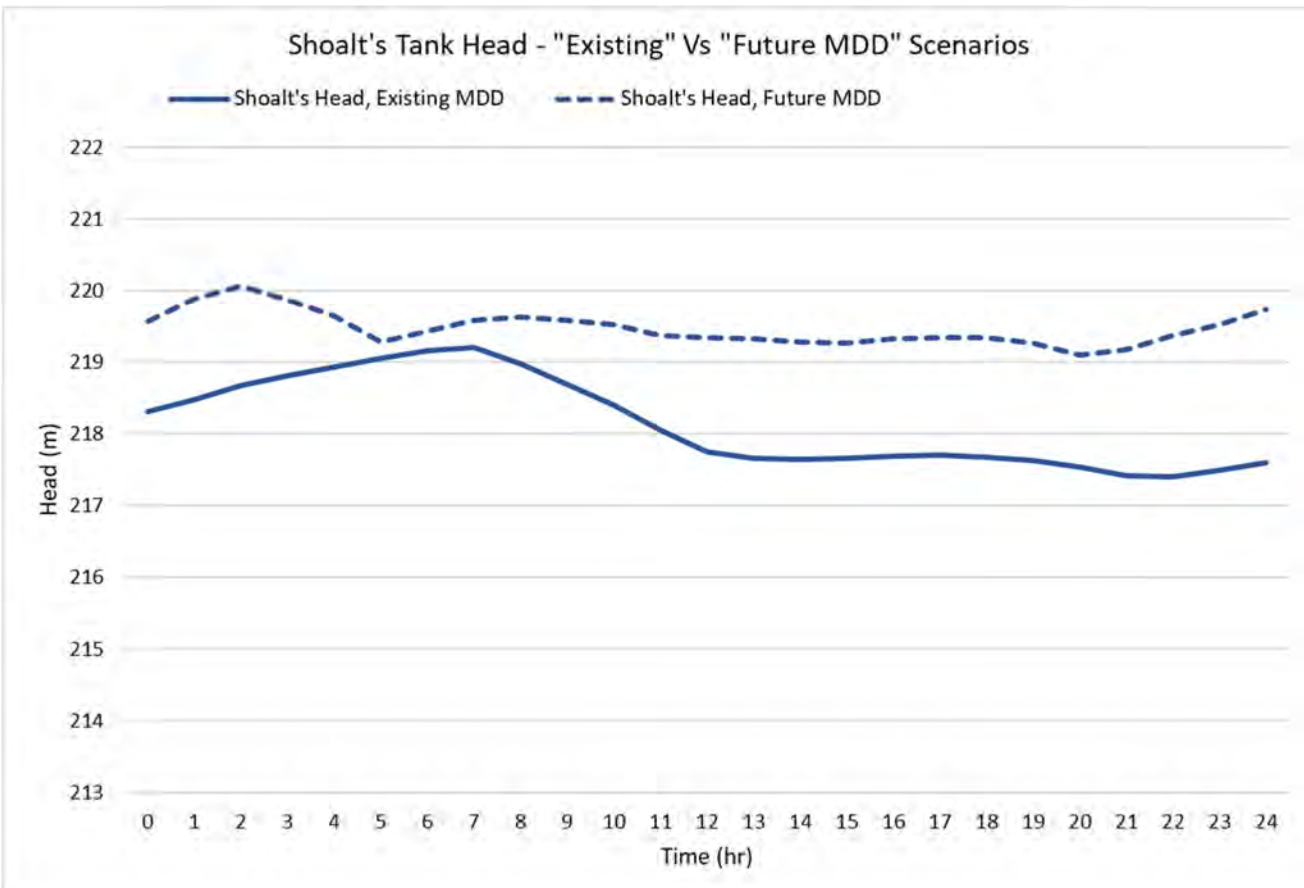


Figure 3-2: Shoalt's Tank Head – Existing and Future MDD Scenarios (without NWSP)

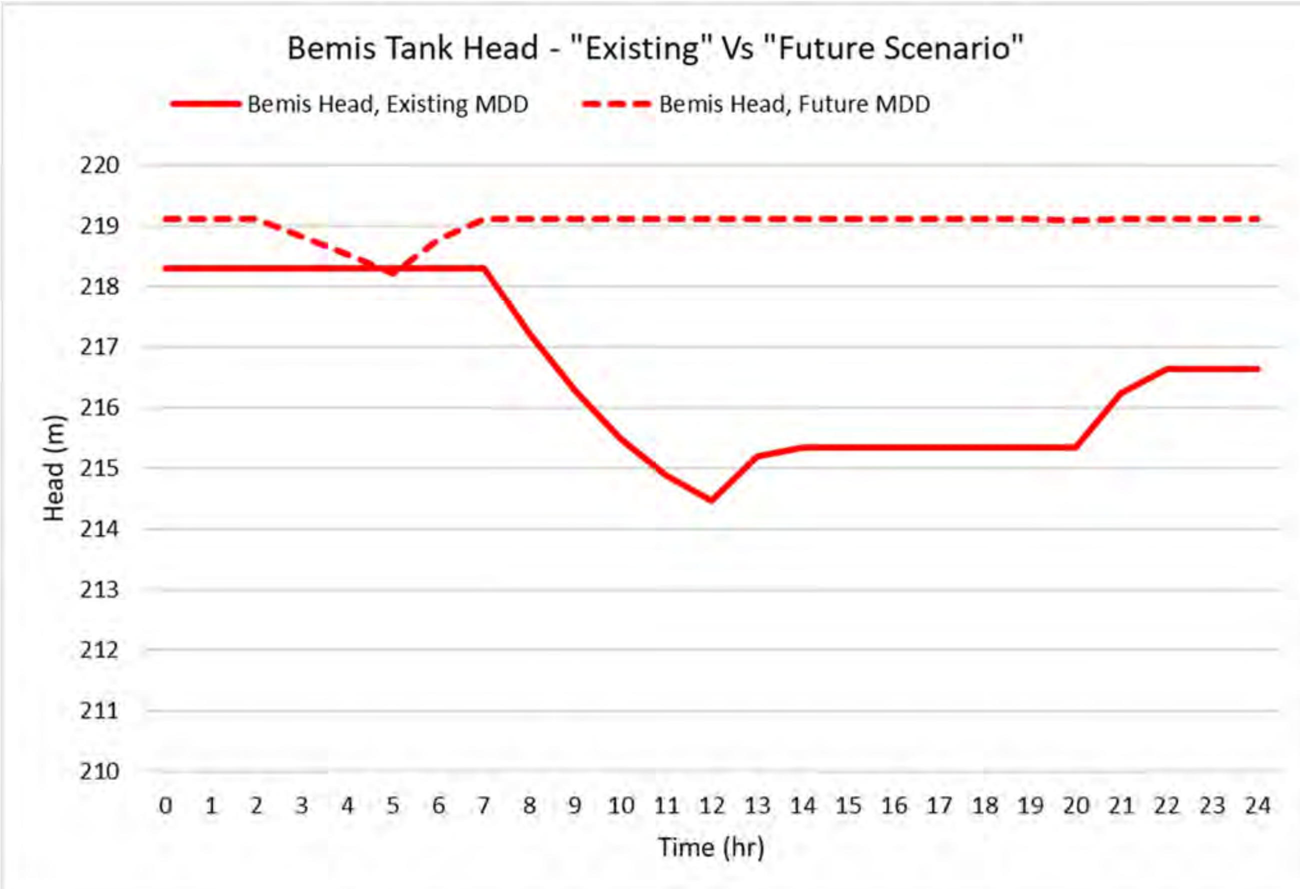


Figure 3-3: Bemis Tank Head – Existing and Future MDD Scenarios (without NWSP)

3.3 Proposed System Requirements

Several pipes and junctions were added to the City of Welland InfoWater model to represent future servicing of the NWSP area. The proposed pipe routing is laid based on the new NWSP site layout as shown in Figure 1-2 in Section 1.0 of this report. As the existing 300mm main on Quaker Road acts as a main supply line for this study area, the proposed mains for NWSP were mainly branched and looped out from this main to service the proposed development. Note that only significant pipes that will connect the NWSP site were included in the model. There will be additional future piping required along local roads upon finalization of the site layout.

Junction elevations for the newly added nodes in the study area were assigned based on the City of Welland 1 m contours. Pipe sizing for the major loops shown in Figure 3-4 was established as part of the hydraulic analysis to achieve the required fire flow of 133 L/s as needed for the medium density residential. New piping is shown in bold red; existing piping in blue.

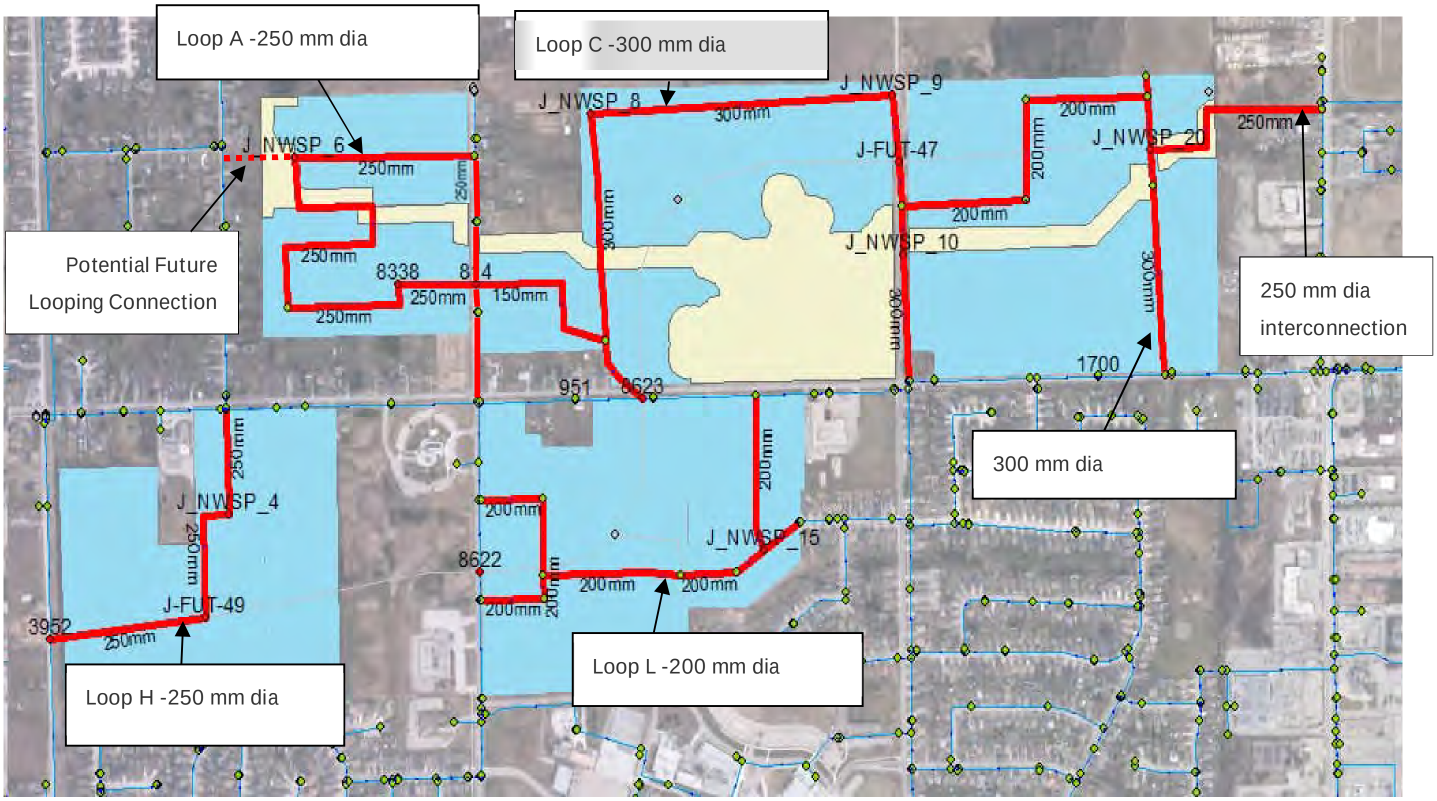


Figure 3-4: Proposed Infrastructure for NWSP Development

3.3.1 Hydraulic Analysis

The development demands for the proposed NWSP development were added to the Futures ADD and MDD scenarios in the model. The hydraulic analysis then was carried out with NWSP future demands to identify the impact of this proposed development on the future system and to confirm the pipe sizing and servicing requirements to support the future NWSP development.

Figures A-7 and A-8 show the minimum available pressures during ADD and MDD EPS, and Figure A-9 shows the available fire flows, with the NWSP area serviced with the proposed watermain sizes identified.

As these figures show, the addition of NWSP area to the future system does not significantly impact the surrounding system pressures, instead the proposed servicing has shown improved pressures over Future ADD and MDD when no NWSP development was added. As with the other modelled scenarios, there are existing low-pressure nodes near Shoalt's Drive Reservoir area, however no exacerbation of low pressures was noted when the NWSP development was added.

Figure A-9 shows most of the NWSP study area meets fire flow requirements of 133 L/s that is required for medium density housing with the following pipe servicing requirements.

The major watermain loops (Loop A, C, H and L) that are proposed to service the future NWSP development are shown in Figure 3-4 above. The pipe routing and sizing was identified based on the current site layout provided by the developers and to achieve the design fire flow of 133 L/s throughout the study area. Should a change in the NWSP site layout occur in the future, a review of the analysis may be required to re-confirm the pipe sizes and servicing options. Furthermore, additional modelling may be required in the future to assess the extent of the overall system that is required to be constructed to facilitate each development block on a project-by-project basis.

To supply the required fire flow (133 L/s) to the northwest portion of the NWSP, specifically, the development that is planned west of Rice Road, an upgrade of Rice Road watermain and as well as the new water mains installed in this area should be a minimum of 250mm as shown as Loop A. With this upgrade, the fire flows in the area were improved and vary from 138 L/s to 213 L/s. It is also noted that a potential future looping connection between the northwest portion of the NWSP and the existing watermain on Montgomery Road can be considered based on final development details and servicing requirements within the area.

A new 300mm watermain loop, Loop C will be required to supply the C-block of the NWSP planned development. In addition, a new interconnection with 250mm watermain connecting the NWSP development to the watermain in Niagara Street on the eastern side is also made to improve the fire flows in the area.

Two major watermain loops with 200mm and 250mm, Loop L and Loop H respectively will be required for the southern portion of the NWSP, to provide the required fire flow of 133 L/s in this area. Without the Loop L, the development blocks K and M were not able to achieve the design fire flows of 133 L/s.

Overall, the proposed NWSP development shows improved operating pressures except in the low-pressure areas previously identified. Improved fire flows were also noted around the NWSP study area with the proposed pipe servicing, both within and outside the development boundaries.

3.3.2 Storage Requirements Review

A review of the City of Welland's overall storage capacity and existing and future storage requirements was conducted to determine the impact of the NWSP area on future storage needs. As per the MECP Design Guidelines for Drinking Water Systems, storage requirements for a water distribution system are as follows:

- Equalization Storage (A) = 25% of Maximum Day Demand
- Fire Storage (B) = 378 L/s for 6 hours (Based on MECP Equivalent Population Fire Flow Requirement)
- Emergency Storage (C) = 25% of A +B

Table 3-4 summarizes the total available storage identified in the Region Master Plan (as used in the previous report) and the calculated existing and future storage needs for the system based on the City of Welland model demands. As shown, there is sufficient storage in the Welland system to allow for the addition of the NWSP area. The total additional storage required for the addition of the NWSP area is 1.4 ML.

Table 3-4: Available and Required Water Storage

Description	Storage (ML)
Total Available Storage	37.0
Existing Required Storage	19.7
Future Required Storage without NWSP (a)	26.5

Description	Storage (ML)
Future Required Storage with NWSP (b)	27.9
Required Additional Storage for NWSP (b-a)	1.4

4 SANITARY

Sanitary servicing in Niagara Region is based on a two-tiered approach. The Region is responsible for the wastewater treatment plants, trunk sewers, pumping stations and forcemains. The City of Welland is responsible for the local gravity sewer system.

The sanitary sewage from the NWSP area will ultimately be treated at the Welland Wastewater Treatment Plant (WWTP). This WWTP services the City of Welland, Town of Pelham, and the Port Robinson area of the City of Thorold.

The existing sanitary services in the NWSP area includes a regional main down Rice Road, local main in the Montgomery subdivision, and local and regional (trunk) sanitary sewer along Quaker Road. Primary sanitary sewage flows south down Rice Road, and then east down Quaker Road to Towpath Road. Sanitary sewage then flows northeast along Towpath Road to Towpath Sewage Pumping Station (SPS). Towpath SPS receives gravity flow from the regional trunk sanitary sewer along Quaker Road and flows from Hurricane Road SPS (Rice Road). Sewage from Towpath SPS is pumped through a forcemain across the Welland River to a gravity system, which ultimately flows to the Welland WWTP. A schematic of the existing sanitary servicing within the NWSP study area is provided in Figure 4-1.

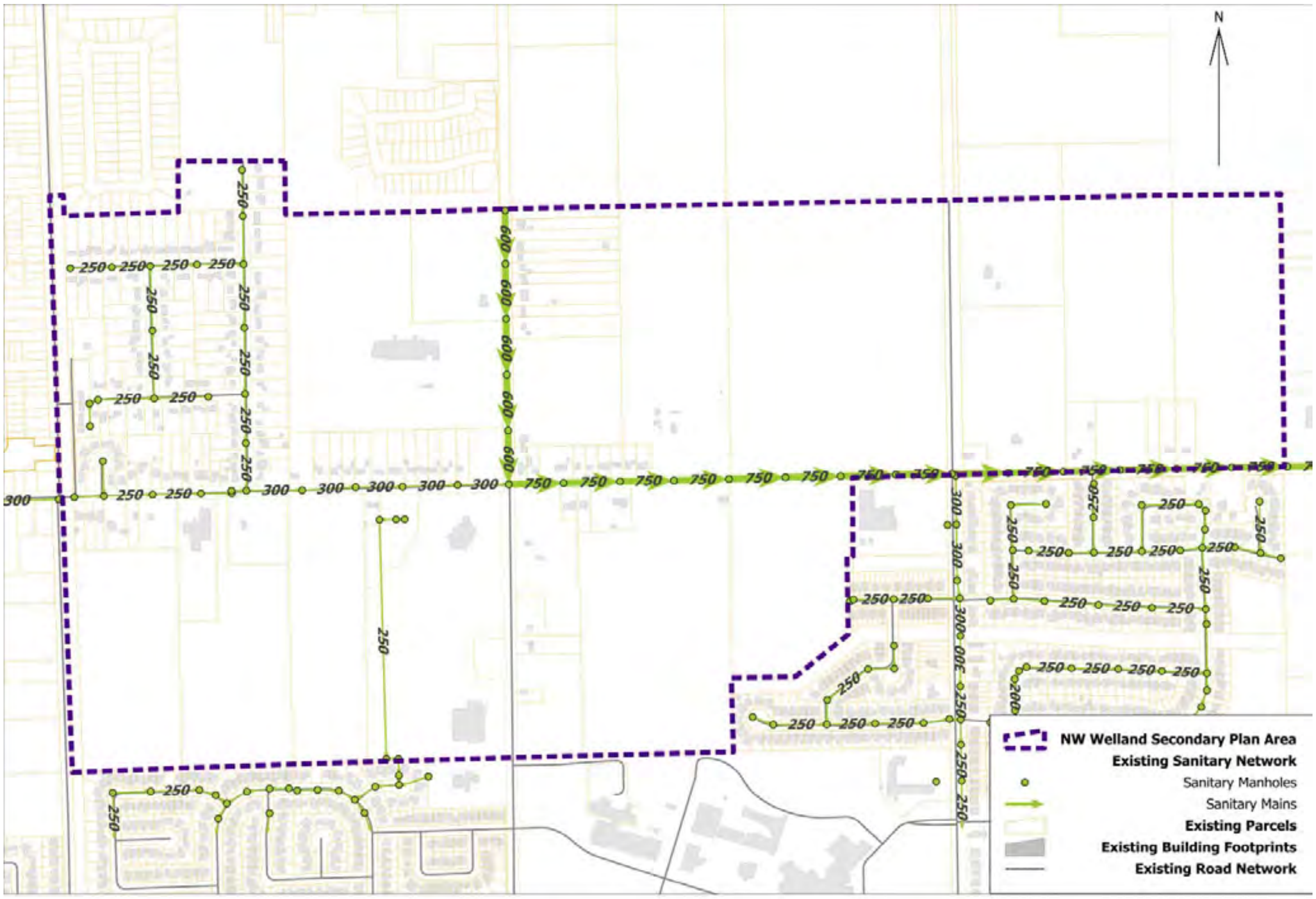


Figure 4-1: Schematic of Existing Sanitary System in NWSP Study Area

4.1 Design Criteria

Existing and future peak flows conveyed by the trunk sewer on Quaker Road to the Towpath SPS were assumed to be equivalent to the flows represented in the City's all-pipe InfoSWMM model.

Additional flows contributed to the Quaker Road trunk sewer, and ultimately the Towpath SPS, by the NWSP area were calculated using the following design criteria:

- Extraneous flows = 0.286 L/s/ha
- Roughness coefficient = 0.013
- Residential per capita flow rate (for sewage generation) = 275 L/cap/day
- Peaking factor = Calculated based on Harmon formula with values between 2.0 and 4.0

4.2 Existing System Capacity

4.2.1 Trunk Sewer

The available capacity of the existing trunk sewer along Quaker Road from Rice Road to the Towpath SPS was reviewed using the City's all pipe InfoSWMM model.

Currently Line Avenue is the break point in the collection system, with areas west of Line Avenue flowing west and then south, contributing to the Welland WWTP drainage area. However, the Region Master Servicing Plan Update (MSPU) identified a new 600mm diameter connection (WW-SS-002) along Quaker Road from Line Avenue to Rice Road, which would redirect approximately 130L/s of flows from Pelham (north-west of Line Avenue) to the Quaker Road trunk sewer, and ultimately the Towpath SPS. Given this change in flows through the Quaker Road trunk sewer, the available capacity of this sewer was reviewed with this new connection. This completed available capacity assessment, based on the InfoSWMM model outputs, is attached in Appendix B. In general, the Quaker Road trunk sewer has significant available capacity – with future available capacity ranging from 100L/s to 3,194L/s with the new Line Avenue connection.

4.2.2 Towpath SPS and Forcemain

The Region MSPU identified that Towpath SPS has existing and future deficiencies based on existing and design peak wet weather flows. As such, the Region MSPU identified a capital project to upgrade the Towpath SPS during the timeframe of 2022 – 2026 from 118L/s to 600L/s (WW-SPS-037).

The Region MSPU also indicates that the existing Towpath SPS forcemain has current capacity; however, will have a projected capacity deficit for 2051 growth. There is already a constructed 600mm diameter forcemain that can be commissioned in line with Towpath upgrades, as identified in the Region MSPU capital projects during the timeframe of 2032-2036 (WW-FM-022).

4.2.3 Welland WWTP

The Region MSPU identified that the existing Welland WWTP has surplus capacity available to treat existing and future flows at the plant, with the plant reaching 80% capacity around the 2041 time horizon.

4.3 Proposed System Requirements

4.3.1 NWSP Sanitary Drainage Areas and Proposed Collection System

As requested, two sanitary servicing options were prepared and reviewed for feasibility for the NWSP area, including: 1) development blocks on the east and west side of First Avenue are connected to a new city trunk located on First Avenue and 2) development blocks on the east and west side of First Avenue are connected through the development blocks to a new city trunk located on Quaker Road.

Figure 4-2 and Figure 4-3 (also provided in Appendix B as Figure B-1 and B-2, respectively) show the approximate location of future city trunk sanitary gravity sewers within the NWSP area and the location where the city trunks will connect to the existing Region trunk sewer on Quaker Road for each servicing option. Figure 4-2 and Figure 4-3 also show identifying numbers for the individual NWSP drainage areas, which are referenced in the sewer design sheets provided in Appendix B.

The design sheets for the proposed sanitary sewers have been prepared with the new Line Avenue connection included. Note that the inverts and pipe lengths assigned to the existing trunk sewer in the proposed design sheets are from the City's InfoSWMM model. Existing peak flows into the trunk sewer, input at existing manhole locations in the design sheets, are also as per the City's InfoSWMM model. All inverts and pipe lengths of the proposed city trunk sewers have been assigned based on preliminary modeling and the existing ground contours of the area. Note that, it is assumed that any other sanitary sewer required on future local roads servicing the NWSP area, will be 200 mm diameter.

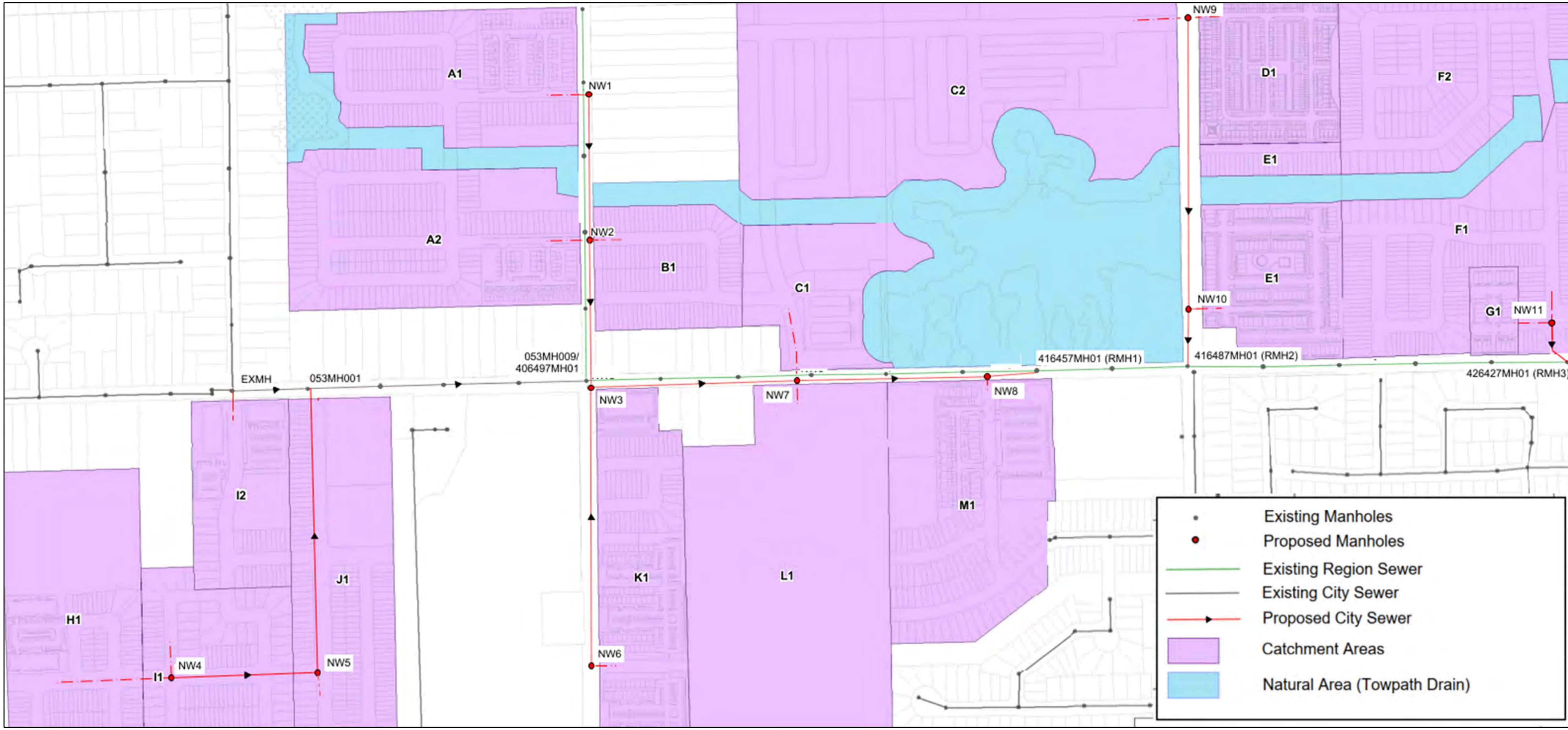


Figure 4-2: Proposed Sanitary System and Drainage Areas – Option 1

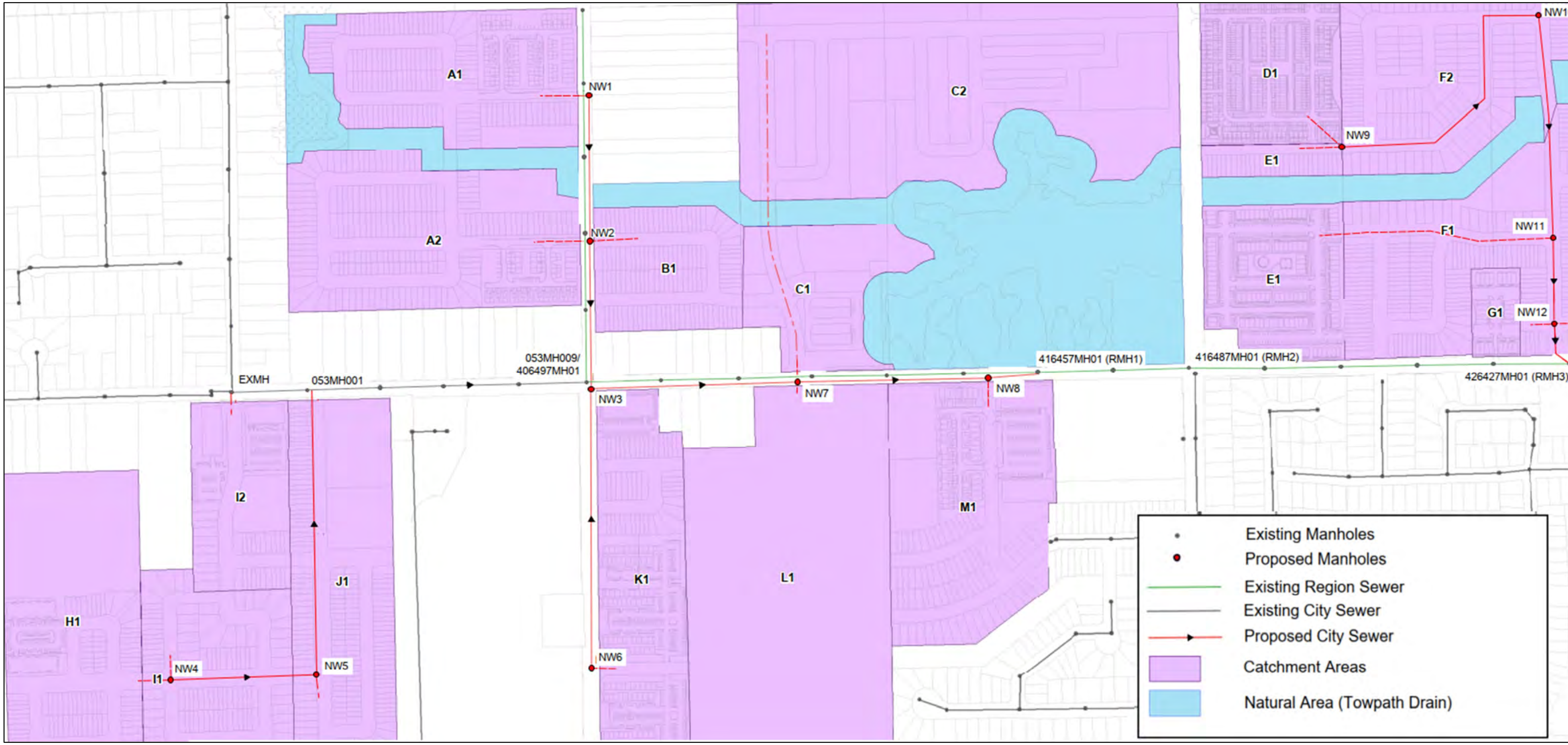


Figure 4-3: Proposed Sanitary System and Drainage Areas – Option 2

For servicing Option 2, the proposed trunk sewer within the quadrant east of First Avenue and north of Quaker Road (from NW10 to NW11) must cross the proposed Towpath Drain. For this preliminary assessment, using the existing ground contours and referencing the Towpath Drain Re-Alignment drawing package (Upper Canada Consultants, 2022) it appears that the proposed trunk sewer will be in direct conflict with the proposed box culvert and new creek bottom, making this servicing option not achievable. Further review and confirmation, based on proposed development details, will be required to determine viability of this servicing option moving forward.

As shown in the appended design sheets, the NWSP drainage area contributes overall an additional 143.3L/s of peak flow to the Quaker Road trunk sewer. Based on the capacity review of the existing trunk sewer on Quaker Road (provided in Appendix B), there are two (2) pipe segments that have an available capacity below 143L/s. The first pipe segment (19001376) is located between Rice Road and RMH1 (as shown on Figures 4-2 and 4-3 above). Since this segment will only receive an additional 27L/s sanitary flow from the NWSP area, this segment is not a concern. The second pipe segment (19001405) is located further downstream on Towpath Road between Grisdale Road and the Towpath Road SPS. Model analysis indicates this segment has 100L/s of available capacity with the Line Avenue trunk sewer connection. Further review and confirmation of available capacity within this segment should be completed prior to full build out of the NWSP area.

Although the phasing of future development within the NWSP area is not currently known, the proposed layout of this area and the associated sanitary design is such that the individual quadrants (defined as: areas west of Rice Road and north of Quaker Road (catchment area A); areas west of Rice Road and south of Quaker Road (catchment areas H, I, J); areas east of Rice Road and south of Quaker Road (catchment areas K, L, M); areas east of Rice Road and north of Quaker Road (catchment areas B, C1); areas east of First Avenue and north of Quaker Road (catchment areas D, E, F, G); and areas west of First Avenue (catchment area C2)) can mostly be developed independently of each other. Several exceptions to this include:

- the proposed city trunk sewer on Quaker Road (from NW3 to RMH1) must be constructed prior to development of catchment area A, catchment area B and catchment area K occurring;
- a portion of the proposed city trunk sewer on Quaker Road (from NW7 to RMH1) must be constructed prior to any development occurring within catchment areas C1 (and C2 for servicing Option 2), L, and M.
- for servicing Option 1, the proposed city trunk sewer on First Avenue (from NW9 to RMH2) must be constructed prior to development within catchment areas C2, D, and E.

The remainder of the city trunk sewers within each development quadrant should be constructed as development occurs in that quadrant starting from the downstream end.

Alternatively, to eliminate duplication of trunk infrastructure along Quaker Road and Rice Road, additional connections can be considered directly to the regional trunk main in order to eliminate the need for a 'local' trunk system. This approach would also eliminate most of the phasing exceptions noted above, as the local trunk would not need to be constructed.

4.3.2 Towpath SPS and Forcemain

The Welland NWSP area will contribute an additional 143.3L/s of peak flow to the Towpath SPS. As previously noted, the Region MSPU identified a planned upgrade to this SPS. The SPS upgrades will be required to address existing and future capacity and will be required to be completed before significant development can occur within the NWSP area.

The Towpath SPS forcemain has sufficient existing and future capacity to accommodate flows from the Welland NWSP area, provided the constructed 600mm diameter forcemain is commissioned prior to 2051 flows and build-out.

4.3.3 Welland WWTP and Downstream System

As previously noted, the Welland WWTP currently has a capacity surplus, and the NWSP area can be added. The Region MSPU did indicate the plant will reach 80% capacity around 2041. The post-2051 flows are expected to exceed the plant capacity; however, the plant can accommodate flows to 2051.

Additionally, the trunk sewer that the Towpath SPS forcemain discharges to has available capacity between the discharge point and the WWTP to accept an increase in flow. The design of the future Towpath SPS upgrade should confirm the capacity of the downstream trunk sewer when determining SPS outflow rates.

5 STORM

The existing NWSP area topography is quite flat and drains in a west to east direction. The land use is mainly pasture/ agricultural land interspersed with country residential homes. The plan area is significantly developed all around the boundary as well as within the plan area itself. The west side of the study area is already developed with country residential homes. There are two (2) major drainage channels that flow through the site – Towpath Drain within the northern portion of the development area and a tributary to Welland Recreational Canal within the southern portion of the development area. These two (2) channels are identified by the Niagara Peninsula Conservation Authority (NPCA) as requiring approval for any development draining to the channels. The existing stormwater drainage paths are shown in Figure 5-1.

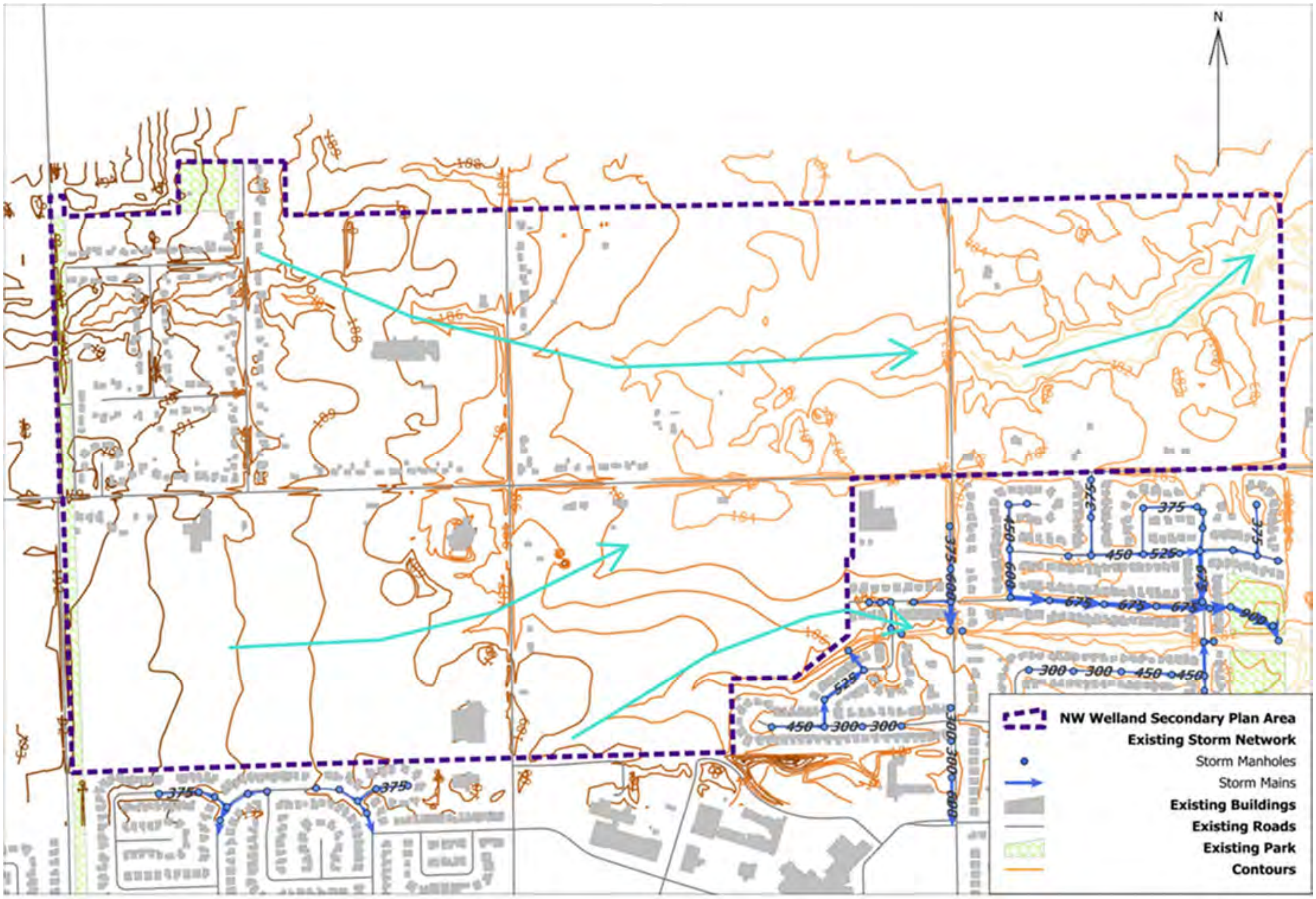


Figure 5-1: Schematic of Existing Stormwater Drainage Path

5.1 Design Criteria

The overall stormwater management plan for the NWSP area was initially developed by Aquafor Beech (2020) and updated and refined by Upper Canada Consultants (2022). The focus of this report is the identification of gravity sewer servicing requirements. The following design criteria were used in identifying these servicing requirements:

- Pipes were sized using the rational method with the City of Welland's 5-Year IDF curve values (a = 830, b =0.777, c = 7.3)
- Friction factor = 0.013
- Run-off coefficients (as per City of Welland's Design Standards) of:
  - Low Density Residential (i.e.: Single Family) = 0.40
  - Medium Density Residential (i.e.: Semi-Detached) = 0.50
  - High Density Residential (i.e.: Townhouses) = 0.60

5.2 Existing System Capacity

Since the proposed servicing, which is the focus of this report, will not leverage any existing gravity storm sewers in the area, no review of existing system capacity was conducted.

5.3 Proposed System Requirements

5.3.1 Proposed Stormwater Management Pond Locations

The stormwater management plan developed by Upper Canada Consultants identified approximate locations for eight (8) storm ponds, which will outlet to the Towpath Drain (channel north of Quaker Road), while one (1) storm pond will outlet to the tributary to Welland Recreational Canal (channel south of Quaker Road). The intent of the stormwater management plan is that all runoff from the proposed NWSP area will be directed to these storm pond locations through new gravity sewers installed on existing and future roads.

The approximate location of these proposed storm ponds is shown on the Ultimate Stormwater Management Plan figure from the Upper Canada Consultants Stormwater Management Implementation Plan (October 2022), which is included in Appendix C for reference. These pond locations were used to identify approximate outlet locations for the gravity sewers that will be required to service the NWSP area.

5.3.2 Proposed Gravity Sewers

Figure 5-2 (also provided in Appendix C as Figure C-2) shows the approximate location of future trunk storm gravity sewer outlets to the proposed storm ponds within the NWSP area. Figure 5-2 also shows identifying numbers for the individual NWSP drainage areas, which are referenced in the sewer design sheet found in Appendix C. Note, the design sheet was used primarily to identify outlet pipe sizing. Pipe sizes/lengths for the remainder of the future system were also approximated for preliminary costing (see Section 6), with a conservative assumption of a minimum pipe size of 450mm.

Based on the results of the completed sewer design sheet found in Appendix C, Table 5-1 shows the identified required outlet sizes for each approximate pond location.

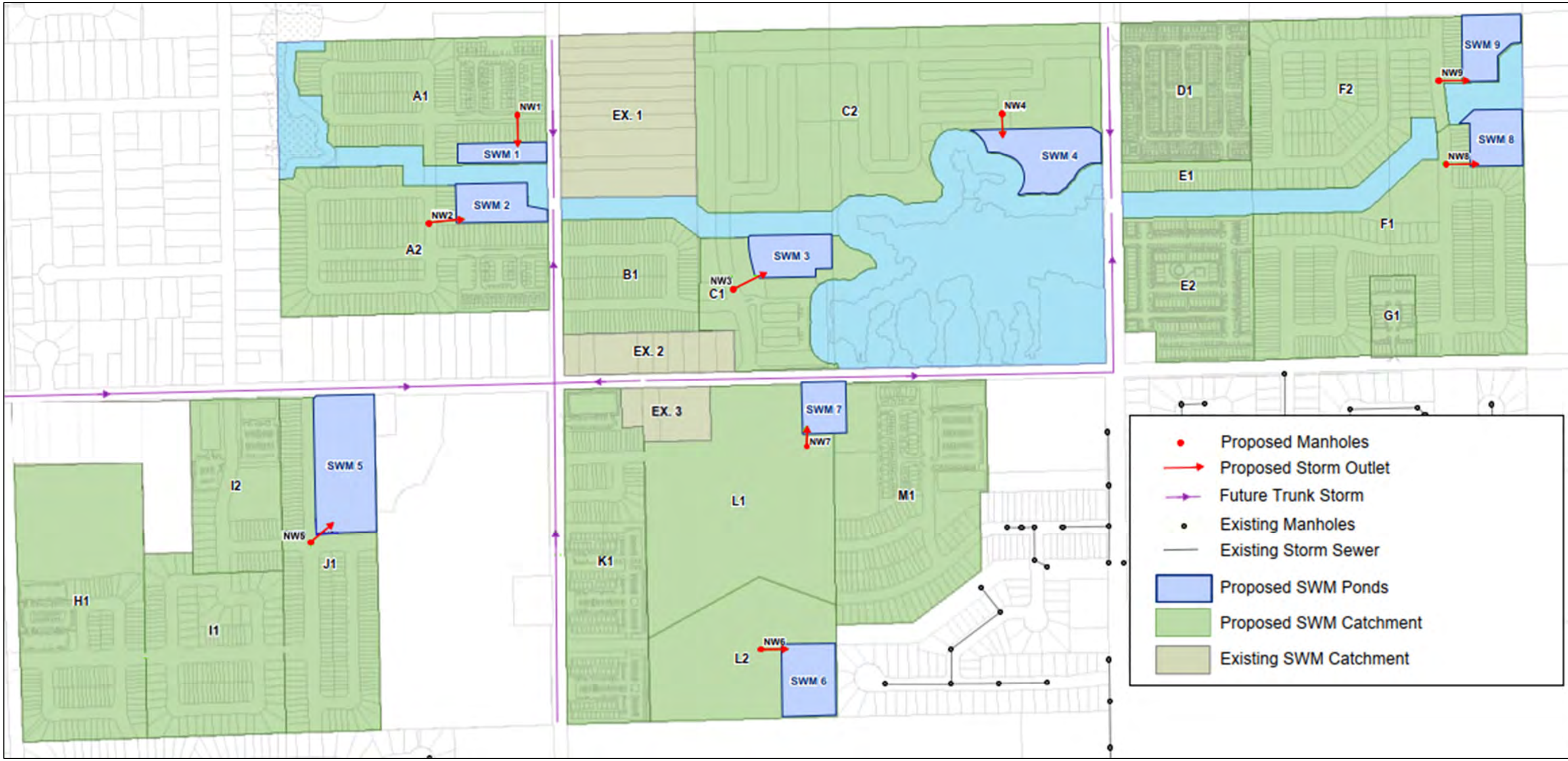


Figure 5-2: Proposed Storm System and Drainage Areas

Table 5-1: Required Outlet Size

Outlet #	Size (mm)
SWM1	900
SWM2	900
SWM3	1050
SWM4	1200
SWM5	1350
SWM6	750
SWM7	1350
SWM8	1200
SWM9	1200

Note that pipe slopes identified in the design sheet were assigned based on the existing ground contours for the area and the required outlet elevations, with the intent of ensuring suitable cover over all proposed pipes.

6 PRELIMINARY COSTING

Preliminary costing for the conceptual water, sanitary, and stormwater servicing is provided in Table 6-1. Note – neither road works, utilities (including hydro, gas and communications servicing), nor restoration cost (asphalt) for works proposed on existing roads (Rice Road, Quaker Road, and First Avenue) are included in this estimate. A more detailed breakdown of these preliminary cost estimates can be found in Appendix D.

Table 6-1: Preliminary Cost Estimate for Municipal Servicing

Item	Scope of Work	Cost
Water Distribution System	Watermain (150mm to 300mm) including services, valves, and hydrants	$26,366,775
Sanitary Collection Servicing	Sanitary Sewer (200mm to 450mm), including laterals and structures	$36,657,195
Storm Collection Servicing	Storm Sewer (450mm to 1350mm), including structures	$19,136,475
Sub-total	Water/Sanitary/Storm	$82,160,445
Engineering	10% of Capital	$8,216,200
Contingency	15% of Capital	$12,324,200
TOTAL		$102,700,845

7 CONCLUSIONS

The conclusions from the water, sanitary, and storm servicing capacity assessments are as follows:

Water:

- Proposed pipe servicing for the NWSP development is sized based on the design fire flow criteria of 133 L/s which are provided in Section 3. These include:
  - To supply fire flows for the northwest portion of NWSP development, the existing Rice Road watermain and the new infrastructure west of Rice Road (Loop A), should be a minimum of 250mm in diameter.
  - To supply water and adequate fire flows to the south-west portion of the development, a new 250mm diameter interconnection (Loop-H) is required to connect the existing 750mm regional trunk main on Clare Avenue to the new 300mm main on Quaker Road.
  - Loop C (300mm dia) for block C of NWSP and Loop L (200mm dia) for blocks K, L and M are required to provide the adequate fire flows.
  - A new 250mm watermain interconnection connecting the NWSP development to the Niagara Street Watermain on the east side will also be required to support the required fire flows.
- The addition of the NWSP development to the City's system does not negatively impact the surrounding system, and instead should improve pressures and fire flows in the area.
- The existing system has sufficient storage to support the future NWSP development.
- The proposed development does not negatively impact the existing low-pressure areas identified near Shoalt's Reservoir.

Sanitary:

- The existing trunk along Quaker Road, which conveys flows to the Towpath SPS, has sufficient capacity to accept the additional 143.3 L/s peak flow generated by the NWSP area, with the exception of pipe segment 19001405 on Towpath Road between Grisdale Road and the Towpath Road SPS. Model results indicate this segment has only 100L/s of available capacity.
- The Towpath SPS was identified in the Region MSPU as requiring an upgrade due to both growth north of the study area and the redirection of a portion of the flows from Pelham (north-west of Line Avenue) to the Towpath SPS through the Quaker Road trunk sewer. The timing of the Towpath SPS upgrade is 2022-2026 and will be required to be completed before significant development can occur within the NWSP area.
- The Towpath SPS forcemain has sufficient existing capacity; however, will have a projected capacity deficit for 2051 growth. There is already a constructed 600mm diameter forcemain that will require commissioning in line with Towpath SPS upgrades during the timeframe of 2032-2036 (WW-FM-022).
- The trunk sewer that the Towpath SPS forcemain discharges to has available capacity between the discharge point and the WWTP to accept an increase in flow.
- The WWTP has sufficient capacity to allow for the addition of the NWSP area.
- Future sanitary sewer sizing will range from 200 mm diameter to 450 mm diameter. Sizing to be confirmed during design.
- The phasing of future development within the NWSP area is not currently known; however, the proposed layout of this area is such that the individual quadrants (defined as: areas west of Rice Road and north of Quaker Road; areas west of Rice Road and south of Quaker Road; areas east of Rice Road and south of Quaker Road; areas east of Rice Road and north of Quaker Road; areas east of First Avenue and north of

Quaker Road; and areas west of First Avenue) can mostly be developed independently of each other, with exceptions noted below.

- The proposed city trunk sewer on Quaker Road (from NW3 to RMH1) must be constructed prior to development west of Rice Road, north of Quaker Road, and lands fronting the east side of Rice Road both north and south of Quaker Road.
- A portion of the proposed city trunk sewer on Quaker Road (from NW7 to RMH1) must be constructed prior to any development occurring east of Rice Road and west of First Avenue.
- For servicing Option 1, the proposed city trunk sewer on First Avenue (from NW9 to RMH2) must be constructed prior to development occurring immediately east and west of First Avenue.

- Alternatively, to eliminate duplication of trunk infrastructure along Quaker Road and Rice Road, additional connections can be considered directly to the regional trunk main in order to eliminate the need for a 'local' trunk system and most of the phasing exceptions noted above.

Storm:

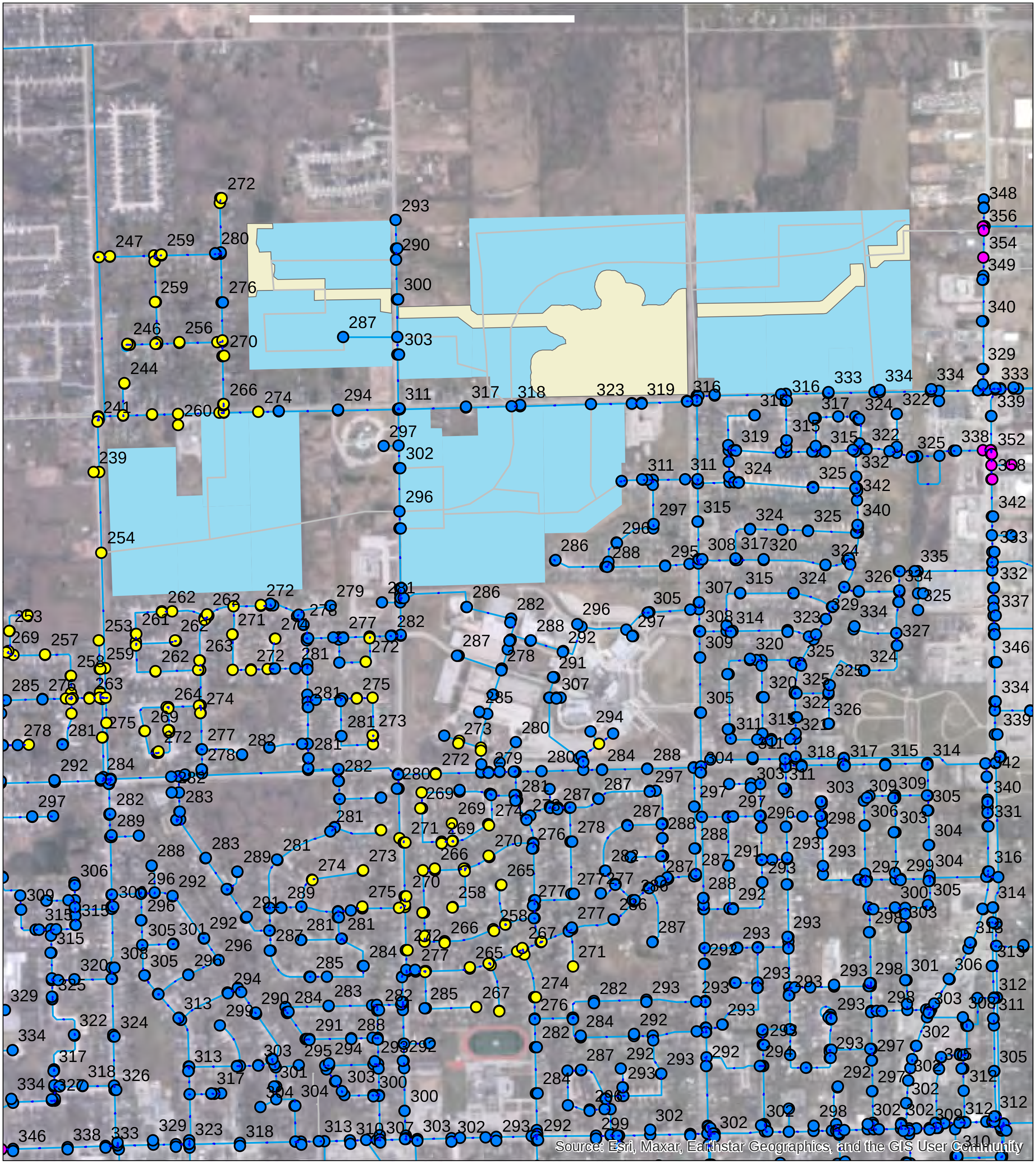
- The stormwater management plan developed by Upper Canada Consultants identified approximate locations for nine (9) new storm water ponds to service the NWSP area. Gravity sewers along the existing and future roads will direct runoff to these pond locations. Outlet sizing for the ponds will range from approximately 750 mm diameter to 1350 mm diameter. Sizing to be confirmed during design.

Respectfully Submitted by,

Andrea LaPlante, P.Eng.
Project Manager

LICENSED PROFESSIONAL ENGINEER
A. O. LAPLANTE
100156210
2024-06-24
PROVINCE OF ONTARIO

APPENDIX A - WATER



Minimum Pressure (kPa)

- < 140 kPa
- 140 - 275 kPa
- 275 - 350 kPa
- 350 - 550 kPa
- 550 - 700 kPa
- >700 kPa

Existing Watermain

Proposed Development

Associated Engineering

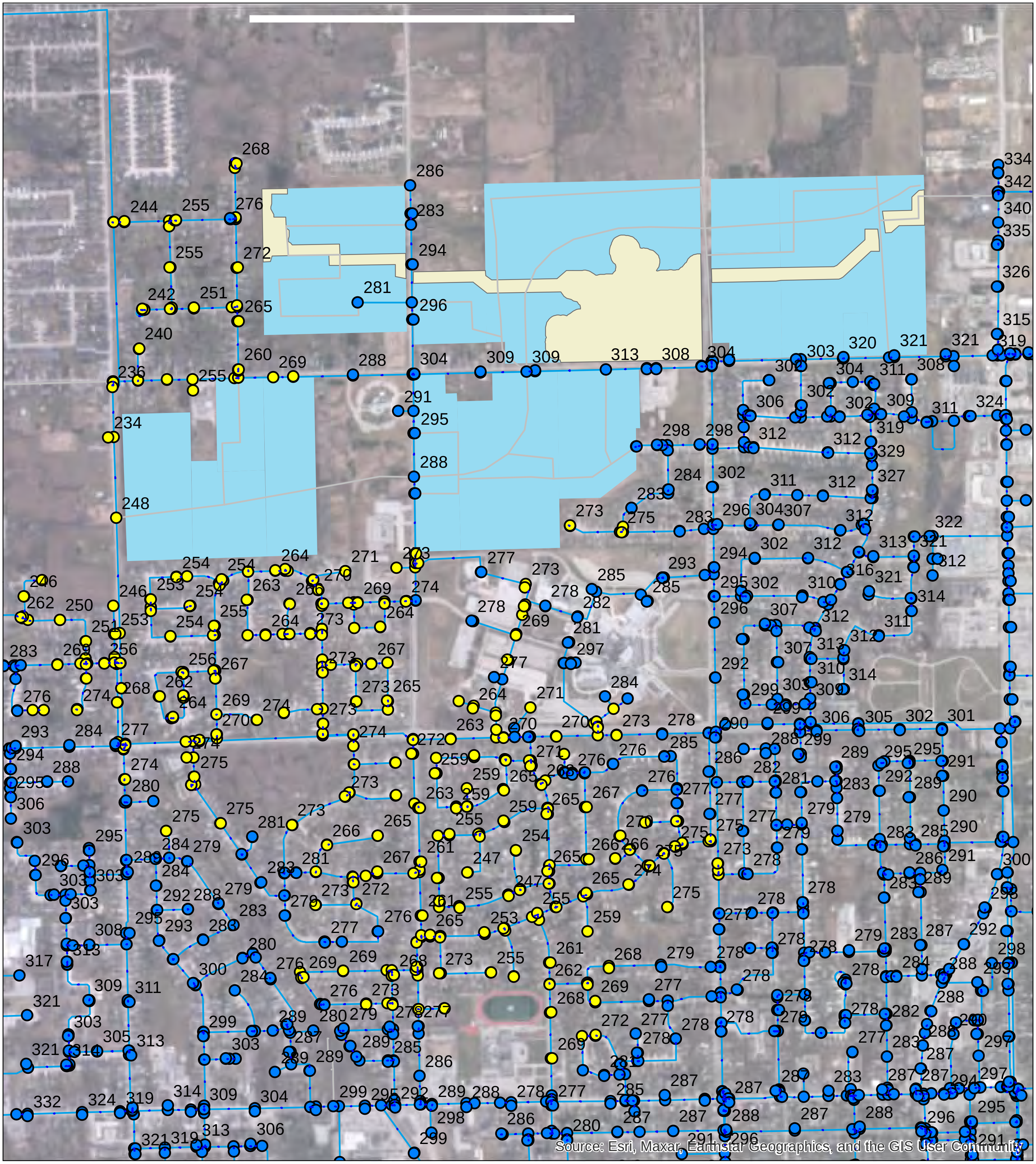
BEST MANAGED COMPANIES CANADA

Platinum member

Northwest Secondary Paln
Municipal Servicing

Existing ADD: Minimum Pressures

Project No: 2023-5773	**Figure A-1**
Date: March 2024	



Minimum Pressure (kPa)

- < 140 kPa
- 140 - 275 kPa
- 275 - 350 kPa
- 350 - 550 kPa
- 550 - 700 kPa
- >700 kPa

Existing Watermain

Proposed Development

Associated Engineering

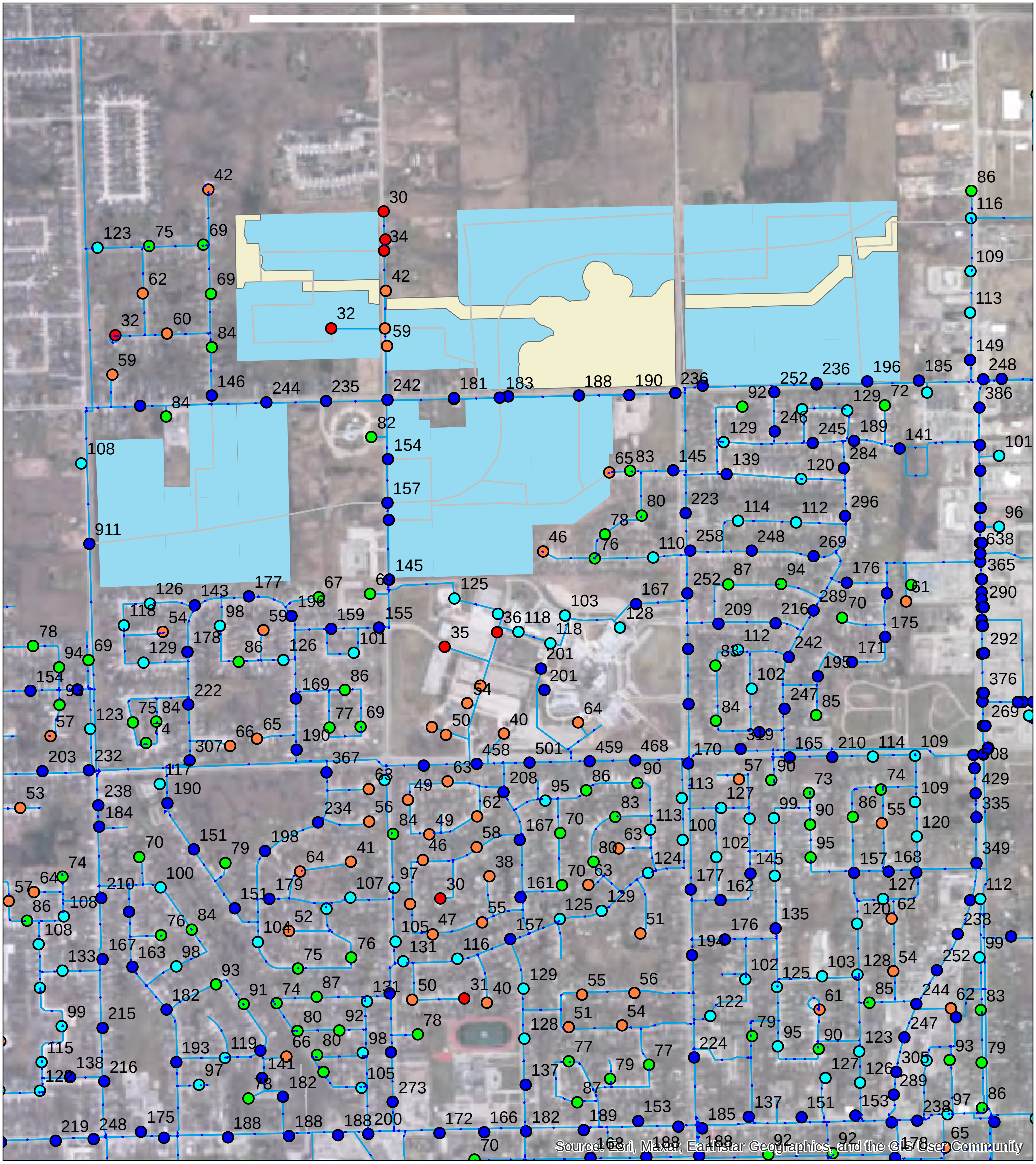
BEST MANAGED COMPANIES
Platinum member

Northwest Secondary Paln
Municipal Servicing

Existing MDD: Minimum Pressures

Project No: 2023-5773
Date: March 2024

Figure A-2



Available Fire Flows (L/s)

- < 37 L/s
- 37 - 67 L/s
- 67 - 95 L/s
- 95 - 133 L/s
- > 133 l/s

Existing Watermain

Proposed Development

Associated Engineering

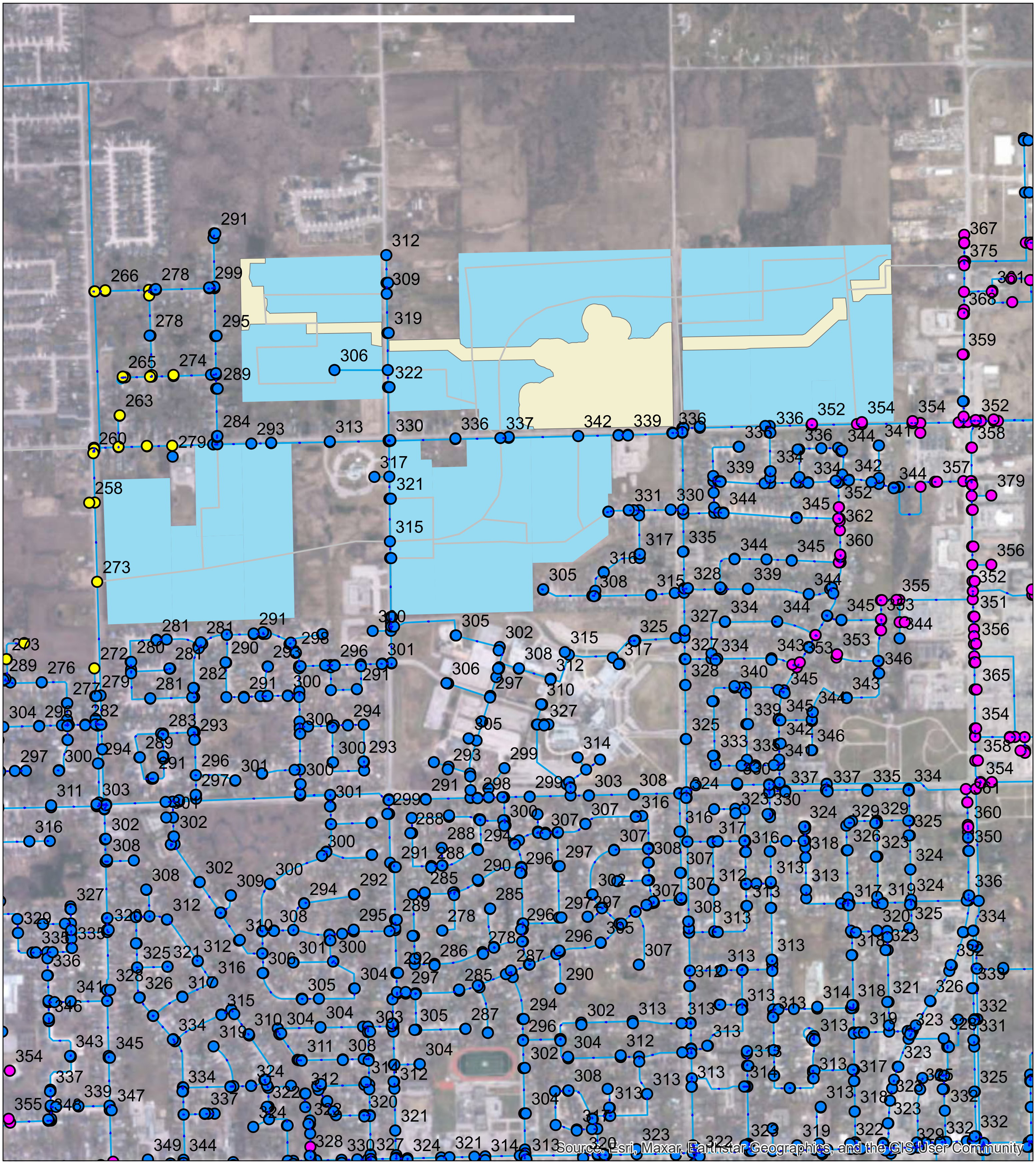
BEST MANAGED COMPANIES
Platinum member

Northwest Secondary Paln
Municipal Servicing

Existing MDD+FF: Available Fire Flows (L/s)

Project No: 2023-5773
Date: March 2024

Figure A-3



Minimum Pressure (kPa)

- < 140 kPa
- 140 - 275 kPa
- 275 - 350 kPa
- 350 - 550 kPa
- 550 - 700 kPa
- >700 kPa

Existing Watermain

Proposed Development

N

Associated Engineering

BEST MANAGED COMPANIES

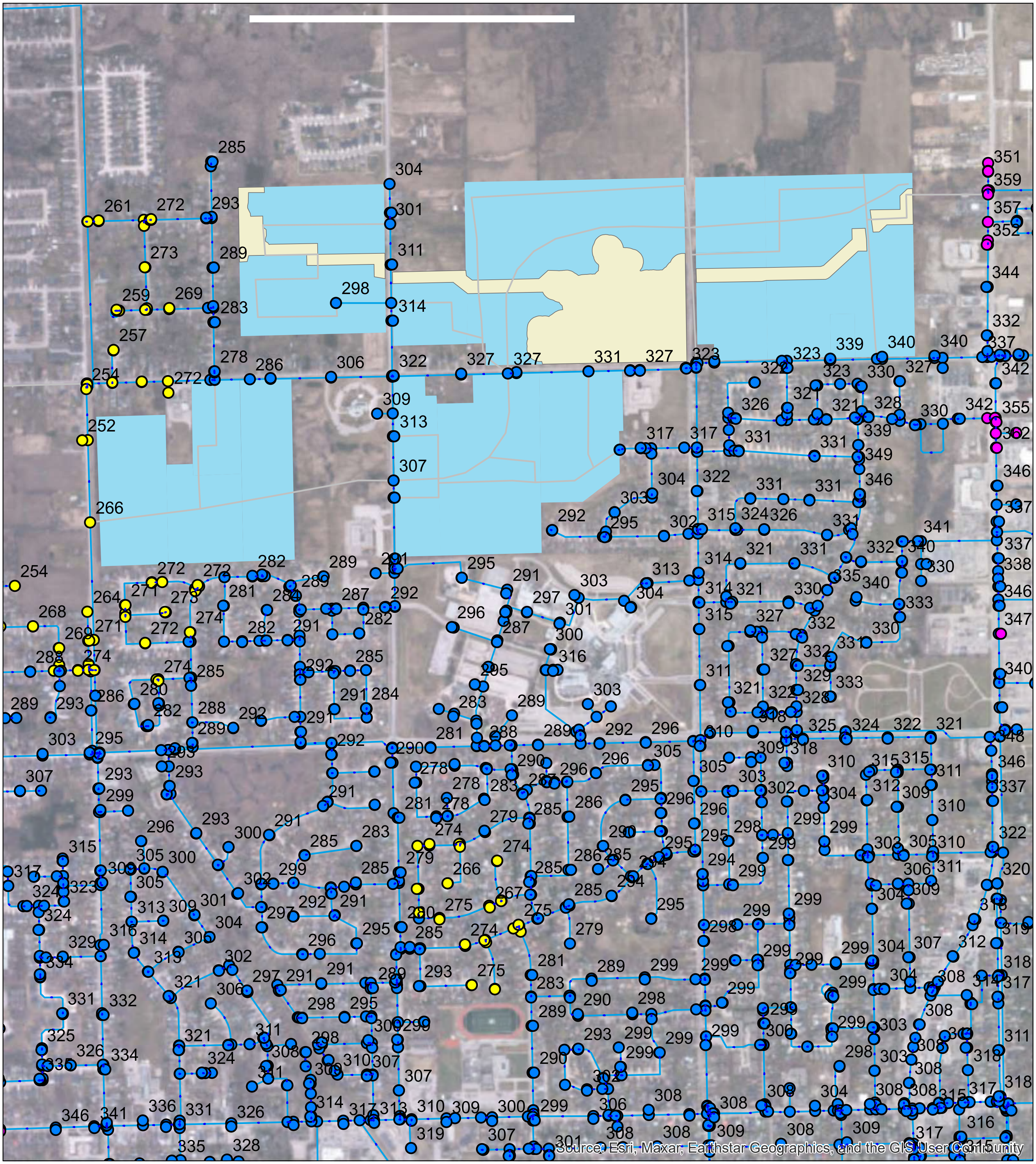
Northwest Secondary Paln Municipal Servicing

Future ADD without NWSP: Minimum Pressures

Project No: 2023-5773

Date: March 2024

Figure A-4



Minimum Pressure (kPa)

- < 140 kPa
- 140 - 275 kPa
- 275 - 350 kPa
- 350 - 550 kPa
- 550 - 700 kPa
- >700 kPa

Existing Watermain

Proposed Development

N

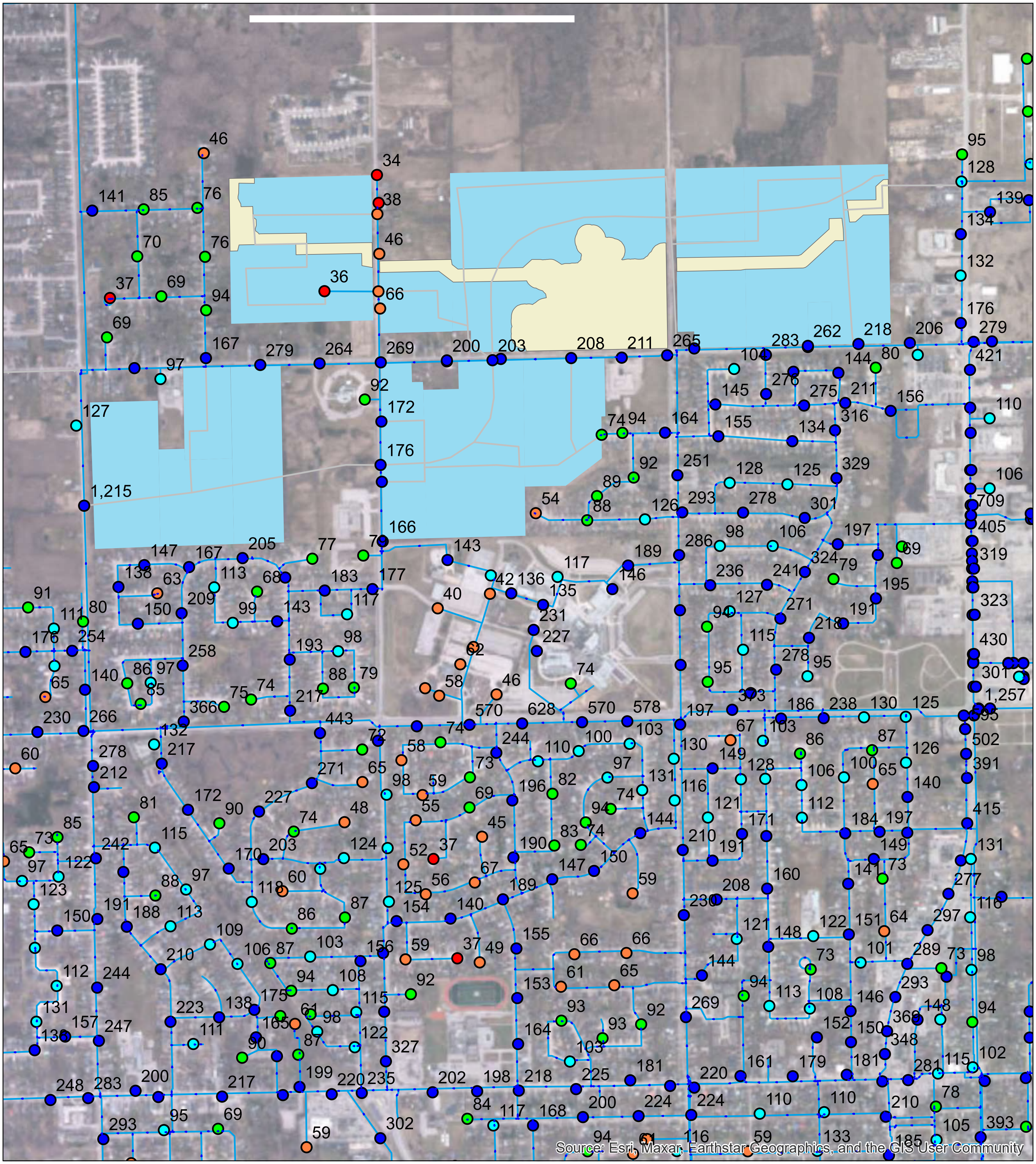
Northwest Secondary Paln Municipal Servicing

Future MDD without NWSP: Minimum Pressures

Project No: 2023-5773

Date: March 2024

Figure A-5



Available Fire Flows (L/s)

- < 37 L/s
- 37 - 67 L/s
- 67 - 95 L/s
- 95 - 133 L/s
- > 133 l/s

Existing Watermain

Proposed Development

N

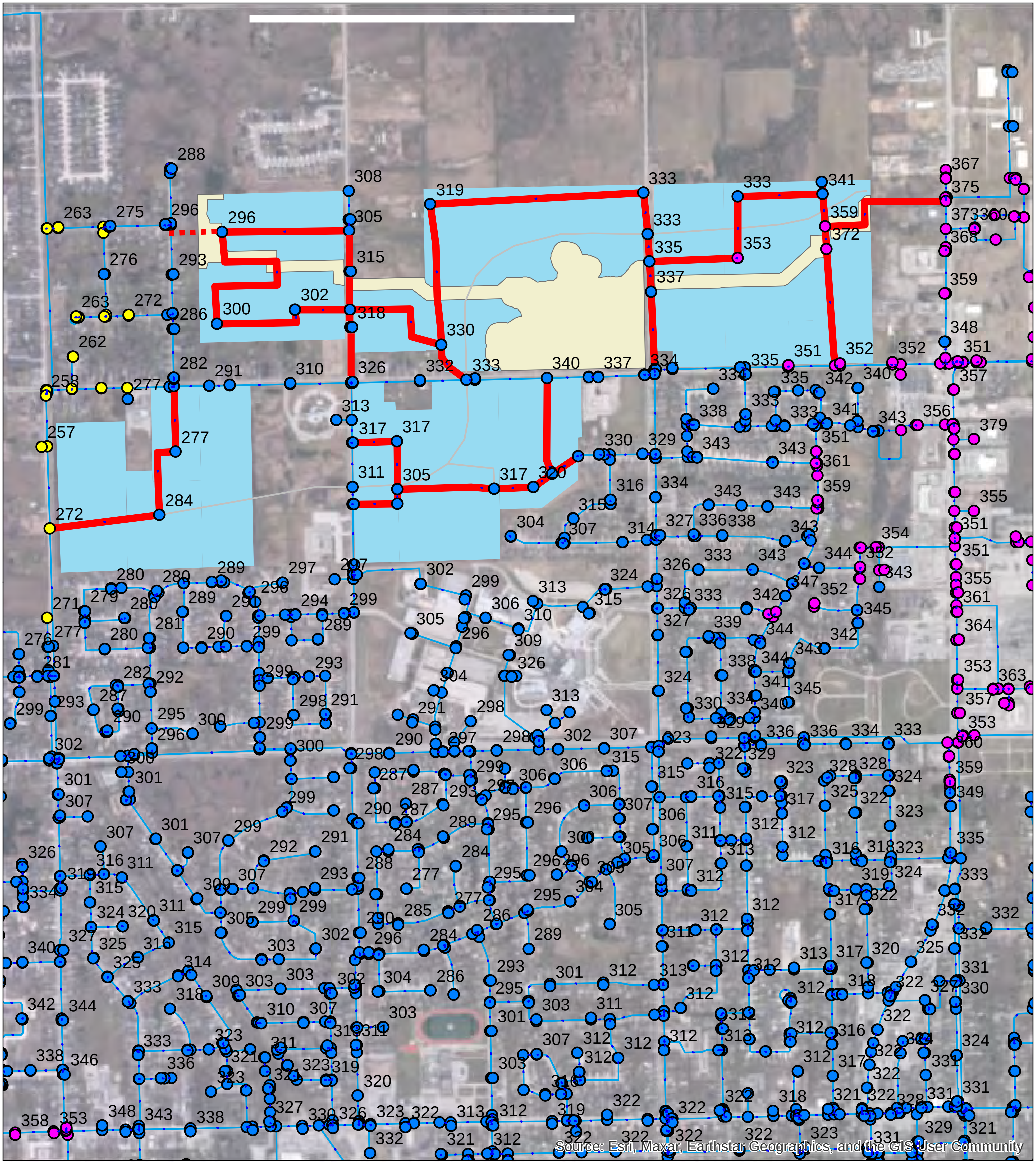
Associated Engineering

BEST MANAGED COMPANIES

Northwest Secondary Paln Municipal Servicing

Future MDD+FF without NWSP : Available Fire Flows

Project No: 2023-5773	**Figure A-6**
Date: March 2024	



Minimum Pressure (kPa)

- < 140 kPa
- 140 - 275 kPa
- 275 - 350 kPa
- 350 - 550 kPa
- 550 - 700 kPa
- >700 kPa

Existing Watermain

Proposed Development

Proposed Pipes for NWSP Development

Potential Future Looping

Associated Engineering

BEST MANAGED COMPANIES Platinum member

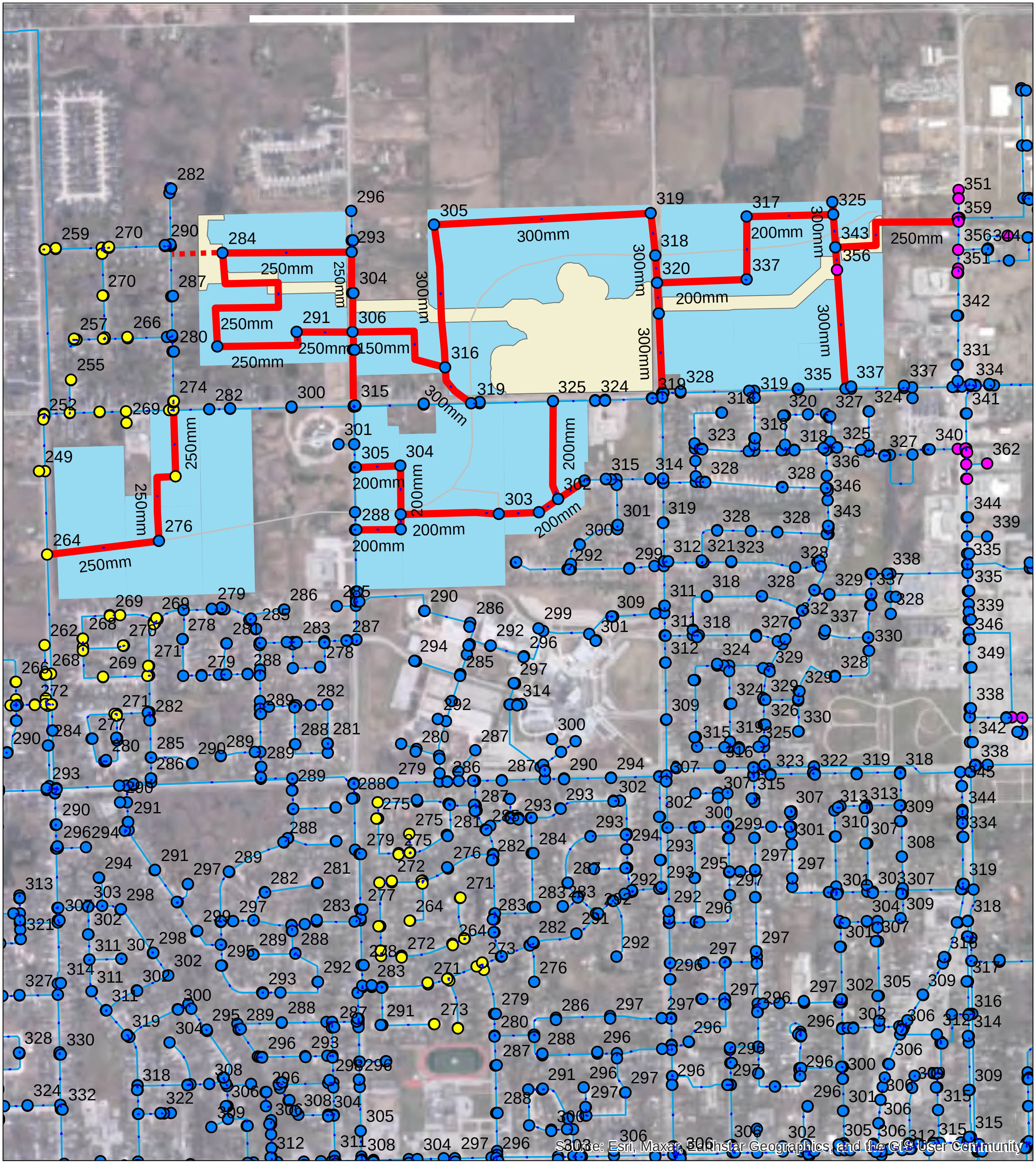
Northwest Secondary Paln Municipal Servicing

Future ADD with NWSP: Minimum Pressures

Project No: 2023-5773

Date: March 2024

Figure A-7



Minimum Pressure (kPa)

- < 140 kPa
- 140 - 275 kPa
- 275 - 350 kPa
- 350 - 550 kPa
- 550 - 700 kPa
- >700 kPa

Existing Watermain

Proposed Development

Proposed Pipes for NWSP Development

Potential Future Looping

Associated Engineering

BEST MANAGED COMPANIES Platinum member

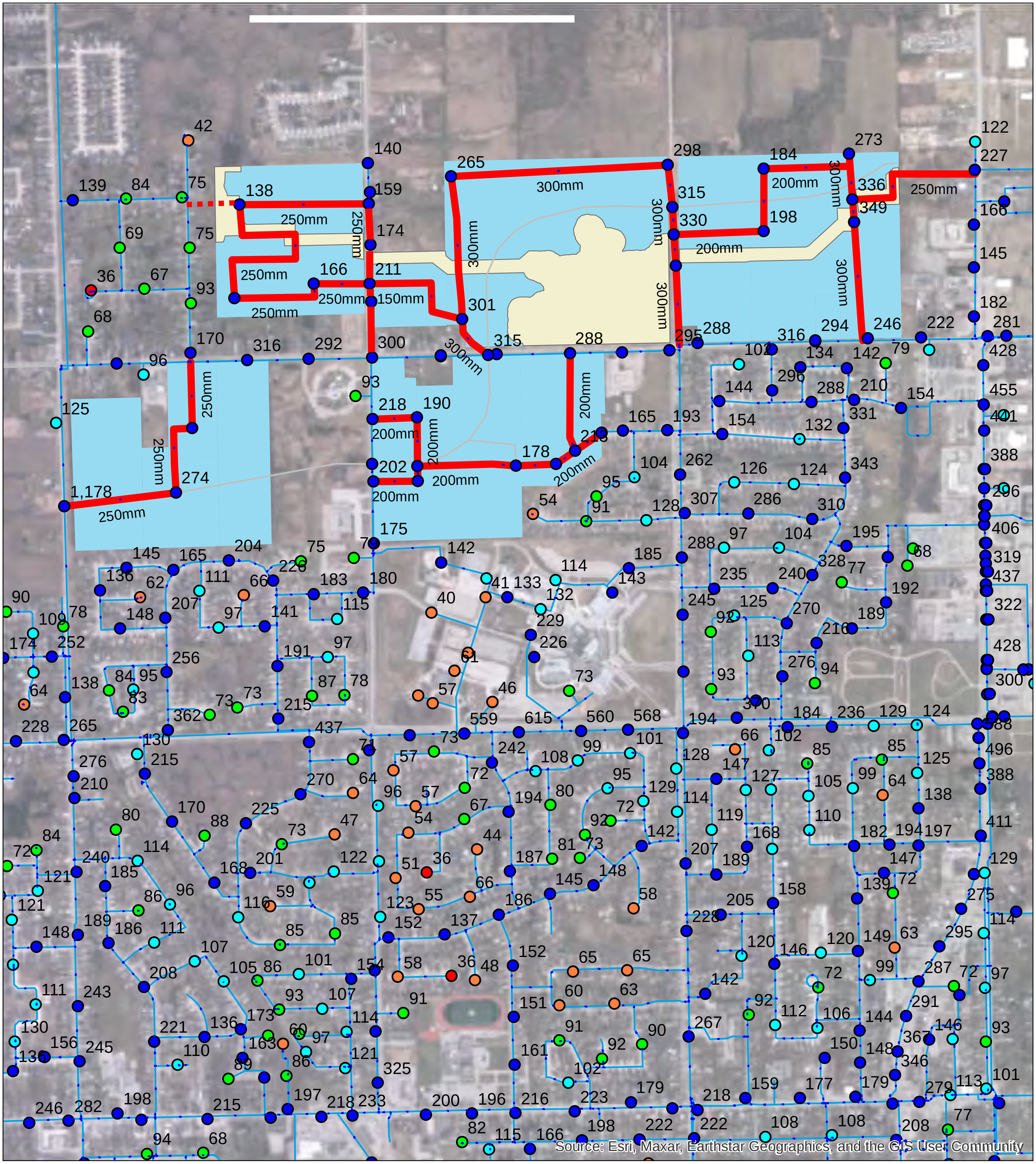
Northwest Secondary Paln Municipal Servicing

Future MDD with NWSP: Minimum Pressures

Project No: 2023-5773

Date: March 2024

Figure A-8



Available Fire Flows (L/s)

- < 37 L/s
- 37 - 67 L/s
- 67 - 95 L/s
- 95 - 133 L/s
- > 133 l/s

Existing Watermain

Proposed Development

Proposed Pipes for NWSP Development

Potential Future Looping

Associated Engineering

BEST MANAGED COMPANIES Platinum member

Northwest Secondary Paln Municipal Servicing

Future MDD with NWSP: Available Fire Flows (L/s)

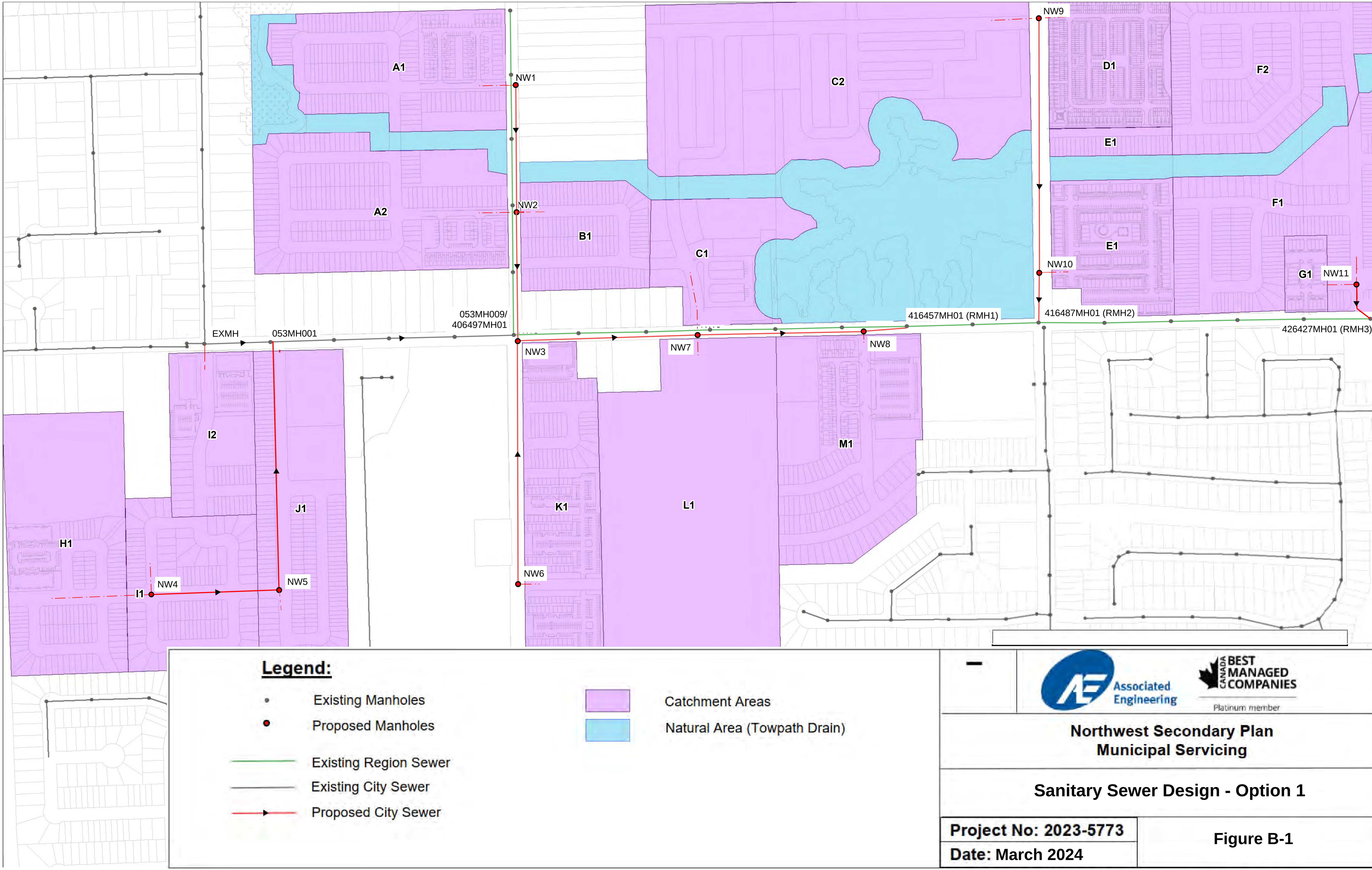
Project No: 2023-5773
Date: March 2024

Figure A-9

APPENDIX B - SANITARY

Northwest Secondary Plan
Municipal Servicing
2041 Quaker Road to Towpath SPS Trunk Sewer Available Capacity

Pipe Segment ID	Full Flow Capacity (L/s)	2041 without Line Avenue Connection		2041 with Line Avenue Connection	
		Peak Flow 2041 (L/s)	Available Capacity (L/s)	Peak Flow 2041 (L/s)	Available Capacity (L/s)
19001374	608	146	462	276	332
19001375	547	146	401	276	271
19001376	383	147	236	277	106
19001377	495	147	348	277	218
19001378	446	147	299	277	169
19001366	282	125	157	124	158
19001367	327	126	201	125	202
19001365	313	124	189	124	189
19001364	370	124	246	123	247
19001363	353	123	230	122	231
19001379	639	147	492	277	362
19001380	623	147	476	277	346
19001381	540	148	392	278	262
19001382	729	148	581	278	451
19001383	452	148	304	278	174
19001384	720	149	571	279	441
19001385	747	149	598	279	468
19001386	638	149	489	279	359
19001387	588	149	439	279	309
19001388	638	150	488	280	358
19001389	816	150	666	280	536
19001390	671	170	501	300	371
19001391	731	170	561	300	431
19001392	718	170	548	300	418
19001393	731	170	561	300	431
19001394	717	170	547	300	417
19001395	714	170	544	300	414
19001396	733	170	563	300	433
19001397	844	170	674	300	544
19001398	708	170	538	300	408
19001399	740	170	570	300	440
19001400	718	170	548	300	418
19001401	718	170	548	300	418
19001402	918	170	748	300	618
19001403	917	170	747	300	617
19001404	907	170	737	300	607
19001405	401	171	230	301	100
19001406	923	171	752	301	622
19001407	1143	177	966	307	836
19001408	914	177	737	307	607
19001409	914	177	737	307	607
19001410	912	177	735	307	605
19001411	914	177	737	307	607
19001412	1125	220	905	350	775
19001413	889	220	669	350	539
19001519	3470	220	3250	350	3120
19001520	3544	220	3324	350	3194



Associated Engineering

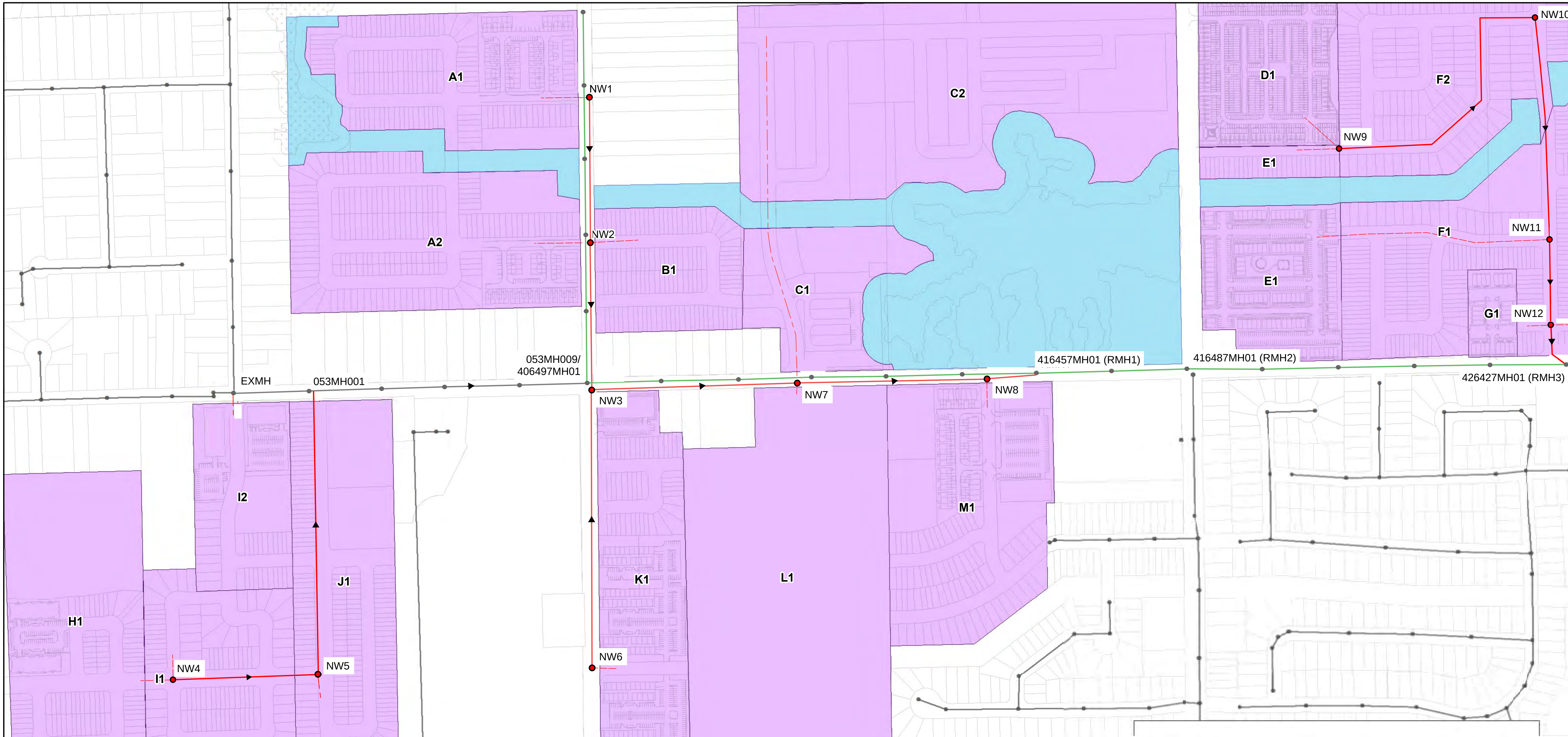
BEST MANAGED COMPANIES CANADA
Platinum member

Northwest Secondary Plan
Municipal Servicing

Sanitary Sewer Design - Option 1

Project No: 2023-5773
Date: March 2024

Figure B-1



Northwest Secondary Plan
Municipal Servicing

Sanitary Sewer Design - Option 2

Project No: 2023-5773

Date: March 2024

Figure B-2

SANITARY SEWER DESIGN SHEET

Design Option - 1

Project: Welland Northwest Secondary Plan
Location:

Roughness Coefficient (n) = 0.013
Residential Per Capita Flow Rate = 0.00318287 L/cap/s (275 L/cap/day)
Infiltration Rate= 0.286 L/s/ha

Associated Engineering

LOCATION: DESCRIPTION	LOCATION: DRAINAGE AREA	LOCATION: MANHOLE FROM	LOCATION: MANHOLE TO	INVERTS U/S	INVERTS D/S	LENGTH	NWSP POPULATION AND FLOW DATA: AREA	POP	CUMULATIVE AREA	CUMULATIVE POP. Served	AVG. DAILY FLOW	PEAKING FACTOR (PF = 1+14/(4+P^1/2))	PEAK FLOW (NO INFIL.)	INFILT. FLOW	PEAK FLOW (W/ INFIL.)	EX TRUNK FLOW: ADDITIONAL PEAK FLOW (FROM MODEL)	CUMULATIVE PEAK FLOW (FROM MODEL)	TOTAL (NWSP + EX): TOTAL PEAK FLOW	SEWER DESIGN: PIPE SIZE	ACTUAL SLOPE	APPROX. CRITICAL SLOPE	DESIGN SLOPE	Act. Dia.	PIPE AREA	HYD. RAD.	FULL FLOW VELOCITY	FULL FLOW CAPACITY	PERCENT FULL	CAPACITY CHECK	ACTUAL VELOCITY
STREET	ID	FROM	TO			m	(ha)	(ppl)	(ha)	(ppl)	(l/s)	(dmnl)	(L/s)	(L/s)	(L/s)	(L/s)		(L/s)	(mm)	(%)	(%)	(%)	(mm)	(m^2)	(m)	(m/s)	(L/s)	(%)		(m/s)
Rice Road (N of Quaker)	A1	NW1	NW2	182.30	181.02	200	6.0	532	6.0	532	1.69	3.96	6.71	1.72	8.43	0.0	0.0	**8.4**	200	0.64	1.54	0.64	203.2	0.032	0.051	0.84	**27.4**	30.8	OK	0.65
Rice Road (N of Quaker)	A2, B1	NW2	NW3	181.02	180.10	197	10.6	868	16.6	1400	4.46	3.70	16.49	4.76	21.25	0.0	0.0	**21.2**	250	0.47	1.43	0.47	254.0	0.051	0.064	0.84	**42.5**	50.0	OK	0.74
Kaywood Crt.				188.89	188.47	65	0.5	15	0.5	15	0.05	4.00	0.19	0.14	0.33	0.0	0.0	**0.3**	200	0.65	1.54	0.65	203.2	0.032	0.051	0.85	**27.6**	1.2	OK	0.20
Quaker Road (School/Daycare)							1.6	500	1.6	500	0.36	3.97	1.41	0.47	1.88	0.0	0.0	**1.9**												
Montgomery (end to Summerlea)				186.53	186.10	179	3.0	25	3.0	25	0.08	4.00	0.32	0.86	1.18	0.0	0.0	**1.2**	250	0.24	1.43	0.24	254.0	0.051	0.064	0.60	**30.4**	3.9	OK	0.24
Topham/Crerar/Summerlea				188.66	186.12	420	10.9	148	10.9	148	0.47	4.00	1.88	3.12	5.00	0.0	0.0	**5.0**	250	0.60	1.43	0.60	254.0	0.051	0.064	0.95	**48.1**	10.4	OK	0.53
Montgomery (Summerlea to Quaker)			EXMH	186.08	185.03	423	5.7	78	19.6	250	0.80	4.00	3.18	5.61	8.79	0.0	0.0	**8.8**	250	0.25	1.43	0.25	254.0	0.051	0.064	0.61	**31.0**	28.3	OK	0.46
Quaker Road (Line to Kaywood)				188.89	188.42	53	0.7	13	0.7	13	0.04	4.00	0.16	0.20	0.36	0.0	0.0	**0.4**	200	0.89	1.54	0.89	203.2	0.032	0.051	1.00	**32.3**	1.1	OK	0.21
Quaker Road (Kaywood to Montgomery)			EXMH	188.41	184.55	270	3.4	38	4.6	565	2.15	3.95	8.50	1.32	9.82	0.0	0.0	**9.8**	250	1.43	1.43	1.43	254.0	0.051	0.064	1.46	**74.2**	13.2	OK	0.88
Quaker Road (W of Rice)	I2	EXMH	053MH001	184.52	183.93	104	3.4	330	27.6	1145	4.00	3.76	15.05	7.90	22.95	0.0	0.0	**22.9**	300	0.57	1.34	0.57	304.8	0.073	0.076	1.04	**76.2**	30.1	OK	0.80
NWSP (W of Rice, S of Quaker)	H1, I1	NW4	NW5	186.40	185.40	210	13.8	938	13.8	938	2.99	3.82	11.40	3.94	15.34	0.0	0.0	**15.3**	200	0.48	1.54	0.48	203.2	0.032	0.051	0.73	**23.7**	64.7	OK	0.69
NWSP (W of Rice, S of Quaker)	J1	NW5	053MH001	185.40	183.90	389	7.0	454	20.8	1392	4.43	3.70	16.41	5.96	22.36	0.0	0.0	**22.4**	250	0.39	1.43	0.39	254.0	0.051	0.064	0.76	**38.7**	57.7	OK	0.70
Quaker Road (W of Rice)	-	053MH001	053MH009 / 406497MH01	183.88	181.64	385	3.5	33	51.9	2570	8.54	3.50	29.87	14.86	44.72	0.0	0.0	**44.7**	300	0.58	1.34	0.58	304.8	0.073	0.076	1.05	**76.8**	58.2	OK	0.97
Rice Road (S of Quaker)	K1	NW6	NW3	184.50	180.10	387	5.7	1229	5.7	1229	3.91	3.74	14.63	1.64	16.27	0.0	0.0	**16.3**	200	1.14	1.54	1.14	203.2	0.032	0.051	1.13	**36.5**	44.5	OK	0.96
Quaker Road (Rice to W of First)	-	NW3	NW7	180.10	179.24	287	-	-	22.4	2629	8.37	3.49	29.21	6.40	35.60	0.0	0.0	**35.6**	300	0.30	1.34	0.30	304.8	0.073	0.076	0.76	**55.3**	64.4	OK	0.71
Quaker Road (Rice to W of First)	C1, L1	NW7	NW8	179.24	178.72	261	16.6	1842	39.0	4471	14.23	3.29	46.81	11.15	57.96	0.0	0.0	**58.0**	375	0.20	1.25	0.20	381.0	0.114	0.095	0.72	**81.8**	70.9	OK	0.69
Quaker Road (Rice to W of First)	M1	NW8	416457MH01 (RMH1)	178.72	178.58	69	7.1	661	46.0	5132	16.33	3.23	52.83	13.17	66.00	0.0	0.0	**66.0**	450	0.20	1.17	0.20	457.2	0.164	0.114	0.81	**133.0**	49.6	OK	0.71
Flows from Hurricane SPS/Rice Road (North)	-	-	053MH009 / 406497MH01	-	-	-	-	-	-	-	-	-	-	-	-	97.7	97.7	**97.7**	-	-	-		-	-	-	-	**-**	**-**	**-**	
Flows from West of Quaker and Rice (from Line Ave)	-	-	053MH009 / 406497MH01	-	-	-	-	-	-	-	-	-	-	-	-	79.1	79.1	**79.1**	-	-	-		-	-	-	-	**-**	-	-	-
Quaker Road (Region Trunk E of Rice)	-	053MH009 / 406497MH01	416457MH01 (RMH1)	179.94	178.58	618	-	-	51.9	2570	8.54	3.50	29.87	14.86	44.72	0.0	176.8	**221.5**	750	0.22	0.99	0.22	762.0	0.456	0.191	1.19	**544.8**	40.7	OK	1.00
Quaker Road (W of First to First)	-	416457MH01 (RMH1)	416487MH01 (RMH2)	178.58	178.25	207	-	-	98.0	7702	24.87	3.07	76.26	28.02	104.29	0.0	176.8	**281.1**	750	0.16	0.99	0.16	762.0	0.456	0.191	1.02	**464.6**	60.5	OK	0.95
First Ave (N of Quaker)	C2, D1, F2	NW9	NW10	179.40	178.41	393	26.1	3223	26.1	3223	10.26	3.42	35.04	7.47	42.51	0.0	0.0	**42.5**	375	0.25	1.25	0.25	381.0	0.114	0.095	0.80	**91.5**	46.5	OK	0.69
First Ave (N of Quaker)	E1	NW10	416487MH01 (RMH2)	178.41	178.25	80	4.8	1123	30.9	4346	13.83	3.30	45.66	8.83	54.49	0.0	0.0	**54.5**	375	0.20	1.25	0.20	381.0	0.114	0.095	0.72	**81.8**	66.6	OK	0.68
Quaker Road (First to W of Niagara)	-	416487MH01 (RMH2)	426427MH01 (RMH3)	178.25	177.07	521	-	-	128.9	12048	38.70	2.87	111.23	36.86	148.09	3.0	179.8	**327.9**	750	0.23	0.99	0.23	762.0	0.456	0.191	1.22	**557.0**	58.9	OK	1.13
NWSP (N of Quaker, E of First)	F1, G1	NW11	426427MH01 (RMH3)	177.29	177.07	50	10.9	980	10.9	980	3.12	3.81	11.87	3.13	15.00	0.0	0.0	**15.0**	200	0.44	1.54	0.44	203.2	0.032	0.051	0.70	**22.7**	66.1	OK	0.67
Quaker Road (W of Niagara to Towpath)	-	426427MH01 (RMH3)	436437MH03	177.07	171.78	1320	-	-	139.8	13028	41.82	2.84	118.77	39.99	158.76	28.8	208.6	**367.4**	750	0.40	0.99	0.40	762.0	0.456	0.191	1.61	**734.5**	50.0	OK	1.42
Towpath (to SPS)	-	436540MH01	446525MH01	171.05	169.40	1002	-	-	139.8	13028	41.82	2.84	118.77	39.99	158.76	98.1	306.7	**465.5**	900	0.16	0.93	0.16	914.4	0.657	0.229	1.15	**755.4**	61.6	OK	1.07

Notes:
1. Residential design flows as per UCC
2. Slopes approximate; calculated based on length
3. Infiltration rate is 0.286 as per Region Master Plan Update 2021
4. Peak Factors for NWSP Flows as per Harmon's Formula
5. Population for NWSP as per UCC
6. All other peak flows as per All Pipe Model
7. Assume population density for existing residential single family home is 2.5p/household
8. School and daycare flows as per Building Code Table 8.2.1.3.B

SANITARY SEWER DESIGN SHEET

Design Option - 2

Project: Welland Northwest Secondary Plan
Location:

Roughness Coefficient (n) = 0.013
Residential Per Capita Flow Rate = 0.00318287 L/cap/s (275 L/cap/day)
Infiltration Rate= 0.286 L/s/ha

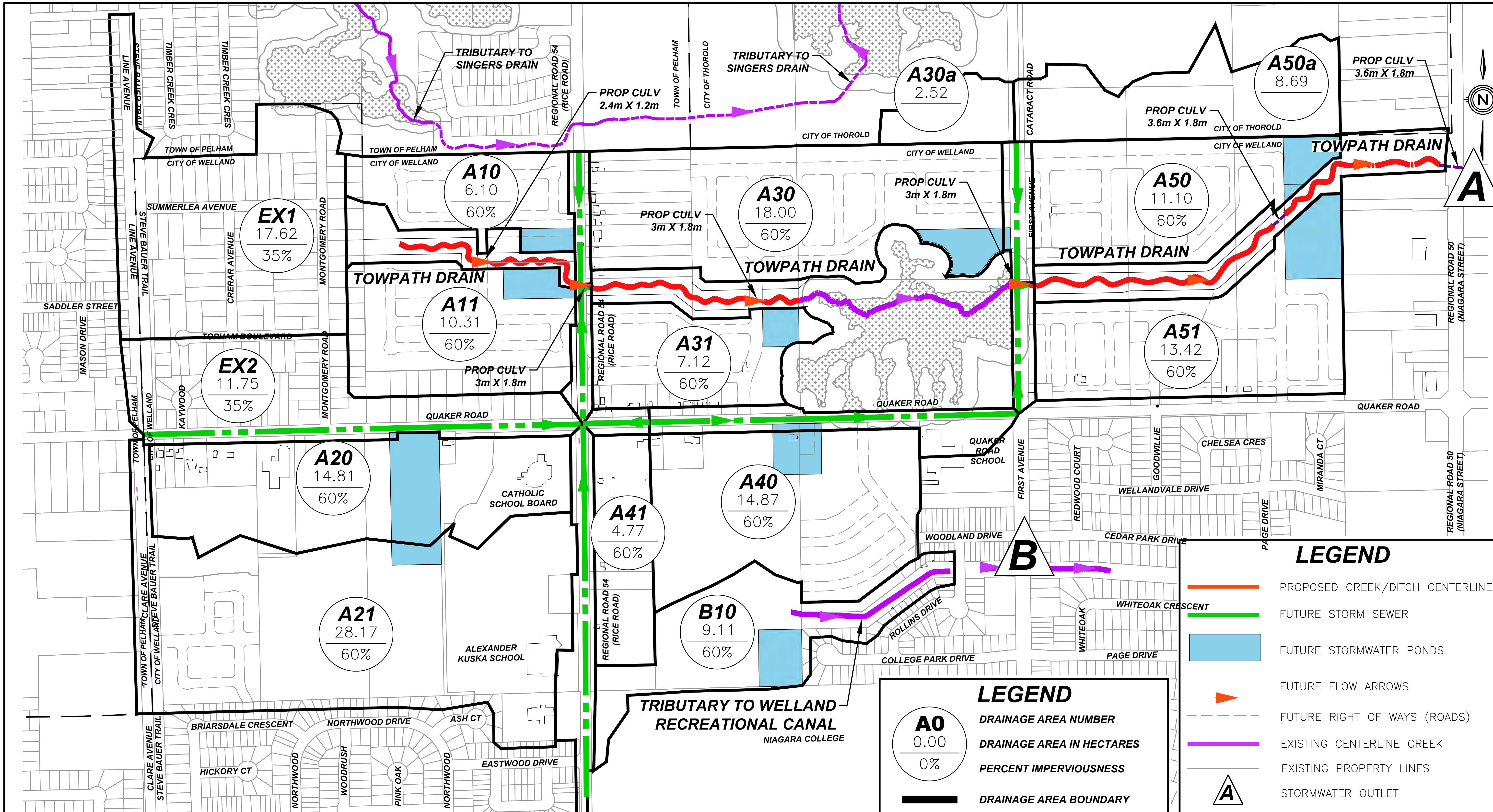
Associated Engineering

LOCATION: DESCRIPTION	LOCATION: DRAINAGE AREA	MANHOLE		INVERTS		LENGTH	NWSP POPULATION AND FLOW DATA: AREA	POP	CUMULATIVE AREA	CUMULATIVE POP. Served	AVG. DAILY FLOW	PEAKING FACTOR (PF = 1+14/(4+P^1/2))	PEAK FLOW (NO INFIL.)	INFILT. FLOW	PEAK FLOW (W/ INFIL.)	EX TRUNK FLOW: ADDITIONAL PEAK FLOW (FROM MODEL)	CUMULATIVE PEAK FLOW (FROM MODEL)	TOTAL (NWSP + EX): TOTAL PEAK FLOW	SEWER DESIGN: PIPE SIZE	ACTUAL SLOPE	APPROX. CRITICAL SLOPE	DESIGN SLOPE	Act. Dia.	PIPE AREA	HYD. RAD.	FULL FLOW VELOCITY	FULL FLOW CAPACITY	PERCENT FULL	CAPACITY CHECK	ACTUAL VELOCITY
STREET	ID	FROM	TO	U/S	D/S	m	(ha)	(ppl)	(ha)	(ppl)	(l/s)	(dmnl)	(L/s)	(L/s)	(L/s)	(L/s)		(L/s)	(mm)	(%)	(%)	(%)	(mm)	(m^2)	(m)	(m/s)	(L/s)	(%)		(m/s)
Rice Road (N of Quaker)	A1	NW1	NW2	182.30	181.02	200	6.0	532	6.0	532	1.69	3.96	6.71	1.72	8.43	0.0	0.0	**8.4**	200	0.64	1.54	0.64	203.2	0.032	0.051	0.84	**27.4**	30.8	OK	0.65
Rice Road (N of Quaker)	A2, B1	NW2	NW3	181.02	180.10	197	10.6	868	16.6	1400	4.46	3.70	16.49	4.76	21.24	0.0	0.0	**21.2**	250	0.47	1.43	0.47	254.0	0.051	0.064	0.84	**42.5**	50.0	OK	0.74
Kaywood Crt.				188.89	188.47	65	0.5	15	0.5	15	0.05	4.00	0.19	0.14	0.33	0.0	0.0	**0.3**	200	0.65	1.54	0.65	203.2	0.032	0.051	0.85	**27.6**	1.2	OK	0.20
Quaker Road (School/Daycare)							1.6	500	1.6	500	0.36	3.97	1.41	0.47	1.88	0.0	0.0	**1.9**												
Montgomery (end to Summerlea)				186.53	186.10	179	3.0	25	3.0	25	0.08	4.00	0.32	0.86	1.18	0.0	0.0	**1.2**	250	0.24	1.43	0.24	254.0	0.051	0.064	0.60	**30.4**	3.9	OK	0.24
Topham/Crerar/Summerlea				188.66	186.12	420	10.9	148	10.9	148	0.47	4.00	1.88	3.12	5.00	0.0	0.0	**5.0**	250	0.60	1.43	0.60	254.0	0.051	0.064	0.95	**48.1**	10.4	OK	0.53
Montgomery (Summerlea to Quaker)			EXMH	186.08	185.03	423	5.7	78	19.6	250	0.80	4.00	3.18	5.61	8.79	0.0	0.0	**8.8**	250	0.25	1.43	0.25	254.0	0.051	0.064	0.61	**31.0**	28.3	OK	0.46
Quaker Road (Line to Kaywood)				188.89	188.42	53	0.7	13	0.7	13	0.04	4.00	0.16	0.20	0.36	0.0	0.0	**0.4**	200	0.89	1.54	0.89	203.2	0.032	0.051	1.00	**32.3**	1.1	OK	0.21
Quaker Road (Kaywood to Montgomery)			EXMH	188.41	184.55	270	3.4	38	4.6	565	2.15	3.95	8.50	1.32	9.82	0.0	0.0	**9.8**	250	1.43	1.43	1.43	254.0	0.051	0.064	1.46	**74.2**	13.2	OK	0.88
Quaker Road (W of Rice)	I2	EXMH	053MH001	184.52	183.93	104	3.4	330	27.6	1145	4.00	3.76	15.05	7.90	22.95	0.0	0.0	**22.9**	300	0.57	1.34	0.57	304.8	0.073	0.076	1.04	**76.2**	30.1	OK	0.80
NWSP (W of Rice, S of Quaker)	H1, I1	NW4	NW5	186.40	185.40	210	13.8	938	13.8	938	2.99	3.82	11.40	3.95	15.35	0.0	0.0	**15.3**	200	0.48	1.54	0.48	203.2	0.032	0.051	0.73	**23.7**	64.7	OK	0.69
NWSP (W of Rice, S of Quaker)	J1	NW5	053MH001	185.40	183.90	389	7.0	454	20.8	1392	4.43	3.70	16.41	5.96	22.37	0.0	0.0	**22.4**	250	0.39	1.43	0.39	254.0	0.051	0.064	0.76	**38.7**	57.7	OK	0.70
Quaker Road (W of Rice)	-	053MH001	053MH009 / 406497MH01	183.88	181.64	385	3.5	33	52.0	2571	8.54	3.50	29.87	14.86	44.73	0.0	0.0	**44.7**	300	0.58	1.34	0.58	304.8	0.073	0.076	1.05	**76.8**	58.2	OK	0.97
Rice Road (S of Quaker)	K1	NW6	NW3	184.50	180.10	387	5.7	1229	5.7	1229	3.91	3.74	14.63	1.64	16.27	0.0	0.0	**16.3**	200	1.14	1.54	1.14	203.2	0.032	0.051	1.13	**36.5**	44.5	OK	0.96
Quaker Road (Rice to W of First)	-	NW3	NW7	180.10	179.24	287	-	-	22.4	2629	8.37	3.49	29.21	6.39	35.60	0.0	0.0	**35.6**	300	0.30	1.34	0.30	304.8	0.073	0.076	0.76	**55.3**	64.4	OK	0.71
Quaker Road (Rice to W of First)	C1, C2, L1	NW7	NW8	179.24	178.72	261	31.2	3640	53.5	6269	19.95	3.15	62.90	15.31	78.21	0.0	0.0	**78.2**	450	0.20	1.17	0.20	457.2	0.164	0.114	0.81	**133.0**	58.8	OK	0.75
Quaker Road (Rice to W of First)	M1	NW8	416457MH01 (RMH1)	178.72	178.58	69	7.1	661	60.6	6930	22.06	3.11	68.61	17.32	85.94	0.0	0.0	**85.9**	450	0.20	1.17	0.20	457.2	0.164	0.114	0.81	**133.0**	64.6	OK	0.77
Flows from Hurricane SPS/Rice Road (North)	-	-	053MH009 / 406497MH01	-	-	-	-	-	-	-	-	-	-	-	-	97.7	97.7	**97.7**	-	-	-		-	-	-	-	**-**	**-**	**-**	
Flows from West of Quaker and Rice (from Line Ave)	-	-	053MH009 / 406497MH01	-	-	-	-	-	-	-	-	-	-	-	-	79.1	79.1	**79.1**	-	-	-		-	-	-	-	**-**	-	-	-
Quaker Road (Region Trunk E of Rice)	-	053MH009 / 406497MH01	416457MH01 (RMH1)	179.94	178.58	618	-	-	52.0	2571	8.54	3.50	29.87	14.86	44.73	0.0	176.8	**221.5**	750	0.22	0.99	0.22	762.0	0.456	0.191	1.19	**544.8**	40.7	OK	1.00
Quaker Road (W of First to W of Niagara)	-	416457MH01 (RMH1)	426427MH01 (RMH3)	178.58	177.07	728	-	-	112.5	9500	30.59	2.98	91.07	32.18	123.26	3.0	179.8	**303.1**	750	0.21	0.99	0.21	762.0	0.456	0.191	1.17	**532.2**	56.9	OK	1.07
NWSP (N of Quaker, E of First)	D1, E1	NW9	NW10	179.99	178.32	408	4.9	1089	4.9	1089	3.47	3.78	13.09	1.40	14.49	0.0	0.0	**14.5**	200	0.41	1.54	0.41	203.2	0.032	0.051	0.68	**21.9**	66.1	OK	0.64
NWSP (N of Quaker, E of First)	F2	NW10	NW11	178.32	177.40	306	7.4	417	12.3	1506	4.79	3.68	17.64	3.53	21.17	0.0	0.0	**21.2**	250	0.30	1.43	0.30	254.0	0.051	0.064	0.67	**34.0**	62.3	OK	0.63
NWSP (N of Quaker, E of First)	E2, F1	NW11	NW12	177.40	177.17	117	14.2	1753	26.5	3259	10.37	3.41	35.39	7.58	42.97	0.0	0.0	**43.0**	375	0.20	1.25	0.20	381.0	0.114	0.095	0.72	**81.8**	52.5	OK	0.64
NWSP (N of Quaker, E of First)	G1	NW12	426427MH01 (RMH3)	177.17	177.07	50	0.8	269	27.3	3528	11.23	3.38	37.97	7.81	45.78	0.0	0.0	**45.8**	375	0.20	1.25	0.20	381.0	0.114	0.095	0.72	**81.8**	56.0	OK	0.65
Quaker Road (W of Niagara to Towpath)	-	426427MH01 (RMH3)	436437MH03	177.07	171.78	1320	-	-	139.8	13029	41.82	2.84	118.77	39.99	158.77	28.8	208.6	**367.4**	750	0.40	0.99	0.40	762.0	0.456	0.191	1.61	**734.5**	50.0	OK	1.42
Towpath (to SPS)	-	436540MH01	446525MH01	171.05	169.40	1002	-	-	139.8	13029	41.82	2.84	118.77	39.99	158.77	98.1	306.7	**465.5**	900	0.16	0.93	0.16	914.4	0.657	0.229	1.15	**755.4**	61.6	OK	1.07

Notes:

1. Residential design flows as per UCC
2. Slopes approximate; calculated based on length
3. Infiltration rate is 0.286 as per Region Master Plan Update 2021
4. Peak Factors for NWSP Flows as per Harmon's Formula
5. Population for NWSP as per UCC
6. All other peak flows as per All Pipe Model
7. Assume population density for existing residential single family home is 2.5p/household
8. School and daycare flows as per Building Code Table 8.2.1.3.B

APPENDIX C - STORM



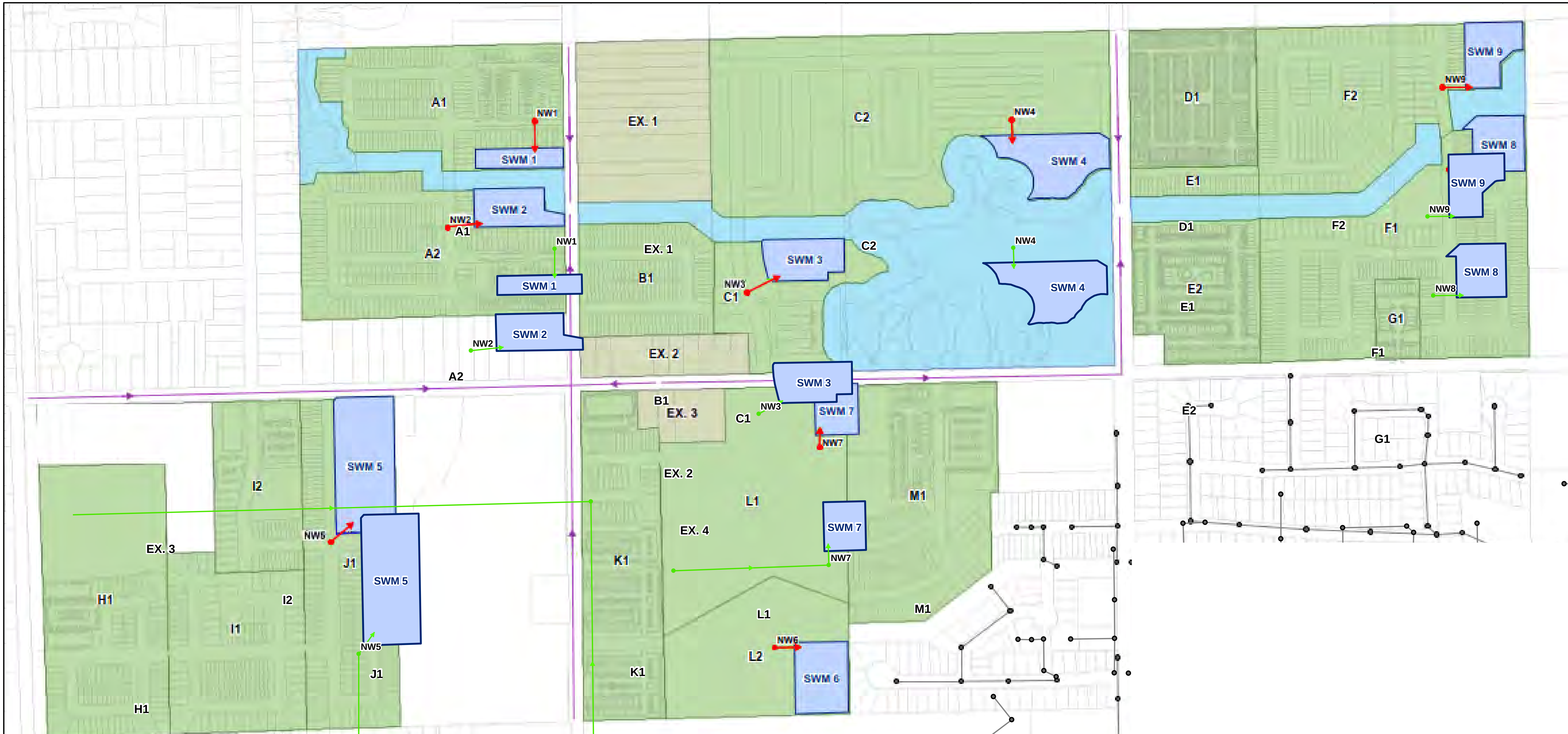
UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

NORTHWEST WELLAND STORMWATER MANAGEMENT IMPLEMENTATION PLAN

CITY OF WELLAND

ULTIMATE STORMWATER MANAGEMENT PLAN

DATE	2022-10-12
SCALE	1:7000
REF No.	21243
DWG No.	FIGURE 10



Legend:

	Proposed Manholes		Proposed SWM Ponds
	Proposed Storm Outlet		Proposed SWM Catchment
	Future Trunk Storm		Existing SWM Catchment
	Existing Manholes		
	Existing Storm Sewer		

Associated Engineering

CANADA BEST MANAGED COMPANIES
Platinum member

Northwest Secondary Plan
Municipal Servicing

Storm Sewer Design

Project No: 2023-5773

Date: November 2023

Figure C-2

STORM SEWER DESIGN SHEET

Q=2.78AiR   Storm Event = 5.00 Years

A = Area (ha)   a = 830, b = 0.777, c = 7.3

R = Runoff Coefficient

T_c = Time of Concentration   n = 0.013

i = Avg Rainfall Intensity (mm/hr) = a / $(T_c+c)^b$

Northwest Secondary Plan
Municipal Servicing

JOB No.: 2023-5773

DEVELOPMENT DATA				DESIGN DATA						PIPE DATA								
AREA NO	FROM	TO	AREA (ha)	RUNOFF COEFF. R	A * R	ACCUM A * R	TIME OF CONC. (min)	INTENSITY i (mm/hr)	PEAK FLOW (l/s)	PIPE DIA (mm)	SLOPE (%)	CRITICAL SLOPE (%)	DESIGN SLOPE (%)	LENGTH (m)	FLOW FULL (l/s)	VEL FULL (m/s)	TRAVEL TIME (min)	% FULL
Pond 1																		
A1	NW1	SWM 1	5.70	0.53	3.006	3.006	12.00	83.21	**695.399**	900	0.20	0.93	0.20	40	**809.60**	1.27	0.52	85.89
Pond 2																		
A2	NW2	SWM2	7.33	0.52	3.775	3.775	12.00	83.21	**873.297**	900	0.30	0.93	0.30	40	**991.55**	1.56	0.43	88.07
Pond 3																		
B1, Ex.2, C1	NW3	SWM3	8.50	0.49	4.193	4.193	12.00	83.21	**969.880**	1050	0.30	0.89	0.30	40	**1495.68**	1.73	0.39	64.85
Pond 4																		
Ex. 1, C2	NW4	SWM4	18.00	0.50	9.034	9.034	15.00	74.38	**1867.971**	1200	0.30	0.85	0.30	40	**2135.42**	1.89	0.35	87.48
Pond 5																		
H1, I1, I2, J1	NW5	SWM5	21.77	0.51	11.131	11.131	15.00	74.38	**2301.570**	1350	0.30	0.81	0.30	40	**2923.42**	2.04	0.33	78.73
Pond 6																		
L2	NW6	SWM6	3.88	0.50	1.940	1.940	12.00	83.21	**448.794**	750	0.30	0.99	0.30	40	**609.77**	1.38	0.48	73.60
Pond 7																		
K1, Ex.3, L1, M1	NW7	SWM7	22.90	0.53	12.041	12.041	15.00	74.38	**2489.732**	1350	0.30	0.81	0.30	40	**2923.42**	2.04	0.33	85.17
Pond 8																		
E2, F1, G1	NW8	SWM8	14.31	0.53	7.634	7.634	15.00	74.38	**1578.491**	1200	0.30	0.85	0.30	116	**2135.42**	1.89	1.02	73.92
Pond 9																		
D1, E1, F2	NW9	SWM9	13.14	0.53	6.975	6.975	15.00	74.38	**1442.229**	1200	0.30	0.85	0.30	116	**2135.42**	1.89	1.02	67.54

APPENDIX D - COST ESTIMATE DETAIL

Northwest Welland Secondary Plan
Municipal Servicing

Preliminary Cost Estimate

Watermain				
Item	Quantity	Unit	Unit Price	Cost
150mm PVC DR18 Watermain	8420	m	$455	$3,831,100
150mm Gate Valve & Box	92	each	$3,250	$299,000
200 mm PVC DR18 Watermain	1645	m	$520	$855,400
200mm Gate Valve & Box	20	each	$4,225	$84,500
250 mm PVC DR18 Watermain	2480	m	$620	$1,537,600
250mm Gate Valve & Box	24	each	$5,200	$124,800
300mm PVC DR18 Watermain	1985	m	$845	$1,677,325
300mm Gate Valve & Box	22	each	$7,150	$157,300
Water Services	4350	each	$2,600	$11,310,000
Hydrants	97	each	$9,750	$945,750
Connect to Existing	13	each	$6,500	$84,500
Granular A	87500	t	$35	$3,062,500
Other General Construction	1	LS	$2,397,000	$2,397,000
Subtotal				$26,366,775
Contingency (15% of subtotal)				$3,955,100
Engineering (10% of subtotal)				$2,636,700
Total				$32,958,575
Rounded Total				$33,000,000

Sanitary Sewer				
Item	Quantity	Unit	Unit Price	Cost
200mm PVC DR35	13,620	m	$490	$6,673,800
250mm PVC DR35	586	m	$585	$342,810
375mm PVC DR35	734	m	$975	$715,650
450mm PVC DR35	69	m	$1,175	$81,075
Maintenance Hole Structure	134	each	$13,000	$1,742,000
Sanitary Laterals	4,350	each	$3,900	$16,965,000
Connect to Existing Trunk	3	each	$6,500	$19,500
Granular A	176,700	t	$35	$6,184,500
Flush & CCTV (end of construction)	15,009	m	$20	$300,180
Flush & CCTV (end of maintenance)	15,009	m	$20	$300,180
Other General Construction	1	LS	$3,332,500	$3,332,500
Subtotal				$36,657,195
Contingency (15% of subtotal)				$5,498,600
Engineering (10% of subtotal)				$3,665,800
Total				$45,821,595
Rounded Total				$45,900,000

Preliminary Cost Estimate

Storm Sewer				
450mm PVC DR35 Ultra Rib	2204	m	$455	$1,002,820
525mm PVC DR35 Ultra Rib	2515	m	$520	$1,307,800
600mm CONC	2661	m	$585	$1,556,685
675mm CONC	81	m	$815	$66,015
750mm CONC	902	m	$1,025	$924,550
825mm CONC	554	m	$1,175	$650,950
900mm CONC	1015	m	$1,380	$1,400,700
1050mm CONC	941	m	$1,775	$1,670,275
1200mm CONC	332	m	$2,190	$727,080
1350mm CONC	80	m	$2,795	$223,600
1200mm Diameter MH	68	each	$13,000	$884,000
1500mm Diameter CBMH	13	each	$18,200	$236,600
1800mm Diameter CBMH	18	each	$20,800	$374,400
2400mm Diameter CBMH	2	each	$24,700	$49,400
Catchbasin	380	each	$4,175	$1,586,500
Catchbasin leads	1900	m	$490	$931,000
Granular A	95800	t	$35	$3,353,000
Flush & CCTV (end of construction)	11285	m	$20	$225,700
Flush & CCTV (end of maintenance)	11285	m	$20	$225,700
Other General Construction	1	LS	$1,739,700	$1,739,700
Subtotal				$19,136,475
Contingency (15% of subtotal)				$2,870,500
Engineering (10% of subtotal)				$1,913,700
Total				$23,920,675
Rounded Total				$24,000,000

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX B

Water Distribution Plan (DWG#: 2200-WD-FSR)

KEY PLAN
N.T.S.

LEGEND

- PROPOSED WATERMAIN
- EXISTING WATERMAIN

CONSULTANT FILE No.	2200
DATE	2024–10–17
PRINTED	2024–10–17
SCALE	1:1000 m
REF No.	
DWG No.	2200-WD-FSR
REV	0

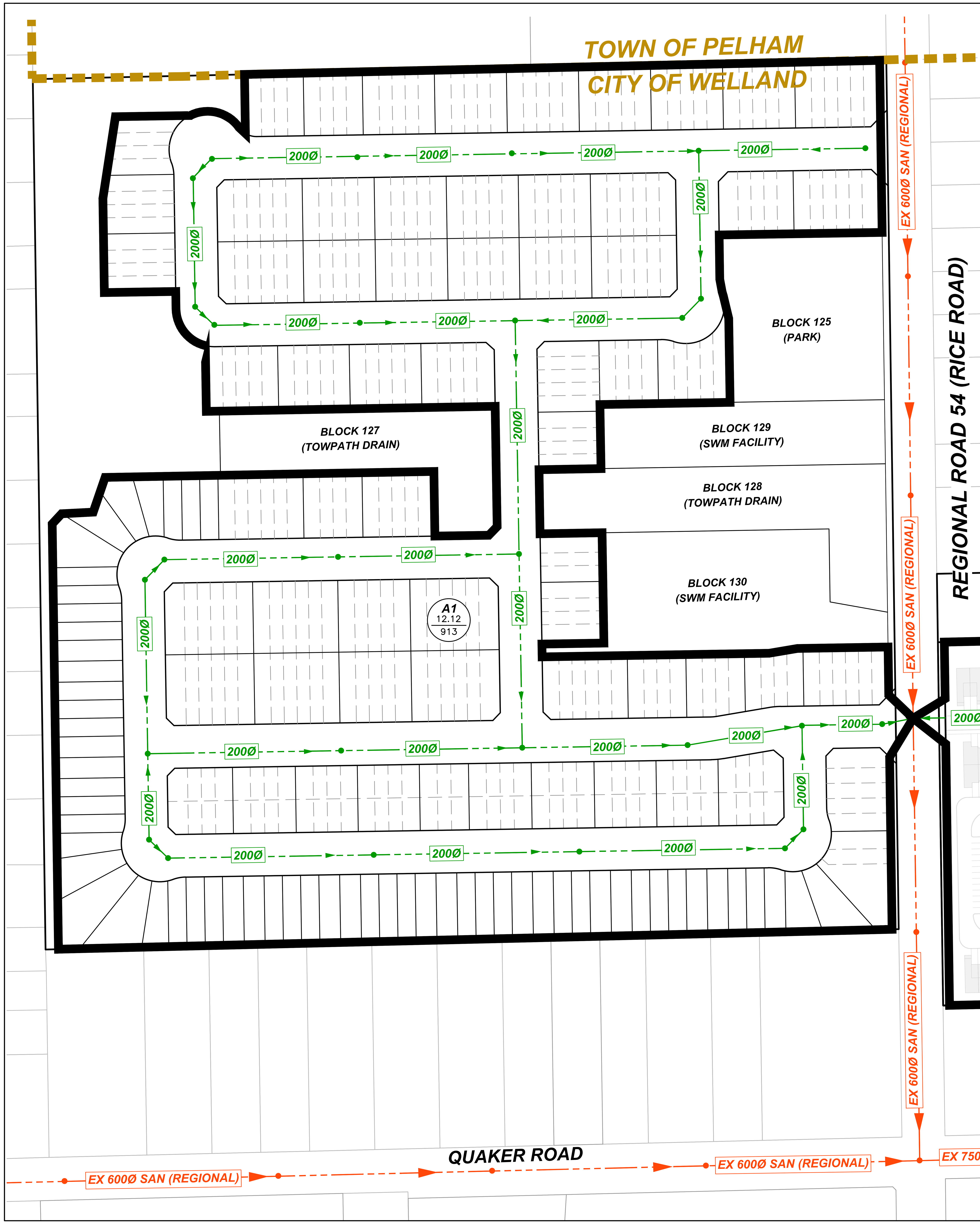
450, 469 & 509 RICE ROAD
WELLAND

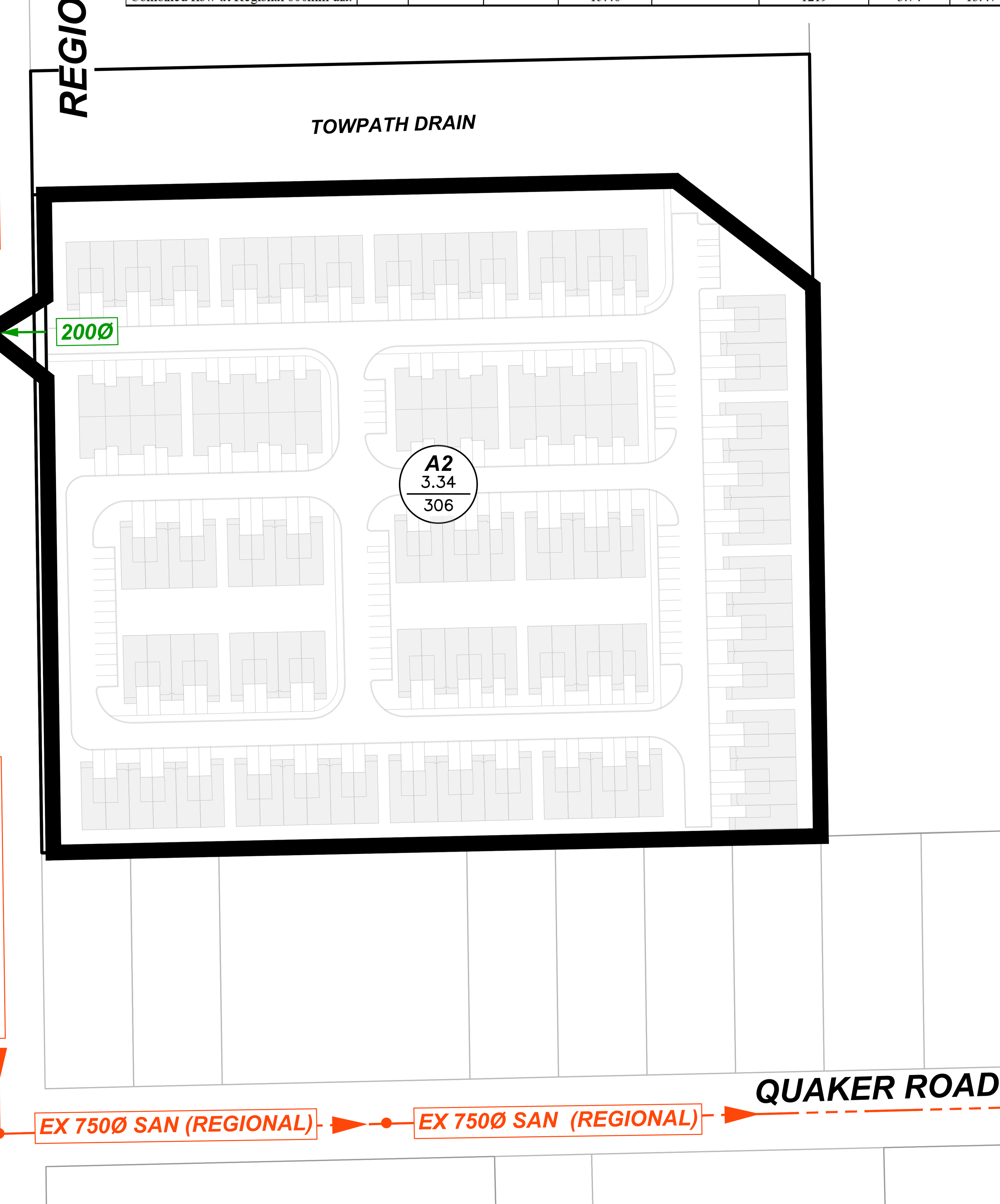
WATER DISTRIBUTION PLAN

DRAWING FILE: F:\2200\SWM\FSR\2200–FUNCTIONAL SERVICING REPORT.dwg PLOTTED: Oct 17, 2024 – 3:24pm PLOTTED BY: brendan

APPENDIX C

Sanitary Drainage Area Plan (DWG#: 2200-SAN-FSR)

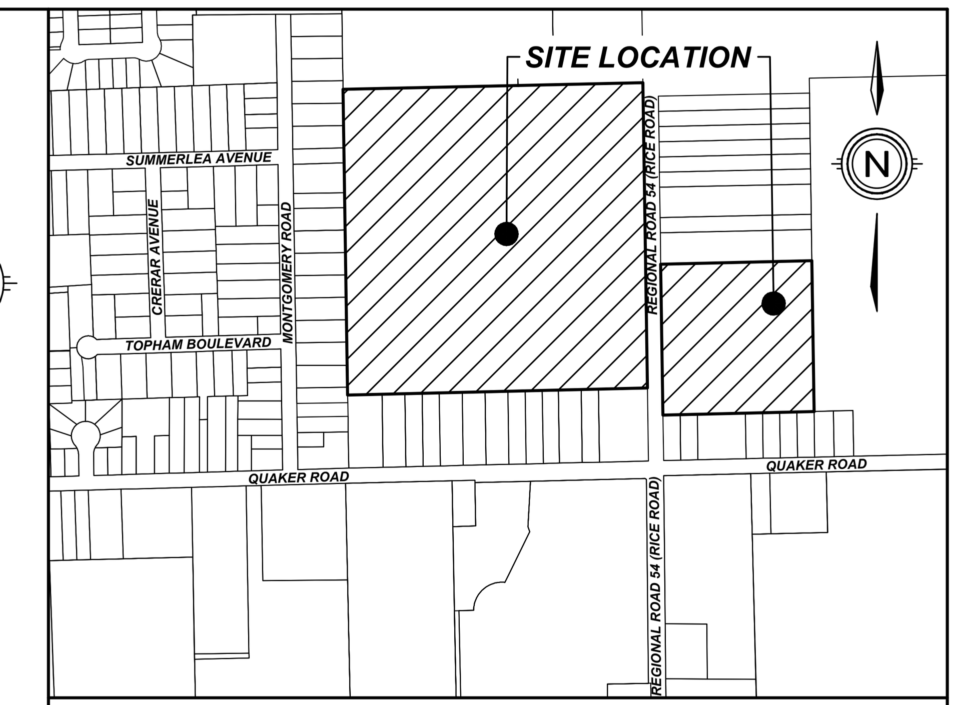




LEGEND

A0 / 0.00 / 000	DRAINAGE AREA NUMBER / TOTAL AREA IN HECTARES / TOTAL POPULATION (PERSONS)
Heavy black line	PROPOSED SANITARY DRAINAGE BOUNDARY
Green arrow line	PROPOSED SANITARY SEWER WITH DIRECTION OF FLOW
Green dot	PROPOSED SANITARY MANHOLE
Red dashed line	EXISTING SANITARY SEWER

N



KEY PLAN
N.T.S.

UPPER CANADA CONSULTANTS
30 HANNOVER DRIVE, UNIT 3
ST.CATHARINES, ON, L2W 1A3

DESIGN FLOWS
RESIDENTIAL: 255 LITRES/PERSON/DAY (AVERAGE DAILY FLOW)
INFILTRATION RATE: 0.286 LITRES/HECTARE (M.O.E FLOW ALLOWANCE IS BETWEEN 0.10 & 0.28 LITRES/HECTARE)
POPULATION / DENSITY: 2.5 PERSONS / UNIT (SINGLE FAMILY DWELLINGS)
2.2 PERSONS / UNIT (TOWNHOUSE DWELLINGS)

SEWER DESIGN
PIPE ROUGHNESS: 0.013 FOR MANNING'S EQUATION
PIPE SIZES: 1.016 IMPERIAL EQUIVALENT FACTOR
PERCENT FULL: TOTAL PEAK FLOW / CAPACITY

MUNICIPALITY: CITY OF WELLAND
PROJECT : 450, 469 & 509 RICE ROAD
PROJECT NO: 2200

SANITARY SEWER DESIGN SHEET

LOCATION			AREA				ACCUMULATED PEAK FLOW									
Description	From M.H	To M.H.	Increment (hectares)	Accumulated (hectares)	Population Increment	Total Population Served (P)	Peaking Factor (PF)	Flow (L/s)	Infiltration Flow L/s	Total Peak Flow (L/s)	Pipe Diameter (mm)	Pipe Slope (%)	Full Flow Velocity (m/s)	Full Flow Capacity (L/s)	Percent Full
A1 - 469 & 509 Rice Road	SITE	EX MH	12.12	12.12	913	913	3.83	10.31	3.47	13.77	200	0.40	0.7	21.64	63.6%
Impact on Regional 600mm dia.				12.12		913	3.83	10.31	3.47	13.77	600	0.50	1.6	452.94	3.0%
A2 - 450 Rice Road	SITE	EX MH	3.34	3.34	306	306	4.07	3.68	0.96	4.64	200	0.40	0.7	21.64	21.4%
Impact on Regional 600mm dia.				3.34		306	4.07	3.68	0.96	4.64	600	0.50	1.6	452.94	1.0%
Combined flow at Regional 600mm dia.				15.46		1219	3.74	13.47	4.42	17.89	600	0.50	1.6	452.94	3.9%

CONSULTANT FILE No.	2200
DATE	2024-10-17
PRINTED	2024-10-17
SCALE	1:1000 m
REF No.	
DWG No.	2200-SAN-FSR
REV	0

450, 469 & 509 RICE ROAD
WELLAND

SANITARY DRAINAGE AREA PLAN

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX D

450 Rice Road Stormwater Management Brief (UCC, October 2024)

Upper Canada
Planning &
Engineering Ltd.
3-30 Hannover Drive
St. Catharines, ON
L2W 1A3
Phone 905-688-9400
Fax 905-688-5274

STORMWATER MANAGEMENT BRIEF

450 RICE ROAD
City of Welland
October 16, 2024

INTRODUCTION

Upper Canada Planning & Engineering Ltd. (UCC) has been retained to provide a Stormwater Management Brief to address the stormwater management needs for the proposed residential condominium development in the City of Welland.

As shown in Figure 1, the proposed development is located at 405 Rice Road, in the north-western portion of the Northwest Welland Secondary Plan (NWWSP) area in the City of Welland, north of Quaker Road, immediately east of Rice Road, west of First Avenue, and south of the municipal boundary with the Town of Pelham.

UCC has previously prepared a Stormwater Management Implementation Plan for the entirety of the NWWSP Area. This Plan identified the preferred locations of future stormwater management (SWM) Facilities within the developable areas in the Secondary Plan in support of the realignment of the Towpath Drain, which flows through the proposed subdivision lands, and identified the existing stormwater flows through each segment of the existing watercourse.

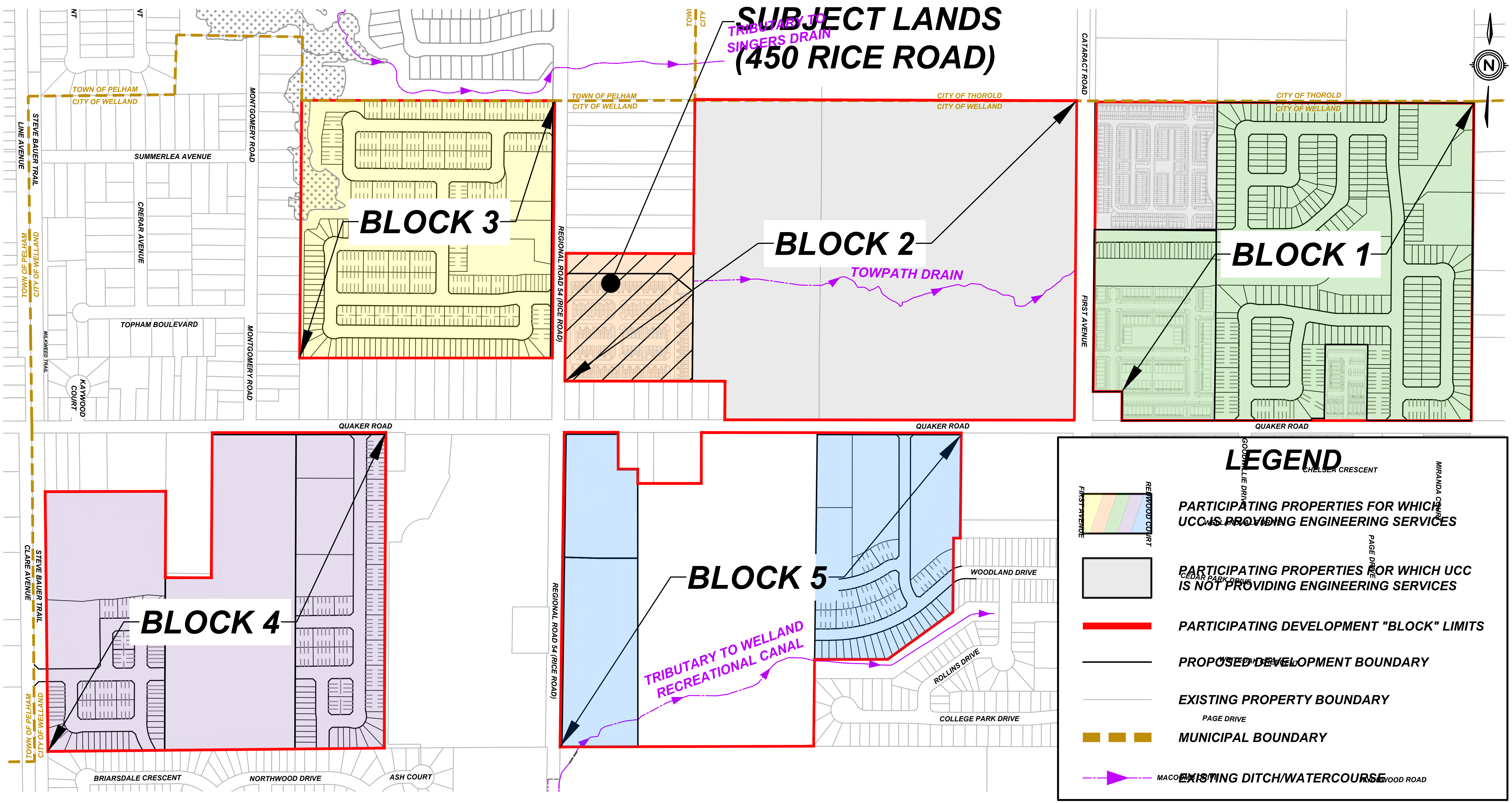
It was identified in the Implementation Plan that SWM Facilities are to be constructed within the 'Block' of development area bound by Quaker Road on the south, Rice Road on the east, west of First Avenue, and south of the municipal boundary with the Town of Pelham and City of Thorold as shown in Figure 1 as Block 2.

It is proposed to develop the 450 Rice Road property as a private condominium. Therefore, the proposed development will provide independent stormwater management from the remaining area within Block 2, and only the 450 Rice Road property will hereafter be referred to as 'subject lands' in this Brief.

The development area is approximately 3.32 hectares and will consist of private residential townhouse condominiums. The subject lands will be developed to include associated asphalt roadways, concrete curb, catch basins, storm sewers, sanitary sewers, and watermain.

The objectives of this study are as follows:

1. Establish criteria for the management of stormwater discharging from the site;
2. Determine the impact of the development on the peak flows discharging from the site; and,
3. Recommend a comprehensive plan for the management of stormwater runoff during and after construction.



UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

NORTHWEST WELLAND SECONDARY PLAN

CITY OF WELLAND

SITE LOCATION PLAN - 450 RICE ROAD

DATE	2024–10–17
SCALE	1:6000 m
REF No.	-
DWG No.	FIGURE 1

STORMWATER QUANTITY ASSESSMENT

As identified in the Implementation Plan, stormwater management quantity controls are required within each Block to reduce future stormwater flows to existing levels within the Towpath Drain.

Immediately adjacent to the subject lands, on the west side of Rice Road are additional lands of the owner (469 & 509 Rice Road), which will be developed as a residential subdivision, including two stormwater management facilities that have been designed by UCC.

As shown in Figures 2 and 3, the 469 & 509 properties (Areas A10 to A14) are upstream of the subject lands (Area A20) and will be developed and constructed ahead of the subject lands, it is proposed to provide over-control future stormwater flows within the two proposed stormwater management facilities (P10 and P11) such that the subject lands can drain to the Towpath Drain without additional on-site quantity controls.

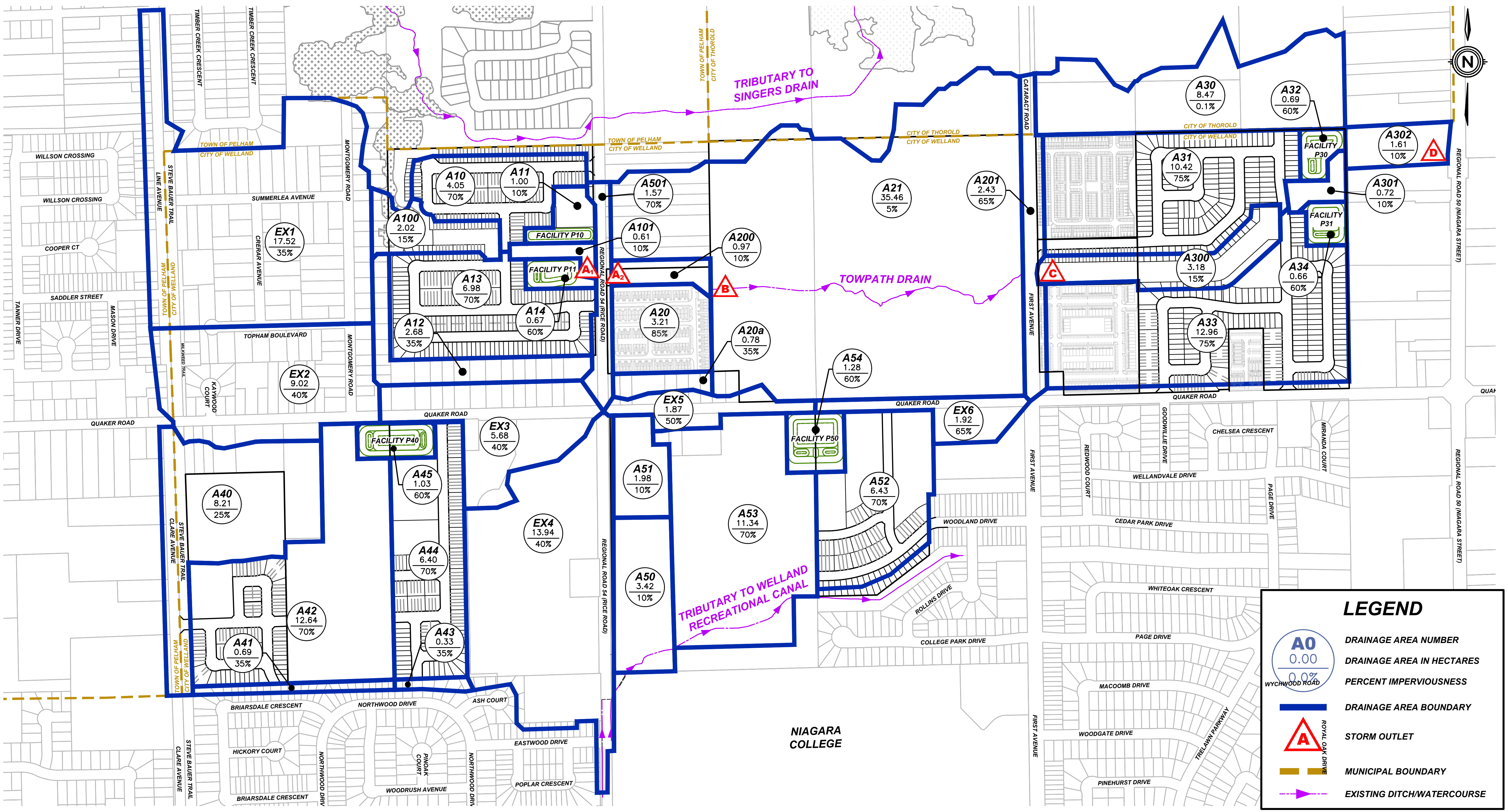
A separate Stormwater Management Plan has been prepared for the adjacent properties, outlining the detailed stormwater management calculations for the proposed stormwater management facilities, and has been enclosed in Appendix C for reference.

As summarized in Table 1 below, with the proposed over-controlling, the future peak flow at each location on the Towpath Drain are maintained below existing levels up to and including the 100 year design storm event. Therefore, independent on-site stormwater quantity controls are not required for the subject lands.

Major overland flows from within the subject lands will be directed northerly to the Towpath Drain.

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

Table 1. Impacts of SWM Facilities on Peak Flows at Outlets A through D			
Design Storm	**Peak Flow (m^3/s)**		
	Existing	**Future with SWM**	**Change**
Upstream of Rice Road Culvert Crossing – Outlet A1			
2 Year	1.317	0.983	-25.4%
5 Year	1.589	1.185	-25.4%
10 Year	1.800	1.344	-25.3%
25 Year	2.099	1.583	-24.6%
100 Year	2.558	1.908	-25.4%
Downstream of Rice Road Culvert Crossing – Outlet A2			
2 Year	3.301	2.916	-11.7%
5 Year	4.194	3.502	-16.5%
10 Year	4.777	3.959	-17.1%
25 Year	5.619	4.621	-17.8%
100 Year	6.987	5.662	-19.0%
Towpath Drain Upstream of Existing PSW – Outlet B			
2 Year	3.425	3.353	-2.1%
5 Year	4.367	4.015	-8.1%
10 Year	4.977	4.532	-8.9%
25 Year	5.863	5.284	-9.9%
100 Year	7.305	6.464	-11.5%
Downstream of First Avenue Culvert Crossing – Outlet C			
2 Year	4.035	4.031	-0.1%
5 Year	5.176	4.834	-6.6%
10 Year	5.914	5.467	-7.6%
25 Year	7.005	6.402	-8.6%
100 Year	8.781	7.881	-10.2%
Upstream of Niagara Street Culvert Crossing – Outlet D			
2 Year	4.509	4.177	-7.4%
5 Year	5.835	5.016	-14.0%
10 Year	6.678	5.677	-15.0%
25 Year	7.938	6.649	-16.2%
100 Year	9.995	8.188	-18.1%

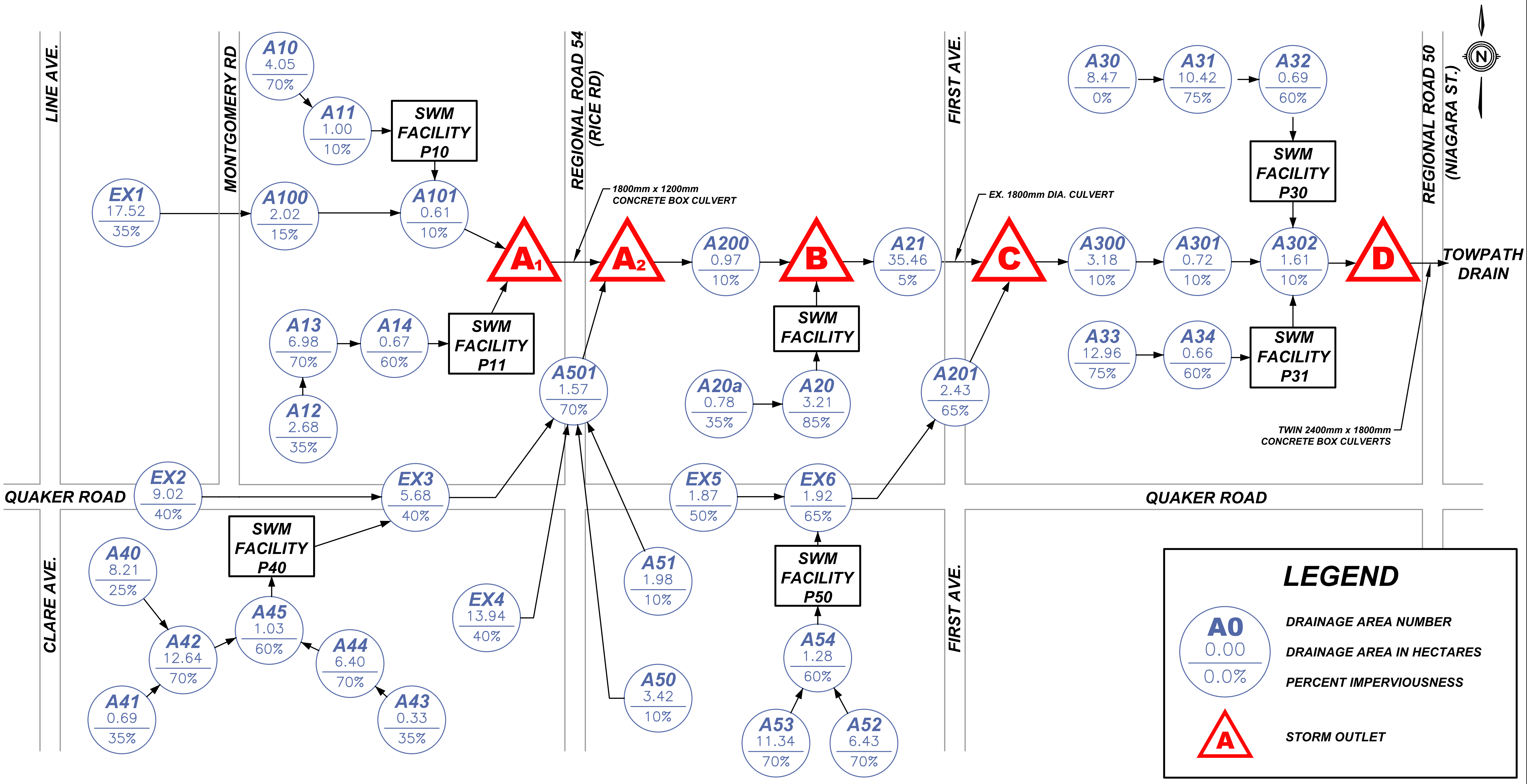


UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

NORTHWEST WELLAND SECONDARY PLAN

CITY OF WELLAND
FUTURE STORM DRAINAGE AREAS

DATE	2024–10–17
SCALE	1:7500 m
REF No.	-
DWG No.	FIGURE 2



UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

NORTHWEST WELLAND SECONDARY PLAN

CITY OF WELLAND

FUTURE HYDROLOGICAL MODELLING SCHEMATIC

DATE	2024–10–17
SCALE	N.T.S.
REF No.	-
DWG No.	FIGURE 3

STORMWATER QUALITY ASSESSMENT

The stormwater outlet for the site stormwater flows is the Towpath Drain. As identified in the Implementation Plan, stormwater quality improvements will be required to MECP Enhanced Levels (80% TSS Removal) prior to discharging from the site.

To improve stormwater quality, a stormwater oil/grit separator is proposed to provide TSS (Total Suspended Solids) removal for the subject lands.

It is required the unit will provide a minimum average of 80% TSS removal which achieves MECP Enhanced Quality Protection. The total stormwater drainage area contributing to the proposed oil/grit separator is 3.99 hectares with an approximate impervious coverage of approximately 75%. The modelling for a Hydroworks unit has indicated that an HD 12 will provide 80.9% TSS overall removal and capture 99.7% of the stormwater flows. Therefore, a Hydroworks HD 12 is proposed for this site development. Output calculations for the quality assessment can be found in Appendix A.

Oil/Grit Separator Maintenance

The future owners of a Hydroworks facility are provided with a Owner's Manual, which explains the function, maintenance requirements and procedures for this facility. In addition to the Owner's Manual, a site inspection report sheet is enclosed in Appendix B for future reference and maintenance activities.

Generally the sediment which is removed from the oil/grit separator will not be contaminated to the point that it would be classified as hazardous waste. However, the sediment should be tested to determine disposal options. The Ministry of Environment, Conservation and Parks publishes sediment disposal guidelines which should be consulted for current information pertaining to the exact parameters and acceptable levels for the various disposal options.

The function of the proposed stormwater quality protection facility, a stormwater oil/grit separator, will require maintenance on a regular basis. Areas prone to oil spills should be inspected frequently. The following is a summary of the maintenance activities required.

Regular inspections of the stormwater maintenance hole (MH) oil/grit interceptor will indicate whether maintenance is required. Post-Construction the separator should be inspected every six months during the first year to establish the rate of sediment accumulation. If the unit is subject to oil spills or runoff from unstabilized sites it should be inspected more frequently.

Points of regular inspections are as follows:

a) Is there sediment in the separator sump? The level of sediment can be measured from the surface without entry into the oil/grit separator with a Sludge Judge, Core Pro, AccuSludge or equivalent sampling device that allows the submerged sediment to be sampled. These clear samplers are equipped with a ball value that allows the inspector to get a core of the contents in the sump. Two or three should be taken in different areas of the sump to ensure samples are accurate.

b) Is there oil in the separator sump? This can usually be seen from the surface and can be physically checked by lowering a sludge Judge about 300mm below the surface of the water and removing it. If an appreciable amount of oil has been captured, an oil layer will be floating on top of the water sample. The separator should be cleaned if an appreciable amount of oil (2.5 centimeters) has been captured.

c) Is there debris or trash in the separator? This can be observed from the surface without entry into the unit. If a significant amount of trash has been captured, the unit should be cleaned to ensure it continues to operate at peak capacity.

d) Completion of the Inspection Report. These reports will provide details about the operation and maintenance requirements for this type of stormwater quality device. After an evaluation period (usually 2 years) this information will be used to maximize efficiency and minimize the costs of operation and maintenance for the maintenance hole oil/grit separator.

Typically, a stormwater MH oil/grit separators are cleaned out using vacuum pumping. No entry into the unit is required for maintenance. Cleaning should occur annually or whenever the accumulation reaches 15 percent of the sediment storage and after any major spills have occurred. The manufacturer provides an installation certificate which contains the separators capacities and sediment depths requiring maintenance. Oil levels greater than 2.5 centimeters should be removed immediately by a licensed waste management firm.

The preferred option is an off-site disposal, arranged by a licensed waste management firm.

The future owners of a Hydroworks facility are provided with an Owner's Manual, which explains the function, maintenance requirements and procedures for the facility. In addition to the Owner's Manual, a site inspection report sheet is attached for future reference and maintenance activities.

CONCLUSIONS AND RECOMMENDATIONS

Therefore, based on the above comments and design calculations provided for this site, the following summarizes the stormwater management plan for this site.

1. Stormwater quantity controls are not required on-site as the upstream adjacent lands (owned by the same owner) will provide adequate over-control to ensure future peak stormwater flows in the Towpath Drain are maintained to below existing levels.

2. The major overland route will convey stormwater flows northerly to the Towpath Drain.

3. Stormwater quality protection is being provided by a Hydroworks HD 12 stormwater oil/grit separator or approved equivalent in the proposed development.

We trust the above comments and enclosed calculations are satisfactory for approval. If you have any questions or require additional information, please do not hesitate to contact our office.

Respectfully Submitted,

LICENSED PROFESSIONAL ENGINEER
B. J. KAPTEYN
100509155
PROVINCE OF ONTARIO

Brendan Kapteyn, P.Eng.

Encl.

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDICES

APPENDIX A

Hydroworks Sizing Software Output File

```
*************************************************
*      Storm Water Management Sizing Model      *
*               Hydroworks, LLC                 *
*                Version 4.4                    *
*                                               *
*        Continuous Simulation Program          *
*              Based on SWMM 4.4H               *
*              Hydroworks, LLC                  *
*               Graham Bryant                   *
*                2003 - 2021                    *
*************************************************

                 Developed by

*************************************************
*               Hydroworks, LLC                 *
*             Metcalf & Eddy, Inc.              *
*            University of Florida              *
*       Water Resources Engineers, Inc.         *
*      (Now Camp Dresser & McKee, Inc.)         *
*              Modified SWMM 4.4                *
*************************************************

         Distributed and Maintained by

*************************************************
*                                               *
*                Hydroworks, LLC                *
*                 888-290-7900                  *
*              www.hydroworks.com               *
*                                               *
*************************************************

*************************************************
*     If any problems occur executing this      *
*     model, contact Mr. Graham Bryant at       *
*     Hydroworks, LLC by phone at 888-290-7900  *
*     or by e-mail: support@hydroworks.com      *
*************************************************

*************************************************
*     This model is based on EPA SWMM 4.4       *
*  "Nature is full of infinite causes which     *
*   have never occurred in experience" da Vinci *
*************************************************


***************************************************
* Entry made to the Rain Block                    *
* Created by the University of Florida - 1988     *
* Updated by Oregon State University, March 2000  *
***************************************************

450 Rice Road
City of Welland

HydroDome Simulation

 ########################################
 #  Precipitation Block Input Commands  #
 ########################################
Station Name.........................  St. Catherines A
Station Location.....................  Ontario
Station, ISTA........................    7287
Beginning date, IYBEG (Yr/Mo/Dy)......  1971/ 1/ 1
Ending date, IYEND (Yr/Mo/Dy).........  2005/12/31
Minimum interevent time, MIT..........     1
Number of ranked storms, NPTS.........    10
NWS format, IFORM (See text)..........     1
Print storm summary, ISUM (O-No 1-Yes)     0
Print all rainfall, IYEAR (O-No 1-Yes)     0
Save storm event data on NSCRAT(1)....     0
(IFILE =0 -Do not save, =1 -Save data)
IDECID 0 - Create interface file
       1 - Create file and analyze
       2 - Synoptic analysis..........     2
Plotting position parameter, A........  0.40
Storm event statistics, NOSTAT........  1100
KODEA (from optional group B0)........     2
 = 0, Do not include NCDC cumulative values.
 = 1, Average NCDC cumulative values.
 = 2, Use NCDC cumulative value as inst. rain.
KODEPR (from optional group B0).......     0
 Print NCDC special codes in event summary:
 = 0, only on days with events.
 = 1, on all days with codes present.
 Codes: A = accumulated value, I = incomplete value,
        M = missing value,     O = other code present

********************************************************
*  Precipitation output created using the Rain block   *
*  Number of precipitation stations...        1        *
********************************************************
Location Station Number
-------- --------------
       1.     7287

STATION ID ON PRECIP. DATA INPUT FILE = 7287
REQUESTED STATION ID =     7287  CHECK TO BE SURE THEY MATCH.

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
Note, 15-min. data are being processed, but hourly
print-out, summaries, and statistics are based on
hourly totals only.  Data placed on interface file
are at correct 15-min. intervals.
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
###################################################
# Entry made to the Runoff Block, last updated by #
# Oregon State University, and Camp, Dresser and  #
# McKee, Inc., March 2002.                        #
###################################################
# "And wherever water goes, amoebae go along for  #
#  the ride"                     Tom Robbins     #
###################################################
```

```
Snowmelt parameter - ISNOW......................          0
Number of rain gages - NRGAG....................          1
Horton infiltration equation used - INFILM.......         2
Maximum infiltration volume is limited to RMAXINF input on  subcatchment lines.
Infiltration volume regenerates during  non rainfall periods.
Quality is simulated - KWALTY...................          1
IVAP is negative.  Evaporation will be set to zero
    during time steps with rainfall.
Read evaporation data on line(s) F1 (F2) - IVAP..         1
Hour of day at start of storm - NHR.............          1
Minute of hour at start of storm - NMN...........         1
Time TZERO at start of storm (hours).............     1.017
Use Metric units for I/O - METRIC................         1
 ===> Ft-sec units used in all internal computations
Runoff input print control...                             0
Runoff graph plot control....                             1
Runoff output print control..                             0
Print headers every 50 lines - NOHEAD (0=yes, 1=no)       0
Print land use load percentages -LANDUPR (0=no, 1=yes)    0
Limit number of groundwater convergence messages to 10000 (if simulated)
Month, day, year of start of storm is:             1/ 1/1971
Wet time step length (seconds).......                  300.
Dry time step length (seconds).......                  900.
Wet/Dry time step length (seconds)...                  450.
Simulation length is......                       20051231.0 Yr/Mo/Dy
Percent of impervious area with zero detention depth    25.0
Horton infiltration model being used
Rate for regeneration of infiltration = REGEN * DECAY
DECAY is read in for each subcatchment
REGEN = .........................................  0.01000

********************************************************
*   Processed Precipitation will be read from file     *
********************************************************
  #############################
  #        Data Group F1      #
  # Evaporation Rate (mm/day) #
  #############################
 JAN.  FEB.  MAR.  APR.  MAY   JUN.  JUL.  AUG.  SEP.  OCT.  NOV.  DEC.
 ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----
 0.00  0.00  0.00  2.54  2.54  3.81  3.81  3.81  2.54  2.54  0.00  0.00

********************************************************
*        C H A N N E L   A N D   P I P E   D A T A     *
********************************************************
Input  NAMEG:     Drains                            Invert  L Side   R Side  Intial     Max  Mann-   Full
equen  Channel      to     Channel  Width  Length    Slope   Slope    Slope   Depth   Depth  ings   Flow
umber    ID #      NGTO:    Type     (m)    (m)      (m/m)   (m/m)    (m/m)    (m)     (m)    "N"   (cms)
-----  ------------------ -------- ------ -------   ------- -------- ------- ------- ------- -----  -----
  1        201       200   Dummy     0.0     0.0    0.0000   0.0000  0.0000     0.0     0.0  0.0000 0.00E+00

 **************************************************
 *         S U B C A T C H M E N T   D A T A      *
 **************************************************
*NOTE. SEE LATER TABLE FOR OPTIONAL SUBCATCHMENT PARAMETERS*
      SUBCATCH-  CHANNEL       WIDTH    AREA  PERCENT     SLOPE      RESISTANCE  FACTOR     DEPRES. STORAGE(MM) INFILTRATION    DECAY RATE GAGE  MAXIMUM
       MENT NO.  OR INLET        (M)    (HA)  IMPERV.     (M/M)        IMPERV.     PERV.   IMPERV.     PERV.       RATE(MM/HR)     (1/SEC)    NO.  VOLUME
                                                                                                               MAXIMUM MINIMUM                        (MM)
 ---  --------    -------- --------- -------- -----    -------     -------  --------     ------     ------     ----   -------  -------  ------ -------
  1       300         200    141.24      3.99  75.00    0.0200       0.015     0.250      0.510      5.080    63.50   10.16    0.00055      1  101.60000
TOTAL NUMBER OF SUBCATCHMENTS...              1
TOTAL TRIBUTARY AREA (HECTARES).           3.99
IMPERVIOUS AREA (HECTARES)......           2.99
PERVIOUS AREA (HECTARES)........           1.00
TOTAL WIDTH (METERS)............         141.24
PERCENT IMPERVIOUSNESS..........          75.00

********************************************************
*     G R O U N D W A T E R   I N P U T   D A T A      *
********************************************************
    SUB-     CHANNEL     ========== E L E V A T I O N S ========  =========== F L O W   C O N S T A N T S ============
    CATCH       OR       GROUND  BOTTOM   STAGE     BC      TW       A1          B1         A2          B2         A3
    NUMBER    INLET        (M)     (M)      (M)     (M)      (M) (MM/HR-M^B1)         (MM/HR-M^B2)          (MM/HR-M^2)
    ------    -----      -------  ------  ------  ------  ------ -----------  ------- -----------  ------- -----------
         0      602        3.05    0.00    0.00    0.61    0.61   3.484E-04    2.600   0.000E+00    1.000    0.00E+00

***********************************************************
* G R O U N D W A T E R   I N P U T   D A T A (CONTINUED) *
***********************************************************
                S O I L   P R O P E R T I E S
                        SATURATED                                      PERCOLATION     E T  P A R A M E T E R S
      SUBCAT.             HYDRAULIC  WILTING  FIELD   INITIAL     MAX. DEEP   PARAMETERS          DEPTH  FRACTION OF ET
       NO.    POROSITY CONDUCTIVITY  POINT  CAPACITY MOISTURE  PERCOLATION   HCO     PCO        OF ET  TO UPPER ZONE
                          (mm/hr)                                (mm/hr)                          (m)
      ----    ------     -------     ------  ------   ------     ----------  ------  ------      ------      ------
         0     .4000     127.000      .1500   .3000    .3000     5.080E-02   10.00    4.57        4.27        0.350

*********************************************************
*    Arrangement of Subcatchments and Channel/Pipes     *
*********************************************************
* See second subcatchment output table for connectivity *
* of subcatchment to subcatchment flows.                *
*********************************************************
   Channel
   or Pipe
       201      No Tributary Channel/Pipes
                No Tributary Subareas.....
    INLET
       200      Tributary Channel/Pipes...        201
                Tributary Subareas........        300

***********************************************************
* Hydrographs will be stored for the following   1 INLETS *
***********************************************************
           200
```

```
####################################################
#             Quality Simulation                   #
####################################################
#      General Quality Control Data Groups         #
####################################################

 Description                          Variable      Value
 -----------                          --------      -----
 Number of quality constituents.....    NQS.......      1
 Number of land uses................  JLAND.......      1
 Standard catchbasin volume.........  CBVOL.......   1.22 cubic meters
 Erosion is not simulated.........    IROS........      0
 DRY DAYS PRIOR TO START OF STORM... DRYDAY.......   3.00 DAYS
 DRY DAYS REQUIRED TO RECHARGE
 CATCHBASIN CONCENTRATION TO
 INITIAL VALUES..................... DRYBSN.......   5.00 DAYS
 DUST AND DIRT
 STREET SWEEPING EFFICIENCY......... REFFDD.......  0.300
 DAY OF YEAR ON WHICH STREET
 SWEEPING BEGINS.................... KLNBGN.......    120
 DAY OF YEAR ON WHICH STREET
 SWEEPING ENDS...................... KLNEND.......    270

############################################
#     Land use data on data group J2      #
############################################
                                                             LIMITING                          CLEANING  AVAIL.    DAYS SINCE
                                                             BUILDUP   BUILDUP  BUILDUP   INTERVAL  FACTOR       LAST
AND USE   BUILDUP EQUATION TYPE   FUNCTIONAL DEPENDENCE OF   QUANTITY  POWER    COEFF.    IN DAYS   FRACTION   SWEEPING
LNAME)          (METHOD)          BUILDUP PARAMETER(JACGUT)  (DDLIM)   (DDPOW)  (DDFACT)  (CLFREQ)  (AVSWP)     (DSLCL)
-------   --------------------    -------------------------  --------  -------  --------  --------  -------    ---------
Urban De  EXPONENTIAL(1)                  AREA(1)           2.802E+01    0.500    67.250    30.000     0.300    30.000

##############################################
#     Constituent data on data group J3      #
##############################################
                               Total Su
                               --------
Constituent units........      mg/l
Type of units............          0
KALC.....................          2
Type of buildup calc.....    EXPONENTIAL(2)
KWASH....................          0
Type of washoff calc.....  POWER EXPONEN.(0)
KACGUT...................          1
Dependence of buildup....        AREA(1)
LINKUP...................          0
Linkage to snowmelt......   NO SNOW LINKAGE
Buildup param 1 (QFACT1).        28.020
Buildup param 2 (QFACT2).         0.500
Buildup param 3 (QFACT3).        67.250
Buildup param 4 (QFACT4).         0.000
Buildup param 5 (QFACT5).         0.000
Washoff power (WASHPO)...         1.100
Washoff coef. (RCOEF)....         0.086
Init catchb conc (CBFACT)       100.000
Precip. conc. (CONCRN)...         0.000
Street sweep effic (REFF)         0.300
Remove fraction (REMOVE).         0.000
1st order QDECAY, 1/day..         0.000
Land use number..........             1

*************************************************
* Constant Groundwater Quality Concentration(s) *
*************************************************
 Total Susp has a concentration of..    0.0000   mg/l

************************************************
* REMOVAL FRACTIONS FOR SELECTED CHANNEL/PIPES *
* FROM J7 LINES                                *
************************************************
  CHANNEL/   CONSTITUENT
     PIPE Total Susp
---------- --------
       201     0.000

*****************************************************
*     Subcatchment surface quality on data group L1 *
*****************************************************
                              Total   Number   Input
                    Land    Gutter     of    Loading
            Land     Use    Length   Catch-  load/ha
        No.  Usage    No.      Km     Basins   Total Su
    ------ --------  ----   -------- --------  -------
   1       300 Urban De  1        0.28      2.00  0.0E+00
   Totals (Loads in kg or other)    0.28      2.00  0.0E+00

    **********************
    *    DATA GROUP M1    *
    **********************
TOTAL NUMBER OF PRINTED GUTTERS/INLETS...NPRNT..        1
NUMBER OF TIME STEPS BETWEEN PRINTINGS..INTERV..        0
STARTING AND STOPPING PRINTOUT DATES...........        0        0

    **********************
    *    DATA GROUP M3    *
    **********************
CHANNEL/INLET PRINT DATA GROUPS......       -200

          ******************************************
          * Rainfall from Nat. Weather Serv. file  *
          * in units of hundredths of an inch      *
          ******************************************
```

Rainfall Station St. Catherines A
State/Province Ontario

Rainfall Depth Summary (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1971.	31.	0.	0.	0.	0.	0.	126.	93.	52.	60.	29.	0.	391.
1972.	0.	0.	0.	47.	65.	100.	39.	115.	63.	90.	1.	0.	521.
1973.	0.	0.	0.	103.	77.	71.	53.	29.	63.	139.	0.	0.	534.
1974.	0.	0.	0.	67.	105.	62.	50.	31.	74.	37.	110.	0.	536.
1975.	0.	0.	0.	0.	0.	94.	78.	76.	73.	56.	59.	6.	442.
1976.	0.	0.	0.	119.	136.	87.	101.	60.	72.	73.	13.	1.	662.
1977.	0.	0.	0.	94.	29.	69.	57.	150.	230.	71.	0.	1.	701.
1978.	0.	0.	0.	72.	43.	72.	43.	86.	156.	95.	0.	0.	567.
1979.	0.	0.	0.	84.	92.	33.	91.	88.	84.	129.	71.	0.	673.
1980.	0.	0.	0.	81.	39.	122.	60.	32.	79.	96.	45.	0.	554.
1981.	0.	0.	0.	91.	71.	106.	122.	61.	123.	91.	84.	0.	749.
1982.	0.	0.	0.	28.	65.	97.	36.	66.	82.	25.	143.	0.	544.
1983.	0.	0.	0.	78.	100.	65.	55.	106.	75.	122.	92.	0.	694.
1984.	0.	0.	0.	31.	113.	136.	19.	51.	144.	24.	44.	0.	562.
1985.	0.	0.	67.	32.	52.	64.	40.	94.	42.	109.	0.	1.	501.
1986.	0.	0.	0.	93.	113.	60.	85.	83.	98.	80.	43.	65.	719.
1987.	0.	2.	11.	77.	42.	80.	122.	97.	99.	71.	94.	34.	730.
1988.	0.	0.	41.	71.	42.	21.	110.	82.	70.	68.	75.	5.	585.
1989.	0.	0.	13.	63.	137.	108.	36.	45.	89.	73.	84.	0.	647.
1990.	0.	2.	38.	99.	124.	44.	68.	95.	56.	112.	96.	0.	735.
1991.	0.	0.	86.	124.	67.	31.	85.	57.	79.	64.	61.	28.	682.
1992.	0.	0.	29.	127.	56.	92.	185.	116.	77.	47.	103.	38.	869.
1993.	3.	0.	7.	83.	56.	86.	32.	61.	71.	92.	80.	38.	610.
1994.	0.	0.	44.	88.	105.	124.	48.	77.	117.	15.	0.	15.	633.
1995.	112.	23.	16.	48.	37.	60.	123.	66.	8.	137.	94.	0.	724.
1998.	0.	0.	0.	0.	51.	54.	64.	29.	9.	0.	1.	0.	207.
1999.	0.	0.	0.	79.	59.	35.	61.	58.	116.	78.	0.	0.	487.
2000.	0.	0.	0.	123.	134.	216.	51.	0.	0.	0.	10.	0.	534.
2001.	0.	0.	0.	56.	88.	45.	25.	30.	81.	129.	0.	0.	454.
2002.	0.	0.	0.	73.	104.	64.	53.	49.	52.	65.	8.	0.	468.
2003.	0.	0.	0.	10.	163.	77.	81.	64.	67.	73.	2.	0.	537.
2004.	0.	0.	0.	131.	126.	99.	115.	40.	88.	17.	0.	0.	616.
2005.	0.	0.	0.	38.	42.	78.	53.	120.	112.	0.	0.	0.	443.

Total Rainfall Depth for Simulation Period 19310. (mm)

Rainfall Intensity Analysis (mm/hr)

(mm/hr)	(#)	(%)	(mm)	(%)
2.50	21481	74.6	6454.	33.4
5.00	3585	12.4	3088.	16.0
7.50	1973	6.8	2886.	14.9
10.00	575	2.0	1233.	6.4
12.50	389	1.4	1070.	5.5
15.00	194	0.7	660.	3.4
17.50	210	0.7	846.	4.4
20.00	66	0.2	306.	1.6
22.50	92	0.3	487.	2.5
25.00	39	0.1	232.	1.2
27.50	37	0.1	246.	1.3
30.00	34	0.1	245.	1.3
32.50	29	0.1	228.	1.2
35.00	5	0.0	42.	0.2
37.50	10	0.0	90.	0.5
40.00	10	0.0	97.	0.5
42.50	12	0.0	124.	0.6
45.00	9	0.0	99.	0.5
47.50	1	0.0	12.	0.1
50.00	3	0.0	37.	0.2
>50.00	49	0.2	829.	4.3

Total # of Intensities 28803

Daily Rainfall Depth Analysis (mm)

(mm)	(#)	(%)	(mm)	(%)
2.50	1077	38.9	1247.	6.5
5.00	507	18.3	1850.	9.6
7.50	326	11.8	2006.	10.4
10.00	226	8.2	1958.	10.1
12.50	150	5.4	1672.	8.7
15.00	111	4.0	1495.	7.7
17.50	100	3.6	1620.	8.4
20.00	67	2.4	1260.	6.5
22.50	45	1.6	958.	5.0
25.00	37	1.3	881.	4.6
27.50	23	0.8	609.	3.2
30.00	20	0.7	575.	3.0
32.50	20	0.7	631.	3.3
35.00	12	0.4	405.	2.1
37.50	8	0.3	290.	1.5
40.00	9	0.3	350.	1.8
42.50	4	0.1	165.	0.9
45.00	4	0.1	173.	0.9
47.50	2	0.1	91.	0.5
50.00	4	0.1	192.	1.0
>50.00	15	0.5	882.	4.6

Total # Days with Rain 2767

```
************************************************
*      End of time step DO-loop in Runoff      *
************************************************
Final Date (Mo/Day/Year)  =                  1/ 1/2006
Total number of time steps =                   2056881
Final Julian Date  =                           2006001
Final time of day  =                                2. seconds.
Final time of day  =                             0.00   hours.
Final running time =                       306816.0000   hours.
Final running time =                        12784.0000    days.
```

```
**************************************************
*     Extrapolation Summary for Watersheds       *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of OVERLND Calls      *
**************************************************
```

Subcatch	# Steps	# Calls	Subcatch	# Steps	# Calls	Subcatch	# Steps	# Calls
300	6298442	1666610						

```
**************************************************
*     Extrapolation Summary for Channel/Pipes    *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of GUTNR Calls        *
**************************************************
```

Chan/Pipe	# Steps	# Calls	Chan/Pipe	# Steps	# Calls	Chan/Pipe	# Steps	# Calls
201	0	0						

```
**********************************************
*       Continuity Check for Surface Water   *
**********************************************
                                                                  Millimeters over
                                                    cubic meters  Total Basin
Total Precipitation (Rain plus Snow)                    768570.     19263.
Total Infiltration                                      191533.      4800.
Total Evaporation                                        68574.      1719.
Surface Runoff from Watersheds                          510637.     12798.
Total Water remaining in Surface Storage                     0.         0.
Infiltration over the Pervious Area...                  191533.     19202.
                                --------
Infiltration + Evaporation +
Surface Runoff + Snow removal +
Water remaining in Surface Storage +
Water remaining in Snow Cover.........                  770744.     19317.
Total Precipitation + Initial Storage.                  768570.     19263.

The error in continuity is calculated as
***************************************
* Precipitation + Initial Snow Cover  *
*       - Infiltration -              *
*Evaporation - Snow removal -         *
*Surface Runoff from Watersheds -     *
*Water in Surface Storage -           *
*Water remaining in Snow Cover        *
*-------------------------------------*
* Precipitation + Initial Snow Cover  *
***************************************
Error.................................       -0.283 Percent

**********************************************
*       Continuity Check for Channel/Pipes   *
**********************************************
                                                                  Millimeters over
                                                    cubic meters  Total Basin
Initial Channel/Pipe Storage................                 0.         0.
Final Channel/Pipe Storage..................                 0.         0.
Surface Runoff from Watersheds..............            510637.     12798.
Baseflow....................................                 0.
Groundwater Subsurface Inflow...............                 0.         0.
Evaporation Loss from Channels..............                 0.         0.
Channel/Pipe/Inlet Outflow..................            510637.     12798.
Initial Storage + Inflow....................            510637.     12798.
Final Storage + Outflow.....................            510637.     12798.
********************************************
* Final Storage + Outflow + Evaporation  - *
* Watershed Runoff - Groundwater Inflow  - *
*     Initial Channel/Pipe Storage         *
*     --------------------------------     *
*  Final Storage + Outflow  + Evaporation  *
********************************************
Error......................................        0.000 Percent

***************************************************
*     Continuity Check for Subsurface Water       *
***************************************************
                                                                   Millimeters over
                                                cubic meters       Subsurface Basin
Total Infiltration                                           0.          0.
Total Upper Zone ET                                          0.          0.
Total Lower Zone ET                                          0.          0.
Total Groundwater flow                                       0.          0.
Total Deep percolation                                       0.          0.
Initial Subsurface Storage                               36483.        914.
Final Subsurface Storage                                 36483.        914.
Upper Zone ET over Pervious Area                             0.          0.
Lower Zone ET over Pervious Area                             0.          0.

*****************************************
* Infiltration + Initial Storage - Final *
* Storage - Upper and Lower Zone ET -    *
* Groundwater Flow - Deep Percolation    *
* -------------------------------------- *
*     Infiltration + Initial Storage     *
*****************************************
Error ..................................    0.000 Percent

                                SUMMARY STATISTICS FOR SUBCATCHMENTS
                                ====================================
                                                PERVIOUS AREA     IMPERVIOUS AREA     TOTAL SUBCATCHMENT AREA
                                            -------------------  -----------------  -------------------------
                                     TOTAL   TOTAL          PEAK              PEAK                PEAK     PEAK
           GUTTER                SIMULATED   RUNOFF TOTAL RUNOFF    RUNOFF    RUNOFF      RUNOFF  RUNOFF   UNIT
  SUBCATCH-  OR INLET  AREA  PERCENT  RAINFALL   DEPTH LOSSES  RATE     DEPTH    RATE        DEPTH   RATE    RUNOFF
  MENT NO.     NO.     (HA)   IMPER.   (MM)      (MM)  (MM)   (CMS)     (MM)   (CMS)        (MM)   (CMS)  (MM/HR)
 --------------------------------------------------------------------------------------------------------------------
      300        200    3.99    75.019262.47    58.511********   0.17817040.139    1.584 12794.732    1.762  160.301
         *** NOTE *** IMPERVIOUS AREA STATISTICS AGGREGATE IMPERVIOUS AREAS WITH AND WITHOUT DEPRESSION STORAGE

                                      SUMMARY STATISTICS FOR CHANNEL/PIPES
                                  ================================================
                                      MAXIMUM   MAXIMUM   MAXIMUM  MAXIMUM     TIME         LENGTH     MAXIMUM     RATIO OF  RATIO OF
           FULL      FULL       FULL   COMPUTED  COMPUTED  COMPUTED COMPUTED     OF            OF      SURCHARGE   MAX. TO  MAX. DEPTH
  CHANNEL  FLOW   VELOCITY     DEPTH    INFLOW   OUTFLOW    DEPTH   VELOCITY OCCURRENCE     SURCHARGE   VOLUME      FULL      TO FULL
   NUMBER  (CMS)    (M/S)       (M)      (CMS)    (CMS)      (M)     (M/S)    DAY   HR.      (HOUR)     (CU-M)     FLOW       DEPTH
 -------- ------------------------   -------------------------------------------------   --------------------- ------------------
      201                              0.00                           1/ 0/1900  0.00
      200                              1.76                           8/14/1972 14.25
                                          TOTAL NUMBER OF CHANNELS/PIPES =     2
 *** NOTE ***  THE MAXIMUM FLOWS AND DEPTHS ARE CALCULATED AT THE END OF THE TIME INTERVAL

                #####################################################
                #             Runoff Quality Summary Page           #
                # If NDIM = 0 Units for:    loads    mass rates     #
                #             METRIC = 1    lb        lb/sec        #
                #             METRIC = 2    kg        kg/sec        #
                # If NDIM = 1 Loads are in units of quantity        #
                #             and mass rates are quantity/sec       #
                # If NDIM = 2 loads are in units of concentration   #
                #             times volume and mass rates have units#
                #             of concentration times volume/second  #
                #####################################################
```

```
               Total Su NDIM =  0
               METRIC =  2
                                  Total Su
                                  --------
Inputs
------
 1. INITIAL SURFACE LOAD........       87.
 2. TOTAL SURFACE BUILDUP.......    67497.
 3. INITIAL CATCHBASIN LOAD.....        0.
 4. TOTAL CATCHBASIN LOAD.......        0.
 5. TOTAL CATCHBASIN AND
    SURFACE BUILDUP (2+4).......    67497.
Remaining Loads
---------------
 6. LOAD REMAINING ON SURFACE...       32.
 7. REMAINING IN CATCHBASINS....        0.
 8. REMAINING IN CHANNEL/PIPES..        0.
Removals
--------
 9. STREET SWEEPING REMOVAL.....     5829.
10. NET SURFACE BUILDUP (2-9)...    61668.
11. SURFACE WASHOFF.............    61617.
12. CATCHBASIN WASHOFF..........        0.
13. TOTAL WASHOFF (11+12).......    61617.
14. LOAD FROM OTHER CONSTITUENTS        0.
15. PRECIPITATION LOAD..........        0.
15a.SUM SURFACE LOAD (13+14+15).    61617.
16. TOTAL GROUNDWATER LOAD......        0.
16a.TOTAL I/I LOAD..............        0.
17. NET SUBCATCHMENT LOAD
    (15a-15b-15c-15d+16+16a)....    61617.
>>Removal in channel/pipes (17a, 17b):
17a.REMOVE BY BMP FRACTION......        0.
17b.REMOVE BY 1st ORDER DECAY...        0.
18. TOTAL LOAD TO INLETS........    61618.
19. FLOW WT'D AVE.CONCENTRATION  mg/l
    (INLET LOAD/TOTAL FLOW).....      121.
Percentages
-----------
20. STREET SWEEPING (9/2).......        9.
21. SURFACE WASHOFF (11/2)......       91.
22. NET SURFACE WASHOFF(11/10)..      100.
23. WASHOFF/SUBCAT LOAD(11/17)..      100.
24. SURFACE WASHOFF/INLET LOAD
    (11/18).....................      100.
25. CATCHBASIN WASHOFF/
    SUBCATCHMENT LOAD (12/17)...        0.
26. CATCHBASIN WASHOFF/
    INLET LOAD (12/18)..........        0.
27. OTHER CONSTITUENT LOAD/
    SUBCATCHMENT LOAD (14/17)...        0.
28. INSOLUBLE FRACTION/
    INLET LOAD (14/18)..........        0.
29. PRECIPITATION/
    SUBCATCHMENT LOAD (15/17)...        0.
30. PRECIPITATION/
    INLET LOAD (15/18)..........        0.
31. GROUNDWATER LOAD/
    SUBCATCHMENT LOAD (16/17)...        0.
32. GROUNDWATER LOAD/
    INLET LOAD (16/18)..........        0.
32a.INFILTRATION/INFLOW LOAD/
    SUBCATCHMENT LOAD (16a/17)..        0.
32b.INFILTRATION/INFLOW LOAD/
    INLET LOAD (16a/18).........        0.
32c.CH/PIPE BMP FRACTION REMOVAL/
    SUBCATCHMENT LOAD (17a/17)..        0.
32d.CH/PIPE 1st ORDER DECAY REMOVAL/
    SUBCATCHMENT LOAD (17b/17)..        0.
33. INLET LOAD SUMMATION ERROR
    (18+8+6a+17a+17b-17)/17.....        0.

CAUTION. Due to method of quality routing (Users Manual, Appendix IX)
quality routing through channel/pipes is sensitive to the time step.
Large "Inlet Load Summation Errors" may result.
These can be reduced by adjusting the time step(s).
Note: surface accumulation during dry time steps at end of simulation is
not included in totals.  Buildup is only performed at beginning of
wet steps or for street cleaning.

********************************************************
*            TSS Particle Size Distribution            *
********************************************************
   Diameter    %     Specific    Settling Velocity   Critical Peclet
     (um)             Gravity        (m/s)               Number
       2.     5.0      2.65        0.000003            0.054484
       5.     5.0      2.65        0.000017            0.061150
       8.    10.0      2.65        0.000043            0.067744
      20.    15.0      2.65        0.000267            0.093400
      50.    10.0      2.65        0.001629            0.152500
      75.     5.0      2.65        0.003548            0.196250
     100.    10.0      2.65        0.006044            0.235000
     150.    15.0      2.65        0.012234            0.297500
     250.    15.0      2.65        0.026615            0.391296
     500.     5.0      2.65        0.060604            0.602917
    1000.     5.0      2.65        0.111334            0.928988

****************************************************
*                                                  *
*              Summary of TSS Removal              *
*                                                  *
****************************************************

TSS Removal based on Lab Performance Curve
 Model      Low Q Treated  High Q Treated     Runoff Treated        TSS Removed
   #           (cms)          (cms)                (%)                  (%)
 HD 4         0.590            0.590               99.7                 49.7
 HD 5         0.590            0.590               99.7                 56.8
 HD 6         0.590            0.590               99.7                 62.2
 HD 7         0.590            0.590               99.7                 66.3
 HD 8         0.590            0.590               99.7                 70.0
 HD 10        0.590            0.590               99.7                 76.1
 HD 12        0.590            0.590               99.7                 80.9
```

```
**************************************************
*                                                *
*  Summary of Annual Flow Treatmnet & TSS Removal  *
*                                                *
**************************************************
```

HD 4

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	116564.	115745.	1222.	552.	670.	0.	99.3	45.1
1972.	149181.	141324.	1619.	811.	808.	38.	94.7	48.9
1973.	149110.	149110.	1727.	846.	881.	0.	100.0	49.0
1974.	152213.	151749.	1812.	1000.	812.	3.	99.7	55.1
1975.	129663.	129663.	1581.	748.	833.	0.	100.0	47.3
1976.	192886.	191465.	1993.	1011.	982.	12.	99.3	50.4
1977.	206453.	204643.	1928.	819.	1109.	11.	99.1	42.3
1978.	165056.	165056.	1850.	846.	1004.	0.	100.0	45.7
1979.	197487.	196447.	2062.	1015.	1047.	6.	99.5	49.1
1980.	158573.	158573.	1981.	970.	1012.	0.	100.0	48.9
1981.	219897.	219897.	2182.	1166.	1016.	0.	100.0	53.4
1982.	155020.	155020.	1782.	956.	826.	0.	100.0	53.6
1983.	204694.	204489.	2287.	1143.	1144.	2.	99.9	49.9
1984.	164353.	164353.	1763.	848.	915.	0.	100.0	48.1
1985.	142913.	142913.	1728.	885.	843.	0.	100.0	51.2
1986.	209145.	209145.	2380.	1252.	1129.	0.	100.0	52.6
1987.	216387.	216006.	2392.	1202.	1190.	1.	99.8	50.2
1988.	172806.	172806.	1983.	1052.	931.	0.	100.0	53.0
1989.	191553.	191553.	1912.	1023.	890.	0.	100.0	53.5
1990.	217088.	217088.	2466.	1329.	1136.	0.	100.0	53.9
1991.	203345.	203345.	2264.	1165.	1099.	0.	100.0	51.5
1992.	258601.	258601.	2663.	1272.	1391.	0.	100.0	47.8
1993.	175049.	175049.	2205.	1213.	992.	0.	100.0	55.0
1994.	187198.	186299.	1832.	842.	990.	5.	99.5	45.9
1995.	218706.	218706.	2205.	1025.	1181.	0.	100.0	46.5
1998.	55011.	55011.	838.	404.	433.	0.	100.0	48.3
1999.	137028.	137028.	1713.	830.	883.	0.	100.0	48.5
2000.	159568.	159568.	1492.	611.	881.	0.	100.0	40.9
2001.	125122.	125122.	1384.	771.	613.	0.	100.0	55.7
2002.	130266.	130266.	1631.	850.	781.	0.	100.0	52.1
2003.	148496.	148496.	1667.	796.	871.	0.	100.0	47.7
2004.	178561.	178561.	1725.	821.	903.	0.	100.0	47.6
2005.	128300.	127924.	1315.	529.	786.	1.	99.7	40.2

HD 5

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	116564.	115745.	1222.	637.	585.	0.	99.3	52.1
1972.	149181.	141324.	1619.	927.	692.	38.	94.7	55.9
1973.	149110.	149110.	1727.	975.	752.	0.	100.0	56.5
1974.	152213.	151749.	1812.	1114.	698.	3.	99.7	61.4
1975.	129663.	129663.	1581.	864.	717.	0.	100.0	54.6
1976.	192886.	191465.	1993.	1140.	852.	12.	99.3	56.9
1977.	206453.	204643.	1928.	963.	965.	11.	99.1	49.7
1978.	165056.	165056.	1850.	990.	861.	0.	100.0	53.5
1979.	197487.	196447.	2062.	1152.	910.	6.	99.5	55.7
1980.	158573.	158573.	1981.	1116.	866.	0.	100.0	56.3
1981.	219897.	219897.	2182.	1310.	872.	0.	100.0	60.1
1982.	155020.	155020.	1782.	1077.	705.	0.	100.0	60.5
1983.	204694.	204489.	2287.	1303.	984.	2.	99.9	56.9
1984.	164353.	164353.	1763.	989.	774.	0.	100.0	56.1
1985.	142913.	142913.	1728.	1014.	714.	0.	100.0	58.7
1986.	209145.	209145.	2380.	1410.	971.	0.	100.0	59.2
1987.	216387.	216006.	2392.	1369.	1022.	1.	99.8	57.2
1988.	172806.	172806.	1983.	1191.	792.	0.	100.0	60.1
1989.	191553.	191553.	1912.	1137.	776.	0.	100.0	59.4
1990.	217088.	217088.	2466.	1505.	961.	0.	100.0	61.0
1991.	203345.	203345.	2264.	1327.	938.	0.	100.0	58.6
1992.	258601.	258601.	2663.	1457.	1206.	0.	100.0	54.7
1993.	175049.	175049.	2205.	1372.	833.	0.	100.0	62.2
1994.	187198.	186299.	1832.	965.	867.	5.	99.5	52.5
1995.	218706.	218706.	2205.	1178.	1028.	0.	100.0	53.4
1998.	55011.	55011.	838.	467.	370.	0.	100.0	55.8
1999.	137028.	137028.	1713.	953.	760.	0.	100.0	55.6
2000.	159568.	159568.	1492.	725.	767.	0.	100.0	48.6
2001.	125122.	125122.	1384.	865.	519.	0.	100.0	62.5
2002.	130266.	130266.	1631.	967.	665.	0.	100.0	59.3
2003.	148496.	148496.	1667.	922.	745.	0.	100.0	55.3
2004.	178561.	178561.	1725.	966.	759.	0.	100.0	56.0
2005.	128300.	127924.	1315.	633.	682.	1.	99.7	48.1

HD 6

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	116564.	115745.	1222.	703.	519.	0.	99.3	57.5
1972.	149181.	141324.	1619.	1010.	609.	38.	94.7	60.9
1973.	149110.	149110.	1727.	1077.	650.	0.	100.0	62.3
1974.	152213.	151749.	1812.	1204.	607.	3.	99.7	66.4
1975.	129663.	129663.	1581.	951.	630.	0.	100.0	60.1
1976.	192886.	191465.	1993.	1238.	754.	12.	99.3	61.8
1977.	206453.	204643.	1928.	1078.	850.	11.	99.1	55.6
1978.	165056.	165056.	1850.	1102.	749.	0.	100.0	59.5
1979.	197487.	196447.	2062.	1272.	790.	6.	99.5	61.5
1980.	158573.	158573.	1981.	1221.	760.	0.	100.0	61.6
1981.	219897.	219897.	2182.	1422.	760.	0.	100.0	65.1
1982.	155020.	155020.	1782.	1170.	612.	0.	100.0	65.6
1983.	204694.	204489.	2287.	1419.	868.	2.	99.9	62.0
1984.	164353.	164353.	1763.	1087.	676.	0.	100.0	61.7
1985.	142913.	142913.	1728.	1106.	622.	0.	100.0	64.0
1986.	209145.	209145.	2380.	1531.	849.	0.	100.0	64.3
1987.	216387.	216006.	2392.	1504.	888.	1.	99.8	62.8
1988.	172806.	172806.	1983.	1298.	684.	0.	100.0	65.5
1989.	191553.	191553.	1912.	1228.	684.	0.	100.0	64.2
1990.	217088.	217088.	2466.	1634.	832.	0.	100.0	66.3
1991.	203345.	203345.	2264.	1445.	819.	0.	100.0	63.8
1992.	258601.	258601.	2663.	1613.	1050.	0.	100.0	60.6
1993.	175049.	175049.	2205.	1484.	722.	0.	100.0	67.3
1994.	187198.	186299.	1832.	1061.	771.	5.	99.5	57.8
1995.	218706.	218706.	2205.	1303.	903.	0.	100.0	59.1
1998.	55011.	55011.	838.	518.	319.	0.	100.0	61.9
1999.	137028.	137028.	1713.	1055.	658.	0.	100.0	61.6
2000.	159568.	159568.	1492.	821.	671.	0.	100.0	55.0
2001.	125122.	125122.	1384.	937.	447.	0.	100.0	67.7
2002.	130266.	130266.	1631.	1057.	574.	0.	100.0	64.8
2003.	148496.	148496.	1667.	1022.	645.	0.	100.0	61.3
2004.	178561.	178561.	1725.	1065.	660.	0.	100.0	61.8
2005.	128300.	127924.	1315.	708.	607.	1.	99.7	53.8

HD 7

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	116564.	115745.	1222.	758.	464.	0.	99.3	62.0
1972.	149181.	141324.	1619.	1073.	545.	38.	94.7	64.8
1973.	149110.	149110.	1727.	1148.	579.	0.	100.0	66.5
1974.	152213.	151749.	1812.	1268.	543.	3.	99.7	69.9
1975.	129663.	129663.	1581.	1018.	563.	0.	100.0	64.4
1976.	192886.	191465.	1993.	1320.	673.	12.	99.3	65.8
1977.	206453.	204643.	1928.	1165.	763.	11.	99.1	60.1
1978.	165056.	165056.	1850.	1186.	664.	0.	100.0	64.1
1979.	197487.	196447.	2062.	1354.	708.	6.	99.5	65.5
1980.	158573.	158573.	1981.	1314.	668.	0.	100.0	66.3
1981.	219897.	219897.	2182.	1506.	676.	0.	100.0	69.0
1982.	155020.	155020.	1782.	1243.	540.	0.	100.0	69.7
1983.	204694.	204489.	2287.	1514.	773.	2.	99.9	66.1
1984.	164353.	164353.	1763.	1162.	601.	0.	100.0	65.9
1985.	142913.	142913.	1728.	1181.	547.	0.	100.0	68.4
1986.	209145.	209145.	2380.	1627.	753.	0.	100.0	68.4
1987.	216387.	216006.	2392.	1600.	791.	1.	99.8	66.9
1988.	172806.	172806.	1983.	1370.	613.	0.	100.0	69.1
1989.	191553.	191553.	1912.	1306.	607.	0.	100.0	68.3
1990.	217088.	217088.	2466.	1713.	753.	0.	100.0	69.5
1991.	203345.	203345.	2264.	1533.	732.	0.	100.0	67.7
1992.	258601.	258601.	2663.	1723.	940.	0.	100.0	64.7
1993.	175049.	175049.	2205.	1563.	642.	0.	100.0	70.9
1994.	187198.	186299.	1832.	1135.	697.	5.	99.5	61.8
1995.	218706.	218706.	2205.	1396.	809.	0.	100.0	63.3
1998.	55011.	55011.	838.	555.	283.	0.	100.0	66.2
1999.	137028.	137028.	1713.	1137.	576.	0.	100.0	66.4
2000.	159568.	159568.	1492.	893.	599.	0.	100.0	59.9
2001.	125122.	125122.	1384.	991.	392.	0.	100.0	71.6
2002.	130266.	130266.	1631.	1126.	505.	0.	100.0	69.0
2003.	148496.	148496.	1667.	1097.	570.	0.	100.0	65.8
2004.	178561.	178561.	1725.	1137.	588.	0.	100.0	65.9
2005.	128300.	127924.	1315.	775.	540.	1.	99.7	58.9

HD 8

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	116564.	115745.	1222.	804.	418.	0.	99.3	65.8
1972.	149181.	141324.	1619.	1129.	490.	38.	94.7	68.1
1973.	149110.	149110.	1727.	1208.	519.	0.	100.0	70.0
1974.	152213.	151749.	1812.	1330.	482.	3.	99.7	73.3
1975.	129663.	129663.	1581.	1075.	506.	0.	100.0	68.0
1976.	192886.	191465.	1993.	1397.	596.	12.	99.3	69.7
1977.	206453.	204643.	1928.	1244.	684.	11.	99.1	64.2
1978.	165056.	165056.	1850.	1255.	595.	0.	100.0	67.8
1979.	197487.	196447.	2062.	1435.	627.	6.	99.5	69.4
1980.	158573.	158573.	1981.	1383.	598.	0.	100.0	69.8
1981.	219897.	219897.	2182.	1578.	603.	0.	100.0	72.3
1982.	155020.	155020.	1782.	1298.	484.	0.	100.0	72.8
1983.	204694.	204489.	2287.	1596.	691.	2.	99.9	69.7
1984.	164353.	164353.	1763.	1225.	538.	0.	100.0	69.5
1985.	142913.	142913.	1728.	1238.	490.	0.	100.0	71.7
1986.	209145.	209145.	2380.	1707.	673.	0.	100.0	71.7
1987.	216387.	216006.	2392.	1691.	700.	1.	99.8	70.7
1988.	172806.	172806.	1983.	1442.	541.	0.	100.0	72.7
1989.	191553.	191553.	1912.	1368.	544.	0.	100.0	71.5
1990.	217088.	217088.	2466.	1795.	671.	0.	100.0	72.8
1991.	203345.	203345.	2264.	1613.	652.	0.	100.0	71.2
1992.	258601.	258601.	2663.	1832.	832.	0.	100.0	68.8
1993.	175049.	175049.	2205.	1639.	566.	0.	100.0	74.3
1994.	187198.	186299.	1832.	1208.	624.	5.	99.5	65.8
1995.	218706.	218706.	2205.	1484.	722.	0.	100.0	67.3
1998.	55011.	55011.	838.	593.	245.	0.	100.0	70.8
1999.	137028.	137028.	1713.	1195.	518.	0.	100.0	69.8
2000.	159568.	159568.	1492.	958.	534.	0.	100.0	64.2
2001.	125122.	125122.	1384.	1034.	349.	0.	100.0	74.8
2002.	130266.	130266.	1631.	1182.	449.	0.	100.0	72.5
2003.	148496.	148496.	1667.	1165.	502.	0.	100.0	69.9
2004.	178561.	178561.	1725.	1199.	526.	0.	100.0	69.5
2005.	128300.	127924.	1315.	834.	481.	1.	99.7	63.4

HD 10

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	116564.	115745.	1222.	893.	329.	0.	99.3	73.1
1972.	149181.	141324.	1619.	1230.	389.	38.	94.7	74.2
1973.	149110.	149110.	1727.	1319.	408.	0.	100.0	76.4
1974.	152213.	151749.	1812.	1438.	373.	3.	99.7	79.2
1975.	129663.	129663.	1581.	1181.	400.	0.	100.0	74.7
1976.	192886.	191465.	1993.	1521.	471.	12.	99.3	75.9
1977.	206453.	204643.	1928.	1375.	553.	11.	99.1	70.9
1978.	165056.	165056.	1850.	1370.	481.	0.	100.0	74.0
1979.	197487.	196447.	2062.	1565.	496.	6.	99.5	75.7
1980.	158573.	158573.	1981.	1508.	473.	0.	100.0	76.1
1981.	219897.	219897.	2182.	1708.	474.	0.	100.0	78.3
1982.	155020.	155020.	1782.	1398.	384.	0.	100.0	78.5
1983.	204694.	204489.	2287.	1734.	553.	2.	99.9	75.8
1984.	164353.	164353.	1763.	1334.	429.	0.	100.0	75.6
1985.	142913.	142913.	1728.	1336.	392.	0.	100.0	77.3
1986.	209145.	209145.	2380.	1848.	532.	0.	100.0	77.6
1987.	216387.	216006.	2392.	1835.	557.	1.	99.8	76.7
1988.	172806.	172806.	1983.	1560.	422.	0.	100.0	78.7
1989.	191553.	191553.	1912.	1488.	424.	0.	100.0	77.8
1990.	217088.	217088.	2466.	1940.	525.	0.	100.0	78.7
1991.	203345.	203345.	2264.	1749.	516.	0.	100.0	77.2
1992.	258601.	258601.	2663.	1997.	667.	0.	100.0	75.0
1993.	175049.	175049.	2205.	1764.	441.	0.	100.0	80.0
1994.	187198.	186299.	1832.	1334.	498.	5.	99.5	72.6
1995.	218706.	218706.	2205.	1617.	589.	0.	100.0	73.3
1998.	55011.	55011.	838.	647.	191.	0.	100.0	77.2
1999.	137028.	137028.	1713.	1293.	421.	0.	100.0	75.4
2000.	159568.	159568.	1492.	1057.	435.	0.	100.0	70.9
2001.	125122.	125122.	1384.	1114.	270.	0.	100.0	80.5
2002.	130266.	130266.	1631.	1273.	358.	0.	100.0	78.1
2003.	148496.	148496.	1667.	1263.	404.	0.	100.0	75.8
2004.	178561.	178561.	1725.	1299.	426.	0.	100.0	75.3
2005.	128300.	127924.	1315.	920.	395.	1.	99.7	69.9

HD 12

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	116564.	115745.	1222.	956.	266.	0.	99.3	78.2
1972.	149181.	141324.	1619.	1303.	316.	38.	94.7	78.6
1973.	149110.	149110.	1727.	1400.	326.	0.	100.0	81.1
1974.	152213.	151749.	1812.	1522.	289.	3.	99.7	83.8
1975.	129663.	129663.	1581.	1262.	320.	0.	100.0	79.9
1976.	192886.	191465.	1993.	1613.	379.	12.	99.3	80.5
1977.	206453.	204643.	1928.	1473.	454.	11.	99.1	76.0
1978.	165056.	165056.	1850.	1463.	388.	0.	100.0	79.0
1979.	197487.	196447.	2062.	1664.	398.	6.	99.5	80.5
1980.	158573.	158573.	1981.	1595.	386.	0.	100.0	80.5
1981.	219897.	219897.	2182.	1809.	373.	0.	100.0	82.9
1982.	155020.	155020.	1782.	1484.	299.	0.	100.0	83.2
1983.	204694.	204489.	2287.	1845.	441.	2.	99.9	80.6
1984.	164353.	164353.	1763.	1417.	346.	0.	100.0	80.4
1985.	142913.	142913.	1728.	1421.	308.	0.	100.0	82.2
1986.	209145.	209145.	2380.	1964.	416.	0.	100.0	82.5
1987.	216387.	216006.	2392.	1947.	445.	1.	99.8	81.3
1988.	172806.	172806.	1983.	1649.	333.	0.	100.0	83.2
1989.	191553.	191553.	1912.	1584.	328.	0.	100.0	82.9
1990.	217088.	217088.	2466.	2062.	403.	0.	100.0	83.7
1991.	203345.	203345.	2264.	1861.	404.	0.	100.0	82.2
1992.	258601.	258601.	2663.	2129.	535.	0.	100.0	79.9
1993.	175049.	175049.	2205.	1859.	346.	0.	100.0	84.3
1994.	187198.	186299.	1832.	1418.	413.	5.	99.5	77.2
1995.	218706.	218706.	2205.	1737.	468.	0.	100.0	78.8
1998.	55011.	55011.	838.	687.	151.	0.	100.0	82.0
1999.	137028.	137028.	1713.	1379.	334.	0.	100.0	80.5
2000.	159568.	159568.	1492.	1130.	362.	0.	100.0	75.7
2001.	125122.	125122.	1384.	1177.	207.	0.	100.0	85.1
2002.	130266.	130266.	1631.	1351.	280.	0.	100.0	82.8
2003.	148496.	148496.	1667.	1344.	323.	0.	100.0	80.6
2004.	178561.	178561.	1725.	1380.	344.	0.	100.0	80.0
2005.	128300.	127924.	1315.	988.	326.	1.	99.7	75.2

```
****************************************************
*                                                  *
*      Summary of Toronto Rainfall Intensities     *
*                                                  *
****************************************************
```

Rainfall Intensity (mm/h)	Flow (L/s)	Percentage %
1.50	12.7	NaN
2.25	19.0	NaN
3.00	25.4	NaN
3.75	31.7	NaN
4.75	40.1	NaN
5.75	48.6	NaN
8.00	67.6	NaN
10.00	84.5	NaN
15.50	131.0	NaN
23.25	196.5	NaN

```
****************************************************
*  Summary of Quantity and Quality Results at      *
*  Location        200  INFlow in cms.             *
*  Values are instantaneous at indicated time step *
****************************************************
     Date     Time        Flow   Total Su
 Mo/Da/Year  Hr:Min       cum/s  mg/l
 ----------  -------    -------  --------
Flow wtd means.....       0.002      121.
Flow wtd std devs..       0.009       65.
Maximum value......       1.762      293.
Minimum value......       0.000        0.
Total loads........     510525.    61654.
                        Cub-Met  KILOGRAM
===> Runoff simulation ended normally.
===> SWMM 4.4    simulation ended normally.
     Always check output file for possible warning messages.

*******************************************************
*       SWMM 4.4    Simulation Date and Time Summary  *
*******************************************************
* Starting Date... October    17, 2024                *
*         Time...        10:44: 2.595                 *
*   Ending Date... October    17, 2024                *
*         Time...        10:44: 5. 83                 *
*  Elapsed Time...             0.041 minutes.         *
*  Elapsed Time...             2.488 seconds.         *
*******************************************************
```

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX B

Oil/Grit Sample Inspection Report

SAMPLE INSPECTION REPORT

Owner:					
Location:					
Manhole Oil/Grit Separator:					
Type of Inspection	☐ Monthly		☐ Annually		☐ Special
Inlet/Outlet Information					
	Inlet		Outlet		
Clear of Debris	☐ Yes	☐ No	☐ Yes	☐ No	
Build Up of Sediment	☐ Yes	☐ No	☐ Yes	☐ No	
Action Taken:					
Sediment Tank Information					
A. Manhole Sump Depth:	± m from cover rim (to be as-constructed verified)				
B. Measurement from Rim to Sediment Level	m				
C. Depth of Sediment:	m (A - B)				
Note: If the measured depth of sediment is greater than **350mm** then sediment removal is required.					
Presence of Contaminants					
Oil	☐ Yes	☐ No	Depth: m		
Foam	☐ Yes	☐ No	Depth: m		
Action Taken:					
Name of Regulatory Agency			Telephone No.:		
			Transaction No.:		
Name of Licensed Waste Management Collector			Telephone No.:		
			Transaction No.:		
Owner Notification	☐ Yes	☐ No	Other:		
	Time:		Date:		
Name of Inspector:					
Signed:				Date:	

UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

APPENDIX C

469 & 509 Rice Road Stormwater Management Plan (UCC, October 2024)

STORMWATER MANAGEMENT PLAN

469 & 509 RICE ROAD

CITY OF WELLAND

Prepared For:

BSF Communities
3340 Schmon Parkway
Thorold, ON
L2V 4Y6

Prepared by:

Upper Canada Consultants
3-30 Hannover Drive
St. Catharines, Ontario
L2W 1A3

October 2024

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

REFERENCES

1. Stormwater Management Planning and Design Manual
   Ontario Ministry of Environment (March 2003)

2. Soils of the Regional Municipality of Niagara Soil Survey Report No. 60 of the Ontario Institute of Pedology. (1989)

3. Northwest Welland Stormwater Management Implementation Plan
   Upper Canada Consultants (October 2022)

STORMWATER MANAGEMENT PLAN

469 & 509 Rice Road

CITY OF WELLAND

1.0 INTRODUCTION

1.1 Study Area

Upper Canada Consultants (UCC) has been retained by landowner of the 469 & 509 Rice Road properties to prepare a stormwater management plan to address the stormwater management needs for the proposed subdivision development located within the aforementioned properties.

The proposed subdivision is located in the north-western portion of the Northwest Welland Secondary Plan (NWWSP) area in the City of Welland, north of Quaker Road, west of Rice Road, east of Montgomery Road, and south of the municipal boundary with the Town of Pelham.

UCC has previously prepared a Stormwater Management Implementation Plan for the entirety of the NWWSP Area. This Plan identified the preferred locations of future stormwater management (SWM) Facilities within the developable areas in the Secondary Plan in support of the realignment of the Towpath Drain, which flows through the proposed subdivision lands, and identified the existing stormwater flows through each segment of the existing watercourse.

It was identified in the Implementation Plan that two SWM Facilities are to be constructed in the eastern limit of the proposed subdivision lands to provide stormwater management quality and quantity controls for the entire 'Block' of development area, bound by Quaker Road on the south, Rice Road on the west, east of Montgomery Road, and south of the municipal boundary with the Town of Pelham as shown in Figure 1 as Block 3. Therefore, this Block (Block 1) will hereafter be referred to as 'subject lands' in this report.

The subject lands are approximately 16.25 hectares and will consist of residential single detached, street townhouse, and back-to-back townhouse dwellings. The subject lands will be developed to include associated asphalt roadways, concrete curb, catch basins, storm sewers, sanitary sewers, and watermain.

1.2 Objectives

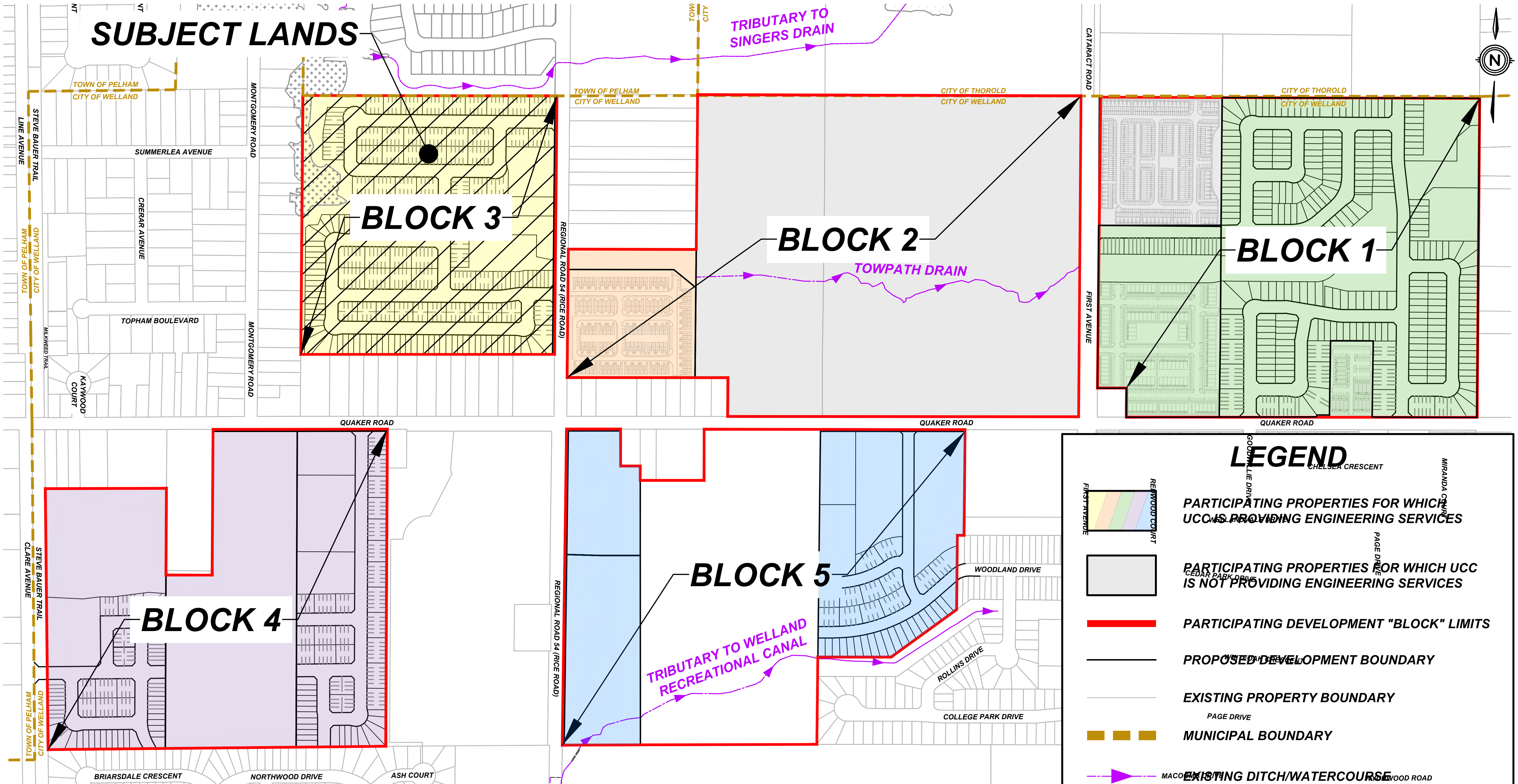
The objectives of this study are as follows:

1. Establish specific criteria for the management of stormwater from this site.

2. Determine the impact of development on the stormwater peak flow & volume of stormwater from the drainage area.

3. Investigate alternatives for controlling the quality of stormwater discharging from the site.

4. Establish the property requirements to construct stormwater management facilities for the Draft Plan of Subdivision.



UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

NORTHWEST WELLAND SECONDARY PLAN

CITY OF WELLAND
SITE LOCATION PLAN - BLOCK 3

DATE	2024-10-17
SCALE	1:6000 m
REF No.	-
DWG No.	FIGURE 1

1.3 Existing & Proposed Conditions

a) Existing Conditions

The topography of the subject lands is relatively flat with a general slope towards the Towpath Drain, which flows through the middle of the site from west to east direction. The Towpath Drain conveys stormwater flows through the City of Welland and the City of Thorold, prior to ultimately outletting into the Welland Canal, with multiple crossings at Municipal and Regional roads, and Highway 406.

Existing stormwater flows and the delineation of existing stormwater drainage areas for the Towpath Drain were assessed as part of the Implementation Plan to the culvert crossing at Regional Road 50 (Niagara Street) and will be the basis for future peak flow targets for all stormwater management facilities constructed within the Secondary Plan Area.

As part of the realignment of the Towpath Drain, twin 2.4 x 1.8m concrete box culverts will be constructed crossing Regional Road 50 (Niagara Street), a 1.8 x 1.2m concrete box culvert will be constructed crossing Regional Road 54 (Rice Road), and the existing 1800mm diameter culvert crossing First Avenue will remain. Upgrades to the First Avenue Culvert will be subject to a future NPCA Work Permit.

b) Proposed Conditions

The subject lands are approximately 16.25 hectares and will consist of residential single detached, street townhouse, and back-to-back townhouse dwellings.

The subject lands will include associated asphalt roadways, concrete curb, catch basins, storm sewers, sanitary sewers, and watermain.

It is proposed to convey all future Stormwater flows from the subject lands to the Towpath Drain as identified in the Implementation Plan.

UCC has been retained as the engineering consultant for the majority of the developing landowners in the NWWSP, as shown in Figure 1. For the purpose of maintaining consistency between the various Draft Plan of Subdivision submissions within the Secondary Plan Area, the “Proposed Conditions” stormwater modelling will include the future SWM Facilities designed for each respective Block in the NWWSP.

For lands where Planning Act Applications are not expected to be submitted in the near future as of the writing of this stormwater management plan, where UCC has not been retained as the engineering consultant, or a stormwater management alternative has not yet been selected, future stormwater flows have been allocated to the Towpath Drain at the existing levels identified in the Implementation Plan.

The existing conditions MIDUSS modelling output file provided in the Implementation Plan has been included in Appendix A for reference.

2.0 STORMWATER MANAGEMENT CRITERIA

New developments are required to provide stormwater management in accordance with provincial and municipal policies including:

- Stormwater Quality Guidelines for New Development (MECP/MNRF, May 1991)
- Stormwater Management Planning and Design Manual (MECP, March 2003)

Based on the comments and outstanding policies from the City of Welland, Regional Municipality of Niagara, Niagara Peninsula Conservation Authority (NPCA), and the Ministry of the Environment, Conservation and Parks (MECP), the following site-specific considerations were identified:

- Per City of Welland requirements, stormwater **quality** improvements must be provided to a minimum of Enhanced Protection (80% TSS Removal).
- Per the Northwest Welland Stormwater Management Implementation Plan prepared by Upper Canada Consultants, future stormwater management facilities within the Secondary Plan Area will be required to provide **quantity** controls up to and including the 100 year design storm event before outletting to the Towapth Drain.
- **Erosion control** to be provided in accordance with MECP guidelines. The guidelines require an extended detention volume to be detained for 24 hours.

Based on above policies and site specific considerations, the following stormwater management criteria have been established for this site:

- Stormwater **quality** controls are to be provided for the more frequent storm events to provide Enhanced Protection (80% TSS Removal), prior to discharging to the receiving watercourse (Towpath Drain).
- To maintain existing water surface elevations in the Towpath Drain, stormwater **quantity controls** will be provided up to and including the 100 year design storm event.
- **Erosion protection** will be provided in accordance with MECP guidelines. The quidelines require an extended detention volume to be detained for 24 hours.

3.0 STORMWATER ANALYSIS

Stormwater for the existing and proposed conditions was estimated using the MIDUSS computer modelling program. This program was selected because it is applicable to both urban and rural drainage areas like the study area. It is relatively easy to use and modify for the future drainage conditions and control facilities. It readily allows for design storm hyetographs for the various return periods being investigated.

3.1 Design Storms

Design storm hyetographs for the storm system design uses a Chicago distribution based on the City of Welland Intensity-Duration-Frequency (IDF) curves. Hyetographs for the 25mm, 2, 5, 10, 25 and 100 year events were developed using a 4 hour Chicago distribution. The 25mm design storm event parameters were derived using the IDF curve and a 4-hour Chicago distribution. Table 1 summarizes the rainfall data applied in the stormwater modelling.

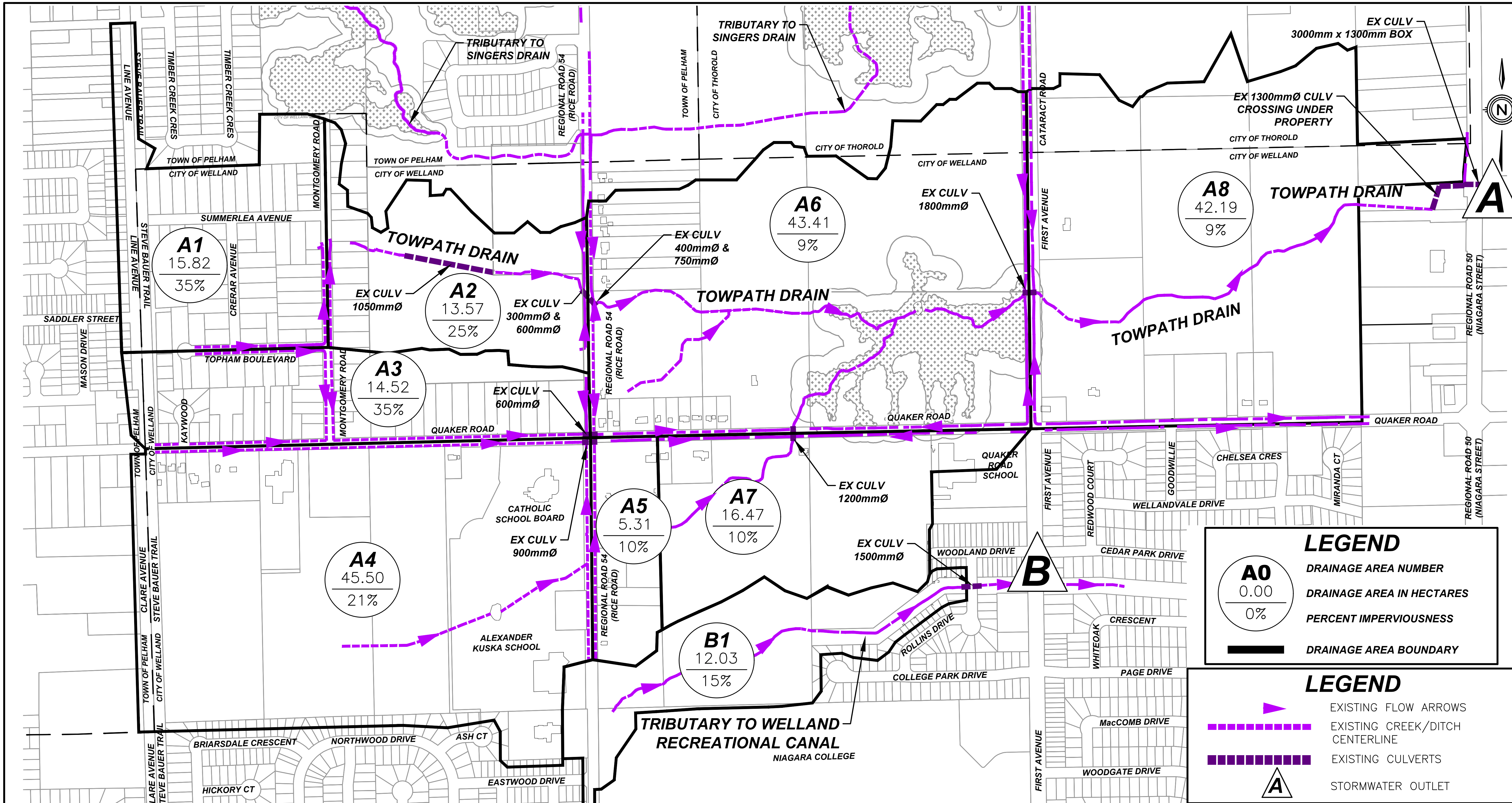
Table 1. Rainfall Data

Design Storm (Return Period)	Chicago Distribution Parameters $i = \frac{a}{(t+b)^c}$			Duration (minutes)
	a	b	c	
25mm	512	6.0	0.800	240
2 Year	755	8.0	0.789	240
5 Year	830	7.3	0.777	240
10 Year	860	6.5	0.763	240
25 Year	900	5.2	0.745	240
100 Year	1020	4.7	0.731	240

3.2 Existing Conditions

Existing conditions within the Towpath Drain were assessed as part of the Implementation Plan to determine the existing the peak flows within the watercourse at existing and future roadway crossings. The existing catchment areas as provided in Figure 2 of the Implementation Plan have been included as Figure 2 in this stormwater management plan for reference.

For consistency between the stormwater management plans submitted by UCC in the NWWSP, Outlets A through D have been identified at specific locations along the Towpath Drain to demonstrate that the existing flows identified in the Implementation Plan are maintained at all locations within the watercourse under future conditions. The locations of Outlets A through D can be found on Figure 3 and the summary of the existing flows at each Outlet have been summarized in Table 2 below.



UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

NORTHWEST WELLAND STORMWATER MANAGEMENT IMPLEMENTATION PLAN

CITY OF WELLAND

EXISTING STORM DRAINAGE AREA PLAN

DATE	2022-10-12
SCALE	1:7000
REF No.	21243
DWG No.	FIGURE 2

Table 2. Existing Peak Stormwater Flows – Towpath Drain

Location	Peak Flow (m^3/s)				
	2 Year	5 Year	10 Year	25 Year	100 Year
Outlet A1	1.317	1.589	1.800	2.099	2.558
Outlet A2	3.301	4.194	4.777	5.619	6.987
Outlet B (*)	3.425	4.367	4.977	5.863	7.305
Outlet C	4.035	5.176	5.914	7.005	8.781
Outlet D	4.509	5.835	6.678	7.938	9.995

Note (*) : Outlet B was not specified as a location where peak flows were evaluated within the Implementation Plan.

Therefore, the change in existing peak flow across the 803m width of Drainage Area A6 (between Rice Road and First Avenue) was prorated to the location of Outlet B (at 205m east of Rice Road) for the peak flow at Outlet B for each design storm event.

3.3 Proposed Conditions

For the purpose of maintaining consistency between the various Draft Plan of Subdivision submissions within the NWWSP Area, the "Proposed Conditions" stormwater modelling will include the future SWM Facilities designed for each respective Block in the NWWSP.

For lands where Planning Act Applications are not expected to be submitted in the near future, as of the writing of this stormwater management plan, or where UCC has not been retained as the engineering consultant, future stormwater flows have been allocated to the Towpath Drain at the existing levels identified in the Implementation Plan.

The future stormwater drainage areas for the NWWSP Area are shown in Figure 3, and a schematic of the future hydrologic modelling is provided as Figure 4.

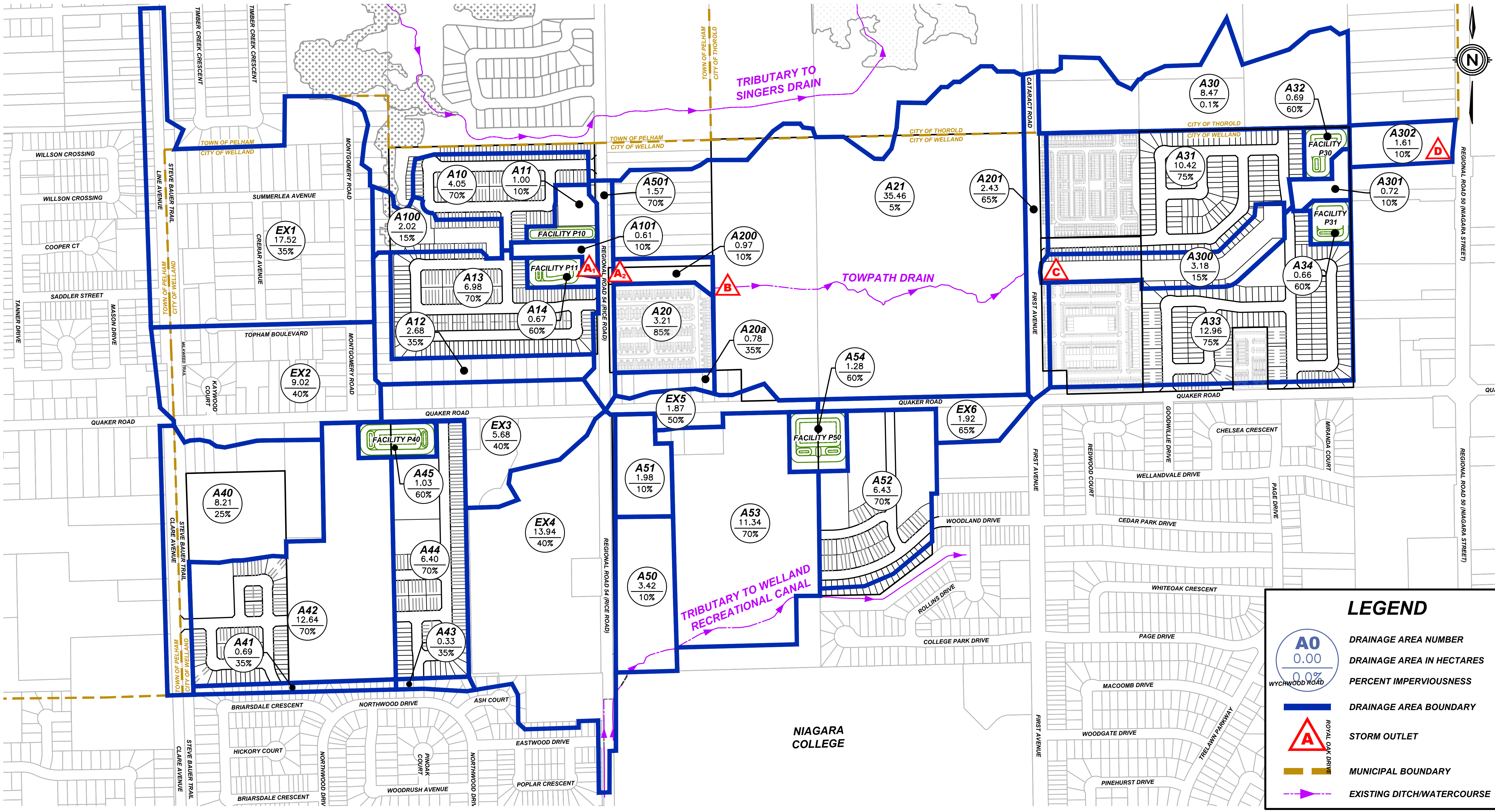
Table 3 below provides a summary of the catchment areas shown in Figure 3 and associated hydrological parameters used for the MIDUSS software model.

The future conditions MIDUSS modelling output file has been enclosed in Appendix F for reference.

Table 3. Hydrologic Parameters for Future Conditions

Area No.	Area (ha)	Length (m)	Slope (%)	Manning – "n"		Soil Type	SCS CN	Percent Impervious
				Perv.	Imperv.			
EX1	17.52	343	1.0	0.25	0.015	CD	74	35%
A100	2.02	116	0.4	0.25	0.015	CD	74	15%
A10	4.05	164	1.0	0.25	0.015	CD	74	70%
A11	1.00	82	1.0	0.25	0.015	CD	74	10%
A101	0.61	64	1.0	0.25	0.015	CD	74	10%
A12	2.68	134	1.0	0.25	0.015	CD	74	35%
A13	6.98	216	1.0	0.25	0.015	CD	74	70%
A14	0.67	67	1.0	0.25	0.015	CD	74	60%
A40	8.21	234	1.0	0.25	0.015	CD	74	25%
A41	0.69	68	1.0	0.25	0.015	CD	74	35%
A42	12.64	290	1.0	0.25	0.015	CD	74	70%
A43	0.33	47	1.0	0.25	0.015	CD	74	35%
A44	6.40	207	1.0	0.25	0.015	CD	74	70%
A45	1.03	83	1.0	0.25	0.015	CD	74	60%
EX2	9.02	245	1.0	0.25	0.015	CD	74	40%
EX3	5.68	195	1.0	0.25	0.015	CD	74	40%
EX4	13.94	305	1.0	0.25	0.015	CD	74	40%
A50	3.42	151	1.0	0.25	0.015	CD	74	10%
A51	1.98	115	1.0	0.25	0.015	CD	74	10%
A501	1.57	102	1.0	0.25	0.015	CD	74	70%
A20a	0.78	72	1.0	0.25	0.015	CD	74	35%
A20	3.21	146	1.0	0.25	0.015	CD	74	85%
A200	0.97	80	1.0	0.25	0.015	CD	74	10%
A21	35.46	487	0.2	0.25	0.015	CD	74	5%
A52	6.43	207	1.0	0.25	0.015	CD	74	70%
A53	11.34	275	1.0	0.25	0.015	CD	74	70%
A54	1.28	92	1.0	0.25	0.015	CD	74	60%
EX5	1.87	112	1.0	0.25	0.015	CD	74	50%
EX6	1.92	113	0.2	0.25	0.015	CD	74	65%

A201	2.43	127	1.0	0.25	0.015	CD	74	65%
A300	3.18	146	0.2	0.25	0.015	CD	74	15%
A301	0.72	69	0.2	0.25	0.015	CD	74	10%
A30	8.47	238	0.2	0.25	0.015	CD	74	0.1%
A31	10.42	264	1.0	0.25	0.015	CD	74	75%
A32	0.69	68	1.0	0.25	0.015	CD	74	60%
A33	12.99	294	1.0	0.25	0.015	CD	74	75%
A34	0.66	66	1.0	0.25	0.015	CD	74	60%
A302	1.61	104	0.2	0.25	0.015	CD	74	10%
	204.87	**Total Area (ha)**						

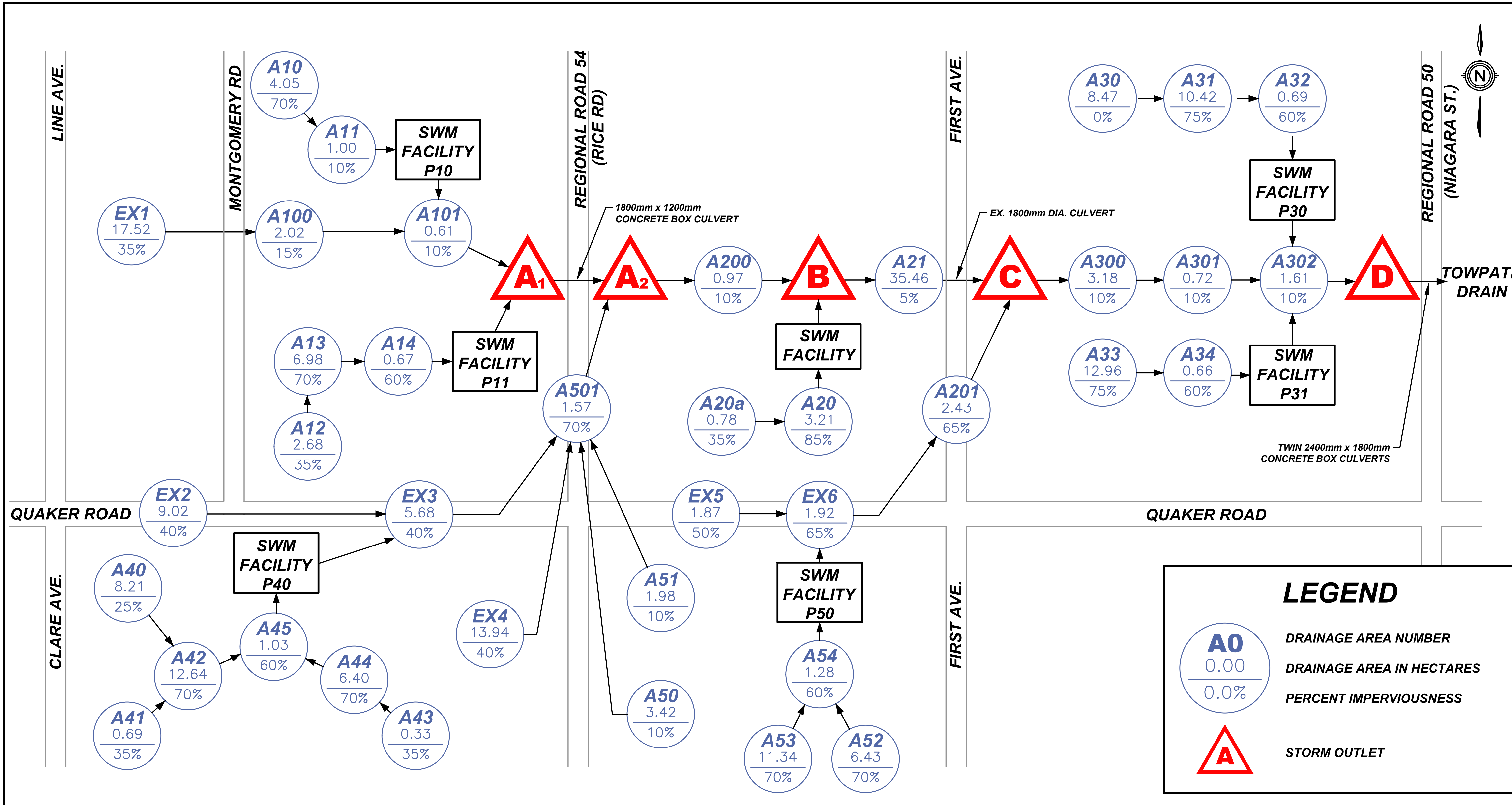


UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

NORTHWEST WELLAND SECONDARY PLAN

CITY OF WELLAND
FUTURE STORM DRAINAGE AREAS

DATE	2024–10–17
SCALE	1:7500 m
REF No.	-
DWG No.	FIGURE 3



UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

NORTHWEST WELLAND SECONDARY PLAN

CITY OF WELLAND

FUTURE HYDROLOGICAL MODELLING SCHEMATIC

DATE	2024–10–17
SCALE	N.T.S.
REF No.	-
DWG No.	FIGURE 4

4.0 STORMWATER MANAGEMENT ALTERNATIVES

4.1 Screening of Stormwater Management Alternatives

A variety of stormwater management alternatives are available to control the quantity and quality of stormwater, most of which are described in the Stormwater Management Planning and Design Manual (MECP, March 2003). Alternatives for the proposed and ultimate developments were considered in the following broad categories: lot level, vegetative, infiltration, and end-of-pipe controls. General comments on each category are provided below. Individual alternatives for the proposed development are listed in Table 4 with comments on their effectiveness and applicability to the proposed outlet.

a) <u>Lot Level Controls</u>

Lot level controls are not generally suitable as the primary control facility for quality control. They are generally used to enhance stormwater quality in conjunction with other types of control facilities.

b) <u>Vegetative Alternatives</u>

Vegetative stormwater management practices are not generally suitable as the primary control facility for quality control. They are generally used to enhance stormwater quality in conjunction with other types of control facilities.

c) <u>Infiltration Alternatives</u>

Where soils are suitable, infiltration techniques can be very effective in providing quantity and quality control. However, the very small amount of surface area on this site dedicated to permeable surfaces such as greenspace and landscaping make this an impractical option. Therefore, infiltration techniques will not be considered for this development.

d) <u>End-of-Pipe Alternatives</u>

Surface storage techniques can be very effective in providing quality and quantity control.

Wet facilities are effective practices for stormwater erosion, quality and quantity control for large drainage areas (>5 ha).

Dry facilities can provide effective quantity control for drainage areas of varying sized. When used in addition to an Oil/Grit Separator, such facilities can provide effective quantity and quality controls for smaller drainage areas (generally <5 ha).

Table 4. Evaluation of Stormwater Management Practices

469 & 509 Rice Road	Criteria for Implementation of Stormwater Management Practices (SWMP)					Technical Effectiveness (10 high)	Recommend Implementation Yes / No	Comments
	Topography	**Soils**	**Bedrock**	**Groundwater**	**Area**			
Site Conditions	***Flat ±1%***	***Variable ±15 mm/hr***	***> 5m***	***At Considerable Depth***	***± 15.38ha***			
Lot Level Controls								
Lot Grading	<5%	nlc	nlc	nlc	nlc	2	Yes	Quality/quantity benefits
Roof Leaders to Surface	nlc	nlc	nlc	nlc	nlc	2	Yes	Quality/quantity benefits
Roof Ldrs.to Soakaway Pits	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 0.5 ha	6	Yes	Quality/quantity benefits
Sump Pump Fdtn. Drains	nlc	nlc	nlc	nlc	nlc	2	No	Unsuitable site conditions
Vegetative								
Grassed Swales	< 5 %	nlc	nlc	nlc	nlc	7	Yes	Quality/quantity benefits
Filter Strips(Veg. Buffer)	< 10 %	nlc	nlc	>.5m Below Bottom	< 2 ha	5	No	Unsuitable site conditions
Infiltration								
Infiltration Basins	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 5 ha	2	No	Unsuitable site conditions
Infiltration Trench	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 2 ha	4	No	Unsuitable site conditions
Rear Yard Infiltration	< 2.0 %	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	< 0.5 ha	7	No	Unsuitable site conditions
Perforated Pipes	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	nlc	4	No	Unsuitable site conditions
Pervious Catch basins	nlc	loam, infiltr. > 15 mm/hr	>1m Below Bottom	>1m Below Bottom	nlc	3	No	Unsuitable site conditions
Sand Filters	nlc	nlc	nlc	>.5m Below Bottom	< 5 ha	5	No	High maintenance/poor aesthetics
Surface Storage								
Dry Ponds	nlc	nlc	nlc	nlc	> 5 ha	7	Yes	No quality control
Wet Ponds	nlc	nlc	nlc	nlc	> 5 ha	9	Yes	Very effective quality/quantity control
Wetlands	nlc	nlc	nlc	nlc	> 5 ha	6	No	Very effective quality control
Other								
Oil/Grit Separator	nlc	nlc	nlc	nlc	<5 ha	7	Yes	Quality Control for small areas

Reference: Stormwater Management Practices Planning and Design Manual - 2003
nlc - No Limiting Criteria

4.2 Selection of Stormwater Management Alternatives

Stormwater management alternatives were screened based on technical effectiveness, physical suitability for this site, and their ability to meet the stormwater management criteria established for proposed and future development areas. The following stormwater management alternatives are recommended for implementation on the proposed development:

- **Lot grading** to be kept as flat as practical in order to slow down stormwater and encourage infiltration.
- **Roof leaders to be discharged to the ground surface** in order to slow down stormwater and encourage infiltration.
- **Grassed swales** to be used to collect rear lot drainage. Grassed swales tend to filter sediments and slow down the rate of stormwater.
- A **dry pond facility** and **oil/grit separator** on the north side of the Towpath Drain is to be constructed to provided stormwater quantity and quality controls.
- One **wet pond facility** on the south side of the Towpath Drain is to be constructed to provide stormwater quality and quantity controls.

5.0 STORMWATER MANAGEMENT PLAN

A MIDUSS model was created to assess existing and future flows generated by the proposed subdivision. The stormwater management facility was sized according to MECP Guidelines (MECP, March 2003) as follows:

5.1 Northern Stormwater Management Facility 'P10'

5.1.1 Stormwater Quality Control

To improve stormwater quality for Drainage Area A10, it is proposed a stormwater oil/grit separator provides TSS (Total Suspended Solids) removal for this type of development.

To provide MECP Enhanced Quality Improvements, the proposed Oil/Grit Separator will be designed to achieve a TSS Removal of at least 80%. The total stormwater drainage area contributing to the proposed oil/grit separator is 4.05 hectares with an overall impervious coverage of approximately 70%. The modelling for a Hydroworks unit has indicated that an HD 12 will provide 81.3% TSS overall removal and capture 99.7% of the stormwater flows. Therefore, a Hydroworks HD 12 is proposed for this site development. Output calculations for the quality assessment can be found in Appendix C.

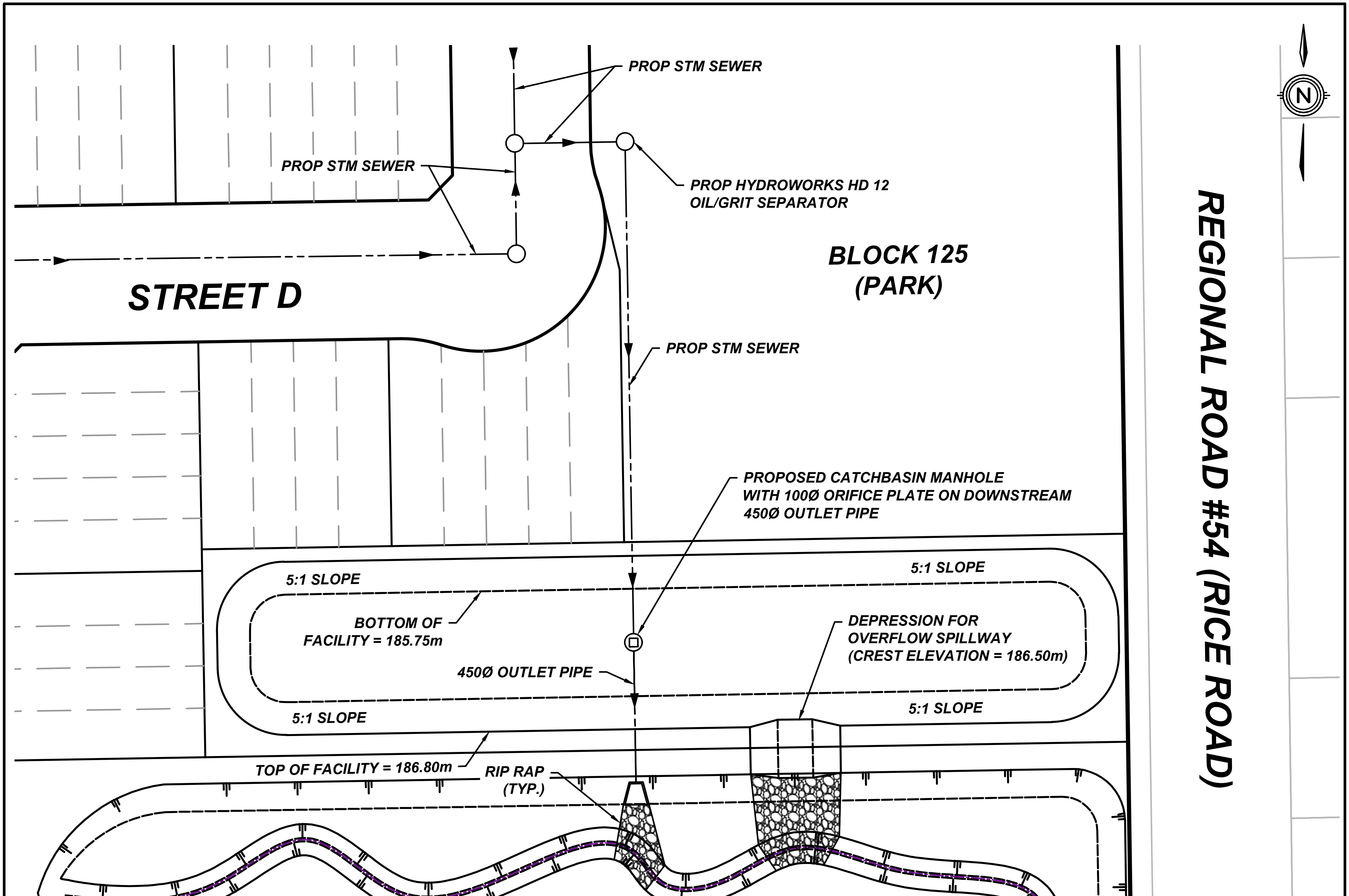
5.1.2 Stormwater Quantity Controls

As shown in Figure 5, it is proposed to construct a dry pond facility along the north of the Towpath Drain, in the eastern portion of the subject lands. It is proposed to construct a two-stage control outlet for the proposed stormwater management facility. The first stage of control consists of a control orifice located immediated upstream of the proposed storm sewer outlet to the Towpath Drain to detain the future stormwater volumes and release them slowly over an extended period of time. The second stage of control consists of a an emergency spillway to provide an outlet for greater storm events.

The proposed bottom elevation of the facility is 185.75 m with a top elevation of 186.70 m, for an active storage depth of 0.95 m and associated storage volume of 2,370 m^3.

Based on the configuration of the proposed facility, it was determined that a 100 mm diameter control orifice at an invert of 184.80 m can adequately control the future flows from the subject lands to the Towpath Drain.

Major overland flows within the northern portion of the subject lands directed to the proposed dry pond facility, and then to the Towpath Drain.



UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

416 & 509 RICE ROAD
CITY OF WELLAND
STORMWATER MANAGEMENT POND P10

DATE	2024-10-16
SCALE	1:750 m
REF No.	2200
DWG No.	FIGURE 5

Table 5 summarizes the peak inflows and outflows for the stormwater management facility along with corresponding pond elevations. Based on the MIDUSS model, the maximum wet pond elevation is 186.51 m, and an active storage volume is 1,804 m^3 for the 100-year design storm event.

Table 5. Stormwater Management Dry Pond Facility 'P10' Characteristics

Design Storm	Peak Flows (L/s)		Maximum Elevation (m)	Maximum Storage (m3)
	Future Inflow	Future Outflow		
25mm	273	23	185.94	390
2 Year	422	25	186.13	803
5 Year	497	26	186.26	1,035
10 Year	1,229	26	186.30	1,229
25 Year	0.644	27	186.41	1,531
100 Year	0.783	105	186.51	1,804

5.2 Southern Stormwater Management Facility 'P31'

5.2.1 Stormwater Quality Control

The stormwater drainage outlet for the proposed Wet Pond 'P11' is the Towpath Drain, where *Enhanced* protection will be provided. Based on Table 3.2 of SWMP & Design Manual, the Enhanced water quality storage requirement for wet pond facilities in a development with 60% impervious area is approximately 202 m^3/ha. The wet pond facility will provide stormwater quality controls for a drainage area of approximately 9.66 hectares (Areas A12 and A13) as shown in Table 6.

Table 6. SWM Facility 'P31' - Stormwater Quality Volume Calculations

Total Water Quality Volume = 9.66 ha x 202 m^3/ha = 1,951 m^3	Reference: Table 3.2, SWMP & Design Manual (MECP 2003)
Permanent Pool Volume = 9.66 ha x 162 m^3/ha = 1,565 m^3	**Extended Detention Volume** = 9.66 ha x 40 m^3/ha = 386m^3

5.1.2 Erosion Control

Using the MIDUSS hydrological model, the stormwater volume from the 25mm - 4 hour design storm event for the overall 10.33 hectare area (Areas A12 to A14) is 1,350 m^3.

The following table shows the stormwater storage volumes required using both the water quality and erosion control guidelines.

Table 7. SWM Facility 'P11' – Stormwater Quality Volume Requirements	
A. Permanent Pool Volume (m^3)	1,565 m^3
B. Extended Detention Volume (m^3)	386 m^3
C. Stormwater Volume from 25mm – 4-hour rainfall event	1,350 m^3
D. Minimum Extended Detention Volume (greater of B & C)	1,350 m^3
Total Quality and Extended Detention Volume (A + D)	**2,915 m^3**

5.1.3 Stormwater Management Facility 'P11' Configuration

As shown in Figure 6, it is proposed to construct a three-stage control outlet for the proposed stormwater management facility. The first stage of control consists of a reverse slope pipe acting as a tubular control orifice to detain the extended detention volume and release it slowly over an extended period of time. The second stage of control consists of a ditch inlet catch basin and outlet pipe which provides an outlet for flows exceeding the extended detention volume. The third stage will consist of an emergency spillway to provide an outlet for greater storm events.

The proposed bottom elevation of the facility is 183.30 m, and the permanent pool water level is proposed at 184.40 m, for a permanent water depth of 1.50 metres. The configuration of the facility provides 1,616 m^3 of permanent pool volume, which is more than the required 1,565 m^3. The proposed top of pond is at an elevation of 186.80 m which provides a total active volume of 6,222 m^3 with 5:1 side slopes.

Based on the configuration of the proposed facility, it was determined that a 100 mm diameter quality orifice at an invert of 184.80 m can provide 40 hours of extended detention for the 25mm design storm event, which has a corresponding water surface elevation of 185.31m within the proposed facility.

The proposed ditch inlet catchbasin will be constructed with the rim at an elevation of 186.10 m which will provide an extended detention volume of 3,519 m^3, which is greater than the minimum volume of 1,350 m^3 specified in Table 7.

The outflow pipe from the stormwater management facility is to be 450mm in diameter and will convey the stormwater flows from the ditch inlet to the proposed headwall structure outletting to Towpath Drain. A stage-storage-discharge relationship was determined for the facility and is included in Appendix E for reference purposes.

Major overland flows within the southern portion of the subject lands directed to the proposed wetpond facility, and then to the Towpath Drain.

A sediment forebay was included in this stormwater management facility to minimize the transport of heavy sediment from the storm sewer outlet throughout the facility and to localize maintenance activities. Calculations for the forebay sizing follow MECP Guidelines and is shown in Table 8.

Table 8. Stormwater Management Facility P11 Forebay Sizing

a) Forebay Settling Length (MOE SWMP&D, Equation 4.5)

$$Settling\ Length = \sqrt{\left(\frac{r \times Q}{V_s}\right)}$$

r =	8.4	:1	(Length:Width Ratio)
Q_p =	0.014	m^3/s	(25mm Storm Pond Discharge)
V_s =	0.0003	m/s	(Settling Velocity)

Settling Length = **19.80** **m**

b) Dispersion Length (MOE SWMP&D, Equation 4.6)

$$Dispersion\ Length = \frac{8 \times Q}{D \times V_f}$$

Q =	1.052	m^3/s	(5 Yr Stm Sew Design Inflow)
D =	1.50	m	(Depth of Perm. Pool in the Forebay)
V_f =	0.5	m/s	(Desired Velocity)

Dispersion Length = **11.22** **m**

c) Minimum Forebay Deep Zone Bottom Width (MOE SWMP&D), Equation 4.7)

$$Width = \frac{Min.Forebay\ Length}{8}$$

19.80 m (minimum required length)

Width = **2.47** **m** (minimum required width)

d) Average Velocity of Flow

$$Average\ Velocity = \frac{Q}{A}$$

Q =	0.584	m^3/s	(25mm Storm Design Inflow)
A =	10.50	m^2	(Cross Sectional Area)
D =	1.50	m	(Depth of Forebay)
W =	2.50	m	(Proposed Bottom Width)
SS =	3	:1	(Side Slopes - Minimum)

Average Velocity = **0.06** **m/s**

Is this Acceptable? **Yes** (Maximum velocity of flow = 0.15 m/s)

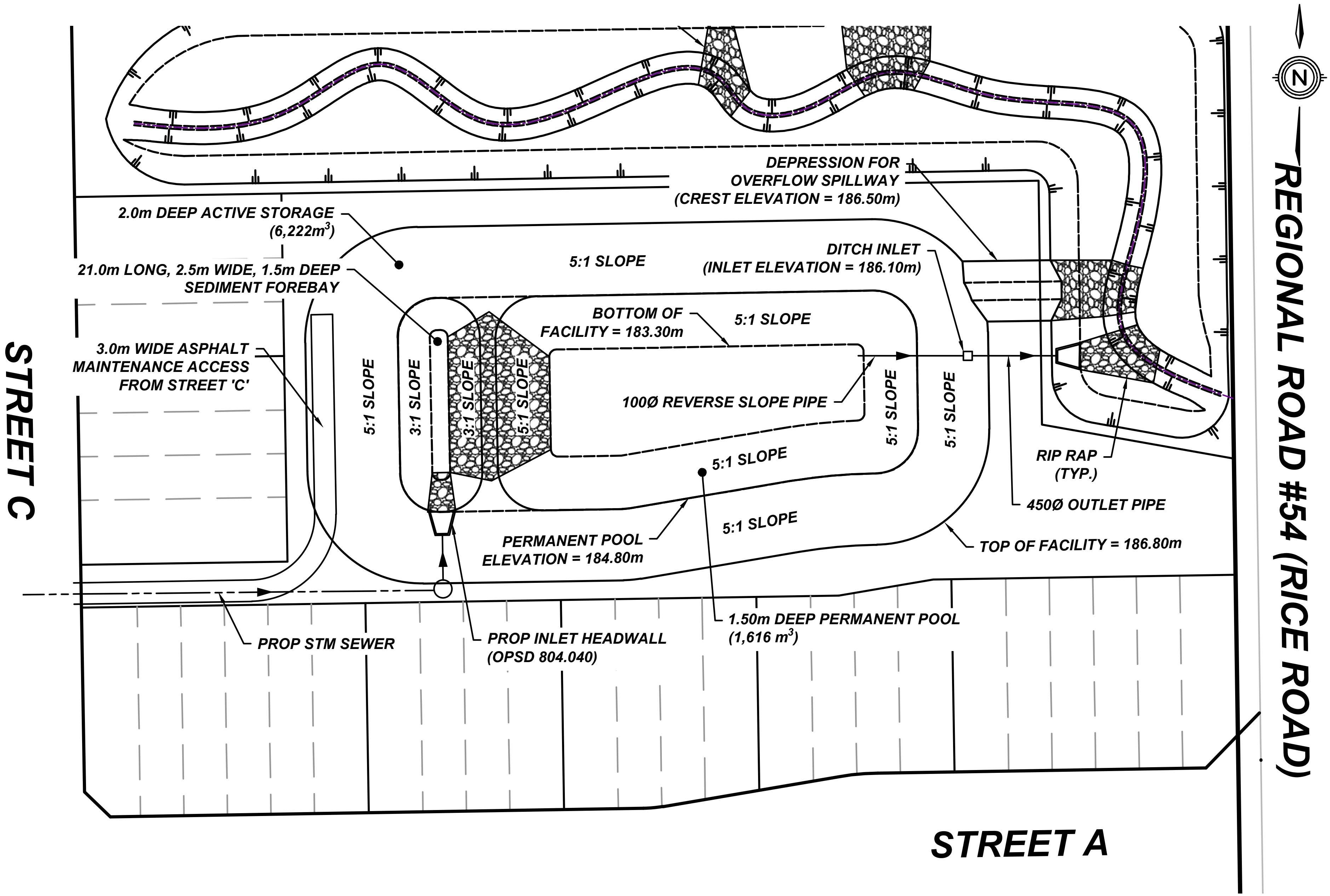
e) Cleanout Frequency

Is this Acceptable? **Yes**

L =	21.0	m	(Proposed Bottom Length)
ASL =	2.2	m^3/ha	(Annual Sediment Loading)
A =	9.66	ha	(Drainage Area)
FRC =	80	%	(Facility Removal Efficiency)
FV =	298.1	m^3	(Forebay Volume)

Cleanout Frequency = **11.2** **Years**

Is this Acceptable? **Yes** (10 Year Minimum Cleanout Frequency)



UPPER CANADA CONSULTANTS
ENGINEERS / PLANNERS

416 & 509 RICE ROAD
CITY OF WELLAND
STORMWATER MANAGEMENT POND P11

DATE	2024–10–16
SCALE	1:750 m
REF No.	2200
DWG No.	FIGURE 6

Table 9 summarizes the peak inflows and outflows for the stormwater management facility along with corresponding pond elevations. Based on the MIDUSS model, Table 9 shows the maximum wet pond elevation of 186.28 m, and an active storage volume of 4,180 m^3 for the 100-year design storm event.

Table 9. Stormwater Management Wet Pond Facility 'P11' Characteristics

Design Storm	Peak Flows (L/s)		Maximum Elevation (m)	Maximum Storage (m3)
	Future Inflow	Future Outflow		
25mm	584	14	185.31	1,163
2 Year	889	18	185.63	2,132
5 Year	1,052	20	185.81	2,641
10 Year	1,177	22	185.95	3,066
25 Year	1,367	48	186.14	3,650
100 Year	1,659	143	186.28	4,180

Table 10. SWM Facility 'P11' – MECP Quality Requirements Comparison

SWM Facility Characteristic	MECP Requirement	Provided by SWM Facility
Permanent Pool Volume (m^3) - *minimum*	1,565 (min)	1,616
Extended Detention Volume (m^3) – *minimum*	1,350 (min)	3,519
Total Quality + Detention Storage (m^3) – *minimum*	2,915 (min)	5,135
Drawdown Time (hr) – *minimum*	24 (min)	40
Forebay Length (m) – *minimum*	19.80 (min)	21.00
Forebay Width (m) – *minimum*	2.41 (min)	2.50
Average Forebay Velocity (m/s) – *maximum*	0.15 (max)	0.06
Cleanout Frequency (years) - *minimum*	10 (min)	11

As shown in Table 10, the proposed stormwater management facility configuration satisfies the quality control requirements for the associated drainage area.

5.3 Overall Stormwater Management Plan

As previously discussed, UCC has prepared a comprehensive Future conditions MIDUSS model to include all of the proposed stormwater management facilities to be constructed within the properties for which UCC is providing engineering services. The facilities included in the model are SWM Facilities P10 through P50, as shown in Figures 3 and 4.

Within properties where there are no Planning Act Applications forthcoming at the time of writing this report, that UCC is not providing engineering services, or a stormwater management alternative has not been selected, existing conditions were assumed in accordance with the Implementation Plan (see Figure 2).

As part of the Planning Act Applications on the properties where UCC is providing engineering services, separate Stormwater Management Reports will be submitted to outline the detailed calculations for each proposed facility. For the purposes of this Stormwater Management Plan, Tables 11 through 18 have been including providing the summary of the characteristics of each SWMF designed by UCC in the NWWSP Area.

5.3.1 Block 2

As shown in Figure 1, Block 2 consists of a property where UCC is providing the engineering services (450 Rice Road) and the remaining property where UCC is not providing engineering services. The same owner owns the subject lands and the 450 Rice Road property.

The proposed stormwater management facilities within the subject lands (P10 and P11) provide over-controlling for stormwater quantity such that the 450 Rice Road property does not require on-site stormwater quantity controls.

The 450 Rice Road will provide only stormwater management quality controls (Facility P20) which will be via an Oil/Grit Separator as the tributary drainage area (Areas A20 and A20a) is below 5.0 hectares. A separate SWM Plan will be submitted outlining the detailed calculations for this Block.

The adjacent lands where UCC is not providing engineering services have been assumed at existing conditions for the purposes of identifying future stormwater flows within the realigned watercourse. A separate SWM Plan will be submitted by the owner's engineering consultant addressing the future stormwater management within this property.

5.3.2 Block 3

As shown in Figure 1, Block 3 consists of lands owned by multiple owners and will include two communal wet pond SWM Facilities (P30 and P31) providing quality and quantity controls for the Areas A30 to A34. A separate SWM Plan will be submitted outlining the detailed calculations for this Block.

Table 11 to 14 below summarize the design characteristics for Facilities P30 and P31.

Table 11. Stormwater Management Wet Pond Facility 'P30' Characteristics

Design Storm	Peak Flows (L/s)		Maximum Elevation (m)	Maximum Storage (m3)
	Inflow	Outflow		
25mm	760	25	179.28	1,460
2 Year	1,210	34	179.64	2,856
5 Year	1,401	38	179.85	3,675
10 Year	1,576	42	180.03	4,365
25 Year	1,840	114	180.19	5,104
100 Year	2,246	250	180.38	5,999

Table 12. SWM Facility 'P30' – MECP Quality Requirements Comparison

SWM Facility Characteristic	MECP Requirement	Provided by SWM Facility
Permanent Pool Volume (m^3) - *minimum*	2,011 (min)	2,221
Extended Detention Volume (m^3) – *minimum*	1,924 (min)	4,649
Total Quality + Detention Storage (m^3) – *minimum*	3,935 min)	6,870
Drawdown Time (hr) – *minimum*	24 (min)	29
Forebay Length (m) – *minimum*	17.08 (min)	21.00
Forebay Width (m) – *minimum*	2.13 (min)	6.00
Average Forebay Velocity (m/s) – *maximum*	0.15 (max)	0.05
Cleanout Frequency (years) - *minimum*	10 (min)	11

Table 13. Stormwater Management Wet Pond Facility 'P31' Characteristics				
Design Storm	**Peak Flows (L/s)**		**Maximum Elevation (m)**	**Maximum Storage (m3)**
	Future Inflow	**Future Outflow**		
25mm	922	32	178.84	1,746
2 Year	1,478	43	179.20	3,116
5 Year	1,765	48	179.39	3,856
10 Year	1,983	52	179.54	4,465
25 Year	2,245	107	179.71	5,183
100 Year	2,731	221	179.88	5,982

Table 14. SWM Facility 'P31' – MECP Quality Requirements Comparison		
SWM Facility Characteristic	**MECP Requirement**	**Provided by SWM Facility**
Permanent Pool Volume (m^3) - *minimum*	2,497 (min)	2,733
Extended Detention Volume (m^3) – *minimum*	2,114 (min)	4,692
Total Quality + Detention Storage (m^3) – *minimum*	4,615 (min)	7,425
Drawdown Time (hr) – *minimum*	24 (min)	26
Forebay Length (m) – *minimum*	29.30 (min)	33
Forebay Width (m) – *minimum*	3.66 (min)	4.10
Average Forebay Velocity (m/s) – *maximum*	0.15 (max)	0.07
Cleanout Frequency (years) - *minimum*	10 (min)	10

As shown in the above tables, Facilities P30 and P31 have adequate capacity to provide stormwater management quantity and quality controls in accordance with MECP requirements and the requirements of the Implementation Plan.

5.3.3 Block 4

As shown in Figure 1, Block 4 consists of multiple properties owned by a single owner for which UCC is providing engineering services separated by a property for which there is not expected to be a future Planning Act Application submitted in the near future.

The area fronting on Rice Road will be consolidated into multiple properties that will be subject to separate applications for Site Plan Approval. The stormwater management facility characteristics for quantity control (storage) within these areas are not presently known and have therefore been included at existing conditions. Stormwater management quality controls will also be provided in accordance with the Implementation Plan.

For the area fronting onto Quaker Road, it is proposed to constuct a single communal wet pond SWM Facility (P50) to provide quality and quantity controls for Areas A52, A53, and A54 prior to discharging to the Towpath Drain.

Additionally, there is an existing catchment area within these lands that drain to the existing unnamed tributary to the Welland Recreational Canal that was constructed as part of the College Park Subdivision.

For the purposes of this Stormwater Management Plan, it was assumed that the majority of this area will convey future stormwater flows to the Towpath Drain. However, a separate SWM Plan will be submitted outlining the detailed calculations for this Block to ensure that future stormwater flows to each watercourse are controlled to existing levels.

Table 15 and 16 below summarize the design characteristics for Facility P50.

Table 15. Stormwater Management Wet Pond Facility 'P50' Characteristics

Design Storm	Peak Flows (L/s)		Maximum Elevation (m)	Maximum Storage (m3)
	Future Inflow	Future Outflow		
25mm	1,227	9	182.40	2,607
2 Year	1,923	17	182.70	4,589
5 Year	2,285	20	182.85	5,617
10 Year	2,514	21	182.96	6,474
25 Year	2,924	23	183.13	7,762
100 Year	3,539	132	183.33	9,342

Table 16. SWM Facility 'P50' – MECP Quality Requirements Comparison		
SWM Facility Characteristic	**MECP Requirement**	**Provided by SWM Facility**
Permanent Pool Volume (m^3) - *minimum*	3,287 (min)	5,743
Extended Detention Volume (m^3) – *minimum*	2,782 (min)	7,895
Total Quality + Detention Storage (m^3) – *minimum*	6,072 (min)	13,638
Drawdown Time (hr) – *minimum*	24 (min)	99
West Forebay		
Forebay Length (m) – *minimum*	12.42 (min)	18.50
Forebay Width (m) – *minimum*	1.55 (min)	3.80
Average Forebay Velocity (m/s) – *maximum*	0.15 (max)	0.04
Cleanout Frequency (years) - *minimum*	10 (min)	11
East Forebay		
Forebay Length (m) – *minimum*	6.98 (min)	18.50
Forebay Width (m) – *minimum*	0.87 (min)	3.80
Average Forebay Velocity (m/s) – *maximum*	0.15 (max)	0.03
Cleanout Frequency (years) - *minimum*	10 (min)	20

As shown in the above tables, Facility P50 has adequate capacity to provide stormwater management quantity and quality controls in accordance with MECP requirements and the requirements of the Implementation Plan.

5.3.4 Block 5

As shown in Figure 1, Block 5 consists of lands owned by multiple owners for which UCC is providing engineering services and will include a single communal wet pond SWM Facility (P40) providing quality and quantity controls for the Areas A40 to A45. A separate SWM Plan will be submitted outlining the detailed calculations for this Block.

Table 17 and 18 below summarize the design characteristics for Facility P40.

Table 17. Stormwater Management Wet Pond Facility 'P40' Characteristics				
Design Storm	**Peak Flows (L/s)**		**Maximum Elevation (m)**	**Maximum Storage (m3)**
	Future Inflow	**Future Outflow**		
25mm	1,513	41	186.59	3,005
2 Year	2,374	64	187.04	5,502
5 Year	2,832	72	187.27	6,887
10 Year	3,124	129	187.42	7,854
25 Year	3,648	198	187.60	9,121
100 Year	4,453	430	187.86	10,981

Table 18. SWM Facility 'P40' – MECP Quality Requirements Comparison		
SWM Facility Characteristic	**MECP Requirement**	**Provided by SWM Facility**
Permanent Pool Volume (m^3) - *minimum*	4,297 (min)	4,612
Extended Detention Volume (m^3) – *minimum*	3,593 (min)	7,091
Total Quality + Detention Storage (m^3) – *minimum*	7,890 (min)	11,703
Drawdown Time (hr) – *minimum*	24 (min)	30
West Forebay		
Forebay Length (m) – *minimum*	23.34 (min)	25.00
Forebay Width (m) – *minimum*	2.92 (min)	5.20
Average Forebay Velocity (m/s) – *maximum*	0.15 (max)	0.07
Cleanout Frequency (years) - *minimum*	10 (min)	10
East Forebay		
Forebay Length (m) – *minimum*	14.14 (min)	25.00
Forebay Width (m) – *minimum*	1.77 (min)	5.00
Average Forebay Velocity (m/s) – *maximum*	0.15 (max)	0.05
Cleanout Frequency (years) - *minimum*	10 (min)	10

As shown in the above tables, Facility P40 has adequate capacity to provide stormwater management quantity and quality controls in accordance with MECP requirements and the requirements of the Implementation Plan.

5.3.5 Existing and Future Peak Flow Comparison

As summarized in Table 19 below, the proposed SWM Facilities (P10 through P50) can provide adequate stormwater quantity controls to control future flows to the existing levels identified in the Implementation Plan at each identified outlet along the Towpath Drain during each storm event.

Table 19. Impacts of SWM Facilities on Peak Flows at Outlets A through D			
Design Storm	**Peak Flow (m^3/s)**		
	Existing	**Future with SWM**	**Change**
Upstream of Rice Road Culvert Crossing – Outlet A1			
2 Year	1.317	0.983	-25.4%
5 Year	1.589	1.185	-25.4%
10 Year	1.800	1.344	-25.3%
25 Year	2.099	1.583	-24.6%
100 Year	2.558	1.908	-25.4%
Downstream of Rice Road Culvert Crossing – Outlet A2			
2 Year	3.301	2.916	-11.7%
5 Year	4.194	3.502	-16.5%
10 Year	4.777	3.959	-17.1%
25 Year	5.619	4.621	-17.8%
100 Year	6.987	5.662	-19.0%
Towpath Drain Upstream of Existing PSW – Outlet B			
2 Year	3.425	3.353	-2.1%
5 Year	4.367	4.015	-8.1%
10 Year	4.977	4.532	-8.9%
25 Year	5.863	5.284	-9.9%
100 Year	7.305	6.464	-11.5%
Downstream of First Avenue Culvert Crossing – Outlet C			
2 Year	4.035	4.031	-0.1%
5 Year	5.176	4.834	-6.6%
10 Year	5.914	5.467	-7.6%
25 Year	7.005	6.402	-8.6%
100 Year	8.781	7.881	-10.2%
Upstream of Niagara Street Culvert Crossing – Outlet D			
2 Year	4.509	4.177	-7.4%
5 Year	5.835	5.016	-14.0%
10 Year	6.678	5.677	-15.0%
25 Year	7.938	6.649	-16.2%
100 Year	9.995	8.188	-18.1%

6.0 SEDIMENT AND EROSION CONTROL

Sediment controls are required during construction. The proposed extended detention facility can be used for this purpose. Therefore, the proposed constructed wet pond facility should be constructed prior to the facility for sediment control during construction.

The following additional erosion and sediment controls will also be implemented during construction:

- Install silt control fencing along the limits of construction where overland flows will flow beyond the limits of the development or into downstream watercourse.

- Re-vegetate disturbed areas as soon as possible after grading works have been completed.

- Lot grading and siltation controls plans will be provided with sediment and erosion control measures to the appropriate agencies for approval during the final design stage.

- The Stormwater management facility be cleaned after construction prior to assumption by municipality.

7.0 STORMWATER MANAGEMENT FACILITY MAINTENANCE

7.1 Oil/Grit Separator

The future owners of a Hydroworks facility are provided with a Owner's Manual, which explains the function, maintenance requirements and procedures for this facility. In addition to the Owner's Manual, a site inspection report sheet is enclosed in Appendix D for future reference and maintenance activities.

Generally, the sediment which is removed from the oil/grit separator will not be contaminated to the point that it would be classified as hazardous waste. However, the sediment should be tested to determine disposal options. The Ministry of Environment, Conservation and Parks publishes sediment disposal guidelines which should be consulted for current information pertaining to the exact parameters and acceptable levels for the various disposal options.

The function of the proposed stormwater quality protection facility, a stormwater oil/grit separator, will require maintenance on a regular basis. Areas prone to oil spills should be inspected frequently. The following is a summary of the maintenance activities required.

Regular inspections of the stormwater maintenance hole (MH) oil/grit interceptor will indicate whether maintenance is required. Post-Construction the separator should be inspected every six months during the first year to establish the rate of sediment accumulation. If the unit is subject to oil spills or runoff from unstabilized sites it should be inspected more frequently.

Points of regular inspections are as follows:

a) Is there sediment in the separator sump? The level of sediment can be measured from the surface without entry into the oil/grit separator with a Sludge Judge, Core Pro, AccuSludge or equivalent sampling device that allows the submerged sediment to be sampled. These clear samplers are equipped with a ball value that allows the inspector to get a core of the contents in the sump. Two or three should be taken in different areas of the sump to ensure samples are accurate.

b) Is there oil in the separator sump? This can usually be seen from the surface and can be physically checked by lowering a sludge Judge about 300mm below the surface of the water and removing it. If an appreciable amount of oil has been captured, an oil layer will be floating on top of the water sample. The separator should be cleaned if an appreciable amount of oil (2.5 centimeters) has been captured.

c) Is there debris or trash in the separator? This can be observed from the surface without entry into the unit. If a significant amount of trash has been captured, the unit should be cleaned to ensure it continues to operate at peak capacity.

d) Completion of the Inspection Report (a sample report is included in Appendix D for reference purposes). These reports will provide details about the operation and maintenance requirements for this type of stormwater quality device. After an evaluation period (usually 2 years) this information will be used to maximize efficiency and minimize the costs of operation and maintenance for the maintenance hole oil/grit separator.

Typically, a stormwater MH oil/grit separators are cleaned out using vacuum pumping. No entry into the unit is required for maintenance. Cleaning should occur annually or whenever the accumulation reaches 15 percent of the sediment storage and after any major spills have occurred. The manufacturer provides an installation certificate which contains th separators capacities and sediment depths requiring maintenance. Oil levels greater than 2.5 centimeters should be removed immediately by a licensed waste management firm.

The preferred option is an off-site disposal, arranged by a licensed waste management firm.

The future owners of a Hydroworks facility are provided with an Owner's Manual, which explains the function, maintenance requirements and procedures for the facility. In addition to the Owner's Manual, a site inspection report sheet is attached for future reference and maintenance activities.

7.2 Dry Pond Facility

The dry detention stormwater management facility for this development may subject to frequent wetting and deposition of sediments as a result of frequent low intensity storm events. The purpose of the dry detention area is detain peak flows to existing levels. For the initial operation period of the stormwater management facility, the required frequency of maintenance is not definitively known and many of the maintenance tasks will be performed on an 'as required' basis. For example, during the construction phase of the development there will be a greater potential for increased maintenance frequency, which depends on the maintenance of the adjacent oil/grit separator and the effectiveness of the sediment and erosion control techniques employed.

Inspections of the dry detention areas will indicate whether or not maintenance is required. Inspections should be made after every significant storm during the first two years of operation or until all development is completed to ensure the dry detention area is functioning properly. This may translate into an average of six inspections per year. Once all building activity is finalized, inspections shall be performed annually.

The following points should be addressed during inspections of the facility:

a) Standing water above the ditch inlet a day or more after a storm may indicate a blockage in the orifices in the control structure. The blockage may be caused by trash or sediment and a visual inspection would be required to determine the cause.

b) The vegetation around the dry detention area should be inspected to ensure its aesthetics. Visual inspections will indicate whether replacement of plantings are required.

c) The dry detention area has been created by excavating a detention area and the integrity of the embankment should be periodically checked to ensure that the side slopes have not sloughed.

Trash removal is an integral part of maintenance and an annual cleanup, usually in the spring, is a minimum requirement. After this, trash removal is performed on an as required basis on observation of trash build-up during inspections.

Grass cutting is a maintenance activity that is done solely for aesthetic purposes. It is recommended that grass cutting be limited to the upper embankment areas. It should b note that municipal by-laws may require regular grass maintenance for weed control

7.3 Wet Pond Facility

Maintenance is a necessary and important aspect of urban stormwater quality and quantity measures such as constructed wetlands. Many pollutants (i.e. nutrients, metals, bacteria, etc.) bind to sediment and therefore removal of sediment on a scheduled basis is required.

The wet pond for this development is subject to frequent wetting and deposition of sediments as a result of frequent low intensity storm event. The purpose of the wet pond is to improve post development sediment and contaminant loadings by detaining the 'first flush' flow for a 24 hour period. For the initial operation period of the stormwater management facility, the required frequency of maintenance is not definitively known and many of the maintenance tasks will be performed on an 'as required' basis. For example, during the home construction phase of the development there will be a greater potential for increased maintenance frequency, which depends on the effectiveness of sediment and erosion control techniques employed.

Inspections of the wet pond will indicate whether or not maintenance is required. Inspections should be made after every significant storm during the first two years of operation or until all development is completed to ensure the wet pond is functioning properly. This may translate into an average of six inspections per year. Once all building activity is finalized, inspections shall be performed annually. The following points should be addressed during inspections of the facility.

a) Standing water above the inlet storm sewer invert a day or more after a storm may indicate a blockage in the reverse slope pipe or orifice. The blockage may be caused by trash or sediment and a visual inspection would be required to determine the cause.

b) The vegetation around the wet pond should be inspected to ensure its function and aesthetics. Visual inspections will indicate whether replacement of plantings are required. A decline in vegetation habitat may indicate that other aspects of the constructed wet pond are operating improperly, such as the detention times may be inadequate or excessive.

c) The accumulation of sediment and debris at the wet pond inlet sediment forebay or around the high water line of the wet pond should be inspected. This will indicate the need for sediment removal or debris clean up.

d) The wet pond has been created by excavating a detention area. The integrity of the embankments should be periodically checked to ensure that it remains watertight and the side slopes have not sloughed.

Grass cutting is a maintenance activity that is done solely for aesthetic purposes. It is recommended that grass cutting be eliminated. It should be noted that municipal by-laws may require regular grass maintenance for weed control.

Trash removal is an integral part of maintenance and an annual clean-up, usually in the spring, is a minimum requirement. After this, trash removal is performed as required basis on observation of trash build-up during inspections.

To ensure long term effectiveness, the sediment that accumulates in the forebay area should be removed periodically to ensure that sediment in not deposited throughout the facility. For sediment removal operations, typical grading/excavating equipment should be used to remove sediment from the inlet forebay and detention areas. Care should be taken to ensure that limited damage occurs to existing vegetation and habitat.

Generally, the sediment which is removed from the detention pond will not be contaminated to the point that it would be classified as hazardous waste. However, the sediment should be tested to determine the disposal options.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of this study, the following conclusions are offered:

- Infiltration techniques are not suitable for this site as the primary control facility due to the low soil infiltration rates.

- One proposed stormwater management wet pond facility and a dry pond and oil/grit separator will provide stormwater quality, quantity and erosion controls to the proposed development.

- Multiple stormwater management facilities external to the subject lands will provide stormwater quality, quantity and erosion controls for the respective catchment areas, to be addressed in separate SWM Reports as part of forthcoming Planning Act Applications.

- Various lot level vegetative stormwater management practices can be implemented to enhance stormwater quality.

- This report was prepared in accordance with the provincial guidelines contained in "Stormwater Management Planning and Design Manual, March 2003".

The above conclusions lead to the following recommendations:

- That the stormwater management criteria established in this report be accepted.

- That the wet pond facility and dry pond and Oil/Grit Separator be constructed to provide stormwater quality protection to MECP *Enhanced* Protection levels and quantity controls as outlined in this report.

- That the external SWM Facilities be constructed to the criteria established in the separately submitted SWM Reports.

- That additional lot level controls and vegetative stormwater management practices as described previously in this report be implemented.

- That sediment and erosion controls during construction as described in this report be implemented.

Respectfully Submitted,

LICENSED PROFESSIONAL ENGINEER
B. J. KAPTEYN
100509155
PROVINCE OF ONTARIO

Brendan Kapteyn, P.Eng.

APPENDICES

APPENDIX A

Existing Conditions MIDUSS Output File

```
      Output File (4.7) EX.OUT       opened 2024-04-03  15:59
      Units used are defined by G =    9.810
          24   144    10.000        are MAXDT MAXHYD & DTMIN values
      Licensee: UPPER CANADA CONSULTANTS
35    COMMENT
     4     line(s) of comment
      STORMWATER MANAGEMENT PLAN
      QUAKER ROAD
      CITY OF WELLAND
      EXISTING CONDITIONS
35    COMMENT
     3     line(s) of comment
      ***********
      25mm STORM EVENT
      ***********
 2    STORM
          1      1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    512.000      Coefficient  a
      6.000      Constant  b    (min)
       .800      Exponent  c
       .450      Fraction to peak  r
    240.000      Duration    240 min
              25.035 mm     Total depth
 3    IMPERVIOUS
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015      Manning "n"
     98.000      SCS Curve No or C
       .100      Ia/S Coefficient
       .518      Initial Abstraction
35    COMMENT
     3     line(s) of comment
      ***********
      AREA NORTH OF QUAKER
      ***********
 4    CATCHMENT
      1.000      ID No.  99999
     15.820      Area in hectares
    325.000      Length (PERV) metres
      1.000      Gradient (%)
     35.000      Per cent Impervious
    325.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .499       .000       .000       .000 c.m/s
             .098       .805       .346     C perv/imperv/total
15    ADD RUNOFF
             .499       .499       .000       .000 c.m/s
 4    CATCHMENT
      2.000      ID No.  99999
     13.570      Area in hectares
    301.000      Length (PERV) metres
      1.000      Gradient (%)
     25.000      Per cent Impervious
    301.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .309       .499       .000       .000 c.m/s
             .098       .802       .274     C perv/imperv/total
35    COMMENT
     3     line(s) of comment
      ************************
      FLOW AT RICE ROAD
      ************************
15    ADD RUNOFF
             .309       .808       .000       .000 c.m/s
 4    CATCHMENT
      3.000      ID No.  99999
     14.520      Area in hectares
    311.000      Length (PERV) metres
      1.000      Gradient (%)
     35.000      Per cent Impervious
    311.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .461       .808       .000       .000 c.m/s
             .098       .803       .345     C perv/imperv/total
15    ADD RUNOFF
             .461      1.269       .000       .000 c.m/s
 4    CATCHMENT
      4.000      ID No.  99999
     45.500      Area in hectares
    551.000      Length (PERV) metres
      1.000      Gradient (%)
     21.000      Per cent Impervious
    551.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .611      1.269       .000       .000 c.m/s
             .098       .804       .247     C perv/imperv/total
15    ADD RUNOFF
             .611      1.879       .000       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      ***********
      AREA SOUTH OF QUAKER
      ***********
```

```
 4    CATCHMENT
      5.000      ID No.  99999
      5.310      Area in hectares
    188.000      Length (PERV) metres
      1.000      Gradient (%)
     10.000      Per cent Impervious
    188.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .051      1.879       .000       .000 c.m/s
             .098       .806       .169     C perv/imperv/total
15    ADD RUNOFF
             .051      1.930       .000       .000 c.m/s
 4    CATCHMENT
      6.000      ID No.  99999
     43.410      Area in hectares
    538.000      Length (PERV) metres
      1.000      Gradient (%)
      9.000      Per cent Impervious
    538.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .255      1.930       .000       .000 c.m/s
             .098       .803       .162     C perv/imperv/total
35    COMMENT
     3     line(s) of comment
      ************************
      TOTAL FLOW AT FIRST AVENUE
      ************************
15    ADD RUNOFF
             .255      2.185       .000       .000 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
          0      No. of sub-reaches
             .255      2.185      2.185       .000 c.m/s
17    COMBINE
     1     Junction Node No.
             .255      2.185      2.185      2.185 c.m/s
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      ***********
      AREA SOUTH OF QUAKER
      ***********
 4    CATCHMENT
      7.000      ID No.  99999
     16.470      Area in hectares
    331.000      Length (PERV) metres
      1.000      Gradient (%)
     10.000      Per cent Impervious
    331.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .149       .000      2.185      2.185 c.m/s
             .098       .805       .169     C perv/imperv/total
15    ADD RUNOFF
             .149       .149      2.185      2.185 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
          0      No. of sub-reaches
             .149       .149       .149      2.185 c.m/s
17    COMBINE
     1     Junction Node No.
             .149       .149       .149      2.334 c.m/s
18    CONFLUENCE
     1     Junction Node No.
             .149      2.334       .149       .000 c.m/s
 4    CATCHMENT
      8.000      ID No.  99999
     42.190      Area in hectares
    530.000      Length (PERV) metres
      1.000      Gradient (%)
      9.000      Per cent Impervious
    530.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .250      2.334       .149       .000 c.m/s
             .098       .803       .162     C perv/imperv/total
35    COMMENT
     3     line(s) of comment
      ***************************
      TOTAL FLOW AT NIAGARA STREET
      ***************************
15    ADD RUNOFF
             .250      2.584       .149       .000 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .1074966E+05 c.m
14    START
     1     1=Zero; 2=Define
```

```
35     COMMENT
      3     line(s) of comment
       ***********
       2-YEAR STORM EVENT
       ***********
 2     STORM
          1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
     755.000     Coefficient  a
       8.000     Constant  b    (min)
        .789     Exponent  c
        .450     Fraction to peak  r
     240.000     Duration    240 min
              38.971 mm     Total depth
 3     IMPERVIOUS
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .015     Manning "n"
      98.000     SCS Curve No or C
        .100     Ia/S Coefficient
        .518     Initial Abstraction
35     COMMENT
      3     line(s) of comment
       ***********
       AREA NORTH OF QUAKER
       ***********
 4     CATCHMENT
       1.000     ID No.  99999
      15.820     Area in hectares
     325.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     325.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .813       .000       .149       .000 c.m/s
             .194       .859       .427     C perv/imperv/total
15     ADD RUNOFF
             .813       .813       .149       .000 c.m/s
 4     CATCHMENT
       2.000     ID No.  99999
      13.570     Area in hectares
     301.000     Length (PERV) metres
       1.000     Gradient (%)
      25.000     Per cent Impervious
     301.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .504       .813       .149       .000 c.m/s
             .194       .862       .361     C perv/imperv/total
35     COMMENT
      3     line(s) of comment
       ***********************
       FLOW AT RICE ROAD
       ***********************
15     ADD RUNOFF
             .504      1.317       .149       .000 c.m/s
 4     CATCHMENT
       3.000     ID No.  99999
      14.520     Area in hectares
     311.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     311.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .749      1.317       .149       .000 c.m/s
             .194       .861       .428     C perv/imperv/total
15     ADD RUNOFF
             .749      2.066       .149       .000 c.m/s
 4     CATCHMENT
       4.000     ID No.  99999
      45.500     Area in hectares
     551.000     Length (PERV) metres
       1.000     Gradient (%)
      21.000     Per cent Impervious
     551.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.153      2.066       .149       .000 c.m/s
             .194       .868       .336     C perv/imperv/total
15     ADD RUNOFF
            1.153      3.219       .149       .000 c.m/s
35     COMMENT
      3     line(s) of comment
       ***********
       AREA SOUTH OF QUAKER
       ***********
```

```
 4     CATCHMENT
       5.000     ID No.  99999
       5.310     Area in hectares
     188.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     188.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .082      3.219       .149       .000 c.m/s
             .194       .863       .261     C perv/imperv/total
15     ADD RUNOFF
             .082      3.301       .149       .000 c.m/s
 4     CATCHMENT
       6.000     ID No.  99999
      43.410     Area in hectares
     538.000     Length (PERV) metres
       1.000     Gradient (%)
       9.000     Per cent Impervious
     538.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .485      3.301       .149       .000 c.m/s
             .194       .868       .255     C perv/imperv/total
35     COMMENT
      3     line(s) of comment
       ***********************
       TOTAL FLOW AT FIRST AVENUE
       ***********************
15     ADD RUNOFF
             .485      3.786       .149       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0     No. of sub-reaches
             .485      3.786      3.786       .000 c.m/s
17     COMBINE
      1     Junction Node No.
             .485      3.786      3.786      3.786 c.m/s
14     START
      1     1=Zero; 2=Define
35     COMMENT
      3     line(s) of comment
       **********
       AREA SOUTH OF QUAKER
       **********
 4     CATCHMENT
       7.000     ID No.  99999
      16.470     Area in hectares
     331.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
     331.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .249       .000      3.786      3.786 c.m/s
             .194       .858       .261     C perv/imperv/total
15     ADD RUNOFF
             .249       .249      3.786      3.786 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0     No. of sub-reaches
             .249       .249       .249      3.786 c.m/s
17     COMBINE
      1     Junction Node No.
             .249       .249       .249      4.035 c.m/s
18     CONFLUENCE
      1     Junction Node No.
             .249      4.035       .249       .000 c.m/s
 4     CATCHMENT
       8.000     ID No.  99999
      42.190     Area in hectares
     530.000     Length (PERV) metres
       1.000     Gradient (%)
       9.000     Per cent Impervious
     530.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .474      4.035       .249       .000 c.m/s
             .194       .867       .255     C perv/imperv/total
35     COMMENT
      3     line(s) of comment
       ***************************
       TOTAL FLOW AT NIAGARA STREET
       ***************************
15     ADD RUNOFF
             .474      4.509       .249       .000 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .2362202E+05 c.m
14     START
      1     1=Zero; 2=Define
```

```
35     COMMENT
     3     line(s) of comment
       ***********
       5-YEAR STORM EVENT
       ***********
 2     STORM
           1       1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    830.000        Coefficient  a
      7.300        Constant  b    (min)
       .777        Exponent  c
       .450        Fraction to peak  r
    240.000        Duration    240 min
             45.874 mm     Total depth
 3     IMPERVIOUS
           1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015        Manning "n"
     98.000        SCS Curve No or C
       .100        Ia/S Coefficient
       .518        Initial Abstraction
35     COMMENT
     3     line(s) of comment
       ***********
       AREA NORTH OF QUAKER
       ***********
 4     CATCHMENT
      1.000        ID No.  99999
     15.820        Area in hectares
    325.000        Length (PERV) metres
      1.000        Gradient (%)
     35.000        Per cent Impervious
    325.000        Length (IMPERV)
       .000        %Imp. with Zero Dpth
           1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250        Manning "n"
     74.000        SCS Curve No or C
       .100        Ia/S Coefficient
      8.924        Initial Abstraction
           1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .980       .000       .249       .000 c.m/s
             .236       .880       .461     C perv/imperv/total
15     ADD RUNOFF
             .980       .980       .249       .000 c.m/s
 4     CATCHMENT
      2.000        ID No.  99999
     13.570        Area in hectares
    301.000        Length (PERV) metres
      1.000        Gradient (%)
     25.000        Per cent Impervious
    301.000        Length (IMPERV)
       .000        %Imp. with Zero Dpth
           1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250        Manning "n"
     74.000        SCS Curve No or C
       .100        Ia/S Coefficient
      8.924        Initial Abstraction
           1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .608       .980       .249       .000 c.m/s
             .236       .883       .398     C perv/imperv/total
35     COMMENT
     3     line(s) of comment
       ************************
       FLOW AT RICE ROAD
       ************************
15     ADD RUNOFF
             .608      1.589       .249       .000 c.m/s
 4     CATCHMENT
      3.000        ID No.  99999
     14.520        Area in hectares
    311.000        Length (PERV) metres
      1.000        Gradient (%)
     35.000        Per cent Impervious
    311.000        Length (IMPERV)
       .000        %Imp. with Zero Dpth
           1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250        Manning "n"
     74.000        SCS Curve No or C
       .100        Ia/S Coefficient
      8.924        Initial Abstraction
           1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .902      1.589       .249       .000 c.m/s
             .236       .882       .462     C perv/imperv/total
15     ADD RUNOFF
             .902      2.491       .249       .000 c.m/s
 4     CATCHMENT
      4.000        ID No.  99999
     45.500        Area in hectares
    551.000        Length (PERV) metres
      1.000        Gradient (%)
     21.000        Per cent Impervious
    551.000        Length (IMPERV)
       .000        %Imp. with Zero Dpth
           1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250        Manning "n"
     74.000        SCS Curve No or C
       .100        Ia/S Coefficient
      8.924        Initial Abstraction
           1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.602      2.491       .249       .000 c.m/s
             .236       .885       .372     C perv/imperv/total
15     ADD RUNOFF
            1.602      4.093       .249       .000 c.m/s
35     COMMENT
     3     line(s) of comment
       ***********
       AREA SOUTH OF QUAKER
       ***********
 4     CATCHMENT
      5.000        ID No.  99999
      5.310        Area in hectares
    188.000        Length (PERV) metres
      1.000        Gradient (%)
     10.000        Per cent Impervious
    188.000        Length (IMPERV)
       .000        %Imp. with Zero Dpth
           1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250        Manning "n"
     74.000        SCS Curve No or C
       .100        Ia/S Coefficient
      8.924        Initial Abstraction
           1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .101      4.093       .249       .000 c.m/s
             .236       .875       .300     C perv/imperv/total
15     ADD RUNOFF
             .101      4.194       .249       .000 c.m/s
 4     CATCHMENT
      6.000        ID No.  99999
     43.410        Area in hectares
    538.000        Length (PERV) metres
      1.000        Gradient (%)
      9.000        Per cent Impervious
    538.000        Length (IMPERV)
       .000        %Imp. with Zero Dpth
           1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250        Manning "n"
     74.000        SCS Curve No or C
       .100        Ia/S Coefficient
      8.924        Initial Abstraction
           1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .676      4.194       .249       .000 c.m/s
             .236       .885       .294     C perv/imperv/total
35     COMMENT
     3     line(s) of comment
       ************************
       TOTAL FLOW AT FIRST AVENUE
       ************************
15     ADD RUNOFF
             .676      4.870       .249       .000 c.m/s
 9     ROUTE
       .000        Conduit Length
       .000        No Conduit defined
       .000        Zero lag
       .000        Beta weighting factor
       .000        Routing timestep
           0       No. of sub-reaches
             .676      4.870      4.870       .000 c.m/s
17     COMBINE
     1     Junction Node No.
             .676      4.870      4.870      4.870 c.m/s
14     START
     1     1=Zero; 2=Define
35     COMMENT
     3     line(s) of comment
       ***********
       AREA SOUTH OF QUAKER
       ***********
 4     CATCHMENT
      7.000        ID No.  99999
     16.470        Area in hectares
    331.000        Length (PERV) metres
      1.000        Gradient (%)
     10.000        Per cent Impervious
    331.000        Length (IMPERV)
       .000        %Imp. with Zero Dpth
           1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250        Manning "n"
     74.000        SCS Curve No or C
       .100        Ia/S Coefficient
      8.924        Initial Abstraction
           1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .306       .000      4.870      4.870 c.m/s
             .236       .880       .300     C perv/imperv/total
15     ADD RUNOFF
             .306       .306      4.870      4.870 c.m/s
 9     ROUTE
       .000        Conduit Length
       .000        No Conduit defined
       .000        Zero lag
       .000        Beta weighting factor
       .000        Routing timestep
           0       No. of sub-reaches
             .306       .306       .306      4.870 c.m/s
17     COMBINE
     1     Junction Node No.
             .306       .306       .306      5.176 c.m/s
18     CONFLUENCE
     1     Junction Node No.
             .306      5.176       .306       .000 c.m/s
 4     CATCHMENT
      8.000        ID No.  99999
     42.190        Area in hectares
    530.000        Length (PERV) metres
      1.000        Gradient (%)
      9.000        Per cent Impervious
    530.000        Length (IMPERV)
       .000        %Imp. with Zero Dpth
           1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250        Manning "n"
     74.000        SCS Curve No or C
       .100        Ia/S Coefficient
      8.924        Initial Abstraction
           1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .659      5.176       .306       .000 c.m/s
             .236       .885       .294     C perv/imperv/total
35     COMMENT
     3     line(s) of comment
       ***************************
       TOTAL FLOW AT NIAGARA STREET
       ***************************
15     ADD RUNOFF
             .659      5.835       .306       .000 c.m/s
27     HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
       Volume  =  .3122033E+05 c.m
14     START
     1     1=Zero; 2=Define
```

```
35     COMMENT
      3     line(s) of comment
       ***********
       10-YEAR STORM EVENT
       ***********
 2     STORM
           1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    860.000     Coefficient  a
      6.500     Constant  b    (min)
       .763     Exponent  c
       .450     Fraction to peak  r
    240.000     Duration    240 min
              51.471 mm     Total depth
 3     IMPERVIOUS
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015     Manning "n"
     98.000     SCS Curve No or C
       .100     Ia/S Coefficient
       .518     Initial Abstraction
35     COMMENT
      3     line(s) of comment
       ***********
       AREA NORTH OF QUAKER
       ***********
 4     CATCHMENT
      1.000     ID No.  99999
     15.820     Area in hectares
    325.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    325.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           1.110       .000       .306       .000 c.m/s
            .267       .894       .486     C perv/imperv/total
15     ADD RUNOFF
           1.110      1.110       .306       .000 c.m/s
 4     CATCHMENT
      2.000     ID No.  99999
     13.570     Area in hectares
    301.000     Length (PERV) metres
      1.000     Gradient (%)
     25.000     Per cent Impervious
    301.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .690      1.110       .306       .000 c.m/s
            .267       .896       .424     C perv/imperv/total
35     COMMENT
      3     line(s) of comment
       ************************
       FLOW AT RICE ROAD
       ************************
15     ADD RUNOFF
            .690      1.800       .306       .000 c.m/s
 4     CATCHMENT
      3.000     ID No.  99999
     14.520     Area in hectares
    311.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    311.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           1.020      1.800       .306       .000 c.m/s
            .267       .896       .487     C perv/imperv/total
15     ADD RUNOFF
           1.020      2.820       .306       .000 c.m/s
 4     CATCHMENT
      4.000     ID No.  99999
     45.500     Area in hectares
    551.000     Length (PERV) metres
      1.000     Gradient (%)
     21.000     Per cent Impervious
    551.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           1.840      2.820       .306       .000 c.m/s
            .267       .896       .399     C perv/imperv/total
15     ADD RUNOFF
           1.840      4.660       .306       .000 c.m/s
35     COMMENT
      3     line(s) of comment
       ***********
       AREA SOUTH OF QUAKER
       ***********
```

```
 4     CATCHMENT
      5.000     ID No.  99999
      5.310     Area in hectares
    188.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
    188.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .117      4.660       .306       .000 c.m/s
            .267       .883       .328     C perv/imperv/total
15     ADD RUNOFF
            .117      4.777       .306       .000 c.m/s
 4     CATCHMENT
      6.000     ID No.  99999
     43.410     Area in hectares
    538.000     Length (PERV) metres
      1.000     Gradient (%)
      9.000     Per cent Impervious
    538.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .784      4.777       .306       .000 c.m/s
            .267       .896       .323     C perv/imperv/total
35     COMMENT
      3     line(s) of comment
       ************************
       TOTAL FLOW AT FIRST AVENUE
       ************************
15     ADD RUNOFF
            .784      5.561       .306       .000 c.m/s
 9     ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
           0     No. of sub-reaches
            .784      5.561      5.561       .000 c.m/s
17     COMBINE
      1     Junction Node No.
            .784      5.561      5.561      5.561 c.m/s
14     START
      1     1=Zero; 2=Define
35     COMMENT
      3     line(s) of comment
       ***********
       AREA SOUTH OF QUAKER
       ***********
 4     CATCHMENT
      7.000     ID No.  99999
     16.470     Area in hectares
    331.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
    331.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .353       .000      5.561      5.561 c.m/s
            .267       .894       .329     C perv/imperv/total
15     ADD RUNOFF
            .353       .353      5.561      5.561 c.m/s
 9     ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
           0     No. of sub-reaches
            .353       .353       .353      5.561 c.m/s
17     COMBINE
      1     Junction Node No.
            .353       .353       .353      5.914 c.m/s
18     CONFLUENCE
      1     Junction Node No.
            .353      5.914       .353       .000 c.m/s
 4     CATCHMENT
      8.000     ID No.  99999
     42.190     Area in hectares
    530.000     Length (PERV) metres
      1.000     Gradient (%)
      9.000     Per cent Impervious
    530.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .764      5.914       .353       .000 c.m/s
            .267       .896       .323     C perv/imperv/total
35     COMMENT
      3     line(s) of comment
       ***************************
       TOTAL FLOW AT NIAGARA STREET
       ***************************
15     ADD RUNOFF
            .764      6.678       .353       .000 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .3783245E+05 c.m
14     START
      1     1=Zero; 2=Define
```

```
35    COMMENT
     3    line(s) of comment
      ***********
      25-YEAR STORM EVENT
      ***********
 2    STORM
          1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    900.000     Coefficient  a
      5.200     Constant  b    (min)
       .745     Exponent  c
       .450     Fraction to peak  r
    240.000     Duration    240 min
               59.713 mm     Total depth
 3    IMPERVIOUS
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015     Manning "n"
     98.000     SCS Curve No or C
       .100     Ia/S Coefficient
       .518     Initial Abstraction
35    COMMENT
     3    line(s) of comment
      ***********
      AREA NORTH OF QUAKER
      ***********
 4    CATCHMENT
      1.000     ID No.  99999
     15.820     Area in hectares
    325.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    325.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.306       .000       .353       .000 c.m/s
             .308       .910       .519     C perv/imperv/total
15    ADD RUNOFF
            1.306      1.306       .353       .000 c.m/s
 4    CATCHMENT
      2.000     ID No.  99999
     13.570     Area in hectares
    301.000     Length (PERV) metres
      1.000     Gradient (%)
     25.000     Per cent Impervious
    301.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .793      1.306       .353       .000 c.m/s
             .308       .910       .459     C perv/imperv/total
35    COMMENT
     3    line(s) of comment
      ************************
      FLOW AT RICE ROAD
      ************************
15    ADD RUNOFF
             .793      2.099       .353       .000 c.m/s
 4    CATCHMENT
      3.000     ID No.  99999
     14.520     Area in hectares
    311.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    311.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.164      2.099       .353       .000 c.m/s
             .308       .910       .519     C perv/imperv/total
15    ADD RUNOFF
            1.164      3.263       .353       .000 c.m/s
 4    CATCHMENT
      4.000     ID No.  99999
     45.500     Area in hectares
    551.000     Length (PERV) metres
      1.000     Gradient (%)
     21.000     Per cent Impervious
    551.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            2.211      3.263       .353       .000 c.m/s
             .308       .907       .434     C perv/imperv/total
15    ADD RUNOFF
            2.211      5.473       .353       .000 c.m/s
35    COMMENT
     3    line(s) of comment
      ***********
      AREA SOUTH OF QUAKER
      ***********
 4    CATCHMENT
      5.000     ID No.  99999
      5.310     Area in hectares
    188.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
    188.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .146      5.473       .353       .000 c.m/s
             .308       .892       .367     C perv/imperv/total
15    ADD RUNOFF
             .146      5.619       .353       .000 c.m/s
 4    CATCHMENT
      6.000     ID No.  99999
     43.410     Area in hectares
    538.000     Length (PERV) metres
      1.000     Gradient (%)
      9.000     Per cent Impervious
    538.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .957      5.619       .353       .000 c.m/s
             .308       .906       .362     C perv/imperv/total
35    COMMENT
     3    line(s) of comment
      ************************
      TOTAL FLOW AT FIRST AVENUE
      ************************
15    ADD RUNOFF
             .957      6.576       .353       .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
             .957      6.576      6.576       .000 c.m/s
17    COMBINE
     1    Junction Node No.
             .957      6.576      6.576      6.576 c.m/s
14    START
     1    1=Zero; 2=Define
35    COMMENT
     3    line(s) of comment
      ***********
      AREA SOUTH OF QUAKER
      ***********
 4    CATCHMENT
      7.000     ID No.  99999
     16.470     Area in hectares
    331.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
    331.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .429       .000      6.576      6.576 c.m/s
             .308       .909       .369     C perv/imperv/total
15    ADD RUNOFF
             .429       .429      6.576      6.576 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
             .429       .429       .429      6.576 c.m/s
17    COMBINE
     1    Junction Node No.
             .429       .429       .429      7.005 c.m/s
18    CONFLUENCE
     1    Junction Node No.
             .429      7.005       .429       .000 c.m/s
 4    CATCHMENT
      8.000     ID No.  99999
     42.190     Area in hectares
    530.000     Length (PERV) metres
      1.000     Gradient (%)
      9.000     Per cent Impervious
    530.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .933      7.005       .429       .000 c.m/s
             .308       .906       .362     C perv/imperv/total
35    COMMENT
     3    line(s) of comment
      ***************************
      TOTAL FLOW AT NIAGARA STREET
      ***************************
15    ADD RUNOFF
             .933      7.938       .429       .000 c.m/s
27    HYDROGRAPH DISPLAY
     5    is # of Hyeto/Hydrograph chosen
      Volume  =  .4820893E+05 c.m
14    START
     1    1=Zero; 2=Define
```

```
35     COMMENT
     3     line(s) of comment
       *************
       100-YEAR STORM EVENT
       *************
 2     STORM
          1       1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
   1020.000       Coefficient  a
      4.700       Constant  b    (min)
       .731       Exponent  c
       .450       Fraction to peak  r
    240.000       Duration    240 min
              73.203 mm     Total depth
 3     IMPERVIOUS
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015       Manning "n"
     98.000       SCS Curve No or C
       .100       Ia/S Coefficient
       .518       Initial Abstraction
35     COMMENT
     3     line(s) of comment
       ***********
       AREA NORTH OF QUAKER
       ***********
 4     CATCHMENT
      1.000       ID No.  99999
     15.820       Area in hectares
    325.000       Length (PERV) metres
      1.000       Gradient (%)
     35.000       Per cent Impervious
    325.000       Length (IMPERV)
       .000       %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250       Manning "n"
     74.000       SCS Curve No or C
       .100       Ia/S Coefficient
      8.924       Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.566       .000       .429       .000 c.m/s
             .368       .924       .562     C perv/imperv/total
15     ADD RUNOFF
            1.566      1.566       .429       .000 c.m/s
 4     CATCHMENT
      2.000       ID No.  99999
     13.570       Area in hectares
    301.000       Length (PERV) metres
      1.000       Gradient (%)
     25.000       Per cent Impervious
    301.000       Length (IMPERV)
       .000       %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250       Manning "n"
     74.000       SCS Curve No or C
       .100       Ia/S Coefficient
      8.924       Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .992      1.566       .429       .000 c.m/s
             .367       .923       .506     C perv/imperv/total
35     COMMENT
     3     line(s) of comment
       ***********************
       FLOW AT RICE ROAD
       ***********************
15     ADD RUNOFF
             .992      2.558       .429       .000 c.m/s
 4     CATCHMENT
      3.000       ID No.  99999
     14.520       Area in hectares
    311.000       Length (PERV) metres
      1.000       Gradient (%)
     35.000       Per cent Impervious
    311.000       Length (IMPERV)
       .000       %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250       Manning "n"
     74.000       SCS Curve No or C
       .100       Ia/S Coefficient
      8.924       Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.440      2.558       .429       .000 c.m/s
             .367       .923       .562     C perv/imperv/total
15     ADD RUNOFF
            1.440      3.998       .429       .000 c.m/s
 4     CATCHMENT
      4.000       ID No.  99999
     45.500       Area in hectares
    551.000       Length (PERV) metres
      1.000       Gradient (%)
     21.000       Per cent Impervious
    551.000       Length (IMPERV)
       .000       %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250       Manning "n"
     74.000       SCS Curve No or C
       .100       Ia/S Coefficient
      8.924       Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            2.790      3.998       .429       .000 c.m/s
             .368       .916       .483     C perv/imperv/total
15     ADD RUNOFF
            2.790      6.789       .429       .000 c.m/s
35     COMMENT
     3     line(s) of comment
       ***********
       AREA SOUTH OF QUAKER
       ***********
 4     CATCHMENT
      5.000       ID No.  99999
      5.310       Area in hectares
    188.000       Length (PERV) metres
      1.000       Gradient (%)
     10.000       Per cent Impervious
    188.000       Length (IMPERV)
       .000       %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250       Manning "n"
     74.000       SCS Curve No or C
       .100       Ia/S Coefficient
      8.924       Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .199      6.789       .429       .000 c.m/s
             .367       .904       .421     C perv/imperv/total
15     ADD RUNOFF
             .199      6.987       .429       .000 c.m/s
 4     CATCHMENT
      6.000       ID No.  99999
     43.410       Area in hectares
    538.000       Length (PERV) metres
      1.000       Gradient (%)
      9.000       Per cent Impervious
    538.000       Length (IMPERV)
       .000       %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250       Manning "n"
     74.000       SCS Curve No or C
       .100       Ia/S Coefficient
      8.924       Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.246      6.987       .429       .000 c.m/s
             .368       .915       .417     C perv/imperv/total
35     COMMENT
     3     line(s) of comment
       ***********************
       TOTAL FLOW AT FIRST AVENUE
       ***********************
15     ADD RUNOFF
            1.246      8.233       .429       .000 c.m/s
 9     ROUTE
       .000       Conduit Length
       .000       No Conduit defined
       .000       Zero lag
       .000       Beta weighting factor
       .000       Routing timestep
          0       No. of sub-reaches
            1.246      8.233      8.233       .000 c.m/s
17     COMBINE
     1     Junction Node No.
            1.246      8.233      8.233      8.233 c.m/s
14     START
     1     1=Zero; 2=Define
35     COMMENT
     3     line(s) of comment
       ***********
       AREA SOUTH OF QUAKER
       ***********
 4     CATCHMENT
      7.000       ID No.  99999
     16.470       Area in hectares
    331.000       Length (PERV) metres
      1.000       Gradient (%)
     10.000       Per cent Impervious
    331.000       Length (IMPERV)
       .000       %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250       Manning "n"
     74.000       SCS Curve No or C
       .100       Ia/S Coefficient
      8.924       Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .548       .000      8.233      8.233 c.m/s
             .368       .925       .423     C perv/imperv/total
15     ADD RUNOFF
             .548       .548      8.233      8.233 c.m/s
 9     ROUTE
       .000       Conduit Length
       .000       No Conduit defined
       .000       Zero lag
       .000       Beta weighting factor
       .000       Routing timestep
          0       No. of sub-reaches
             .548       .548       .548      8.233 c.m/s
17     COMBINE
     1     Junction Node No.
             .548       .548       .548      8.781 c.m/s
18     CONFLUENCE
     1     Junction Node No.
             .548      8.781       .548       .000 c.m/s
 4     CATCHMENT
      8.000       ID No.  99999
     42.190       Area in hectares
    530.000       Length (PERV) metres
      1.000       Gradient (%)
      9.000       Per cent Impervious
    530.000       Length (IMPERV)
       .000       %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250       Manning "n"
     74.000       SCS Curve No or C
       .100       Ia/S Coefficient
      8.924       Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.214      8.781       .548       .000 c.m/s
             .368       .916       .417     C perv/imperv/total
35     COMMENT
     3     line(s) of comment
       ***************************
       TOTAL FLOW AT NIAGARA STREET
       ***************************
15     ADD RUNOFF
            1.214      9.995       .548       .000 c.m/s
27     HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
       Volume  =  .6645652E+05 c.m
14     START
     1     1=Zero; 2=Define
```

APPENDIX B

Stormwater Management Facility Calculations (P10)

Upper Canada Consultants
3-30 Hannover Drive
St. Catharines, ON, L2W 1A3
PROJECT NAME: **469 & 509 RICE ROAD, CITY OF WELLAND**
PROJECT NO.: **2200**

PROPOSED NORTH DRY POND CALCULATIONS (POND A10)

Outlet Orifice		**Overflow Spillway**	
Diameter (m) =	0.100	Length (m) =	5.00
Cd =	0.63	Slopes (X:1) =	20.00
Invert (m) =	184.80	Invert (m) =	186.50

Elevation	**Increment Depth (m)**	**Active Depth (m)**	**Surface Area (m2)**	**Average Surface Area (m2)**	**Increment Volume (m3)**	**Active Volume (m3)**	**Quality Orifice (m3/s)**	**Overflow Spillway (m3/s)**	**Total Outflow (m3/s)**
184.80		0.00				0	0.000	0.000	0.000
	-0.95								
185.75		0.00	1,845			0	0.021	0.000	0.021
	0.25			2,012	503				
186.00		0.25	2,179			503	0.023	0.000	0.023
	0.25			2,351	588				
186.25		0.50	2,523			1,091	0.026	0.000	0.026
	0.25			2,699	675				
186.50		0.75	2,876			1,765	0.028	0.000	0.028
	0.20			3,021	604				
186.70		0.95	3,166			2,370	0.030	1.215	1.244

Notes

1. Pipe Orifice flow is calcuated using an orifice formula on the pipe from the ditch inlet to the outlet and uses the total head on the orifice.
2. Overflow Weir flow is calculated using a trapezondial weir to convey outflow for less frequent storms through the embankment with an emergency spillway.

APPENDIX C

Hydroworks Sizing Software Output File

```
         *************************************************
         *      Storm Water Management Sizing Model      *
         *               Hydroworks, LLC                 *
         *                Version 4.4                    *
         *                                               *
         *        Continuous Simulation Program          *
         *              Based on SWMM 4.4H               *
         *              Hydroworks, LLC                  *
         *               Graham Bryant                   *
         *                2003 - 2021                    *
         *************************************************

                          Developed by

         *************************************************
         *               Hydroworks, LLC                 *
         *             Metcalf & Eddy, Inc.              *
         *            University of Florida              *
         *       Water Resources Engineers, Inc.         *
         *      (Now Camp Dresser & McKee, Inc.)         *
         *              Modified SWMM 4.4                *
         *************************************************

                  Distributed and Maintained by

         *************************************************
         *                                               *
         *                Hydroworks, LLC                *
         *                 888-290-7900                  *
         *              www.hydroworks.com               *
         *                                               *
         *************************************************

         *************************************************
         *     If any problems occur executing this      *
         *     model, contact Mr. Graham Bryant at       *
         *     Hydroworks, LLC by phone at 888-290-7900  *
         *     or by e-mail: support@hydroworks.com      *
         *************************************************

         *************************************************
         *     This model is based on EPA SWMM 4.4       *
         *  "Nature is full of infinite causes which     *
         *   have never occurred in experience" da Vinci *
         *************************************************


         ***************************************************
         * Entry made to the Rain Block                    *
         * Created by the University of Florida - 1988     *
         * Updated by Oregon State University, March 2000  *
         ***************************************************

         469 & 509 Rice Road
         City of Welland
         HydroDome Simulation

     ########################################
     #  Precipitation Block Input Commands  #
     ########################################
    Station Name.........................  St. Catherines A
    Station Location.....................  Ontario
    Station, ISTA........................    7287
    Beginning date, IYBEG (Yr/Mo/Dy)......  1971/ 1/ 1
    Ending date, IYEND (Yr/Mo/Dy).........  2005/12/31
    Minimum interevent time, MIT..........     1
    Number of ranked storms, NPTS.........    10
    NWS format, IFORM (See text)..........     1
    Print storm summary, ISUM (O-No 1-Yes)     0
    Print all rainfall, IYEAR (O-No 1-Yes)     0
    Save storm event data on NSCRAT(1)....     0
    (IFILE =0 -Do not save, =1 -Save data)
    IDECID 0 - Create interface file
           1 - Create file and analyze
           2 - Synoptic analysis..........     2
    Plotting position parameter, A........  0.40
    Storm event statistics, NOSTAT........  1100
    KODEA (from optional group B0)........     2
     = 0, Do not include NCDC cumulative values.
     = 1, Average NCDC cumulative values.
     = 2, Use NCDC cumulative value as inst. rain.
    KODEPR (from optional group B0).......     0
     Print NCDC special codes in event summary:
     = 0, only on days with events.
     = 1, on all days with codes present.
     Codes: A = accumulated value, I = incomplete value,
            M = missing value,     O = other code present

********************************************************
*  Precipitation output created using the Rain block   *
*  Number of precipitation stations...        1        *
********************************************************
Location Station Number
-------- -------------
       1.     7287
STATION ID ON PRECIP. DATA INPUT FILE = 7287
REQUESTED STATION ID =     7287  CHECK TO BE SURE THEY MATCH.
```

```
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
Note, 15-min. data are being processed, but hourly
print-out, summaries, and statistics are based on
hourly totals only.  Data placed on interface file
are at correct 15-min. intervals.
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

###################################################
# Entry made to the Runoff Block, last updated by #
# Oregon State University, and Camp, Dresser and  #
# McKee, Inc., March 2002.                        #
###################################################
# "And wherever water goes, amoebae go along for  #
#  the ride"                      Tom Robbins     #
###################################################
Snowmelt parameter - ISNOW......................         0
Number of rain gages - NRGAG....................         1
Horton infiltration equation used - INFILM.......        2
Maximum infiltration volume is limited to RMAXINF input on  subcatchment lines.
Infiltration volume regenerates during  non rainfall periods.
Quality is simulated - KWALTY...................         1
IVAP is negative.  Evaporation will be set to zero
    during time steps with rainfall.
Read evaporation data on line(s) F1 (F2) - IVAP..        1
Hour of day at start of storm - NHR.............         1
Minute of hour at start of storm - NMN..........         1
Time TZERO at start of storm (hours)............     1.017
Use Metric units for I/O - METRIC...............         1
 ===> Ft-sec units used in all internal computations
Runoff input print control...                            0
Runoff graph plot control....                            1
Runoff output print control..                            0
Print headers every 50 lines - NOHEAD (0=yes, 1=no)      0
Print land use load percentages -LANDUPR (0=no, 1=yes)   0
Limit number of groundwater convergence messages to 10000 (if simulated)
Month, day, year of start of storm is:            1/ 1/1971
Wet time step length (seconds).......                300.
Dry time step length (seconds).......                900.
Wet/Dry time step length (seconds)...                450.
Simulation length is......                  20051231.0 Yr/Mo/Dy
Percent of impervious area with zero detention depth   25.0
Horton infiltration model being used
Rate for regeneration of infiltration = REGEN * DECAY
DECAY is read in for each subcatchment
REGEN = ........................................  0.01000

********************************************************
*   Processed Precipitation will be read from file     *
********************************************************
  #############################
  #       Data Group F1       #
  # Evaporation Rate (mm/day) #
  #############################
 JAN.  FEB.  MAR.  APR.  MAY   JUN.  JUL.  AUG.  SEP.  OCT.  NOV.  DEC.
 ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----  ----
 0.00  0.00  0.00  2.54  2.54  3.81  3.81  3.81  2.54  2.54  0.00  0.00

*********************************************************
*       C H A N N E L  A N D  P I P E  D A T A          *
*********************************************************
Input  NAMEG:     Drains                       Invert  L Side   R Side  Intial     Max  Mann-   Full
equen  Channel      to     Channel  Width  Length   Slope   Slope    Slope   Depth   Depth   ings   Flow
umber    ID #     NGTO:     Type     (m)    (m)     (m/m)   (m/m)    (m/m)    (m)     (m)    "N"   (cms)
-----  ------------------ -------- ------ -------  ------- -------- ------- ------- ------- -----  -----
  1        201        200   Dummy     0.0     0.0   0.0000   0.0000  0.0000     0.0     0.0  0.0000 0.00E+00

 **************************************************
 *        S U B C A T C H M E N T  D A T A        *
 **************************************************
*NOTE. SEE LATER TABLE FOR OPTIONAL SUBCATCHMENT PARAMETERS*
      SUBCATCH-  CHANNEL      WIDTH    AREA  PERCENT    SLOPE    RESISTANCE  FACTOR    DEPRES. STORAGE(MM) INFILTRATION   DECAY RATE GAGE  MAXIMUM
       MENT NO.  OR INLET       (M)    (HA)  IMPERV.    (M/M)     IMPERV.     PERV.   IMPERV.    PERV.      RATE(MM/HR)    (1/SEC)    NO.  VOLUME
                                                                                                        MAXIMUM MINIMUM                     (MM)
 ---  --------   -------- --------- --------  -----   -------     -------  --------    ------    ------    ----   -------   -------  ------ -------
  1        300        200   142.30     4.05  70.00    0.0200       0.015     0.250     0.510     5.080    63.50   10.16    0.00055     1  101.60000
TOTAL NUMBER OF SUBCATCHMENTS...           1
TOTAL TRIBUTARY AREA (HECTARES).        4.05
IMPERVIOUS AREA (HECTARES)......        2.84
PERVIOUS AREA (HECTARES)........        1.22
TOTAL WIDTH (METERS)............      142.30
PERCENT IMPERVIOUSNESS..........       70.00

********************************************************
*     G R O U N D W A T E R   I N P U T   D A T A      *
********************************************************
    SUB-     CHANNEL     ========== E L E V A T I O N S ========  =========== F L O W   C O N S T A N T S ============
    CATCH        OR       GROUND  BOTTOM   STAGE     BC      TW       A1         B1         A2          B2         A3
    NUMBER     INLET       (M)     (M)      (M)     (M)     (M) (MM/HR-M^B1)         (MM/HR-M^B2)         (MM/HR-M^2)
    ------     -----     ------- ------  ------  ------  ------ -----------  ------- -----------  ------- -----------
        0       602       3.05    0.00    0.00    0.61    0.61   3.484E-04    2.600   0.000E+00    1.000    0.00E+00

***********************************************************
* G R O U N D W A T E R   I N P U T   D A T A (CONTINUED) *
***********************************************************
               S O I L   P R O P E R T I E S
                       SATURATED                                          PERCOLATION      E T  P A R A M E T E R S
       SUBCAT.           HYDRAULIC  WILTING  FIELD   INITIAL     MAX. DEEP   PARAMETERS          DEPTH  FRACTION OF ET
       NO.   POROSITY CONDUCTIVITY  POINT  CAPACITY MOISTURE  PERCOLATION   HCO     PCO         OF ET  TO UPPER ZONE
                        (mm/hr)                               (mm/hr)                           (m)
      ----   ------    -------     ------  ------   ------    ----------  ------  ------      ------      ------
         0    .4000     127.000     .1500   .3000    .3000     5.080E-02   10.00    4.57        4.27        0.350
```

```
*********************************************************
*    Arrangement of Subcatchments and Channel/Pipes     *
*********************************************************
* See second subcatchment output table for connectivity *
* of subcatchment to subcatchment flows.                *
*********************************************************
   Channel
   or Pipe
       201     No Tributary Channel/Pipes
               No Tributary Subareas.....
    INLET
       200     Tributary Channel/Pipes...        201
               Tributary Subareas........        300

***********************************************************
* Hydrographs will be stored for the following   1 INLETS *
***********************************************************
           200

###################################################
#              Quality Simulation                 #
###################################################
#      General Quality Control Data Groups        #
###################################################
 Description                           Variable       Value
 -----------                           --------       -----
 Number of quality constituents.....    NQS.......         1
 Number of land uses................  JLAND.......         1
 Standard catchbasin volume.........  CBVOL.......      1.22 cubic meters
 Erosion is not simulated.........    IROS........         0
 DRY DAYS PRIOR TO START OF STORM... DRYDAY.......      3.00 DAYS
 DRY DAYS REQUIRED TO RECHARGE
 CATCHBASIN CONCENTRATION TO
 INITIAL VALUES..................... DRYBSN.......      5.00 DAYS
 DUST AND DIRT
 STREET SWEEPING EFFICIENCY......... REFFDD.......     0.300
 DAY OF YEAR ON WHICH STREET
 SWEEPING BEGINS.................... KLNBGN.......       120
 DAY OF YEAR ON WHICH STREET
 SWEEPING ENDS...................... KLNEND.......       270

###########################################
#     Land use data on data group J2      #
###########################################
                                                             LIMITING                       CLEANING  AVAIL.    DAYS SINCE
                                                             BUILDUP   BUILDUP  BUILDUP     INTERVAL  FACTOR       LAST
AND USE   BUILDUP EQUATION TYPE   FUNCTIONAL DEPENDENCE OF   QUANTITY  POWER    COEFF.      IN DAYS   FRACTION   SWEEPING
LNAME)          (METHOD)          BUILDUP PARAMETER(JACGUT)  (DDLIM)   (DDPOW)  (DDFACT)    (CLFREQ)  (AVSWP)     (DSLCL)
-------   ---------------------   -------------------------  --------  -------  --------    --------  -------   ---------
Urban De  EXPONENTIAL(1)                 AREA(1)            2.802E+01    0.500    67.250      30.000     0.300    30.000

##############################################
#     Constituent data on data group J3      #
##############################################
                               Total Su
                               --------
Constituent units........      mg/l
Type of units............          0
KALC.....................          2
Type of buildup calc.....    EXPONENTIAL(2)
KWASH....................          0
Type of washoff calc.....  POWER EXPONEN.(0)
KACGUT...................          1
Dependence of buildup....         AREA(1)
LINKUP...................          0
Linkage to snowmelt......   NO SNOW LINKAGE
Buildup param 1 (QFACT1).         28.020
Buildup param 2 (QFACT2).          0.500
Buildup param 3 (QFACT3).         67.250
Buildup param 4 (QFACT4).          0.000
Buildup param 5 (QFACT5).          0.000
Washoff power (WASHPO)...          1.100
Washoff coef. (RCOEF)....          0.086
Init catchb conc (CBFACT)        100.000
Precip. conc. (CONCRN)...          0.000
Street sweep effic (REFF)          0.300
Remove fraction (REMOVE).          0.000
1st order QDECAY, 1/day..          0.000
Land use number..........              1

*************************************************
* Constant Groundwater Quality Concentration(s) *
*************************************************
 Total Susp has a concentration of..    0.0000   mg/l

************************************************
* REMOVAL FRACTIONS FOR SELECTED CHANNEL/PIPES *
* FROM J7 LINES                                *
************************************************
  CHANNEL/   CONSTITUENT
     PIPE Total Susp
---------- --------
       201     0.000
```

```
*****************************************************
*     Subcatchment surface quality on data group L1 *
*****************************************************
                                  Total   Number   Input
                         Land    Gutter     of    Loading
                 Land     Use    Length   Catch-  load/ha
            No.  Usage    No.      Km     Basins   Total Su
        ------ --------  ----   -------- --------  -------
   1       300 Urban De  1         0.28    12.00  0.0E+00
   Totals (Loads in kg or other)    0.28    12.00  0.0E+00

    ***********************
    *    DATA GROUP M1    *
    ***********************
TOTAL NUMBER OF PRINTED GUTTERS/INLETS...NPRNT..        1
NUMBER OF TIME STEPS BETWEEN PRINTINGS..INTERV..        0
STARTING AND STOPPING PRINTOUT DATES............        0        0

    ***********************
    *    DATA GROUP M3    *
    ***********************
CHANNEL/INLET PRINT DATA GROUPS......       -200

          ******************************************
          * Rainfall from Nat. Weather Serv. file  *
          * in units of hundredths of an inch      *
          ******************************************
Rainfall Station    St. Catherines A
State/Province      Ontario
Rainfall Depth Summary (mm)
```

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1971.	31.	0.	0.	0.	0.	0.	126.	93.	52.	60.	29.	0.	391.
1972.	0.	0.	0.	47.	65.	100.	39.	115.	63.	90.	1.	0.	521.
1973.	0.	0.	0.	103.	77.	71.	53.	29.	63.	139.	0.	0.	534.
1974.	0.	0.	0.	67.	105.	62.	50.	31.	74.	37.	110.	0.	536.
1975.	0.	0.	0.	0.	0.	94.	78.	76.	73.	56.	59.	6.	442.
1976.	0.	0.	0.	119.	136.	87.	101.	60.	72.	73.	13.	1.	662.
1977.	0.	0.	0.	94.	29.	69.	57.	150.	230.	71.	0.	1.	701.
1978.	0.	0.	0.	72.	43.	72.	43.	86.	156.	95.	0.	0.	567.
1979.	0.	0.	0.	84.	92.	33.	91.	88.	84.	129.	71.	0.	673.
1980.	0.	0.	0.	81.	39.	122.	60.	32.	79.	96.	45.	0.	554.
1981.	0.	0.	0.	91.	71.	106.	122.	61.	123.	91.	84.	0.	749.
1982.	0.	0.	0.	28.	65.	97.	36.	66.	82.	25.	143.	0.	544.
1983.	0.	0.	0.	78.	100.	65.	55.	106.	75.	122.	92.	0.	694.
1984.	0.	0.	0.	31.	113.	136.	19.	51.	144.	24.	44.	0.	562.
1985.	0.	0.	67.	32.	52.	64.	40.	94.	42.	109.	0.	1.	501.
1986.	0.	0.	0.	93.	113.	60.	85.	83.	98.	80.	43.	65.	719.
1987.	0.	2.	11.	77.	42.	80.	122.	97.	99.	71.	94.	34.	730.
1988.	0.	0.	41.	71.	42.	21.	110.	82.	70.	68.	75.	5.	585.
1989.	0.	0.	13.	63.	137.	108.	36.	45.	89.	73.	84.	0.	647.
1990.	0.	2.	38.	99.	124.	44.	68.	95.	56.	112.	96.	0.	735.
1991.	0.	0.	86.	124.	67.	31.	85.	57.	79.	64.	61.	28.	682.
1992.	0.	0.	29.	127.	56.	92.	185.	116.	77.	47.	103.	38.	869.
1993.	3.	0.	7.	83.	56.	86.	32.	61.	71.	92.	80.	38.	610.
1994.	0.	0.	44.	88.	105.	124.	48.	77.	117.	15.	0.	15.	633.
1995.	112.	23.	16.	48.	37.	60.	123.	66.	8.	137.	94.	0.	724.
1998.	0.	0.	0.	0.	51.	54.	64.	29.	9.	0.	1.	0.	207.
1999.	0.	0.	0.	79.	59.	35.	61.	58.	116.	78.	0.	0.	487.
2000.	0.	0.	0.	123.	134.	216.	51.	0.	0.	0.	10.	0.	534.
2001.	0.	0.	0.	56.	88.	45.	25.	30.	81.	129.	0.	0.	454.
2002.	0.	0.	0.	73.	104.	64.	53.	49.	52.	65.	8.	0.	468.
2003.	0.	0.	0.	10.	163.	77.	81.	64.	67.	73.	2.	0.	537.
2004.	0.	0.	0.	131.	126.	99.	115.	40.	88.	17.	0.	0.	616.
2005.	0.	0.	0.	38.	42.	78.	53.	120.	112.	0.	0.	0.	443.

Total Rainfall Depth for Simulation Period   19310. (mm)

Rainfall Intensity Analysis (mm/hr)

(mm/hr)	(#)	(%)	(mm)	(%)
2.50	21481	74.6	6454.	33.4
5.00	3585	12.4	3088.	16.0
7.50	1973	6.8	2886.	14.9
10.00	575	2.0	1233.	6.4
12.50	389	1.4	1070.	5.5
15.00	194	0.7	660.	3.4
17.50	210	0.7	846.	4.4
20.00	66	0.2	306.	1.6
22.50	92	0.3	487.	2.5
25.00	39	0.1	232.	1.2
27.50	37	0.1	246.	1.3
30.00	34	0.1	245.	1.3
32.50	29	0.1	228.	1.2
35.00	5	0.0	42.	0.2
37.50	10	0.0	90.	0.5
40.00	10	0.0	97.	0.5
42.50	12	0.0	124.	0.6
45.00	9	0.0	99.	0.5
47.50	1	0.0	12.	0.1
50.00	3	0.0	37.	0.2
>50.00	49	0.2	829.	4.3

Total # of Intensities 28803

```
Daily Rainfall Depth Analysis (mm)
  (mm)    (#)      (%)      (mm)      (%)
  2.50   1077     38.9     1247.      6.5
  5.00    507     18.3     1850.      9.6
  7.50    326     11.8     2006.     10.4
 10.00    226      8.2     1958.     10.1
 12.50    150      5.4     1672.      8.7
 15.00    111      4.0     1495.      7.7
 17.50    100      3.6     1620.      8.4
 20.00     67      2.4     1260.      6.5
 22.50     45      1.6      958.      5.0
 25.00     37      1.3      881.      4.6
 27.50     23      0.8      609.      3.2
 30.00     20      0.7      575.      3.0
 32.50     20      0.7      631.      3.3
 35.00     12      0.4      405.      2.1
 37.50      8      0.3      290.      1.5
 40.00      9      0.3      350.      1.8
 42.50      4      0.1      165.      0.9
 45.00      4      0.1      173.      0.9
 47.50      2      0.1       91.      0.5
 50.00      4      0.1      192.      1.0
>50.00     15      0.5      882.      4.6
Total # Days with Rain   2767

************************************************
*      End of time step DO-loop in Runoff      *
************************************************
Final Date (Mo/Day/Year)   =                 1/ 1/2006
Total number of time steps =                   2056852
Final Julian Date  =                           2006001
Final time of day  =                                1. seconds.
Final time of day  =                              0.00   hours.
Final running time =                       306816.0000   hours.
Final running time =                        12784.0000    days.

**************************************************
*     Extrapolation Summary for Watersheds       *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of OVERLND Calls      *
**************************************************
 Subcatch   # Steps   # Calls  Subcatch   # Steps   # Calls  Subcatch   # Steps   # Calls
 --------   -------   -------  --------   -------   -------  --------   -------   -------
      300   6296297   1661463

**************************************************
*     Extrapolation Summary for Channel/Pipes    *
* # Steps ==> Total Number of Extrapolated Steps *
* # Calls ==> Total Number of GUTNR Calls        *
**************************************************
Chan/Pipe   # Steps   # Calls Chan/Pipe   # Steps   # Calls Chan/Pipe   # Steps   # Calls
 --------   -------   -------  --------   -------   -------  --------   -------   -------
      201         0         0
**********************************************
*       Continuity Check for Surface Water   *
**********************************************
                                                                    Millimeters over
                                                      cubic meters  Total Basin
Total Precipitation (Rain plus Snow)                      780127.     19263.
Total Infiltration                                        233360.      5762.
Total Evaporation                                          64396.      1590.
Surface Runoff from Watersheds                            484532.     11964.
Total Water remaining in Surface Storage                       0.         0.
Infiltration over the Pervious Area...                    233360.     19207.
                              --------
Infiltration + Evaporation +
Surface Runoff + Snow removal +
Water remaining in Surface Storage +
Water remaining in Snow Cover.........                    782288.     19316.
Total Precipitation + Initial Storage.                    780127.     19263.

The error in continuity is calculated as
***************************************
* Precipitation + Initial Snow Cover  *
*       - Infiltration -              *
*Evaporation - Snow removal -         *
*Surface Runoff from Watersheds -     *
*Water in Surface Storage -           *
*Water remaining in Snow Cover        *
*-------------------------------------*
* Precipitation + Initial Snow Cover  *
***************************************
Error.................................       -0.277 Percent

**********************************************
*       Continuity Check for Channel/Pipes   *
**********************************************
                                                                    Millimeters over
                                                      cubic meters  Total Basin
Initial Channel/Pipe Storage...............                    0.         0.
Final Channel/Pipe Storage.................                    0.         0.
Surface Runoff from Watersheds.............               484532.     11964.
Baseflow...................................                    0.
Groundwater Subsurface Inflow..............                    0.         0.
Evaporation Loss from Channels.............                    0.         0.
Channel/Pipe/Inlet Outflow.................               484532.     11964.
Initial Storage + Inflow...................               484532.     11964.
Final Storage + Outflow....................               484532.     11964.
```

```
********************************************
* Final Storage + Outflow + Evaporation  - *
* Watershed Runoff - Groundwater Inflow  - *
*     Initial Channel/Pipe Storage         *
*     ---------------------------------    *
*  Final Storage + Outflow  + Evaporation  *
********************************************
Error.....................................      0.000 Percent

***************************************************
*     Continuity Check for Subsurface Water       *
***************************************************
                                                                  Millimeters over
                                                  cubic meters      Subsurface Basin
Total Infiltration                                           0.         0.
Total Upper Zone ET                                          0.         0.
Total Lower Zone ET                                          0.         0.
Total Groundwater flow                                       0.         0.
Total Deep percolation                                       0.         0.
Initial Subsurface Storage                               37032.       914.
Final Subsurface Storage                                 37032.       914.
Upper Zone ET over Pervious Area                             0.         0.
Lower Zone ET over Pervious Area                             0.         0.

******************************************
* Infiltration + Initial Storage - Final *
* Storage - Upper and Lower Zone ET -    *
* Groundwater Flow - Deep Percolation    *
* -------------------------------------- *
*     Infiltration + Initial Storage     *
******************************************
Error ..................................     0.000 Percent

                                  SUMMARY STATISTICS FOR SUBCATCHMENTS
                                  ====================================
                                                     PERVIOUS AREA     IMPERVIOUS AREA     TOTAL SUBCATCHMENT AREA
                                                  -------------------  -----------------  -------------------------
                                        TOTAL     TOTAL         PEAK               PEAK                PEAK     PEAK
               GUTTER                 SIMULATED   RUNOFF TOTAL RUNOFF    RUNOFF    RUNOFF      RUNOFF  RUNOFF   UNIT
   SUBCATCH-  OR INLET   AREA  PERCENT  RAINFALL    DEPTH LOSSES  RATE      DEPTH     RATE        DEPTH   RATE    RUNOFF
   MENT NO.     NO.     (HA)   IMPER.   (MM)       (MM)   (MM)  (CMS)      (MM)   (CMS)        (MM)   (CMS)   (MM/HR)
  ---------------------------------------------------------------------------------------------------------------------
       300        200    4.05    70.019262.47    52.776********   0.18917063.861     1.507 11960.536     1.696  152.056
          *** NOTE *** IMPERVIOUS AREA STATISTICS AGGREGATE IMPERVIOUS AREAS WITH AND WITHOUT DEPRESSION STORAGE

                                    SUMMARY STATISTICS FOR CHANNEL/PIPES
                                  ================================================
                                        MAXIMUM   MAXIMUM   MAXIMUM  MAXIMUM     TIME        LENGTH     MAXIMUM    RATIO OF  RATIO OF
            FULL     FULL      FULL    COMPUTED  COMPUTED  COMPUTED COMPUTED      OF            OF      SURCHARGE   MAX. TO  MAX. DEPTH
   CHANNEL  FLOW   VELOCITY    DEPTH    INFLOW   OUTFLOW    DEPTH   VELOCITY OCCURRENCE     SURCHARGE   VOLUME     FULL      TO FULL
    NUMBER  (CMS)    (M/S)      (M)      (CMS)    (CMS)       (M)    (M/S)     DAY   HR.      (HOUR)     (CU-M)     FLOW       DEPTH
  -------- ------------------------    ---------------------------------------------------    --------------------- -------------------
       201                                0.00                            1/ 0/1900  0.00
       200                                1.70                            8/14/1972 14.25
                                              TOTAL NUMBER OF CHANNELS/PIPES =    2
 *** NOTE ***  THE MAXIMUM FLOWS AND DEPTHS ARE CALCULATED AT THE END OF THE TIME INTERVAL

               #####################################################
               #             Runoff Quality Summary Page           #
               # If NDIM = 0 Units for:   loads    mass rates      #
               #             METRIC = 1    lb        lb/sec        #
               #             METRIC = 2    kg        kg/sec        #
               # If NDIM = 1 Loads are in units of quantity        #
               #             and mass rates are quantity/sec       #
               # If NDIM = 2 loads are in units of concentration   #
               #             times volume and mass rates have units#
               #             of concentration times volume/second  #
               #####################################################
              Total Su NDIM =  0
              METRIC =  2
                                 Total Su
                                 --------
Inputs
------
 1. INITIAL SURFACE LOAD........       88.
 2. TOTAL SURFACE BUILDUP.......    66440.
 3. INITIAL CATCHBASIN LOAD.....        1.
 4. TOTAL CATCHBASIN LOAD.......        0.
 5. TOTAL CATCHBASIN AND
    SURFACE BUILDUP (2+4).......    66440.
Remaining Loads
---------------
 6. LOAD REMAINING ON SURFACE...       34.
 7. REMAINING IN CATCHBASINS....        0.
 8. REMAINING IN CHANNEL/PIPES..        0.
Removals
--------
 9. STREET SWEEPING REMOVAL.....     5955.
10. NET SURFACE BUILDUP (2-9)...    60486.
11. SURFACE WASHOFF.............    60435.
12. CATCHBASIN WASHOFF..........        0.
13. TOTAL WASHOFF (11+12).......    60435.
14. LOAD FROM OTHER CONSTITUENTS        0.
15. PRECIPITATION LOAD..........        0.
15a.SUM SURFACE LOAD (13+14+15).    60435.
16. TOTAL GROUNDWATER LOAD......        0.
16a.TOTAL I/I LOAD.............        0.
17. NET SUBCATCHMENT LOAD
    (15a-15b-15c-15d+16+16a)....    60435.
>>Removal in channel/pipes (17a, 17b):
```

```
17a.REMOVE BY BMP FRACTION......        0.
17b.REMOVE BY 1st ORDER DECAY...        0.
18. TOTAL LOAD TO INLETS........    60436.
19. FLOW WT'D AVE.CONCENTRATION  mg/l
    (INLET LOAD/TOTAL FLOW).....      125.
Percentages
-----------
20. STREET SWEEPING (9/2).......        9.
21. SURFACE WASHOFF (11/2)......       91.
22. NET SURFACE WASHOFF(11/10)..      100.
23. WASHOFF/SUBCAT LOAD(11/17)..      100.
24. SURFACE WASHOFF/INLET LOAD
    (11/18).....................      100.
25. CATCHBASIN WASHOFF/
    SUBCATCHMENT LOAD (12/17)...        0.
26. CATCHBASIN WASHOFF/
    INLET LOAD (12/18)..........        0.
27. OTHER CONSTITUENT LOAD/
    SUBCATCHMENT LOAD (14/17)...        0.
28. INSOLUBLE FRACTION/
    INLET LOAD (14/18)..........        0.
29. PRECIPITATION/
    SUBCATCHMENT LOAD (15/17)...        0.
30. PRECIPITATION/
    INLET LOAD (15/18)..........        0.
31. GROUNDWATER LOAD/
    SUBCATCHMENT LOAD (16/17)...        0.
32. GROUNDWATER LOAD/
    INLET LOAD (16/18)..........        0.
32a.INFILTRATION/INFLOW LOAD/
    SUBCATCHMENT LOAD (16a/17)..        0.
32b.INFILTRATION/INFLOW LOAD/
    INLET LOAD (16a/18).........        0.
32c.CH/PIPE BMP FRACTION REMOVAL/
    SUBCATCHMENT LOAD (17a/17)..        0.
32d.CH/PIPE 1st ORDER DECAY REMOVAL/
    SUBCATCHMENT LOAD (17b/17)..        0.
33. INLET LOAD SUMMATION ERROR
    (18+8+6a+17a+17b-17)/17.....        0.

CAUTION. Due to method of quality routing (Users Manual, Appendix IX)
quality routing through channel/pipes is sensitive to the time step.
Large "Inlet Load Summation Errors" may result.
These can be reduced by adjusting the time step(s).
Note: surface accumulation during dry time steps at end of simulation is
not included in totals.  Buildup is only performed at beginning of
wet steps or for street cleaning.

********************************************************
*            TSS Particle Size Distribution            *
********************************************************
   Diameter    %     Specific    Settling Velocity   Critical Peclet
     (um)             Gravity       (m/s)              Number
       2.     5.0      2.65        0.000003           0.054484
       5.     5.0      2.65        0.000017           0.061150
       8.    10.0      2.65        0.000043           0.067744
      20.    15.0      2.65        0.000267           0.093400
      50.    10.0      2.65        0.001629           0.152500
      75.     5.0      2.65        0.003548           0.196250
     100.    10.0      2.65        0.006044           0.235000
     150.    15.0      2.65        0.012234           0.297500
     250.    15.0      2.65        0.026615           0.391296
     500.     5.0      2.65        0.060604           0.602917
    1000.     5.0      2.65        0.111334           0.928988

****************************************************
*                                                  *
*              Summary of TSS Removal              *
*                                                  *
****************************************************
TSS Removal based on Lab Performance Curve
 Model      Low Q Treated  High Q Treated     Runoff Treated        TSS Removed
   #           (cms)          (cms)                (%)                  (%)
 HD 4         0.570          0.570                99.7                 50.1
 HD 5         0.570          0.570                99.7                 57.2
 HD 6         0.570          0.570                99.7                 62.6
 HD 7         0.570          0.570                99.7                 66.7
 HD 8         0.570          0.570                99.7                 70.3
 HD 10        0.570          0.570                99.7                 76.4
 HD 12        0.570          0.570                99.7                 81.3
```

```
***************************************************
*                                                 *
*  Summary of Annual Flow Treatmnet & TSS Removal  *
*                                                 *
***************************************************
```

HD 4

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	110842.	110083.	1199.	544.	655.	1.	99.3	45.4
1972.	141853.	134234.	1584.	801.	783.	40.	94.6	49.3
1973.	141509.	141509.	1690.	836.	854.	0.	100.0	49.5
1974.	144458.	144022.	1773.	986.	787.	3.	99.7	55.5
1975.	123017.	123017.	1548.	738.	811.	0.	100.0	47.6
1976.	183000.	181642.	1955.	1000.	955.	12.	99.3	50.8
1977.	195902.	194171.	1900.	814.	1086.	11.	99.1	42.6
1978.	156589.	156589.	1815.	838.	977.	0.	100.0	46.2
1979.	187366.	186369.	2032.	1007.	1025.	7.	99.5	49.4
1980.	150474.	150474.	1936.	957.	979.	0.	100.0	49.4
1981.	208604.	208604.	2140.	1150.	990.	0.	100.0	53.7
1982.	147048.	147048.	1744.	944.	799.	0.	100.0	54.2
1983.	194167.	193985.	2244.	1134.	1110.	2.	99.9	50.5
1984.	155914.	155914.	1732.	840.	892.	0.	100.0	48.5
1985.	135611.	135611.	1689.	875.	815.	0.	100.0	51.8
1986.	198414.	198414.	2330.	1235.	1096.	0.	100.0	53.0
1987.	205267.	204916.	2348.	1186.	1162.	1.	99.8	50.5
1988.	164020.	164020.	1945.	1039.	906.	0.	100.0	53.4
1989.	181655.	181655.	1882.	1012.	870.	0.	100.0	53.8
1990.	205888.	205888.	2416.	1317.	1099.	0.	100.0	54.5
1991.	192861.	192861.	2224.	1153.	1071.	0.	100.0	51.9
1992.	245243.	245243.	2623.	1263.	1360.	0.	100.0	48.2
1993.	166069.	166069.	2155.	1198.	957.	0.	100.0	55.6
1994.	177635.	176860.	1806.	833.	972.	5.	99.6	46.0
1995.	207427.	207427.	2172.	1017.	1155.	0.	100.0	46.8
1998.	52279.	52279.	812.	393.	419.	0.	100.0	48.4
1999.	130058.	130058.	1672.	818.	855.	0.	100.0	48.9
2000.	151338.	151338.	1469.	608.	861.	0.	100.0	41.4
2001.	118744.	118744.	1351.	760.	592.	0.	100.0	56.2
2002.	123654.	123654.	1591.	836.	755.	0.	100.0	52.5
2003.	140924.	140924.	1630.	784.	846.	0.	100.0	48.1
2004.	169456.	169456.	1696.	818.	879.	0.	100.0	48.2
2005.	121805.	121455.	1291.	524.	768.	1.	99.7	40.5

HD 5

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	110842.	110083.	1199.	627.	573.	1.	99.3	52.2
1972.	141853.	134234.	1584.	914.	670.	40.	94.6	56.3
1973.	141509.	141509.	1690.	965.	725.	0.	100.0	57.1
1974.	144458.	144022.	1773.	1097.	676.	3.	99.7	61.7
1975.	123017.	123017.	1548.	852.	697.	0.	100.0	55.0
1976.	183000.	181642.	1955.	1124.	831.	12.	99.3	57.1
1977.	195902.	194171.	1900.	960.	940.	11.	99.1	50.2
1978.	156589.	156589.	1815.	977.	838.	0.	100.0	53.8
1979.	187366.	186369.	2032.	1146.	886.	7.	99.5	56.2
1980.	150474.	150474.	1936.	1098.	838.	0.	100.0	56.7
1981.	208604.	208604.	2140.	1295.	845.	0.	100.0	60.5
1982.	147048.	147048.	1744.	1064.	680.	0.	100.0	61.0
1983.	194167.	193985.	2244.	1290.	954.	2.	99.9	57.5
1984.	155914.	155914.	1732.	979.	753.	0.	100.0	56.5
1985.	135611.	135611.	1689.	997.	693.	0.	100.0	59.0
1986.	198414.	198414.	2330.	1391.	939.	0.	100.0	59.7
1987.	205267.	204916.	2348.	1354.	995.	1.	99.8	57.6
1988.	164020.	164020.	1945.	1182.	763.	0.	100.0	60.8
1989.	181655.	181655.	1882.	1126.	756.	0.	100.0	59.8
1990.	205888.	205888.	2416.	1489.	928.	0.	100.0	61.6
1991.	192861.	192861.	2224.	1315.	910.	0.	100.0	59.1
1992.	245243.	245243.	2623.	1447.	1176.	0.	100.0	55.2
1993.	166069.	166069.	2155.	1354.	801.	0.	100.0	62.8
1994.	177635.	176860.	1806.	955.	851.	5.	99.6	52.7
1995.	207427.	207427.	2172.	1169.	1003.	0.	100.0	53.8
1998.	52279.	52279.	812.	457.	355.	0.	100.0	56.3
1999.	130058.	130058.	1672.	943.	730.	0.	100.0	56.4
2000.	151338.	151338.	1469.	720.	749.	0.	100.0	49.0
2001.	118744.	118744.	1351.	849.	502.	0.	100.0	62.9
2002.	123654.	123654.	1591.	952.	639.	0.	100.0	59.8
2003.	140924.	140924.	1630.	908.	722.	0.	100.0	55.7
2004.	169456.	169456.	1696.	955.	741.	0.	100.0	56.3
2005.	121805.	121455.	1291.	627.	665.	1.	99.7	48.5

HD 6

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	110842.	110083.	1199.	692.	508.	1.	99.3	57.6
1972.	141853.	134234.	1584.	994.	590.	40.	94.6	61.2
1973.	141509.	141509.	1690.	1059.	631.	0.	100.0	62.7
1974.	144458.	144022.	1773.	1186.	587.	3.	99.7	66.8
1975.	123017.	123017.	1548.	936.	613.	0.	100.0	60.4
1976.	183000.	181642.	1955.	1220.	735.	12.	99.3	62.0
1977.	195902.	194171.	1900.	1072.	828.	11.	99.1	56.1
1978.	156589.	156589.	1815.	1088.	727.	0.	100.0	59.9
1979.	187366.	186369.	2032.	1262.	770.	7.	99.5	61.9
1980.	150474.	150474.	1936.	1198.	738.	0.	100.0	61.9
1981.	208604.	208604.	2140.	1399.	741.	0.	100.0	65.4
1982.	147048.	147048.	1744.	1151.	593.	0.	100.0	66.0
1983.	194167.	193985.	2244.	1403.	841.	2.	99.9	62.5
1984.	155914.	155914.	1732.	1076.	656.	0.	100.0	62.1
1985.	135611.	135611.	1689.	1087.	603.	0.	100.0	64.3
1986.	198414.	198414.	2330.	1509.	821.	0.	100.0	64.8
1987.	205267.	204916.	2348.	1483.	866.	1.	99.8	63.1
1988.	164020.	164020.	1945.	1280.	665.	0.	100.0	65.8
1989.	181655.	181655.	1882.	1211.	671.	0.	100.0	64.4
1990.	205888.	205888.	2416.	1608.	809.	0.	100.0	66.5
1991.	192861.	192861.	2224.	1429.	796.	0.	100.0	64.2
1992.	245243.	245243.	2623.	1599.	1024.	0.	100.0	61.0
1993.	166069.	166069.	2155.	1462.	693.	0.	100.0	67.8
1994.	177635.	176860.	1806.	1047.	759.	5.	99.6	57.8
1995.	207427.	207427.	2172.	1288.	884.	0.	100.0	59.3
1998.	52279.	52279.	812.	506.	306.	0.	100.0	62.3
1999.	130058.	130058.	1672.	1037.	635.	0.	100.0	62.0
2000.	151338.	151338.	1469.	816.	653.	0.	100.0	55.6
2001.	118744.	118744.	1351.	920.	431.	0.	100.0	68.1
2002.	123654.	123654.	1591.	1036.	556.	0.	100.0	65.1
2003.	140924.	140924.	1630.	1011.	619.	0.	100.0	62.0
2004.	169456.	169456.	1696.	1053.	643.	0.	100.0	62.1
2005.	121805.	121455.	1291.	700.	591.	1.	99.7	54.2

HD 7

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	110842.	110083.	1199.	748.	452.	1.	99.3	62.3
1972.	141853.	134234.	1584.	1057.	528.	40.	94.6	65.1
1973.	141509.	141509.	1690.	1130.	560.	0.	100.0	66.9
1974.	144458.	144022.	1773.	1250.	523.	3.	99.7	70.4
1975.	123017.	123017.	1548.	1002.	546.	0.	100.0	64.7
1976.	183000.	181642.	1955.	1300.	655.	12.	99.3	66.1
1977.	195902.	194171.	1900.	1158.	743.	11.	99.1	60.6
1978.	156589.	156589.	1815.	1175.	641.	0.	100.0	64.7
1979.	187366.	186369.	2032.	1348.	685.	7.	99.5	66.1
1980.	150474.	150474.	1936.	1290.	646.	0.	100.0	66.6
1981.	208604.	208604.	2140.	1483.	657.	0.	100.0	69.3
1982.	147048.	147048.	1744.	1221.	523.	0.	100.0	70.0
1983.	194167.	193985.	2244.	1496.	748.	2.	99.9	66.6
1984.	155914.	155914.	1732.	1148.	583.	0.	100.0	66.3
1985.	135611.	135611.	1689.	1160.	530.	0.	100.0	68.6
1986.	198414.	198414.	2330.	1603.	727.	0.	100.0	68.8
1987.	205267.	204916.	2348.	1578.	770.	1.	99.8	67.2
1988.	164020.	164020.	1945.	1350.	595.	0.	100.0	69.4
1989.	181655.	181655.	1882.	1291.	591.	0.	100.0	68.6
1990.	205888.	205888.	2416.	1689.	728.	0.	100.0	69.9
1991.	192861.	192861.	2224.	1513.	711.	0.	100.0	68.0
1992.	245243.	245243.	2623.	1708.	915.	0.	100.0	65.1
1993.	166069.	166069.	2155.	1537.	618.	0.	100.0	71.3
1994.	177635.	176860.	1806.	1124.	681.	5.	99.6	62.1
1995.	207427.	207427.	2172.	1385.	787.	0.	100.0	63.8
1998.	52279.	52279.	812.	543.	269.	0.	100.0	66.9
1999.	130058.	130058.	1672.	1118.	554.	0.	100.0	66.9
2000.	151338.	151338.	1469.	883.	586.	0.	100.0	60.1
2001.	118744.	118744.	1351.	973.	379.	0.	100.0	72.0
2002.	123654.	123654.	1591.	1106.	485.	0.	100.0	69.5
2003.	140924.	140924.	1630.	1080.	550.	0.	100.0	66.2
2004.	169456.	169456.	1696.	1124.	572.	0.	100.0	66.3
2005.	121805.	121455.	1291.	765.	527.	1.	99.7	59.2

HD 8

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	110842.	110083.	1199.	794.	405.	1.	99.3	66.2
1972.	141853.	134234.	1584.	1111.	474.	40.	94.6	68.4
1973.	141509.	141509.	1690.	1190.	500.	0.	100.0	70.4
1974.	144458.	144022.	1773.	1307.	466.	3.	99.7	73.6
1975.	123017.	123017.	1548.	1060.	489.	0.	100.0	68.5
1976.	183000.	181642.	1955.	1375.	580.	12.	99.3	69.9
1977.	195902.	194171.	1900.	1230.	670.	11.	99.1	64.4
1978.	156589.	156589.	1815.	1238.	577.	0.	100.0	68.2
1979.	187366.	186369.	2032.	1420.	613.	7.	99.5	69.6
1980.	150474.	150474.	1936.	1361.	575.	0.	100.0	70.3
1981.	208604.	208604.	2140.	1556.	585.	0.	100.0	72.7
1982.	147048.	147048.	1744.	1276.	468.	0.	100.0	73.2
1983.	194167.	193985.	2244.	1575.	670.	2.	99.9	70.1
1984.	155914.	155914.	1732.	1210.	522.	0.	100.0	69.8
1985.	135611.	135611.	1689.	1219.	471.	0.	100.0	72.1
1986.	198414.	198414.	2330.	1681.	650.	0.	100.0	72.1
1987.	205267.	204916.	2348.	1668.	680.	1.	99.8	71.0
1988.	164020.	164020.	1945.	1421.	524.	0.	100.0	73.1
1989.	181655.	181655.	1882.	1353.	529.	0.	100.0	71.9
1990.	205888.	205888.	2416.	1768.	649.	0.	100.0	73.1
1991.	192861.	192861.	2224.	1594.	631.	0.	100.0	71.7
1992.	245243.	245243.	2623.	1812.	811.	0.	100.0	69.1
1993.	166069.	166069.	2155.	1611.	544.	0.	100.0	74.7
1994.	177635.	176860.	1806.	1194.	612.	5.	99.6	65.9
1995.	207427.	207427.	2172.	1467.	705.	0.	100.0	67.5
1998.	52279.	52279.	812.	577.	235.	0.	100.0	71.1
1999.	130058.	130058.	1672.	1172.	500.	0.	100.0	70.1
2000.	151338.	151338.	1469.	950.	519.	0.	100.0	64.6
2001.	118744.	118744.	1351.	1015.	336.	0.	100.0	75.1
2002.	123654.	123654.	1591.	1159.	432.	0.	100.0	72.8
2003.	140924.	140924.	1630.	1145.	485.	0.	100.0	70.3
2004.	169456.	169456.	1696.	1185.	511.	0.	100.0	69.9
2005.	121805.	121455.	1291.	822.	470.	1.	99.7	63.6

HD 10

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	110842.	110083.	1199.	879.	321.	1.	99.3	73.2
1972.	141853.	134234.	1584.	1210.	375.	40.	94.6	74.5
1973.	141509.	141509.	1690.	1296.	394.	0.	100.0	76.7
1974.	144458.	144022.	1773.	1413.	359.	3.	99.7	79.6
1975.	123017.	123017.	1548.	1162.	387.	0.	100.0	75.0
1976.	183000.	181642.	1955.	1499.	456.	12.	99.3	76.2
1977.	195902.	194171.	1900.	1362.	539.	11.	99.1	71.2
1978.	156589.	156589.	1815.	1350.	465.	0.	100.0	74.4
1979.	187366.	186369.	2032.	1550.	482.	7.	99.5	76.0
1980.	150474.	150474.	1936.	1481.	454.	0.	100.0	76.5
1981.	208604.	208604.	2140.	1683.	457.	0.	100.0	78.6
1982.	147048.	147048.	1744.	1374.	370.	0.	100.0	78.8
1983.	194167.	193985.	2244.	1711.	533.	2.	99.9	76.2
1984.	155914.	155914.	1732.	1315.	417.	0.	100.0	75.9
1985.	135611.	135611.	1689.	1314.	376.	0.	100.0	77.8
1986.	198414.	198414.	2330.	1817.	513.	0.	100.0	78.0
1987.	205267.	204916.	2348.	1808.	540.	1.	99.8	77.0
1988.	164020.	164020.	1945.	1538.	407.	0.	100.0	79.0
1989.	181655.	181655.	1882.	1470.	412.	0.	100.0	78.1
1990.	205888.	205888.	2416.	1912.	505.	0.	100.0	79.1
1991.	192861.	192861.	2224.	1726.	498.	0.	100.0	77.6
1992.	245243.	245243.	2623.	1980.	643.	0.	100.0	75.5
1993.	166069.	166069.	2155.	1732.	423.	0.	100.0	80.4
1994.	177635.	176860.	1806.	1317.	488.	5.	99.6	72.8
1995.	207427.	207427.	2172.	1598.	574.	0.	100.0	73.6
1998.	52279.	52279.	812.	629.	183.	0.	100.0	77.5
1999.	130058.	130058.	1672.	1272.	401.	0.	100.0	76.0
2000.	151338.	151338.	1469.	1046.	423.	0.	100.0	71.2
2001.	118744.	118744.	1351.	1094.	257.	0.	100.0	81.0
2002.	123654.	123654.	1591.	1248.	343.	0.	100.0	78.4
2003.	140924.	140924.	1630.	1240.	391.	0.	100.0	76.0
2004.	169456.	169456.	1696.	1282.	414.	0.	100.0	75.6
2005.	121805.	121455.	1291.	905.	386.	1.	99.7	70.1

HD 12

Year	Flow Vol (m3)	Flow Treated (m3)	TSS In (kg)	TSS Rem (kg)	TSS Out (kg)	TSS Byp (kg)	Flow Treated (%)	TSS Removal (%)
1971.	110842.	110083.	1199.	940.	259.	1.	99.3	78.3
1972.	141853.	134234.	1584.	1282.	302.	40.	94.6	78.9
1973.	141509.	141509.	1690.	1377.	313.	0.	100.0	81.5
1974.	144458.	144022.	1773.	1497.	275.	3.	99.7	84.3
1975.	123017.	123017.	1548.	1242.	308.	0.	100.0	80.2
1976.	183000.	181642.	1955.	1589.	366.	12.	99.3	80.8
1977.	195902.	194171.	1900.	1459.	441.	11.	99.1	76.3
1978.	156589.	156589.	1815.	1440.	375.	0.	100.0	79.4
1979.	187366.	186369.	2032.	1648.	385.	7.	99.5	80.8
1980.	150474.	150474.	1936.	1567.	368.	0.	100.0	80.9
1981.	208604.	208604.	2140.	1782.	358.	0.	100.0	83.3
1982.	147048.	147048.	1744.	1461.	284.	0.	100.0	83.8
1983.	194167.	193985.	2244.	1821.	423.	2.	99.9	81.1
1984.	155914.	155914.	1732.	1398.	334.	0.	100.0	80.7
1985.	135611.	135611.	1689.	1397.	293.	0.	100.0	82.7
1986.	198414.	198414.	2330.	1934.	397.	0.	100.0	83.0
1987.	205267.	204916.	2348.	1918.	430.	1.	99.8	81.6
1988.	164020.	164020.	1945.	1624.	321.	0.	100.0	83.5
1989.	181655.	181655.	1882.	1565.	318.	0.	100.0	83.1
1990.	205888.	205888.	2416.	2033.	384.	0.	100.0	84.1
1991.	192861.	192861.	2224.	1835.	389.	0.	100.0	82.5
1992.	245243.	245243.	2623.	2110.	514.	0.	100.0	80.4
1993.	166069.	166069.	2155.	1828.	327.	0.	100.0	84.8
1994.	177635.	176860.	1806.	1404.	402.	5.	99.6	77.6
1995.	207427.	207427.	2172.	1717.	455.	0.	100.0	79.0
1998.	52279.	52279.	812.	667.	145.	0.	100.0	82.2
1999.	130058.	130058.	1672.	1353.	320.	0.	100.0	80.9
2000.	151338.	151338.	1469.	1118.	351.	0.	100.0	76.1
2001.	118744.	118744.	1351.	1155.	196.	0.	100.0	85.5
2002.	123654.	123654.	1591.	1325.	266.	0.	100.0	83.3
2003.	140924.	140924.	1630.	1320.	310.	0.	100.0	81.0
2004.	169456.	169456.	1696.	1367.	330.	0.	100.0	80.6
2005.	121805.	121455.	1291.	978.	313.	1.	99.7	75.7

```
****************************************************
*                                                  *
*      Summary of Toronto Rainfall Intensities     *
*                                                  *
****************************************************
Rainfall Intensity (mm/h)   Flow (L/s)     Percentage %
        1.50                  12.2           NaN
        2.25                  18.4           NaN
        3.00                  24.5           NaN
        3.75                  30.6           NaN
        4.75                  38.7           NaN
        5.75                  46.9           NaN
        8.00                  65.2           NaN
       10.00                  81.6           NaN
       15.50                 126.4           NaN
       23.25                 189.6           NaN

****************************************************
*  Summary of Quantity and Quality Results at      *
*  Location        200  INFlow in cms.             *
*  Values are instantaneous at indicated time step *
****************************************************
     Date     Time        Flow   Total Su
 Mo/Da/Year  Hr:Min       cum/s  mg/l
 ----------  -------    -------  --------
Flow wtd means.....        0.001      125.
Flow wtd std devs..        0.009       65.
Maximum value......        1.696      293.
Minimum value......        0.000        0.
Total loads........      484408.    60472.
                        Cub-Met  KILOGRAM
===> Runoff simulation ended normally.
===> SWMM 4.4    simulation ended normally.
     Always check output file for possible warning messages.
*******************************************************
*       SWMM 4.4    Simulation Date and Time Summary  *
*******************************************************
* Starting Date... October    17, 2024                *
*          Time...         11:15:47.553               *
*   Ending Date... October    17, 2024                *
*          Time...         11:15:50. 29               *
*  Elapsed Time...               0.041 minutes.       *
*  Elapsed Time...               2.476 seconds.       *
*******************************************************
```

APPENDIX D

Oil/Grit Separator Sample Inspection Report

SAMPLE INSPECTION REPORT

Owner:					
Location:					
Manhole Oil/Grit Separator:					
Type of Inspection	☐ Monthly		☐ Annually		☐ Special
Inlet/Outlet Information					
	Inlet		Outlet		
Clear of Debris	☐ Yes	☐ No	☐ Yes	☐ No	
Build Up of Sediment	☐ Yes	☐ No	☐ Yes	☐ No	
Action Taken:					
Sediment Tank Information					
A. Manhole Sump Depth:	± m from cover rim (to be as-constructed verified)				
B. Measurement from Rim to Sediment Level	m				
C. Depth of Sediment:	m (A - B)				
Note: If the measured depth of sediment is greater than **350mm** then sediment removal is required.					
Presence of Contaminants					
Oil	☐ Yes	☐ No	Depth: m		
Foam	☐ Yes	☐ No	Depth: m		
Action Taken:					
Name of Regulatory Agency			Telephone No.:		
			Transaction No.:		
Name of Licensed Waste Management Collector			Telephone No.:		
			Transaction No.:		
Owner Notification	☐ Yes	☐ No	Other:		
	Time:		Date:		
Name of Inspector:					
Signed:				Date:	

APPENDIX E

Stormwater Management Facility Calculations (P11)

Upper Canada Consultants
3-30 Hannover Drive
St. Catharines, ON, L2W 1A3
PROJECT NAME: **469 & 509 RICE ROAD, CITY OF WELLAND**
PROJECT NO.: **2200**

PROPOSED SOUTH WET POND CALCULATIONS (POND A11)

Quality Requirements
Drainage Area (ha) = 9.66
Enhanced (m3/ha) = 202
Perm Pool (m3/ha) = 162
Perm Pool Vol (m3) = 1,565
Active Vol (m3) 386
25mm MOE Volume = 1,350
Water Level Elev. = 184.80 m

Quality Orifice
Diameter (m) = 0.100
Cd = 0.63
Invert (m) = 184.80

Outlet Weir
Perimeter Length (m) = 0.60
Inlet Elevation (m) = 186.10

Overflow Spillway
Length (m) = 2.50
Slopes (X:1) = 10.00
Invert (m) = 186.50

Outflow Pipe Orifice
Diameter (m) = 0.450
Cd = 0.65
Invert (m) = 184.80
Obvert (m) = 185.25
Top of Pipe (m) = 185.35

Pond Drawdown Time Calculation (MOE, 2003)
Water Surface Elevation during 25mm Design Storm Event = 185.31
MOE Equation 4.11 Drawdown Coefficient 'C2' = 1,059
MOE Equation 4.11 Drawdown Coefficient 'C3' = 2,024
MOE Equation 4.11 Drawdown Time (h) = **40**

Elevation	Increment Depth (m)	Active Depth (m)	Surface Area (m2)	Average Surface Area (m2)	Increment Volume (m3)	Permanent Volume (m3)	Active Volume (m3)	Quality Orifice (m3/s)	Ditch Inlet (m3/s)	Max Pipe Orifice (m3/s)	Overflow Spillway (m3/s)	Total Outflow (m3/s)	Average Discharge (m3/s)
183.30		-1.50	575			0							
5:1 SLOPE	0.75			815	611								
184.05		-0.75	1,055			**611**							
5:1 SLOPE	0.75			1,339	1,005								
184.80		**0.00**	**1,624**			**1,616**							
5:1 SLOPE													
184.80		**0.00**	**2,037**				**0**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	
5:1 SLOPE	0.50			2,285	1,142								0.013
185.30		0.50	2,532				1,142	0.014	0.000	0.205	0.000	0.014	
5:1 SLOPE	0.80			2,971	2,377								0.109
186.10		1.30	3,410				3,519	0.024	0.000	0.458	0.000	0.024	
5:1 SLOPE	0.40			3,648	1,459								0.744
186.50		1.70	3,886				4,978	0.028	0.259	0.542	0.000	0.287	
5:1 SLOPE	0.30			4,148	1,244								1.104
186.80		2.00	4,410				6,222	0.030	0.599	0.597	1.324	1.922	

Notes
1. Quality Orifice flow is the orifice controlling for the 24 hour detention period and uses an orifice formula.
2. Pipe Orifice flow is calcuated using an orifice formula on the pipe from the ditch inlet to the outlet and uses the total head on the orifice.
3. Overflow Weir flow is calculated using a trapezondial weir to convey outflow for less frequent storms through the embankment with an emergency spillway.
4. Total Outflow is calculated by adding the Overflow Spillway with the lowest of Quality Orifice plus Ditch Inlet or Max Pipe Orifice.

APPENDIX F

Future Conditions MIDUSS Output File

Development Conditions with SWM

```
         Output File (4.7) 25MM.OUT     opened 2024-10-16  18:02
         Units used are defined by G =     9.810
             24   144    10.000        are MAXDT MAXHYD & DTMIN values
         Licensee: UPPER CANADA CONSULTANTS
 35      COMMENT
        4     line(s) of comment
         STORMWATER MANAGEMENT PLAN
         QUAKER ROAD
         CITY OF WELLAND
         FUTURE CONDITIONS
 35      COMMENT
        3     line(s) of comment
         ************************************************************
         25mm STORM EVENT
         ************************************************************
  2      STORM
            1      1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
      512.000      Coefficient  a
        6.000      Constant  b    (min)
         .800      Exponent  c
         .450      Fraction to peak  r
      240.000      Duration ó  240 min
                 25.035 mm     Total depth
  3      IMPERVIOUS
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .015      Manning "n"
       98.000      SCS Curve No or C
         .100      Ia/S Coefficient
         .518      Initial Abstraction
 35      COMMENT
        3     line(s) of comment
         *****************
         PROP DEVELOPMENT NORTH OF SEGMENT 1 - POND P10
         *****************
  4      CATCHMENT
       10.000      ID No.ó 99999
        4.050      Area in hectares
      164.000      Length (PERV) metres
        1.000      Gradient (%)
       70.000      Per cent Impervious
      164.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .264       .000       .000       .000 c.m/s
                .098       .806       .594     C perv/imperv/total
 15      ADD RUNOFF
                .264       .264       .000       .000 c.m/s
  4      CATCHMENT
       11.000      ID No.ó 99999
        1.000      Area in hectares
       82.000      Length (PERV) metres
        1.000      Gradient (%)
       10.000      Per cent Impervious
       82.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .009       .264       .000       .000 c.m/s
                .098       .791       .168     C perv/imperv/total
 15      ADD RUNOFF
                .009       .273       .000       .000 c.m/s
 10      POND
        6 Depth - Discharge - Volume sets
         184.800        .000          .0
         185.750       .0210         1.0
         186.000       .0230       503.0
         186.250       .0260      1091.0
         186.500       .0280      1765.0
         186.700       1.244      2370.0
         Peak Outflow    =      .023 c.m/s
         Maximum Depth   =   185.944 metres
         Maximum Storage =      390. c.m
                .009       .273       .023       .000 c.m/s
 14      START
        1     1=Zero; 2=Define
 35      COMMENT
        3     line(s) of comment
         *****************
         PROP DEVELOPMENT SOUTH OF SEGMENT 1 - POND P11
         *****************
  4      CATCHMENT
       12.000      ID No.ó 99999
        2.680      Area in hectares
      134.000      Length (PERV) metres
        1.000      Gradient (%)
       35.000      Per cent Impervious
      134.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .088       .000       .023       .000 c.m/s
                .098       .801       .344     C perv/imperv/total
 15      ADD RUNOFF
                .088       .088       .023       .000 c.m/s
  4      CATCHMENT
       13.000      ID No.ó 99999
        6.980      Area in hectares
      216.000      Length (PERV) metres
        1.000      Gradient (%)
       70.000      Per cent Impervious
      216.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .461       .088       .023       .000 c.m/s
                .098       .804       .592     C perv/imperv/total
 15      ADD RUNOFF
                .461       .549       .023       .000 c.m/s
  4      CATCHMENT
       14.000      ID No.ó 99999
         .670      Area in hectares
       67.000      Length (PERV) metres
        1.000      Gradient (%)
       60.000      Per cent Impervious
       67.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .036       .549       .023       .000 c.m/s
                .098       .798       .518     C perv/imperv/total
 15      ADD RUNOFF
                .036       .584       .023       .000 c.m/s
 27      HYDROGRAPH DISPLAY
        5     is # of Hyeto/Hydrograph chosen
         Volume  =  .1350286E+04 c.m
 10      POND
        5 Depth - Discharge - Volume sets
         184.800        .000          .0
         185.300       .0140      1142.0
         186.100       .0240      3519.0
         186.500        .287      4978.0
         186.800       1.922      6222.0
         Peak Outflow    =      .014 c.m/s
         Maximum Depth   =   185.307 metres
         Maximum Storage =     1163. c.m
                .036       .584       .014       .000 c.m/s
 14      START
        1     1=Zero; 2=Define
 35      COMMENT
        3     line(s) of comment
         **********************
         PROP DEVELOPMENT SOUTH OF QUAKER RD & WEST OF RICE RD. - PON
         **********************
  4      CATCHMENT
       40.000      ID No.ó 99999
        8.210      Area in hectares
      234.000      Length (PERV) metres
        1.000      Gradient (%)
       25.000      Per cent Impervious
      234.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .193       .000       .014       .000 c.m/s
                .098       .800       .274     C perv/imperv/total
 15      ADD RUNOFF
                .193       .193       .014       .000 c.m/s
  9      ROUTE
         .000      Conduit Length
         .000      No Conduit defined
         .000      Zero lag
         .000      Beta weighting factor
         .000      Routing timestep
            0      No. of sub-reaches
                .193       .193       .193       .000 c.m/s
 17      COMBINE
        2     Junction Node No.
                .193       .193       .193       .193 c.m/s
 14      START
        1     1=Zero; 2=Define
  4      CATCHMENT
       41.000      ID No.ó 99999
         .690      Area in hectares
       68.000      Length (PERV) metres
        1.000      Gradient (%)
       35.000      Per cent Impervious
       68.000      Length (IMPERV)
         .000      %Imp. with Zero Dpth
            1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250      Manning "n"
       74.000      SCS Curve No or C
         .100      Ia/S Coefficient
        8.924      Initial Abstraction
            1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
                .022       .000       .193       .193 c.m/s
                .098       .798       .343     C perv/imperv/total
 15      ADD RUNOFF
                .022       .022       .193       .193 c.m/s
  4      CATCHMENT
       42.000      ID No.ó 99999
```

```
      12.640      Area in hectares
     290.000      Length (PERV) metres
       1.000      Gradient (%)
      70.000      Per cent Impervious
     290.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .809       .022       .193       .193 c.m/s
             .098       .800       .590     C perv/imperv/total
 15    ADD RUNOFF
             .809       .831       .193       .193 c.m/s
  9    ROUTE
        .000      Conduit Length
        .000      No Conduit defined
        .000      Zero lag
        .000      Beta weighting factor
        .000      Routing timestep
          0       No. of sub-reaches
             .809       .831       .831       .193 c.m/s
 17    COMBINE
      2     Junction Node No.
             .809       .831       .831      1.024 c.m/s
 14    START
      1     1=Zero; 2=Define
  4    CATCHMENT
      43.000      ID No.ó 99999
        .330      Area in hectares
      47.000      Length (PERV) metres
       1.000      Gradient (%)
      35.000      Per cent Impervious
      47.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .011       .000       .831      1.024 c.m/s
             .098       .798       .343     C perv/imperv/total
 15    ADD RUNOFF
             .011       .011       .831      1.024 c.m/s
  4    CATCHMENT
      44.000      ID No.ó 99999
       6.400      Area in hectares
     207.000      Length (PERV) metres
       1.000      Gradient (%)
      70.000      Per cent Impervious
     207.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .424       .011       .831      1.024 c.m/s
             .098       .805       .593     C perv/imperv/total
 15    ADD RUNOFF
             .424       .433       .831      1.024 c.m/s
  9    ROUTE
        .000      Conduit Length
        .000      No Conduit defined
        .000      Zero lag
        .000      Beta weighting factor
        .000      Routing timestep
          0       No. of sub-reaches
             .424       .433       .433      1.024 c.m/s
 17    COMBINE
      2     Junction Node No.
             .424       .433       .433      1.457 c.m/s
 14    START
      1     1=Zero; 2=Define
 18    CONFLUENCE
      2     Junction Node No.
             .424      1.457       .433       .000 c.m/s
  4    CATCHMENT
      45.000      ID No.ó 99999
       1.030      Area in hectares
      83.000      Length (PERV) metres
       1.000      Gradient (%)
      60.000      Per cent Impervious
      83.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .056      1.457       .433       .000 c.m/s
             .098       .791       .514     C perv/imperv/total
 15    ADD RUNOFF
             .056      1.513       .433       .000 c.m/s
 27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .3593299E+04 c.m
 10    POND
      6 Depth - Discharge - Volume sets
       186.000        .000          .0
       186.800       .0550      4048.0
       187.300       .0730      7091.0
       187.500        .170      8424.0
       187.800        .257     10552.0
       188.000        .880     12094.0
       Peak Outflow    =      .041 c.m/s
       Maximum Depth   =   186.594 metres
       Maximum Storage =     3005. c.m
             .056      1.513       .041       .000 c.m/s
 14    START
      1     1=Zero; 2=Define
 35    COMMENT
      3     line(s) of comment
       ***********
       PROP DEVELOPMENT SOUTH OF QUAKER, EAST OF RICE - POND P50
       ***********
  4    CATCHMENT
      52.000      ID No.ó 99999
       6.430      Area in hectares
     207.000      Length (PERV) metres
       1.000      Gradient (%)
      70.000      Per cent Impervious
     207.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .426       .000       .041       .000 c.m/s
             .098       .805       .593     C perv/imperv/total
 15    ADD RUNOFF
             .426       .426       .041       .000 c.m/s
  9    ROUTE
        .000      Conduit Length
        .000      No Conduit defined
        .000      Zero lag
        .000      Beta weighting factor
        .000      Routing timestep
          0       No. of sub-reaches
             .426       .426       .426       .000 c.m/s
 17    COMBINE
      2     Junction Node No.
             .426       .426       .426       .426 c.m/s
 14    START
      1     1=Zero; 2=Define
  4    CATCHMENT
      53.000      ID No.ó 99999
      11.340      Area in hectares
     275.000      Length (PERV) metres
       1.000      Gradient (%)
      70.000      Per cent Impervious
     275.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .731       .000       .426       .426 c.m/s
             .098       .798       .588     C perv/imperv/total
 15    ADD RUNOFF
             .731       .731       .426       .426 c.m/s
  9    ROUTE
        .000      Conduit Length
        .000      No Conduit defined
        .000      Zero lag
        .000      Beta weighting factor
        .000      Routing timestep
          0       No. of sub-reaches
             .731       .731       .731       .426 c.m/s
 17    COMBINE
      2     Junction Node No.
             .731       .731       .731      1.157 c.m/s
 18    CONFLUENCE
      2     Junction Node No.
             .731      1.157       .731       .000 c.m/s
  4    CATCHMENT
      54.000      ID No.ó 99999
       1.280      Area in hectares
      92.000      Length (PERV) metres
       1.000      Gradient (%)
      60.000      Per cent Impervious
      92.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .070      1.157       .731       .000 c.m/s
             .098       .786       .511     C perv/imperv/total
 15    ADD RUNOFF
             .070      1.227       .731       .000 c.m/s
 27    HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .2781534E+04 c.m
 10    POND
      6 Depth - Discharge - Volume sets
       182.000        .000          .0
       182.800       .0190      5251.0
       183.150       .0230      7895.0
       183.500        .238     10751.0
       183.800        .396     13425.0
       184.000       1.028     15337.0
       Peak Outflow    =      .009 c.m/s
       Maximum Depth   =   182.397 metres
       Maximum Storage =     2607. c.m
             .070      1.227       .009       .000 c.m/s
 14    START
```

```
      1     1=Zero; 2=Define
35     COMMENT
      3     line(s) of comment
       ***********
       PROP DEVELOPMENT NORTH OF SEGMENT 3 - POND P30
       ***********
 4     CATCHMENT
      30.000     ID No.ó 99999
       8.470     Area in hectares
     238.000     Length (PERV) metres
        .200     Gradient (%)
        .100     Per cent Impervious
     238.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .007       .000       .009       .000 c.m/s
              .098       .803       .099     C perv/imperv/total
15     ADD RUNOFF
              .007       .007       .009       .000 c.m/s
 4     CATCHMENT
      31.000     ID No.ó 99999
      10.420     Area in hectares
     264.000     Length (PERV) metres
       1.000     Gradient (%)
      75.000     Per cent Impervious
     264.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .723       .007       .009       .000 c.m/s
              .098       .798       .623     C perv/imperv/total
15     ADD RUNOFF
              .723       .724       .009       .000 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .1834827E+04 c.m
 4     CATCHMENT
      32.000     ID No.ó 99999
        .690     Area in hectares
      68.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      68.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .037       .724       .009       .000 c.m/s
              .098       .798       .518     C perv/imperv/total
15     ADD RUNOFF
              .037       .760       .009       .000 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .1924289E+04 c.m
10     POND
      5 Depth - Discharge - Volume sets
       178.800        .000          .0
       179.300       .0260      1520.0
       180.100       .0440      4649.0
       180.600        .414      7069.0
       180.800       1.204      8137.0
       Peak Outflow    =      .025 c.m/s
       Maximum Depth   =   179.280 metres
       Maximum Storage =     1460. c.m
              .037       .760       .025       .000 c.m/s
14     START
      1     1=Zero; 2=Define
35     COMMENT
      3     line(s) of comment
       ***********
       PROP DEVELOPMENT SOUTH OF SEGMENT 3 - POND P31
       ***********
 4     CATCHMENT
      33.000     ID No.ó 99999
      12.960     Area in hectares
     294.000     Length (PERV) metres
       1.000     Gradient (%)
      75.000     Per cent Impervious
     294.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .887       .000       .025       .000 c.m/s
              .098       .801       .625     C perv/imperv/total
15     ADD RUNOFF
              .887       .887       .025       .000 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .2028780E+04 c.m
 4     CATCHMENT
      34.000     ID No.ó 99999
        .660     Area in hectares
      66.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      66.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .036       .887       .025       .000 c.m/s
              .098       .798       .518     C perv/imperv/total
15     ADD RUNOFF
              .036       .922       .025       .000 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .2114417E+04 c.m
10     POND
      6 Depth - Discharge - Volume sets
       178.300        .000          .0
       178.900       .0350      1927.0
       179.600       .0540      4692.0
       179.800        .150      5590.0
       180.000        .321      6538.0
       180.300       1.922      8059.0
       Peak Outflow    =      .032 c.m/s
       Maximum Depth   =   178.844 metres
       Maximum Storage =     1746. c.m
              .036       .922       .032       .000 c.m/s
14     START
      1     1=Zero; 2=Define
```

```
35    COMMENT
     3     line(s) of comment
      ************************************************************
      2-YEAR STORM EVENT
      ************************************************************
 2    STORM
          1     1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    755.000     Coefficient  a
      8.000     Constant  b    (min)
       .789     Exponent  c
       .450     Fraction to peak  r
    240.000     Duration ó  240 min
              38.971 mm     Total depth
 3    IMPERVIOUS
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015     Manning "n"
     98.000     SCS Curve No or C
       .100     Ia/S Coefficient
       .518     Initial Abstraction
35    COMMENT
     3     line(s) of comment
      *******************
      EXISTING RES. WEST OF SEGMENT 1
      *******************
 4    CATCHMENT
      1.000     ID No.ó 99999
     17.520     Area in hectares
    343.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    343.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .896       .000       .000       .000 c.m/s
             .194       .857       .426     C perv/imperv/total
15    ADD RUNOFF
             .896       .896       .000       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      *****************
      REALIGNED CHANNEL - SEGMENT 1
      *****************
 4    CATCHMENT
    100.000     ID No.ó 99999
      2.020     Area in hectares
    116.000     Length (PERV) metres
       .400     Gradient (%)
     15.000     Per cent Impervious
    116.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .046       .896       .000       .000 c.m/s
             .194       .862       .294     C perv/imperv/total
35    COMMENT
     3     line(s) of comment
      *****************
      FLOW AT FUT ROADWAY CULVERT - SEGMENT 1
      *****************
15    ADD RUNOFF
             .046       .941       .000       .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
             .046       .941       .941       .000 c.m/s
17    COMBINE
     1     Junction Node No.
             .046       .941       .941       .941 c.m/s
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      *****************
      PROP DEVELOPMENT NORTH OF SEGMENT 1 - POND P10
      *****************
 4    CATCHMENT
     10.000     ID No.ó 99999
      4.050     Area in hectares
    164.000     Length (PERV) metres
      1.000     Gradient (%)
     70.000     Per cent Impervious
    164.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .406       .000       .941       .941 c.m/s
             .194       .857       .658     C perv/imperv/total
15    ADD RUNOFF
             .406       .406       .941       .941 c.m/s
 4    CATCHMENT
     11.000     ID No.ó 99999
      1.000     Area in hectares
     82.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
     82.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .015       .406       .941       .941 c.m/s
             .194       .858       .261     C perv/imperv/total
15    ADD RUNOFF
             .015       .422       .941       .941 c.m/s
10    POND
     6 Depth - Discharge - Volume sets
      184.800        .000          .0
      185.750       .0210         1.0
      186.000       .0230       503.0
      186.250       .0260      1091.0
      186.500       .0280      1765.0
      186.700       1.244      2370.0
      Peak Outflow    =      .025 c.m/s
      Maximum Depth   =   186.128 metres
      Maximum Storage =      803. c.m
             .015       .422       .025       .941 c.m/s
17    COMBINE
     1     Junction Node No.
             .015       .422       .025       .963 c.m/s
14    START
     1     1=Zero; 2=Define
18    CONFLUENCE
     1     Junction Node No.
             .015       .963       .025       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      *****************
      REALIGNED CHANNEL - SEGMENT 1
      *****************
 4    CATCHMENT
    101.000     ID No.ó 99999
       .610     Area in hectares
     64.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
     64.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .010       .963       .025       .000 c.m/s
             .194       .855       .260     C perv/imperv/total
15    ADD RUNOFF
             .010       .972       .025       .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
             .010       .972       .972       .000 c.m/s
17    COMBINE
     1     Junction Node No.
             .010       .972       .972       .972 c.m/s
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      *****************
      PROP DEVELOPMENT SOUTH OF SEGMENT 1 - POND P11
      *****************
 4    CATCHMENT
     12.000     ID No.ó 99999
      2.680     Area in hectares
    134.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    134.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .134       .000       .972       .972 c.m/s
             .194       .850       .424     C perv/imperv/total
15    ADD RUNOFF
             .134       .134       .972       .972 c.m/s
 4    CATCHMENT
     13.000     ID No.ó 99999
      6.980     Area in hectares
    216.000     Length (PERV) metres
      1.000     Gradient (%)
     70.000     Per cent Impervious
    216.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .704       .134       .972       .972 c.m/s
```

```
          .194       .867       .665     C perv/imperv/total
15    ADD RUNOFF
          .704       .838       .972       .972 c.m/s
 4    CATCHMENT
     14.000      ID No.ó 99999
       .670      Area in hectares
     67.000      Length (PERV) metres
      1.000      Gradient (%)
     60.000      Per cent Impervious
     67.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .060       .838       .972       .972 c.m/s
          .194       .856       .592     C perv/imperv/total
15    ADD RUNOFF
          .060       .889       .972       .972 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .2406793E+04 c.m
10    POND
     5 Depth - Discharge - Volume sets
      184.800        .000          .0
      185.300       .0140       1142.0
      186.100       .0240       3519.0
      186.500        .287       4978.0
      186.800       1.922       6222.0
      Peak Outflow    =       .018 c.m/s
      Maximum Depth   =   185.633 metres
      Maximum Storage =     2132. c.m
          .060       .889       .018       .972 c.m/s
35    COMMENT
     3     line(s) of comment
      *****************
      FLOW U/S OF RICE RD CULVERT - OUTLET A1
      *****************
17    COMBINE
     1     Junction Node No.
          .060       .889       .018       .983 c.m/s
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      ***********************
      PROP DEVELOPMENT SOUTH OF QUAKER RD & WEST OF RICE RD. - PON
      ***********************
 4    CATCHMENT
     40.000      ID No.ó 99999
      8.210      Area in hectares
    234.000      Length (PERV) metres
      1.000      Gradient (%)
     25.000      Per cent Impervious
    234.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .300       .000       .018       .983 c.m/s
          .194       .868       .363     C perv/imperv/total
15    ADD RUNOFF
          .300       .300       .018       .983 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
         0       No. of sub-reaches
          .300       .300       .300       .983 c.m/s
17    COMBINE
     2     Junction Node No.
          .300       .300       .300       .300 c.m/s
14    START
     1     1=Zero; 2=Define
 4    CATCHMENT
     41.000      ID No.ó 99999
       .690      Area in hectares
     68.000      Length (PERV) metres
      1.000      Gradient (%)
     35.000      Per cent Impervious
     68.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .036       .000       .300       .300 c.m/s
          .194       .857       .426     C perv/imperv/total
15    ADD RUNOFF
          .036       .036       .300       .300 c.m/s
 4    CATCHMENT
     42.000      ID No.ó 99999
     12.640      Area in hectares
    290.000      Length (PERV) metres
      1.000      Gradient (%)
     70.000      Per cent Impervious
    290.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.302      .036       .300       .300 c.m/s
          .194       .863       .662     C perv/imperv/total
15    ADD RUNOFF
          1.302     1.333       .300       .300 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
         0       No. of sub-reaches
          1.302     1.333      1.333       .300 c.m/s
17    COMBINE
     2     Junction Node No.
          1.302     1.333      1.333      1.633 c.m/s
14    START
     1     1=Zero; 2=Define
 4    CATCHMENT
     43.000      ID No.ó 99999
       .330      Area in hectares
     47.000      Length (PERV) metres
      1.000      Gradient (%)
     35.000      Per cent Impervious
     47.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .018       .000      1.333      1.633 c.m/s
          .194       .858       .426     C perv/imperv/total
15    ADD RUNOFF
          .018       .018      1.333      1.633 c.m/s
 4    CATCHMENT
     44.000      ID No.ó 99999
      6.400      Area in hectares
    207.000      Length (PERV) metres
      1.000      Gradient (%)
     70.000      Per cent Impervious
    207.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .646       .018      1.333      1.633 c.m/s
          .194       .866       .665     C perv/imperv/total
15    ADD RUNOFF
          .646       .660      1.333      1.633 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
         0       No. of sub-reaches
          .646       .660       .660      1.633 c.m/s
17    COMBINE
     2     Junction Node No.
          .646       .660       .660      2.293 c.m/s
14    START
     1     1=Zero; 2=Define
18    CONFLUENCE
     2     Junction Node No.
          .646      2.293       .660       .000 c.m/s
 4    CATCHMENT
     45.000      ID No.ó 99999
      1.030      Area in hectares
     83.000      Length (PERV) metres
      1.000      Gradient (%)
     60.000      Per cent Impervious
     83.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .088      2.293       .660       .000 c.m/s
          .194       .857       .592     C perv/imperv/total
15    ADD RUNOFF
          .088      2.374       .660       .000 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .6483683E+04 c.m
10    POND
     6 Depth - Discharge - Volume sets
      186.000        .000          .0
      186.800       .0550       4048.0
      187.300       .0730       7091.0
      187.500        .170       8424.0
      187.800        .257      10552.0
      188.000        .880      12094.0
      Peak Outflow    =       .064 c.m/s
      Maximum Depth   =   187.039 metres
      Maximum Storage =     5502. c.m
          .088      2.374       .064       .000 c.m/s
17    COMBINE
     2     Junction Node No.
          .088      2.374       .064       .064 c.m/s
```

```
14    START
   1     1=Zero; 2=Define
35    COMMENT
   3     line(s) of comment
      ***********************
      EXISTING AREA ON QUAKER RD, WEST OF RICE RD
      ***********************
 4    CATCHMENT
      2.000     ID No.ó 99999
      9.020     Area in hectares
    245.000     Length (PERV) metres
      1.000     Gradient (%)
     40.000     Per cent Impervious
    245.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .520       .000       .064       .064 c.m/s
             .194       .868       .464     C perv/imperv/total
15    ADD RUNOFF
             .520       .520       .064       .064 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
             .520       .520       .520       .064 c.m/s
17    COMBINE
   2     Junction Node No.
             .520       .520       .520       .548 c.m/s
14    START
   1     1=Zero; 2=Define
18    CONFLUENCE
   2     Junction Node No.
             .520       .548       .520       .000 c.m/s
35    COMMENT
   3     line(s) of comment
      ***********************
      EXISTING AREA ON QUAKER RD, WEST OF RICE RD
      ***********************
 4    CATCHMENT
      3.000     ID No.ó 99999
      5.680     Area in hectares
    195.000     Length (PERV) metres
      1.000     Gradient (%)
     40.000     Per cent Impervious
    195.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .330       .548       .520       .000 c.m/s
             .194       .865       .462     C perv/imperv/total
15    ADD RUNOFF
             .330       .878       .520       .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
             .330       .878       .878       .000 c.m/s
17    COMBINE
   2     Junction Node No.
             .330       .878       .878       .878 c.m/s
14    START
   1     1=Zero; 2=Define
35    COMMENT
   3     line(s) of comment
      ***********************
      PROP DEVELOPMENT SOUTH OF QUAKER RD, EAST OF RICE RD
      ***********************
 4    CATCHMENT
     50.000     ID No.ó 99999
      3.420     Area in hectares
    151.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
    151.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .053       .000       .878       .878 c.m/s
             .194       .854       .260     C perv/imperv/total
15    ADD RUNOFF
             .053       .053       .878       .878 c.m/s
 4    CATCHMENT
     51.000     ID No.ó 99999
      1.980     Area in hectares
    115.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
    115.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .031       .053       .878       .878 c.m/s
             .194       .850       .260     C perv/imperv/total
15    ADD RUNOFF
             .031       .084       .878       .878 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
             .031       .084       .084       .878 c.m/s
17    COMBINE
   2     Junction Node No.
             .031       .084       .084       .962 c.m/s
14    START
   1     1=Zero; 2=Define
35    COMMENT
   3     line(s) of comment
      ***********************
      EXISTING AREA WEST OF RICE RD AND SOUTH OF QUAKER ROAD
      ***********************
 4    CATCHMENT
      4.000     ID No.ó 99999
     13.940     Area in hectares
    305.000     Length (PERV) metres
      1.000     Gradient (%)
     40.000     Per cent Impervious
    305.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .822       .000       .084       .962 c.m/s
             .194       .862       .461     C perv/imperv/total
15    ADD RUNOFF
             .822       .822       .084       .962 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
             .822       .822       .822       .962 c.m/s
17    COMBINE
   2     Junction Node No.
             .822       .822       .822      1.784 c.m/s
14    START
   1     1=Zero; 2=Define
18    CONFLUENCE
   2     Junction Node No.
             .822      1.784       .822       .000 c.m/s
35    COMMENT
   3     line(s) of comment
      *****************
      RICE ROAD FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
      *****************
 4    CATCHMENT
    501.000     ID No.ó 99999
      1.570     Area in hectares
    102.000     Length (PERV) metres
      1.000     Gradient (%)
     70.000     Per cent Impervious
    102.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
          1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
          1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .149      1.784       .822       .000 c.m/s
             .194       .854       .656     C perv/imperv/total
15    ADD RUNOFF
             .149      1.933       .822       .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
          0     No. of sub-reaches
             .149      1.933      1.933       .000 c.m/s
35    COMMENT
   3     line(s) of comment
      *****************
      FLOW D/S OF RICE RD CULVERT - OUTLET A2
      *****************
17    COMBINE
   1     Junction Node No.
             .149      1.933      1.933      2.916 c.m/s
14    START
   1     1=Zero; 2=Define
35    COMMENT
   3     line(s) of comment
      *****************
      PROP DEVELOPMENT SOUTH OF QUAKER RD - QUALLITY CONTROL ONLY
      *****************
 4    CATCHMENT
     20.100     ID No.ó 99999
```

```
         .780     Area in hectares
       72.000     Length (PERV) metres
        1.000     Gradient (%)
       35.000     Per cent Impervious
       72.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .040       .000      1.933      2.916 c.m/s
               .194       .857       .426     C perv/imperv/total
 15     ADD RUNOFF
               .040       .040      1.933      2.916 c.m/s
  4     CATCHMENT
       20.000     ID No.ó 99999
        3.210     Area in hectares
      146.000     Length (PERV) metres
        1.000     Gradient (%)
       85.000     Per cent Impervious
      146.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .386       .040      1.933      2.916 c.m/s
               .194       .854       .755     C perv/imperv/total
 15     ADD RUNOFF
               .386       .422      1.933      2.916 c.m/s
  9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
               .386       .422       .422      2.916 c.m/s
 17     COMBINE
      1     Junction Node No.
               .386       .422       .422      3.338 c.m/s
 14     START
      1     1=Zero; 2=Define
 18     CONFLUENCE
      1     Junction Node No.
               .386      3.338       .422       .000 c.m/s
 35     COMMENT
      3     line(s) of comment
        *****************
        REALIGNED CHANNEL - SEGMENT 2
        *****************
  4     CATCHMENT
      200.000     ID No.ó 99999
         .970     Area in hectares
       80.416     Length (PERV) metres
        1.000     Gradient (%)
       10.000     Per cent Impervious
       80.416     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .015      3.338       .422       .000 c.m/s
               .194       .858       .261     C perv/imperv/total
 35     COMMENT
      3     line(s) of comment
        *****************
        FLOW D/S OF AREA A20 - OUTLET B
        *****************
 15     ADD RUNOFF
               .015      3.353       .422       .000 c.m/s
 35     COMMENT
      3     line(s) of comment
        ************************
        EX RES. AND FUT DEVELOPMENT LANDS BY OTHERS WEST OF FIRST AV
        ************************
  4     CATCHMENT
       21.000     ID No.ó 99999
       35.460     Area in hectares
      487.000     Length (PERV) metres
         .200     Gradient (%)
        5.000     Per cent Impervious
      487.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .181      3.353       .422       .000 c.m/s
               .194       .867       .228     C perv/imperv/total
 15     ADD RUNOFF
               .181      3.489       .422       .000 c.m/s
  9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
               .181      3.489      3.489       .000 c.m/s
```

```
 35     COMMENT
      3     line(s) of comment
        ************************
        FLOW U/S OF FIRST AVE CULVERT
        ************************
 17     COMBINE
      1     Junction Node No.
               .181      3.489      3.489      3.489 c.m/s
 14     START
      1     1=Zero; 2=Define
 35     COMMENT
      3     line(s) of comment
        ***********
        PROP DEVELOPMENT SOUTH OF QUAKER, EAST OF RICE - POND P50
        ***********
  4     CATCHMENT
       52.000     ID No.ó 99999
        6.430     Area in hectares
      207.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      207.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .649       .000      3.489      3.489 c.m/s
               .194       .866       .665     C perv/imperv/total
 15     ADD RUNOFF
               .649       .649      3.489      3.489 c.m/s
  9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
               .649       .649       .649      3.489 c.m/s
 17     COMBINE
      2     Junction Node No.
               .649       .649       .649       .649 c.m/s
 14     START
      1     1=Zero; 2=Define
  4     CATCHMENT
       53.000     ID No.ó 99999
       11.340     Area in hectares
      275.000     Length (PERV) metres
        1.000     Gradient (%)
       70.000     Per cent Impervious
      275.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              1.171       .000       .649       .649 c.m/s
               .194       .865       .664     C perv/imperv/total
 15     ADD RUNOFF
              1.171      1.171       .649       .649 c.m/s
  9     ROUTE
         .000     Conduit Length
         .000     No Conduit defined
         .000     Zero lag
         .000     Beta weighting factor
         .000     Routing timestep
            0     No. of sub-reaches
              1.171      1.171      1.171       .649 c.m/s
 17     COMBINE
      2     Junction Node No.
              1.171      1.171      1.171      1.820 c.m/s
 18     CONFLUENCE
      2     Junction Node No.
              1.171      1.820      1.171       .000 c.m/s
  4     CATCHMENT
       54.000     ID No.ó 99999
        1.280     Area in hectares
       92.000     Length (PERV) metres
        1.000     Gradient (%)
       60.000     Per cent Impervious
       92.000     Length (IMPERV)
         .000     %Imp. with Zero Dpth
            1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
         .250     Manning "n"
       74.000     SCS Curve No or C
         .100     Ia/S Coefficient
        8.924     Initial Abstraction
            1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
               .107      1.820      1.171       .000 c.m/s
               .194       .857       .592     C perv/imperv/total
 15     ADD RUNOFF
               .107      1.923      1.171       .000 c.m/s
 27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
        Volume  =  .4892284E+04 c.m
 10     POND
      6 Depth - Discharge - Volume sets
        182.000        .000          .0
        182.800       .0190      5251.0
        183.150       .0230      7895.0
        183.500        .238     10751.0
        183.800        .396     13425.0
        184.000       1.028     15337.0
        Peak Outflow    =      .017 c.m/s
        Maximum Depth   =   182.699 metres
```

```
      Maximum Storage =     4589. c.m
            .107      1.923      .017       .000 c.m/s
17    COMBINE
     2    Junction Node No.
            .107      1.923      .017       .017 c.m/s
14    START
     1    1=Zero; 2=Define
35    COMMENT
     3    line(s) of comment
      ************************
      EXISTING AREA ON QUAKER RD, EAST OF RICE RD
      ************************
 4    CATCHMENT
      5.000     ID No.ó 99999
      1.870     Area in hectares
    112.000     Length (PERV) metres
      1.000     Gradient (%)
     50.000     Per cent Impervious
    112.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .130       .000      .017       .017 c.m/s
            .194       .851      .522     C perv/imperv/total
15    ADD RUNOFF
            .130       .130      .017       .017 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
         0      No. of sub-reaches
            .130       .130      .130       .017 c.m/s
17    COMBINE
     2    Junction Node No.
            .130       .130      .130       .136 c.m/s
18    CONFLUENCE
     2    Junction Node No.
            .130       .136      .130       .000 c.m/s
35    COMMENT
     3    line(s) of comment
      ************************
      EXISTING AREA ON QUAKER RD, EAST OF RICE RD
      ************************
 4    CATCHMENT
      6.000     ID No.ó 99999
      1.920     Area in hectares
    113.000     Length (PERV) metres
       .200     Gradient (%)
     65.000     Per cent Impervious
    113.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .185       .136      .130       .000 c.m/s
            .194       .867      .631     C perv/imperv/total
15    ADD RUNOFF
            .185       .321      .130       .000 c.m/s
35    COMMENT
     3    line(s) of comment
      ***********
      FIRST AVE FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
      ***********
 4    CATCHMENT
    201.000     ID No.ó 99999
      2.430     Area in hectares
    127.000     Length (PERV) metres
      1.000     Gradient (%)
     65.000     Per cent Impervious
    127.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .221       .321      .130       .000 c.m/s
            .194       .848      .619     C perv/imperv/total
15    ADD RUNOFF
            .221       .542      .130       .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
         0      No. of sub-reaches
            .221       .542      .542       .000 c.m/s
17    COMBINE
     1    Junction Node No.
            .221       .542      .542      4.031 c.m/s
35    COMMENT
     3    line(s) of comment
      ************************
      FLOW D/S OF FIRST AVE CULVERT - OUTLET C
      ************************
18    CONFLUENCE
     1    Junction Node No.
            .221      4.031      .542       .000 c.m/s
```

```
35    COMMENT
     3    line(s) of comment
      ***********
      REALIGNED CHANNEL - SEGMENT 3
      ***********
 4    CATCHMENT
    300.000     ID No.ó 99999
      3.180     Area in hectares
    146.000     Length (PERV) metres
       .200     Gradient (%)
     15.000     Per cent Impervious
    146.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .071      4.031      .542       .000 c.m/s
            .194       .859      .294     C perv/imperv/total
15    ADD RUNOFF
            .071      4.102      .542       .000 c.m/s
 4    CATCHMENT
    301.000     ID No.ó 99999
       .720     Area in hectares
     69.000     Length (PERV) metres
       .200     Gradient (%)
     10.000     Per cent Impervious
     69.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .011      4.102      .542       .000 c.m/s
            .194       .855      .260     C perv/imperv/total
15    ADD RUNOFF
            .011      4.113      .542       .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
         0      No. of sub-reaches
            .011      4.113     4.113       .000 c.m/s
17    COMBINE
     1    Junction Node No.
            .011      4.113     4.113      4.113 c.m/s
14    START
     1    1=Zero; 2=Define
35    COMMENT
     3    line(s) of comment
      ***********
      PROP DEVELOPMENT NORTH OF SEGMENT 3 - POND P30
      ***********
 4    CATCHMENT
     30.000     ID No.ó 99999
      8.470     Area in hectares
    238.000     Length (PERV) metres
       .200     Gradient (%)
       .100     Per cent Impervious
    238.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .035       .000     4.113      4.113 c.m/s
            .194       .867      .195     C perv/imperv/total
15    ADD RUNOFF
            .035       .035     4.113      4.113 c.m/s
 4    CATCHMENT
     31.000     ID No.ó 99999
     10.420     Area in hectares
    264.000     Length (PERV) metres
      1.000     Gradient (%)
     75.000     Per cent Impervious
    264.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           1.154       .035     4.113      4.113 c.m/s
            .194       .866      .698     C perv/imperv/total
15    ADD RUNOFF
           1.154      1.158     4.113      4.113 c.m/s
27    HYDROGRAPH DISPLAY
     5    is # of Hyeto/Hydrograph chosen
      Volume  =  .3477034E+04 c.m
 4    CATCHMENT
     32.000     ID No.ó 99999
       .690     Area in hectares
     68.000     Length (PERV) metres
      1.000     Gradient (%)
     60.000     Per cent Impervious
     68.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
```

```
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .061      1.158      4.113      4.113 c.m/s
             .194       .857       .592     C perv/imperv/total
15     ADD RUNOFF
             .061      1.210      4.113      4.113 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .3636135E+04 c.m
10     POND
      5 Depth - Discharge - Volume sets
       178.800        .000          .0
       179.300       .0260      1520.0
       180.100       .0440      4649.0
       180.600        .414      7069.0
       180.800       1.204      8137.0
       Peak Outflow    =      .034 c.m/s
       Maximum Depth   =   179.642 metres
       Maximum Storage =     2856. c.m
             .061      1.210       .034      4.113 c.m/s
17     COMBINE
      1     Junction Node No.
             .061      1.210       .034      4.131 c.m/s
14     START
      1     1=Zero; 2=Define
35     COMMENT
      3     line(s) of comment
       ***********
       PROP DEVELOPMENT SOUTH OF SEGMENT 3 - POND P31
       ***********
 4     CATCHMENT
      33.000     ID No.ó 99999
      12.960     Area in hectares
     294.000     Length (PERV) metres
       1.000     Gradient (%)
      75.000     Per cent Impervious
     294.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.428       .000       .034      4.131 c.m/s
             .194       .863       .696     C perv/imperv/total
15     ADD RUNOFF
            1.428      1.428       .034      4.131 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .3513004E+04 c.m
 4     CATCHMENT
      34.000     ID No.ó 99999
        .660     Area in hectares
      66.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      66.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .059      1.428       .034      4.131 c.m/s
             .194       .856       .591     C perv/imperv/total
15     ADD RUNOFF
             .059      1.478       .034      4.131 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .3665095E+04 c.m
10     POND
      6 Depth - Discharge - Volume sets
       178.300        .000          .0
       178.900       .0350      1927.0
       179.600       .0540      4692.0
       179.800        .150      5590.0
       180.000        .321      6538.0
       180.300       1.922      8059.0
       Peak Outflow    =      .043 c.m/s
       Maximum Depth   =   179.201 metres
       Maximum Storage =     3116. c.m
             .059      1.478       .043      4.131 c.m/s
17     COMBINE
      1     Junction Node No.
             .059      1.478       .043      4.153 c.m/s
14     START
      1     1=Zero; 2=Define
18     CONFLUENCE
      1     Junction Node No.
             .059      4.153       .043       .000 c.m/s
35     COMMENT
      3     line(s) of comment
       ***********************
       REALIGNED CHANNEL - SEGMENT 3
       ***********************
 4     CATCHMENT
     302.000     ID No.ó 99999
       1.610     Area in hectares
     104.000     Length (PERV) metres
        .200     Gradient (%)
      10.000     Per cent Impervious
     104.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .024      4.153       .043       .000 c.m/s
             .194       .868       .262     C perv/imperv/total
35     COMMENT
      3     line(s) of comment
       ****************************
       FLOW U/S OF NIAGARA ST CULVERT - OUTLET D
       ****************************
15     ADD RUNOFF
             .024      4.177       .043       .000 c.m/s
14     START
      1     1=Zero; 2=Define
```

```
35    COMMENT
     3    line(s) of comment
      ************************************************************
      5-YEAR STORM EVENT
      ************************************************************
 2    STORM
         1      1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
   830.000      Coefficient  a
     7.300      Constant  b    (min)
      .777      Exponent  c
      .450      Fraction to peak  r
   240.000      Duration ó  240 min
              45.874 mm     Total depth
 3    IMPERVIOUS
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .015      Manning "n"
    98.000      SCS Curve No or C
      .100      Ia/S Coefficient
      .518      Initial Abstraction
35    COMMENT
     3    line(s) of comment
      *******************
      EXISTING RES. WEST OF SEGMENT 1
      *******************
 4    CATCHMENT
     1.000      ID No.ó 99999
    17.520      Area in hectares
   343.000      Length (PERV) metres
     1.000      Gradient (%)
    35.000      Per cent Impervious
   343.000      Length (IMPERV)
      .000      %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
    74.000      SCS Curve No or C
      .100      Ia/S Coefficient
     8.924      Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           1.082       .000       .000       .000 c.m/s
            .236       .879       .461     C perv/imperv/total
15    ADD RUNOFF
           1.082      1.082       .000       .000 c.m/s
35    COMMENT
     3    line(s) of comment
      *****************
      REALIGNED CHANNEL - SEGMENT 1
      *****************
 4    CATCHMENT
   100.000      ID No.ó 99999
     2.020      Area in hectares
   116.000      Length (PERV) metres
      .400      Gradient (%)
    15.000      Per cent Impervious
   116.000      Length (IMPERV)
      .000      %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
    74.000      SCS Curve No or C
      .100      Ia/S Coefficient
     8.924      Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .055      1.082       .000       .000 c.m/s
            .236       .874       .332     C perv/imperv/total
35    COMMENT
     3    line(s) of comment
      *****************
      FLOW AT FUT ROADWAY CULVERT - SEGMENT 1
      *****************
15    ADD RUNOFF
            .055      1.137       .000       .000 c.m/s
 9    ROUTE
      .000      Conduit Length
      .000      No Conduit defined
      .000      Zero lag
      .000      Beta weighting factor
      .000      Routing timestep
         0      No. of sub-reaches
            .055      1.137      1.137       .000 c.m/s
17    COMBINE
     1    Junction Node No.
            .055      1.137      1.137      1.137 c.m/s
14    START
     1    1=Zero; 2=Define
35    COMMENT
     3    line(s) of comment
      *****************
      PROP DEVELOPMENT NORTH OF SEGMENT 1 - POND P10
      *****************
 4    CATCHMENT
    10.000      ID No.ó 99999
     4.050      Area in hectares
   164.000      Length (PERV) metres
     1.000      Gradient (%)
    70.000      Per cent Impervious
   164.000      Length (IMPERV)
      .000      %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
    74.000      SCS Curve No or C
      .100      Ia/S Coefficient
     8.924      Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .477       .000      1.137      1.137 c.m/s
            .236       .871       .681     C perv/imperv/total
15    ADD RUNOFF
            .477       .477      1.137      1.137 c.m/s
 4    CATCHMENT
    11.000      ID No.ó 99999
     1.000      Area in hectares
```

```
    82.000      Length (PERV) metres
     1.000      Gradient (%)
    10.000      Per cent Impervious
    82.000      Length (IMPERV)
      .000      %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
    74.000      SCS Curve No or C
      .100      Ia/S Coefficient
     8.924      Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .020       .477      1.137      1.137 c.m/s
            .235       .875       .299     C perv/imperv/total
15    ADD RUNOFF
            .020       .497      1.137      1.137 c.m/s
10    POND
     6 Depth - Discharge - Volume sets
     184.800        .000          .0
     185.750       .0210         1.0
     186.000       .0230       503.0
     186.250       .0260      1091.0
     186.500       .0280      1765.0
     186.700       1.244      2370.0
     Peak Outflow    =      .026 c.m/s
     Maximum Depth   =  186.226 metres
     Maximum Storage =     1035. c.m
            .020       .497       .026      1.137 c.m/s
17    COMBINE
     1    Junction Node No.
            .020       .497       .026      1.160 c.m/s
14    START
     1    1=Zero; 2=Define
18    CONFLUENCE
     1    Junction Node No.
            .020      1.160       .026       .000 c.m/s
35    COMMENT
     3    line(s) of comment
      *****************
      REALIGNED CHANNEL - SEGMENT 1
      *****************
 4    CATCHMENT
   101.000      ID No.ó 99999
      .610      Area in hectares
    64.000      Length (PERV) metres
     1.000      Gradient (%)
    10.000      Per cent Impervious
    64.000      Length (IMPERV)
      .000      %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
    74.000      SCS Curve No or C
      .100      Ia/S Coefficient
     8.924      Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .012      1.160       .026       .000 c.m/s
            .235       .873       .299     C perv/imperv/total
15    ADD RUNOFF
            .012      1.172       .026       .000 c.m/s
 9    ROUTE
      .000      Conduit Length
      .000      No Conduit defined
      .000      Zero lag
      .000      Beta weighting factor
      .000      Routing timestep
         0      No. of sub-reaches
            .012      1.172      1.172       .000 c.m/s
17    COMBINE
     1    Junction Node No.
            .012      1.172      1.172      1.172 c.m/s
14    START
     1    1=Zero; 2=Define
35    COMMENT
     3    line(s) of comment
      *****************
      PROP DEVELOPMENT SOUTH OF SEGMENT 1 - POND P11
      *****************
 4    CATCHMENT
    12.000      ID No.ó 99999
     2.680      Area in hectares
   134.000      Length (PERV) metres
     1.000      Gradient (%)
    35.000      Per cent Impervious
   134.000      Length (IMPERV)
      .000      %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
    74.000      SCS Curve No or C
      .100      Ia/S Coefficient
     8.924      Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .159       .000      1.172      1.172 c.m/s
            .236       .866       .456     C perv/imperv/total
15    ADD RUNOFF
            .159       .159      1.172      1.172 c.m/s
 4    CATCHMENT
    13.000      ID No.ó 99999
     6.980      Area in hectares
   216.000      Length (PERV) metres
     1.000      Gradient (%)
    70.000      Per cent Impervious
   216.000      Length (IMPERV)
      .000      %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250      Manning "n"
    74.000      SCS Curve No or C
      .100      Ia/S Coefficient
     8.924      Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .835       .159      1.172      1.172 c.m/s
```

```
          .236       .882       .688     C perv/imperv/total
15    ADD RUNOFF
          .835       .994      1.172      1.172 c.m/s
 4    CATCHMENT
     14.000      ID No.ó 99999
       .670      Area in hectares
     67.000      Length (PERV) metres
      1.000      Gradient (%)
     60.000      Per cent Impervious
     67.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .072       .994      1.172      1.172 c.m/s
          .235       .873       .618     C perv/imperv/total
15    ADD RUNOFF
          .072      1.052      1.172      1.172 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .2954374E+04 c.m
10    POND
     5 Depth - Discharge - Volume sets
      184.800        .000          .0
      185.300       .0140      1142.0
      186.100       .0240      3519.0
      186.500        .287      4978.0
      186.800       1.922      6222.0
      Peak Outflow    =       .020 c.m/s
      Maximum Depth   =   185.805 metres
      Maximum Storage =     2641. c.m
          .072      1.052       .020      1.172 c.m/s
35    COMMENT
     3     line(s) of comment
      *****************
      FLOW U/S OF RICE RD CULVERT - OUTLET A1
      *****************
17    COMBINE
     1     Junction Node No.
          .072      1.052       .020      1.185 c.m/s
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      ***********************
      PROP DEVELOPMENT SOUTH OF QUAKER RD & WEST OF RICE RD. - PON
      ***********************
 4    CATCHMENT
     40.000      ID No.ó 99999
      8.210      Area in hectares
    234.000      Length (PERV) metres
      1.000      Gradient (%)
     25.000      Per cent Impervious
    234.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .361       .000       .020      1.185 c.m/s
          .236       .884       .398     C perv/imperv/total
15    ADD RUNOFF
          .361       .361       .020      1.185 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
         0       No. of sub-reaches
          .361       .361       .361      1.185 c.m/s
17    COMBINE
     2     Junction Node No.
          .361       .361       .361       .361 c.m/s
14    START
     1     1=Zero; 2=Define
 4    CATCHMENT
     41.000      ID No.ó 99999
       .690      Area in hectares
     68.000      Length (PERV) metres
      1.000      Gradient (%)
     35.000      Per cent Impervious
     68.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .044       .000       .361       .361 c.m/s
          .236       .873       .459     C perv/imperv/total
15    ADD RUNOFF
          .044       .044       .361       .361 c.m/s
 4    CATCHMENT
     42.000      ID No.ó 99999
     12.640      Area in hectares
    290.000      Length (PERV) metres
      1.000      Gradient (%)
     70.000      Per cent Impervious
    290.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.556       .044       .361       .361 c.m/s
          .236       .884       .690     C perv/imperv/total
15    ADD RUNOFF
         1.556      1.594       .361       .361 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
         0       No. of sub-reaches
         1.556      1.594      1.594       .361 c.m/s
17    COMBINE
     2     Junction Node No.
         1.556      1.594      1.594      1.955 c.m/s
14    START
     1     1=Zero; 2=Define
 4    CATCHMENT
     43.000      ID No.ó 99999
       .330      Area in hectares
     47.000      Length (PERV) metres
      1.000      Gradient (%)
     35.000      Per cent Impervious
     47.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .022       .000      1.594      1.955 c.m/s
          .236       .875       .460     C perv/imperv/total
15    ADD RUNOFF
          .022       .022      1.594      1.955 c.m/s
 4    CATCHMENT
     44.000      ID No.ó 99999
      6.400      Area in hectares
    207.000      Length (PERV) metres
      1.000      Gradient (%)
     70.000      Per cent Impervious
    207.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .765       .022      1.594      1.955 c.m/s
          .236       .880       .687     C perv/imperv/total
15    ADD RUNOFF
          .765       .782      1.594      1.955 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
         0       No. of sub-reaches
          .765       .782       .782      1.955 c.m/s
17    COMBINE
     2     Junction Node No.
          .765       .782       .782      2.737 c.m/s
14    START
     1     1=Zero; 2=Define
18    CONFLUENCE
     2     Junction Node No.
          .765      2.737       .782       .000 c.m/s
 4    CATCHMENT
     45.000      ID No.ó 99999
      1.030      Area in hectares
     83.000      Length (PERV) metres
      1.000      Gradient (%)
     60.000      Per cent Impervious
     83.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .107      2.737       .782       .000 c.m/s
          .236       .876       .620     C perv/imperv/total
15    ADD RUNOFF
          .107      2.832       .782       .000 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .8023741E+04 c.m
10    POND
     6 Depth - Discharge - Volume sets
      186.000        .000          .0
      186.800       .0550      4048.0
      187.300       .0730      7091.0
      187.500        .170      8424.0
      187.800        .257     10552.0
      188.000        .880     12094.0
      Peak Outflow    =       .072 c.m/s
      Maximum Depth   =   187.266 metres
      Maximum Storage =     6887. c.m
          .107      2.832       .072       .000 c.m/s
17    COMBINE
     2     Junction Node No.
          .107      2.832       .072       .072 c.m/s
```

```
14    START
   1     1=Zero; 2=Define
35    COMMENT
   3     line(s) of comment
      ***********************
      EXISTING AREA ON QUAKER RD, WEST OF RICE RD
      ***********************
 4    CATCHMENT
      2.000      ID No.ó 99999
      9.020      Area in hectares
    245.000      Length (PERV) metres
      1.000      Gradient (%)
     40.000      Per cent Impervious
    245.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .624       .000       .072       .072 c.m/s
             .236       .885       .496     C perv/imperv/total
15    ADD RUNOFF
             .624       .624       .072       .072 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
          0      No. of sub-reaches
             .624       .624       .624       .072 c.m/s
17    COMBINE
   2     Junction Node No.
             .624       .624       .624       .660 c.m/s
14    START
   1     1=Zero; 2=Define
18    CONFLUENCE
   2     Junction Node No.
             .624       .660       .624       .000 c.m/s
35    COMMENT
   3     line(s) of comment
      ***********************
      EXISTING AREA ON QUAKER RD, WEST OF RICE RD
      ***********************
 4    CATCHMENT
      3.000      ID No.ó 99999
      5.680      Area in hectares
    195.000      Length (PERV) metres
      1.000      Gradient (%)
     40.000      Per cent Impervious
    195.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .392       .660       .624       .000 c.m/s
             .236       .877       .492     C perv/imperv/total
15    ADD RUNOFF
             .392      1.052       .624       .000 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
          0      No. of sub-reaches
             .392      1.052      1.052       .000 c.m/s
17    COMBINE
   2     Junction Node No.
             .392      1.052      1.052      1.052 c.m/s
14    START
   1     1=Zero; 2=Define
35    COMMENT
   3     line(s) of comment
      ***********************
      PROP DEVELOPMENT SOUTH OF QUAKER RD, EAST OF RICE RD
      ***********************
 4    CATCHMENT
     50.000      ID No.ó 99999
      3.420      Area in hectares
    151.000      Length (PERV) metres
      1.000      Gradient (%)
     10.000      Per cent Impervious
    151.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .066       .000      1.052      1.052 c.m/s
             .236       .868       .299     C perv/imperv/total
15    ADD RUNOFF
             .066       .066      1.052      1.052 c.m/s
 4    CATCHMENT
     51.000      ID No.ó 99999
      1.980      Area in hectares
    115.000      Length (PERV) metres
      1.000      Gradient (%)
     10.000      Per cent Impervious
    115.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .039       .066      1.052      1.052 c.m/s
             .236       .872       .299     C perv/imperv/total
15    ADD RUNOFF
             .039       .104      1.052      1.052 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
          0      No. of sub-reaches
             .039       .104       .104      1.052 c.m/s
17    COMBINE
   2     Junction Node No.
             .039       .104       .104      1.156 c.m/s
14    START
   1     1=Zero; 2=Define
35    COMMENT
   3     line(s) of comment
      ***********************
      EXISTING AREA WEST OF RICE RD AND SOUTH OF QUAKER ROAD
      ***********************
 4    CATCHMENT
      4.000      ID No.ó 99999
     13.940      Area in hectares
    305.000      Length (PERV) metres
      1.000      Gradient (%)
     40.000      Per cent Impervious
    305.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .988       .000       .104      1.156 c.m/s
             .236       .883       .495     C perv/imperv/total
15    ADD RUNOFF
             .988       .988       .104      1.156 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
          0      No. of sub-reaches
             .988       .988       .988      1.156 c.m/s
17    COMBINE
   2     Junction Node No.
             .988       .988       .988      2.144 c.m/s
14    START
   1     1=Zero; 2=Define
18    CONFLUENCE
   2     Junction Node No.
             .988      2.144       .988       .000 c.m/s
35    COMMENT
   3     line(s) of comment
      *****************
      RICE ROAD FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
      *****************
 4    CATCHMENT
    501.000      ID No.ó 99999
      1.570      Area in hectares
    102.000      Length (PERV) metres
      1.000      Gradient (%)
     70.000      Per cent Impervious
    102.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .182      2.144       .988       .000 c.m/s
             .236       .874       .683     C perv/imperv/total
15    ADD RUNOFF
             .182      2.317       .988       .000 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
          0      No. of sub-reaches
             .182      2.317      2.317       .000 c.m/s
35    COMMENT
   3     line(s) of comment
      *****************
      FLOW D/S OF RICE RD CULVERT - OUTLET A2
      *****************
17    COMBINE
   1     Junction Node No.
             .182      2.317      2.317      3.502 c.m/s
14    START
   1     1=Zero; 2=Define
35    COMMENT
   3     line(s) of comment
      *****************
      PROP DEVELOPMENT SOUTH OF QUAKER RD - QUALLITY CONTROL ONLY
      *****************
 4    CATCHMENT
     20.100      ID No.ó 99999
```

```
      .780     Area in hectares
    72.000     Length (PERV) metres
     1.000     Gradient (%)
    35.000     Per cent Impervious
    72.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .049      .000     2.317     3.502 c.m/s
            .236      .873      .459     C perv/imperv/total
15   ADD RUNOFF
            .049      .049     2.317     3.502 c.m/s
 4   CATCHMENT
    20.000     ID No.ó 99999
     3.210     Area in hectares
   146.000     Length (PERV) metres
     1.000     Gradient (%)
    85.000     Per cent Impervious
   146.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .452      .049     2.317     3.502 c.m/s
            .236      .866      .772     C perv/imperv/total
15   ADD RUNOFF
            .452      .494     2.317     3.502 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .452      .494      .494     3.502 c.m/s
17   COMBINE
     1     Junction Node No.
            .452      .494      .494     3.996 c.m/s
14   START
     1     1=Zero; 2=Define
18   CONFLUENCE
     1     Junction Node No.
            .452     3.996      .494      .000 c.m/s
35   COMMENT
     3     line(s) of comment
     *****************
     REALIGNED CHANNEL - SEGMENT 2
     *****************
 4   CATCHMENT
   200.000     ID No.ó 99999
      .970     Area in hectares
    80.416     Length (PERV) metres
     1.000     Gradient (%)
    10.000     Per cent Impervious
    80.416     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .019     3.996      .494      .000 c.m/s
            .236      .875      .299     C perv/imperv/total
35   COMMENT
     3     line(s) of comment
     *****************
     FLOW D/S OF AREA A20 - OUTLET B
     *****************
15   ADD RUNOFF
            .019     4.015      .494      .000 c.m/s
35   COMMENT
     3     line(s) of comment
     ************************
     EX RES. AND FUT DEVELOPMENT LANDS BY OTHERS WEST OF FIRST AV
     ************************
 4   CATCHMENT
    21.000     ID No.ó 99999
    35.460     Area in hectares
   487.000     Length (PERV) metres
      .200     Gradient (%)
     5.000     Per cent Impervious
   487.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .229     4.015      .494      .000 c.m/s
            .236      .884      .268     C perv/imperv/total
15   ADD RUNOFF
            .229     4.202      .494      .000 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .229     4.202     4.202      .000 c.m/s
```

```
35   COMMENT
     3     line(s) of comment
     ************************
     FLOW U/S OF FIRST AVE CULVERT
     ************************
17   COMBINE
     1     Junction Node No.
            .229     4.202     4.202     4.202 c.m/s
14   START
     1     1=Zero; 2=Define
35   COMMENT
     3     line(s) of comment
     ***********
     PROP DEVELOPMENT SOUTH OF QUAKER, EAST OF RICE - POND P50
     ***********
 4   CATCHMENT
    52.000     ID No.ó 99999
     6.430     Area in hectares
   207.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   207.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .768      .000     4.202     4.202 c.m/s
            .236      .880      .687     C perv/imperv/total
15   ADD RUNOFF
            .768      .768     4.202     4.202 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .768      .768      .768     4.202 c.m/s
17   COMBINE
     2     Junction Node No.
            .768      .768      .768      .768 c.m/s
14   START
     1     1=Zero; 2=Define
 4   CATCHMENT
    53.000     ID No.ó 99999
    11.340     Area in hectares
   275.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   275.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           1.397      .000      .768      .768 c.m/s
            .236      .886      .691     C perv/imperv/total
15   ADD RUNOFF
           1.397     1.397      .768      .768 c.m/s
 9   ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
           1.397     1.397     1.397      .768 c.m/s
17   COMBINE
     2     Junction Node No.
           1.397     1.397     1.397     2.165 c.m/s
18   CONFLUENCE
     2     Junction Node No.
           1.397     2.165     1.397      .000 c.m/s
 4   CATCHMENT
    54.000     ID No.ó 99999
     1.280     Area in hectares
    92.000     Length (PERV) metres
     1.000     Gradient (%)
    60.000     Per cent Impervious
    92.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .131     2.165     1.397      .000 c.m/s
            .236      .876      .620     C perv/imperv/total
15   ADD RUNOFF
            .131     2.285     1.397      .000 c.m/s
27   HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
     Volume  =  .5982220E+04 c.m
10   POND
     6 Depth - Discharge - Volume sets
     182.000       .000         .0
     182.800      .0190       5251.0
     183.150      .0230       7895.0
     183.500       .238      10751.0
     183.800       .396      13425.0
     184.000      1.028      15337.0
     Peak Outflow    =      .020 c.m/s
     Maximum Depth   =   182.848 metres
```

```
      Maximum Storage =     5617. c.m
              .131      2.285       .020       .000 c.m/s
17    COMBINE
    2     Junction Node No.
              .131      2.285       .020       .020 c.m/s
14    START
    1     1=Zero; 2=Define
35    COMMENT
    3     line(s) of comment
      ***********************
      EXISTING AREA ON QUAKER RD, EAST OF RICE RD
      ***********************
 4    CATCHMENT
    5.000      ID No.ó 99999
    1.870      Area in hectares
  112.000      Length (PERV) metres
    1.000      Gradient (%)
   50.000      Per cent Impervious
  112.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
     .100      Ia/S Coefficient
    8.924      Initial Abstraction
        1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .153       .000       .020       .020 c.m/s
              .236       .873       .554     C perv/imperv/total
15    ADD RUNOFF
              .153       .153       .020       .020 c.m/s
 9    ROUTE
     .000      Conduit Length
     .000      No Conduit defined
     .000      Zero lag
     .000      Beta weighting factor
     .000      Routing timestep
        0      No. of sub-reaches
              .153       .153       .153       .020 c.m/s
17    COMBINE
    2     Junction Node No.
              .153       .153       .153       .160 c.m/s
18    CONFLUENCE
    2     Junction Node No.
              .153       .160       .153       .000 c.m/s
35    COMMENT
    3     line(s) of comment
      ***********************
      EXISTING AREA ON QUAKER RD, EAST OF RICE RD
      ***********************
 4    CATCHMENT
    6.000      ID No.ó 99999
    1.920      Area in hectares
  113.000      Length (PERV) metres
     .200      Gradient (%)
   65.000      Per cent Impervious
  113.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
     .100      Ia/S Coefficient
    8.924      Initial Abstraction
        1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .214       .160       .153       .000 c.m/s
              .236       .886       .658     C perv/imperv/total
15    ADD RUNOFF
              .214       .374       .153       .000 c.m/s
35    COMMENT
    3     line(s) of comment
      ***********
      FIRST AVE FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
      ***********
 4    CATCHMENT
  201.000      ID No.ó 99999
    2.430      Area in hectares
  127.000      Length (PERV) metres
    1.000      Gradient (%)
   65.000      Per cent Impervious
  127.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
     .100      Ia/S Coefficient
    8.924      Initial Abstraction
        1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .259       .374       .153       .000 c.m/s
              .236       .868       .647     C perv/imperv/total
15    ADD RUNOFF
              .259       .632       .153       .000 c.m/s
 9    ROUTE
     .000      Conduit Length
     .000      No Conduit defined
     .000      Zero lag
     .000      Beta weighting factor
     .000      Routing timestep
        0      No. of sub-reaches
              .259       .632       .632       .000 c.m/s
17    COMBINE
    1     Junction Node No.
              .259       .632       .632      4.834 c.m/s
35    COMMENT
    3     line(s) of comment
      ***********************
      FLOW D/S OF FIRST AVE CULVERT - OUTLET C
      ***********************
18    CONFLUENCE
    1     Junction Node No.
              .259      4.834       .632       .000 c.m/s
```

```
35    COMMENT
    3     line(s) of comment
      ***********
      REALIGNED CHANNEL - SEGMENT 3
      ***********
 4    CATCHMENT
  300.000      ID No.ó 99999
    3.180      Area in hectares
  146.000      Length (PERV) metres
     .200      Gradient (%)
   15.000      Per cent Impervious
  146.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
     .100      Ia/S Coefficient
    8.924      Initial Abstraction
        1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .087      4.834       .632       .000 c.m/s
              .236       .880       .332     C perv/imperv/total
15    ADD RUNOFF
              .087      4.921       .632       .000 c.m/s
 4    CATCHMENT
  301.000      ID No.ó 99999
     .720      Area in hectares
   69.000      Length (PERV) metres
     .200      Gradient (%)
   10.000      Per cent Impervious
   69.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
     .100      Ia/S Coefficient
    8.924      Initial Abstraction
        1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .014      4.921       .632       .000 c.m/s
              .236       .869       .299     C perv/imperv/total
15    ADD RUNOFF
              .014      4.935       .632       .000 c.m/s
 9    ROUTE
     .000      Conduit Length
     .000      No Conduit defined
     .000      Zero lag
     .000      Beta weighting factor
     .000      Routing timestep
        0      No. of sub-reaches
              .014      4.935      4.935       .000 c.m/s
17    COMBINE
    1     Junction Node No.
              .014      4.935      4.935      4.935 c.m/s
14    START
    1     1=Zero; 2=Define
35    COMMENT
    3     line(s) of comment
      ***********
      PROP DEVELOPMENT NORTH OF SEGMENT 3 - POND P30
      ***********
 4    CATCHMENT
   30.000      ID No.ó 99999
    8.470      Area in hectares
  238.000      Length (PERV) metres
     .200      Gradient (%)
     .100      Per cent Impervious
  238.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
     .100      Ia/S Coefficient
    8.924      Initial Abstraction
        1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .057       .000      4.935      4.935 c.m/s
              .236       .885       .236     C perv/imperv/total
15    ADD RUNOFF
              .057       .057      4.935      4.935 c.m/s
 4    CATCHMENT
   31.000      ID No.ó 99999
   10.420      Area in hectares
  264.000      Length (PERV) metres
    1.000      Gradient (%)
   75.000      Per cent Impervious
  264.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
     .100      Ia/S Coefficient
    8.924      Initial Abstraction
        1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             1.333       .057      4.935      4.935 c.m/s
              .236       .886       .723     C perv/imperv/total
15    ADD RUNOFF
             1.333      1.341      4.935      4.935 c.m/s
27    HYDROGRAPH DISPLAY
    5     is # of Hyeto/Hydrograph chosen
      Volume  =  .4376407E+04 c.m
 4    CATCHMENT
   32.000      ID No.ó 99999
     .690      Area in hectares
   68.000      Length (PERV) metres
    1.000      Gradient (%)
   60.000      Per cent Impervious
   68.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
```

```
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .074      1.341      4.935      4.935 c.m/s
             .236       .873       .618     C perv/imperv/total
15     ADD RUNOFF
             .074      1.401      4.935      4.935 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .4571937E+04 c.m
10     POND
       5 Depth - Discharge - Volume sets
       178.800        .000          .0
       179.300       .0260      1520.0
       180.100       .0440      4649.0
       180.600        .414      7069.0
       180.800       1.204      8137.0
       Peak Outflow    =      .038 c.m/s
       Maximum Depth   =   179.851 metres
       Maximum Storage =     3675. c.m
             .074      1.401       .038      4.935 c.m/s
17     COMBINE
      1     Junction Node No.
             .074      1.401       .038      4.958 c.m/s
14     START
      1     1=Zero; 2=Define
35     COMMENT
      3     line(s) of comment
       ***********
       PROP DEVELOPMENT SOUTH OF SEGMENT 3 - POND P31
       ***********
 4     CATCHMENT
      33.000     ID No.ó 99999
      12.960     Area in hectares
     294.000     Length (PERV) metres
       1.000     Gradient (%)
      75.000     Per cent Impervious
     294.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.708       .000       .038      4.958 c.m/s
             .236       .884       .722     C perv/imperv/total
15     ADD RUNOFF
            1.708      1.708       .038      4.958 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .4291300E+04 c.m
 4     CATCHMENT
      34.000     ID No.ó 99999
        .660     Area in hectares
      66.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      66.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .072      1.708       .038      4.958 c.m/s
             .235       .873       .618     C perv/imperv/total
15     ADD RUNOFF
             .072      1.765       .038      4.958 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .4478340E+04 c.m
10     POND
      6 Depth - Discharge - Volume sets
       178.300        .000          .0
       178.900       .0350      1927.0
       179.600       .0540      4692.0
       179.800        .150      5590.0
       180.000        .321      6538.0
       180.300       1.922      8059.0
       Peak Outflow    =      .048 c.m/s
       Maximum Depth   =   179.388 metres
       Maximum Storage =     3856. c.m
             .072      1.765       .048      4.958 c.m/s
17     COMBINE
      1     Junction Node No.
             .072      1.765       .048      4.986 c.m/s
14     START
      1     1=Zero; 2=Define
18     CONFLUENCE
      1     Junction Node No.
             .072      4.986       .048       .000 c.m/s
35     COMMENT
      3     line(s) of comment
       ***********************
       REALIGNED CHANNEL - SEGMENT 3
       ***********************
 4     CATCHMENT
     302.000     ID No.ó 99999
       1.610     Area in hectares
     104.000     Length (PERV) metres
        .200     Gradient (%)
      10.000     Per cent Impervious
     104.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .030      4.986       .048       .000 c.m/s
             .236       .884       .301     C perv/imperv/total
35     COMMENT
      3     line(s) of comment
       ***************************
       FLOW U/S OF NIAGARA ST CULVERT - OUTLET D
       ***************************
15     ADD RUNOFF
             .030      5.016       .048       .000 c.m/s
14     START
      1     1=Zero; 2=Define
```

```
35    COMMENT
     3     line(s) of comment
      ************************************************************
      10-YEAR STORM EVENT
      ************************************************************
 2    STORM
         1      1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    860.000     Coefficient  a
      6.500     Constant  b    (min)
       .763     Exponent  c
       .450     Fraction to peak  r
    240.000     Duration ó  240 min
              51.471 mm     Total depth
 3    IMPERVIOUS
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015     Manning "n"
     98.000     SCS Curve No or C
       .100     Ia/S Coefficient
       .518     Initial Abstraction
35    COMMENT
     3     line(s) of comment
      *******************
      EXISTING RES. WEST OF SEGMENT 1
      *******************
 4    CATCHMENT
      1.000     ID No.ó 99999
     17.520     Area in hectares
    343.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    343.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           1.227       .000       .000       .000 c.m/s
            .267       .892       .486     C perv/imperv/total
15    ADD RUNOFF
           1.227      1.227       .000       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      *****************
      REALIGNED CHANNEL - SEGMENT 1
      *****************
 4    CATCHMENT
    100.000     ID No.ó 99999
      2.020     Area in hectares
    116.000     Length (PERV) metres
       .400     Gradient (%)
     15.000     Per cent Impervious
    116.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .063      1.227       .000       .000 c.m/s
            .267       .883       .359     C perv/imperv/total
35    COMMENT
     3     line(s) of comment
      *****************
      FLOW AT FUT ROADWAY CULVERT - SEGMENT 1
      *****************
15    ADD RUNOFF
            .063      1.290       .000       .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
         0      No. of sub-reaches
            .063      1.290      1.290       .000 c.m/s
17    COMBINE
     1     Junction Node No.
            .063      1.290      1.290      1.290 c.m/s
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      *****************
      PROP DEVELOPMENT NORTH OF SEGMENT 1 - POND P10
      *****************
 4    CATCHMENT
     10.000     ID No.ó 99999
      4.050     Area in hectares
    164.000     Length (PERV) metres
      1.000     Gradient (%)
     70.000     Per cent Impervious
    164.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .531       .000      1.290      1.290 c.m/s
            .267       .879       .695     C perv/imperv/total
15    ADD RUNOFF
            .531       .531      1.290      1.290 c.m/s
 4    CATCHMENT
     11.000     ID No.ó 99999
      1.000     Area in hectares
     82.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
     82.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .024       .531      1.290      1.290 c.m/s
            .267       .886       .329     C perv/imperv/total
15    ADD RUNOFF
            .024       .555      1.290      1.290 c.m/s
10    POND
     6 Depth - Discharge - Volume sets
      184.800        .000          .0
      185.750       .0210         1.0
      186.000       .0230       503.0
      186.250       .0260      1091.0
      186.500       .0280      1765.0
      186.700      1.244       2370.0
      Peak Outflow    =      .026 c.m/s
      Maximum Depth   =  186.301 metres
      Maximum Storage =     1229. c.m
            .024       .555       .026      1.290 c.m/s
17    COMBINE
     1     Junction Node No.
            .024       .555       .026      1.313 c.m/s
14    START
     1     1=Zero; 2=Define
18    CONFLUENCE
     1     Junction Node No.
            .024      1.313       .026       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      *****************
      REALIGNED CHANNEL - SEGMENT 1
      *****************
 4    CATCHMENT
    101.000     ID No.ó 99999
       .610     Area in hectares
     64.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
     64.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .016      1.313       .026       .000 c.m/s
            .266       .884       .328     C perv/imperv/total
15    ADD RUNOFF
            .016      1.329       .026       .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
         0      No. of sub-reaches
            .016      1.329      1.329       .000 c.m/s
17    COMBINE
     1     Junction Node No.
            .016      1.329      1.329      1.329 c.m/s
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      *****************
      PROP DEVELOPMENT SOUTH OF SEGMENT 1 - POND P11
      *****************
 4    CATCHMENT
     12.000     ID No.ó 99999
      2.680     Area in hectares
    134.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    134.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .178       .000      1.329      1.329 c.m/s
            .267       .880       .481     C perv/imperv/total
15    ADD RUNOFF
            .178       .178      1.329      1.329 c.m/s
 4    CATCHMENT
     13.000     ID No.ó 99999
      6.980     Area in hectares
    216.000     Length (PERV) metres
      1.000     Gradient (%)
     70.000     Per cent Impervious
    216.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .933       .178      1.329      1.329 c.m/s
```

```
           .267       .890       .703     C perv/imperv/total
15    ADD RUNOFF
           .933      1.112      1.329      1.329 c.m/s
 4    CATCHMENT
     14.000      ID No.ó 99999
       .670      Area in hectares
     67.000      Length (PERV) metres
      1.000      Gradient (%)
     60.000      Per cent Impervious
     67.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .083      1.112      1.329      1.329 c.m/s
           .267       .884       .637     C perv/imperv/total
15    ADD RUNOFF
           .083      1.177      1.329      1.329 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .3408792E+04 c.m
10    POND
     5 Depth - Discharge - Volume sets
      184.800        .000          .0
      185.300       .0140      1142.0
      186.100       .0240      3519.0
      186.500        .287      4978.0
      186.800       1.922      6222.0
      Peak Outflow    =       .022 c.m/s
      Maximum Depth   =   185.947 metres
      Maximum Storage =     3066. c.m
           .083      1.177       .022      1.329 c.m/s
35    COMMENT
     3     line(s) of comment
      *****************
      FLOW U/S OF RICE RD CULVERT - OUTLET A1
      *****************
17    COMBINE
     1     Junction Node No.
           .083      1.177       .022      1.344 c.m/s
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      ***********************
      PROP DEVELOPMENT SOUTH OF QUAKER RD & WEST OF RICE RD. - PON
      ***********************
 4    CATCHMENT
     40.000      ID No.ó 99999
      8.210      Area in hectares
    234.000      Length (PERV) metres
      1.000      Gradient (%)
     25.000      Per cent Impervious
    234.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .408       .000       .022      1.344 c.m/s
           .267       .894       .423     C perv/imperv/total
15    ADD RUNOFF
           .408       .408       .022      1.344 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
         0       No. of sub-reaches
           .408       .408       .408      1.344 c.m/s
17    COMBINE
     2     Junction Node No.
           .408       .408       .408       .408 c.m/s
14    START
     1     1=Zero; 2=Define
 4    CATCHMENT
     41.000      ID No.ó 99999
       .690      Area in hectares
     68.000      Length (PERV) metres
      1.000      Gradient (%)
     35.000      Per cent Impervious
     68.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .051       .000       .408       .408 c.m/s
           .267       .884       .483     C perv/imperv/total
15    ADD RUNOFF
           .051       .051       .408       .408 c.m/s
 4    CATCHMENT
     42.000      ID No.ó 99999
     12.640      Area in hectares
    290.000      Length (PERV) metres
      1.000      Gradient (%)
     70.000      Per cent Impervious
    290.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.695       .051       .408       .408 c.m/s
           .267       .897       .708     C perv/imperv/total
15    ADD RUNOFF
          1.695      1.737       .408       .408 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
         0       No. of sub-reaches
          1.695      1.737      1.737       .408 c.m/s
17    COMBINE
     2     Junction Node No.
          1.695      1.737      1.737      2.145 c.m/s
14    START
     1     1=Zero; 2=Define
 4    CATCHMENT
     43.000      ID No.ó 99999
       .330      Area in hectares
     47.000      Length (PERV) metres
      1.000      Gradient (%)
     35.000      Per cent Impervious
     47.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .026       .000      1.737      2.145 c.m/s
           .266       .885       .483     C perv/imperv/total
15    ADD RUNOFF
           .026       .026      1.737      2.145 c.m/s
 4    CATCHMENT
     44.000      ID No.ó 99999
      6.400      Area in hectares
    207.000      Length (PERV) metres
      1.000      Gradient (%)
     70.000      Per cent Impervious
    207.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .854       .026      1.737      2.145 c.m/s
           .267       .887       .701     C perv/imperv/total
15    ADD RUNOFF
           .854       .874      1.737      2.145 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
         0       No. of sub-reaches
           .854       .874       .874      2.145 c.m/s
17    COMBINE
     2     Junction Node No.
           .854       .874       .874      3.019 c.m/s
14    START
     1     1=Zero; 2=Define
18    CONFLUENCE
     2     Junction Node No.
           .854      3.019       .874       .000 c.m/s
 4    CATCHMENT
     45.000      ID No.ó 99999
      1.030      Area in hectares
     83.000      Length (PERV) metres
      1.000      Gradient (%)
     60.000      Per cent Impervious
     83.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
         1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
         1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .122      3.019       .874       .000 c.m/s
           .267       .886       .638     C perv/imperv/total
15    ADD RUNOFF
           .122      3.124       .874       .000 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .9292279E+04 c.m
10    POND
     6 Depth - Discharge - Volume sets
      186.000        .000          .0
      186.800       .0550      4048.0
      187.300       .0730      7091.0
      187.500        .170      8424.0
      187.800        .257     10552.0
      188.000        .880     12094.0
      Peak Outflow    =       .129 c.m/s
      Maximum Depth   =   187.415 metres
      Maximum Storage =     7854. c.m
           .122      3.124       .129       .000 c.m/s
17    COMBINE
     2     Junction Node No.
           .122      3.124       .129       .129 c.m/s
```

```
14    START
   1     1=Zero; 2=Define
35    COMMENT
   3     line(s) of comment
      ***********************
      EXISTING AREA ON QUAKER RD, WEST OF RICE RD
      ***********************
 4    CATCHMENT
     2.000     ID No.ó 99999
     9.020     Area in hectares
   245.000     Length (PERV) metres
     1.000     Gradient (%)
    40.000     Per cent Impervious
   245.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .702       .000       .129       .129 c.m/s
           .267       .895       .518     C perv/imperv/total
15    ADD RUNOFF
           .702       .702       .129       .129 c.m/s
 9    ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
           .702       .702       .702       .129 c.m/s
17    COMBINE
   2     Junction Node No.
           .702       .702       .702       .745 c.m/s
14    START
   1     1=Zero; 2=Define
18    CONFLUENCE
   2     Junction Node No.
           .702       .745       .702       .000 c.m/s
35    COMMENT
   3     line(s) of comment
      ***********************
      EXISTING AREA ON QUAKER RD, WEST OF RICE RD
      ***********************
 4    CATCHMENT
     3.000     ID No.ó 99999
     5.680     Area in hectares
   195.000     Length (PERV) metres
     1.000     Gradient (%)
    40.000     Per cent Impervious
   195.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .440       .745       .702       .000 c.m/s
           .267       .885       .514     C perv/imperv/total
15    ADD RUNOFF
           .440      1.185       .702       .000 c.m/s
 9    ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
           .440      1.185      1.185       .000 c.m/s
17    COMBINE
   2     Junction Node No.
           .440      1.185      1.185      1.185 c.m/s
14    START
   1     1=Zero; 2=Define
35    COMMENT
   3     line(s) of comment
      ***********************
      PROP DEVELOPMENT SOUTH OF QUAKER RD, EAST OF RICE RD
      ***********************
 4    CATCHMENT
    50.000     ID No.ó 99999
     3.420     Area in hectares
   151.000     Length (PERV) metres
     1.000     Gradient (%)
    10.000     Per cent Impervious
   151.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .077       .000      1.185      1.185 c.m/s
           .267       .875       .328     C perv/imperv/total
15    ADD RUNOFF
           .077       .077      1.185      1.185 c.m/s
 4    CATCHMENT
    51.000     ID No.ó 99999
     1.980     Area in hectares
   115.000     Length (PERV) metres
     1.000     Gradient (%)
    10.000     Per cent Impervious
   115.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .046       .077      1.185      1.185 c.m/s
           .267       .885       .328     C perv/imperv/total
15    ADD RUNOFF
           .046       .123      1.185      1.185 c.m/s
 9    ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
           .046       .123       .123      1.185 c.m/s
17    COMBINE
   2     Junction Node No.
           .046       .123       .123      1.308 c.m/s
14    START
   1     1=Zero; 2=Define
35    COMMENT
   3     line(s) of comment
      ***********************
      EXISTING AREA WEST OF RICE RD AND SOUTH OF QUAKER ROAD
      ***********************
 4    CATCHMENT
     4.000     ID No.ó 99999
    13.940     Area in hectares
   305.000     Length (PERV) metres
     1.000     Gradient (%)
    40.000     Per cent Impervious
   305.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.115       .000       .123      1.308 c.m/s
           .267       .896       .518     C perv/imperv/total
15    ADD RUNOFF
          1.115      1.115       .123      1.308 c.m/s
 9    ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
          1.115      1.115      1.115      1.308 c.m/s
17    COMBINE
   2     Junction Node No.
          1.115      1.115      1.115      2.423 c.m/s
14    START
   1     1=Zero; 2=Define
18    CONFLUENCE
   2     Junction Node No.
          1.115      2.423      1.115       .000 c.m/s
35    COMMENT
   3     line(s) of comment
      *****************
      RICE ROAD FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
      *****************
 4    CATCHMENT
   501.000     ID No.ó 99999
     1.570     Area in hectares
   102.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   102.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .209      2.423      1.115       .000 c.m/s
           .267       .886       .700     C perv/imperv/total
15    ADD RUNOFF
           .209      2.615      1.115       .000 c.m/s
 9    ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
           .209      2.615      2.615       .000 c.m/s
35    COMMENT
   3     line(s) of comment
      *****************
      FLOW D/S OF RICE RD CULVERT - OUTLET A2
      *****************
17    COMBINE
   1     Junction Node No.
           .209      2.615      2.615      3.959 c.m/s
14    START
   1     1=Zero; 2=Define
35    COMMENT
   3     line(s) of comment
      *****************
      PROP DEVELOPMENT SOUTH OF QUAKER RD - QUALLITY CONTROL ONLY
      *****************
 4    CATCHMENT
    20.100     ID No.ó 99999
```

```
      .780     Area in hectares
    72.000     Length (PERV) metres
     1.000     Gradient (%)
    35.000     Per cent Impervious
    72.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .057       .000      2.615      3.959 c.m/s
            .267       .884       .483     C perv/imperv/total
15    ADD RUNOFF
            .057       .057      2.615      3.959 c.m/s
 4    CATCHMENT
    20.000     ID No.ó 99999
     3.210     Area in hectares
   146.000     Length (PERV) metres
     1.000     Gradient (%)
    85.000     Per cent Impervious
   146.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .500       .057      2.615      3.959 c.m/s
            .267       .877       .785     C perv/imperv/total
15    ADD RUNOFF
            .500       .549      2.615      3.959 c.m/s
 9    ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .500       .549       .549      3.959 c.m/s
17    COMBINE
     1     Junction Node No.
            .500       .549       .549      4.508 c.m/s
14    START
     1     1=Zero; 2=Define
18    CONFLUENCE
     1     Junction Node No.
            .500      4.508       .549       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      *****************
      REALIGNED CHANNEL - SEGMENT 2
      *****************
 4    CATCHMENT
   200.000     ID No.ó 99999
      .970     Area in hectares
    80.416     Length (PERV) metres
     1.000     Gradient (%)
    10.000     Per cent Impervious
    80.416     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .024      4.508       .549       .000 c.m/s
            .267       .886       .328     C perv/imperv/total
35    COMMENT
     3     line(s) of comment
      *****************
      FLOW D/S OF AREA A20 - OUTLET B
      *****************
15    ADD RUNOFF
            .024      4.532       .549       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      ************************
      EX RES. AND FUT DEVELOPMENT LANDS BY OTHERS WEST OF FIRST AV
      ************************
 4    CATCHMENT
    21.000     ID No.ó 99999
    35.460     Area in hectares
   487.000     Length (PERV) metres
      .200     Gradient (%)
     5.000     Per cent Impervious
   487.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .269      4.532       .549       .000 c.m/s
            .267       .897       .298     C perv/imperv/total
15    ADD RUNOFF
            .269      4.762       .549       .000 c.m/s
 9    ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .269      4.762      4.762       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      ************************
      FLOW U/S OF FIRST AVE CULVERT
      ************************
17    COMBINE
     1     Junction Node No.
            .269      4.762      4.762      4.762 c.m/s
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      ***********
      PROP DEVELOPMENT SOUTH OF QUAKER, EAST OF RICE - POND P50
      ***********
 4    CATCHMENT
    52.000     ID No.ó 99999
     6.430     Area in hectares
   207.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   207.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .858       .000      4.762      4.762 c.m/s
            .267       .887       .701     C perv/imperv/total
15    ADD RUNOFF
            .858       .858      4.762      4.762 c.m/s
 9    ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .858       .858       .858      4.762 c.m/s
17    COMBINE
     2     Junction Node No.
            .858       .858       .858       .858 c.m/s
14    START
     1     1=Zero; 2=Define
 4    CATCHMENT
    53.000     ID No.ó 99999
    11.340     Area in hectares
   275.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   275.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           1.523       .000       .858       .858 c.m/s
            .267       .897       .708     C perv/imperv/total
15    ADD RUNOFF
           1.523      1.523       .858       .858 c.m/s
 9    ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
           1.523      1.523      1.523       .858 c.m/s
17    COMBINE
     2     Junction Node No.
           1.523      1.523      1.523      2.381 c.m/s
18    CONFLUENCE
     2     Junction Node No.
           1.523      2.381      1.523       .000 c.m/s
 4    CATCHMENT
    54.000     ID No.ó 99999
     1.280     Area in hectares
    92.000     Length (PERV) metres
     1.000     Gradient (%)
    60.000     Per cent Impervious
    92.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .149      2.381      1.523       .000 c.m/s
            .267       .887       .639     C perv/imperv/total
15    ADD RUNOFF
            .149      2.514      1.523       .000 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .6870401E+04 c.m
10    POND
     6 Depth - Discharge - Volume sets
      182.000        .000          .0
      182.800       .0190      5251.0
      183.150       .0230      7895.0
      183.500        .238     10751.0
      183.800        .396     13425.0
      184.000       1.028     15337.0
      Peak Outflow    =      .021 c.m/s
      Maximum Depth   =   182.962 metres
```

```
      Maximum Storage =     6474. c.m
            .149      2.514      .021       .000 c.m/s
17    COMBINE
   2    Junction Node No.
            .149      2.514      .021       .021 c.m/s
14    START
   1    1=Zero; 2=Define
35    COMMENT
   3    line(s) of comment
      ************************
      EXISTING AREA ON QUAKER RD, EAST OF RICE RD
      ************************
 4    CATCHMENT
    5.000     ID No.ó 99999
    1.870     Area in hectares
  112.000     Length (PERV) metres
    1.000     Gradient (%)
   50.000     Per cent Impervious
  112.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .175       .000      .021       .021 c.m/s
            .267       .885      .576     C perv/imperv/total
15    ADD RUNOFF
            .175       .175      .021       .021 c.m/s
 9    ROUTE
     .000     Conduit Length
     .000     No Conduit defined
     .000     Zero lag
     .000     Beta weighting factor
     .000     Routing timestep
        0     No. of sub-reaches
            .175       .175      .175       .021 c.m/s
17    COMBINE
   2    Junction Node No.
            .175       .175      .175       .180 c.m/s
18    CONFLUENCE
   2    Junction Node No.
            .175       .180      .175       .000 c.m/s
35    COMMENT
   3    line(s) of comment
      ************************
      EXISTING AREA ON QUAKER RD, EAST OF RICE RD
      ************************
 4    CATCHMENT
    6.000     ID No.ó 99999
    1.920     Area in hectares
  113.000     Length (PERV) metres
     .200     Gradient (%)
   65.000     Per cent Impervious
  113.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .240       .180      .175       .000 c.m/s
            .267       .896      .676     C perv/imperv/total
15    ADD RUNOFF
            .240       .418      .175       .000 c.m/s
35    COMMENT
   3    line(s) of comment
      ***********
      FIRST AVE FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
      ***********
 4    CATCHMENT
  201.000     ID No.ó 99999
    2.430     Area in hectares
  127.000     Length (PERV) metres
    1.000     Gradient (%)
   65.000     Per cent Impervious
  127.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .287       .418      .175       .000 c.m/s
            .267       .882      .667     C perv/imperv/total
15    ADD RUNOFF
            .287       .705      .175       .000 c.m/s
 9    ROUTE
     .000     Conduit Length
     .000     No Conduit defined
     .000     Zero lag
     .000     Beta weighting factor
     .000     Routing timestep
        0     No. of sub-reaches
            .287       .705      .705       .000 c.m/s
17    COMBINE
   1    Junction Node No.
            .287       .705      .705      5.467 c.m/s
35    COMMENT
   3    line(s) of comment
      ************************
      FLOW D/S OF FIRST AVE CULVERT - OUTLET C
      ************************
18    CONFLUENCE
   1    Junction Node No.
            .287      5.467      .705       .000 c.m/s
```

```
35    COMMENT
   3    line(s) of comment
      ***********
      REALIGNED CHANNEL - SEGMENT 3
      ***********
 4    CATCHMENT
  300.000     ID No.ó 99999
    3.180     Area in hectares
  146.000     Length (PERV) metres
     .200     Gradient (%)
   15.000     Per cent Impervious
  146.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .099      5.467      .705       .000 c.m/s
            .267       .894      .361     C perv/imperv/total
15    ADD RUNOFF
            .099      5.566      .705       .000 c.m/s
 4    CATCHMENT
  301.000     ID No.ó 99999
     .720     Area in hectares
   69.000     Length (PERV) metres
     .200     Gradient (%)
   10.000     Per cent Impervious
   69.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .016      5.566      .705       .000 c.m/s
            .267       .876      .328     C perv/imperv/total
15    ADD RUNOFF
            .016      5.582      .705       .000 c.m/s
 9    ROUTE
     .000     Conduit Length
     .000     No Conduit defined
     .000     Zero lag
     .000     Beta weighting factor
     .000     Routing timestep
        0     No. of sub-reaches
            .016      5.582     5.582       .000 c.m/s
17    COMBINE
   1    Junction Node No.
            .016      5.582     5.582      5.582 c.m/s
14    START
   1    1=Zero; 2=Define
35    COMMENT
   3    line(s) of comment
      ***********
      PROP DEVELOPMENT NORTH OF SEGMENT 3 - POND P30
      ***********
 4    CATCHMENT
   30.000     ID No.ó 99999
    8.470     Area in hectares
  238.000     Length (PERV) metres
     .200     Gradient (%)
     .100     Per cent Impervious
  238.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .077       .000     5.582      5.582 c.m/s
            .267       .896      .267     C perv/imperv/total
15    ADD RUNOFF
            .077       .077     5.582      5.582 c.m/s
 4    CATCHMENT
   31.000     ID No.ó 99999
   10.420     Area in hectares
  264.000     Length (PERV) metres
    1.000     Gradient (%)
   75.000     Per cent Impervious
  264.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           1.498       .077     5.582      5.582 c.m/s
            .267       .897      .739     C perv/imperv/total
15    ADD RUNOFF
           1.498      1.509     5.582      5.582 c.m/s
27    HYDROGRAPH DISPLAY
   5    is # of Hyeto/Hydrograph chosen
      Volume  =  .5129908E+04 c.m
 4    CATCHMENT
   32.000     ID No.ó 99999
     .690     Area in hectares
   68.000     Length (PERV) metres
    1.000     Gradient (%)
   60.000     Per cent Impervious
   68.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
```

```
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .085      1.509      5.582      5.582 c.m/s
             .267       .884       .637     C perv/imperv/total
15     ADD RUNOFF
             .085      1.576      5.582      5.582 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .5356146E+04 c.m
10     POND
      5 Depth - Discharge - Volume sets
       178.800        .000          .0
       179.300       .0260      1520.0
       180.100       .0440      4649.0
       180.600        .414      7069.0
       180.800       1.204      8137.0
       Peak Outflow    =      .042 c.m/s
       Maximum Depth   =   180.027 metres
       Maximum Storage =     4365. c.m
             .085      1.576       .042      5.582 c.m/s
17     COMBINE
      1     Junction Node No.
             .085      1.576       .042      5.608 c.m/s
14     START
      1     1=Zero; 2=Define
35     COMMENT
      3     line(s) of comment
       ***********
       PROP DEVELOPMENT SOUTH OF SEGMENT 3 - POND P31
       ***********
 4     CATCHMENT
      33.000     ID No.ó 99999
      12.960     Area in hectares
     294.000     Length (PERV) metres
       1.000     Gradient (%)
      75.000     Per cent Impervious
     294.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.919       .000       .042      5.608 c.m/s
             .267       .897       .739     C perv/imperv/total
15     ADD RUNOFF
            1.919      1.919       .042      5.608 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .4931688E+04 c.m
 4     CATCHMENT
      34.000     ID No.ó 99999
        .660     Area in hectares
      66.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      66.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .082      1.919       .042      5.608 c.m/s
             .267       .884       .637     C perv/imperv/total
15     ADD RUNOFF
             .082      1.983       .042      5.608 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .5148061E+04 c.m
10     POND
      6 Depth - Discharge - Volume sets
       178.300        .000          .0
       178.900       .0350      1927.0
       179.600       .0540      4692.0
       179.800        .150      5590.0
       180.000        .321      6538.0
       180.300       1.922      8059.0
       Peak Outflow    =      .052 c.m/s
       Maximum Depth   =   179.543 metres
       Maximum Storage =     4465. c.m
             .082      1.983       .052      5.608 c.m/s
17     COMBINE
      1     Junction Node No.
             .082      1.983       .052      5.642 c.m/s
14     START
      1     1=Zero; 2=Define
18     CONFLUENCE
      1     Junction Node No.
             .082      5.642       .052       .000 c.m/s
35     COMMENT
      3     line(s) of comment
       ***********************
       REALIGNED CHANNEL - SEGMENT 3
       ***********************
 4     CATCHMENT
     302.000     ID No.ó 99999
       1.610     Area in hectares
     104.000     Length (PERV) metres
        .200     Gradient (%)
      10.000     Per cent Impervious
     104.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
```

```
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .035      5.642       .052       .000 c.m/s
             .267       .893       .329     C perv/imperv/total
35     COMMENT
      3     line(s) of comment
       ****************************
       FLOW U/S OF NIAGARA ST CULVERT - OUTLET D
       ****************************
15     ADD RUNOFF
             .035      5.677       .052       .000 c.m/s
14     START
      1     1=Zero; 2=Define
```

```
35    COMMENT
     3     line(s) of comment
      *************************************************************
      25-YEAR STORM EVENT
      *************************************************************
 2    STORM
         1      1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    900.000     Coefficient  a
      5.200     Constant  b    (min)
       .745     Exponent  c
       .450     Fraction to peak  r
    240.000     Duration ó  240 min
              59.713 mm     Total depth
 3    IMPERVIOUS
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .015     Manning "n"
     98.000     SCS Curve No or C
       .100     Ia/S Coefficient
       .518     Initial Abstraction
35    COMMENT
     3     line(s) of comment
      *******************
      EXISTING RES. WEST OF SEGMENT 1
      *******************
 4    CATCHMENT
      1.000     ID No.ó 99999
     17.520     Area in hectares
    343.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    343.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.445       .000       .000       .000 c.m/s
           .308       .909       .518     C perv/imperv/total
15    ADD RUNOFF
          1.445      1.445       .000       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      *****************
      REALIGNED CHANNEL - SEGMENT 1
      *****************
 4    CATCHMENT
    100.000     ID No.ó 99999
      2.020     Area in hectares
    116.000     Length (PERV) metres
       .400     Gradient (%)
     15.000     Per cent Impervious
    116.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .077      1.445       .000       .000 c.m/s
           .308       .891       .396     C perv/imperv/total
35    COMMENT
     3     line(s) of comment
      *****************
      FLOW AT FUT ROADWAY CULVERT - SEGMENT 1
      *****************
15    ADD RUNOFF
           .077      1.522       .000       .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
         0      No. of sub-reaches
           .077      1.522      1.522       .000 c.m/s
17    COMBINE
     1     Junction Node No.
           .077      1.522      1.522      1.522 c.m/s
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      *****************
      PROP DEVELOPMENT NORTH OF SEGMENT 1 - POND P10
      *****************
 4    CATCHMENT
     10.000     ID No.ó 99999
      4.050     Area in hectares
    164.000     Length (PERV) metres
      1.000     Gradient (%)
     70.000     Per cent Impervious
    164.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .612       .000      1.522      1.522 c.m/s
           .308       .889       .715     C perv/imperv/total
15    ADD RUNOFF
           .612       .612      1.522      1.522 c.m/s
 4    CATCHMENT
     11.000     ID No.ó 99999
      1.000     Area in hectares
```

```
     82.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
     82.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .033       .612      1.522      1.522 c.m/s
           .308       .898       .367     C perv/imperv/total
15    ADD RUNOFF
           .033       .644      1.522      1.522 c.m/s
10    POND
     6 Depth - Discharge - Volume sets
      184.800        .000          .0
      185.750       .0210         1.0
      186.000       .0230       503.0
      186.250       .0260      1091.0
      186.500       .0280      1765.0
      186.700      1.244      2370.0
      Peak Outflow    =      .027 c.m/s
      Maximum Depth   =   186.413 metres
      Maximum Storage =     1531. c.m
           .033       .644       .027      1.522 c.m/s
17    COMBINE
     1     Junction Node No.
           .033       .644       .027      1.546 c.m/s
14    START
     1     1=Zero; 2=Define
18    CONFLUENCE
     1     Junction Node No.
           .033      1.546       .027       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      *****************
      REALIGNED CHANNEL - SEGMENT 1
      *****************
 4    CATCHMENT
    101.000     ID No.ó 99999
       .610     Area in hectares
     64.000     Length (PERV) metres
      1.000     Gradient (%)
     10.000     Per cent Impervious
     64.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .023      1.546       .027       .000 c.m/s
           .308       .899       .367     C perv/imperv/total
15    ADD RUNOFF
           .023      1.567       .027       .000 c.m/s
 9    ROUTE
       .000     Conduit Length
       .000     No Conduit defined
       .000     Zero lag
       .000     Beta weighting factor
       .000     Routing timestep
         0      No. of sub-reaches
           .023      1.567      1.567       .000 c.m/s
17    COMBINE
     1     Junction Node No.
           .023      1.567      1.567      1.567 c.m/s
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      *****************
      PROP DEVELOPMENT SOUTH OF SEGMENT 1 - POND P11
      *****************
 4    CATCHMENT
     12.000     ID No.ó 99999
      2.680     Area in hectares
    134.000     Length (PERV) metres
      1.000     Gradient (%)
     35.000     Per cent Impervious
    134.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .209       .000      1.567      1.567 c.m/s
           .308       .897       .514     C perv/imperv/total
15    ADD RUNOFF
           .209       .209      1.567      1.567 c.m/s
 4    CATCHMENT
     13.000     ID No.ó 99999
      6.980     Area in hectares
    216.000     Length (PERV) metres
      1.000     Gradient (%)
     70.000     Per cent Impervious
    216.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.083       .209      1.567      1.567 c.m/s
```

```
          .308       .897       .721     C perv/imperv/total
15    ADD RUNOFF
         1.083      1.292      1.567      1.567 c.m/s
 4    CATCHMENT
     14.000      ID No.ó 99999
       .670      Area in hectares
     67.000      Length (PERV) metres
      1.000      Gradient (%)
     60.000      Per cent Impervious
     67.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .099      1.292      1.567      1.567 c.m/s
          .308       .898       .662     C perv/imperv/total
15    ADD RUNOFF
          .099      1.367      1.567      1.567 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .4091430E+04 c.m
10    POND
     5 Depth - Discharge - Volume sets
      184.800        .000          .0
      185.300       .0140      1142.0
      186.100       .0240      3519.0
      186.500        .287      4978.0
      186.800       1.922      6222.0
      Peak Outflow    =       .048 c.m/s
      Maximum Depth   =   186.136 metres
      Maximum Storage =     3650. c.m
          .099      1.367       .048      1.567 c.m/s
35    COMMENT
     3     line(s) of comment
      *****************
      FLOW U/S OF RICE RD CULVERT - OUTLET A1
      *****************
17    COMBINE
     1     Junction Node No.
          .099      1.367       .048      1.583 c.m/s
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      ***********************
      PROP DEVELOPMENT SOUTH OF QUAKER RD & WEST OF RICE RD. - PON
      ***********************
 4    CATCHMENT
     40.000      ID No.ó 99999
      8.210      Area in hectares
    234.000      Length (PERV) metres
      1.000      Gradient (%)
     25.000      Per cent Impervious
    234.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .484       .000       .048      1.583 c.m/s
          .308       .902       .457     C perv/imperv/total
15    ADD RUNOFF
          .484       .484       .048      1.583 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
          0      No. of sub-reaches
          .484       .484       .484      1.583 c.m/s
17    COMBINE
     2     Junction Node No.
          .484       .484       .484       .484 c.m/s
14    START
     1     1=Zero; 2=Define
 4    CATCHMENT
     41.000      ID No.ó 99999
       .690      Area in hectares
     68.000      Length (PERV) metres
      1.000      Gradient (%)
     35.000      Per cent Impervious
     68.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .061       .000       .484       .484 c.m/s
          .308       .898       .515     C perv/imperv/total
15    ADD RUNOFF
          .061       .061       .484       .484 c.m/s
 4    CATCHMENT
     42.000      ID No.ó 99999
     12.640      Area in hectares
    290.000      Length (PERV) metres
      1.000      Gradient (%)
     70.000      Per cent Impervious
    290.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.980       .061       .484       .484 c.m/s
          .308       .910       .729     C perv/imperv/total
15    ADD RUNOFF
         1.980      2.030       .484       .484 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
          0      No. of sub-reaches
         1.980      2.030      2.030       .484 c.m/s
17    COMBINE
     2     Junction Node No.
         1.980      2.030      2.030      2.514 c.m/s
14    START
     1     1=Zero; 2=Define
 4    CATCHMENT
     43.000      ID No.ó 99999
       .330      Area in hectares
     47.000      Length (PERV) metres
      1.000      Gradient (%)
     35.000      Per cent Impervious
     47.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .031       .000      2.030      2.514 c.m/s
          .308       .898       .515     C perv/imperv/total
15    ADD RUNOFF
          .031       .031      2.030      2.514 c.m/s
 4    CATCHMENT
     44.000      ID No.ó 99999
      6.400      Area in hectares
    207.000      Length (PERV) metres
      1.000      Gradient (%)
     70.000      Per cent Impervious
    207.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .990       .031      2.030      2.514 c.m/s
          .308       .896       .719     C perv/imperv/total
15    ADD RUNOFF
          .990      1.014      2.030      2.514 c.m/s
 9    ROUTE
       .000      Conduit Length
       .000      No Conduit defined
       .000      Zero lag
       .000      Beta weighting factor
       .000      Routing timestep
          0      No. of sub-reaches
          .990      1.014      1.014      2.514 c.m/s
17    COMBINE
     2     Junction Node No.
          .990      1.014      1.014      3.528 c.m/s
14    START
     1     1=Zero; 2=Define
18    CONFLUENCE
     2     Junction Node No.
          .990      3.528      1.014       .000 c.m/s
 4    CATCHMENT
     45.000      ID No.ó 99999
      1.030      Area in hectares
     83.000      Length (PERV) metres
      1.000      Gradient (%)
     60.000      Per cent Impervious
     83.000      Length (IMPERV)
       .000      %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250      Manning "n"
     74.000      SCS Curve No or C
       .100      Ia/S Coefficient
      8.924      Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .147      3.528      1.014       .000 c.m/s
          .308       .899       .662     C perv/imperv/total
15    ADD RUNOFF
          .147      3.648      1.014       .000 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .1120983E+05 c.m
10    POND
     6 Depth - Discharge - Volume sets
      186.000        .000          .0
      186.800       .0550      4048.0
      187.300       .0730      7091.0
      187.500        .170      8424.0
      187.800        .257     10552.0
      188.000        .880     12094.0
      Peak Outflow    =       .198 c.m/s
      Maximum Depth   =   187.598 metres
      Maximum Storage =     9121. c.m
          .147      3.648       .198       .000 c.m/s
17    COMBINE
     2     Junction Node No.
          .147      3.648       .198       .198 c.m/s
```

```
14    START
   1    1=Zero; 2=Define
35    COMMENT
   3    line(s) of comment
      ***********************
      EXISTING AREA ON QUAKER RD, WEST OF RICE RD
      ***********************
 4    CATCHMENT
    2.000     ID No.ó 99999
    9.020     Area in hectares
  245.000     Length (PERV) metres
    1.000     Gradient (%)
   40.000     Per cent Impervious
  245.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .824       .000       .198       .198 c.m/s
           .308       .904       .547     C perv/imperv/total
15    ADD RUNOFF
           .824       .824       .198       .198 c.m/s
 9    ROUTE
     .000     Conduit Length
     .000     No Conduit defined
     .000     Zero lag
     .000     Beta weighting factor
     .000     Routing timestep
        0     No. of sub-reaches
           .824       .824       .824       .198 c.m/s
17    COMBINE
   2    Junction Node No.
           .824       .824       .824       .877 c.m/s
14    START
   1    1=Zero; 2=Define
18    CONFLUENCE
   2    Junction Node No.
           .824       .877       .824       .000 c.m/s
35    COMMENT
   3    line(s) of comment
      ***********************
      EXISTING AREA ON QUAKER RD, WEST OF RICE RD
      ***********************
 4    CATCHMENT
    3.000     ID No.ó 99999
    5.680     Area in hectares
  195.000     Length (PERV) metres
    1.000     Gradient (%)
   40.000     Per cent Impervious
  195.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .515       .877       .824       .000 c.m/s
           .308       .894       .543     C perv/imperv/total
15    ADD RUNOFF
           .515      1.392       .824       .000 c.m/s
 9    ROUTE
     .000     Conduit Length
     .000     No Conduit defined
     .000     Zero lag
     .000     Beta weighting factor
     .000     Routing timestep
        0     No. of sub-reaches
           .515      1.392      1.392       .000 c.m/s
17    COMBINE
   2    Junction Node No.
           .515      1.392      1.392      1.392 c.m/s
14    START
   1    1=Zero; 2=Define
35    COMMENT
   3    line(s) of comment
      ***********************
      PROP DEVELOPMENT SOUTH OF QUAKER RD, EAST OF RICE RD
      ***********************
 4    CATCHMENT
   50.000     ID No.ó 99999
    3.420     Area in hectares
  151.000     Length (PERV) metres
    1.000     Gradient (%)
   10.000     Per cent Impervious
  151.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .097       .000      1.392      1.392 c.m/s
           .308       .892       .367     C perv/imperv/total
15    ADD RUNOFF
           .097       .097      1.392      1.392 c.m/s
 4    CATCHMENT
   51.000     ID No.ó 99999
    1.980     Area in hectares
  115.000     Length (PERV) metres
    1.000     Gradient (%)
   10.000     Per cent Impervious
  115.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
```

```
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .059       .097      1.392      1.392 c.m/s
           .308       .899       .367     C perv/imperv/total
15    ADD RUNOFF
           .059       .156      1.392      1.392 c.m/s
 9    ROUTE
     .000     Conduit Length
     .000     No Conduit defined
     .000     Zero lag
     .000     Beta weighting factor
     .000     Routing timestep
        0     No. of sub-reaches
           .059       .156       .156      1.392 c.m/s
17    COMBINE
   2    Junction Node No.
           .059       .156       .156      1.548 c.m/s
14    START
   1    1=Zero; 2=Define
35    COMMENT
   3    line(s) of comment
      ***********************
      EXISTING AREA WEST OF RICE RD AND SOUTH OF QUAKER ROAD
      ***********************
 4    CATCHMENT
    4.000     ID No.ó 99999
   13.940     Area in hectares
  305.000     Length (PERV) metres
    1.000     Gradient (%)
   40.000     Per cent Impervious
  305.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.270       .000       .156      1.548 c.m/s
           .308       .910       .549     C perv/imperv/total
15    ADD RUNOFF
          1.270      1.270       .156      1.548 c.m/s
 9    ROUTE
     .000     Conduit Length
     .000     No Conduit defined
     .000     Zero lag
     .000     Beta weighting factor
     .000     Routing timestep
        0     No. of sub-reaches
          1.270      1.270      1.270      1.548 c.m/s
17    COMBINE
   2    Junction Node No.
          1.270      1.270      1.270      2.818 c.m/s
14    START
   1    1=Zero; 2=Define
18    CONFLUENCE
   2    Junction Node No.
          1.270      2.818      1.270       .000 c.m/s
35    COMMENT
   3    line(s) of comment
      *****************
      RICE ROAD FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
      *****************
 4    CATCHMENT
  501.000     ID No.ó 99999
    1.570     Area in hectares
  102.000     Length (PERV) metres
    1.000     Gradient (%)
   70.000     Per cent Impervious
  102.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .250      2.818      1.270       .000 c.m/s
           .308       .901       .723     C perv/imperv/total
15    ADD RUNOFF
           .250      3.038      1.270       .000 c.m/s
 9    ROUTE
     .000     Conduit Length
     .000     No Conduit defined
     .000     Zero lag
     .000     Beta weighting factor
     .000     Routing timestep
        0     No. of sub-reaches
           .250      3.038      3.038       .000 c.m/s
35    COMMENT
   3    line(s) of comment
      *****************
      FLOW D/S OF RICE RD CULVERT - OUTLET A2
      *****************
17    COMBINE
   1    Junction Node No.
           .250      3.038      3.038      4.621 c.m/s
14    START
   1    1=Zero; 2=Define
35    COMMENT
   3    line(s) of comment
      *****************
      PROP DEVELOPMENT SOUTH OF QUAKER RD - QUALLITY CONTROL ONLY
      *****************
 4    CATCHMENT
   20.100     ID No.ó 99999
```

```
     .780     Area in hectares
   72.000     Length (PERV) metres
    1.000     Gradient (%)
   35.000     Per cent Impervious
   72.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .068       .000      3.038      4.621 c.m/s
           .308       .897       .514     C perv/imperv/total
15     ADD RUNOFF
           .068       .068      3.038      4.621 c.m/s
 4     CATCHMENT
   20.000     ID No.ó 99999
    3.210     Area in hectares
  146.000     Length (PERV) metres
    1.000     Gradient (%)
   85.000     Per cent Impervious
  146.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .575       .068      3.038      4.621 c.m/s
           .308       .893       .806     C perv/imperv/total
15     ADD RUNOFF
           .575       .639      3.038      4.621 c.m/s
 9     ROUTE
     .000     Conduit Length
     .000     No Conduit defined
     .000     Zero lag
     .000     Beta weighting factor
     .000     Routing timestep
        0     No. of sub-reaches
           .575       .639       .639      4.621 c.m/s
17     COMBINE
    1     Junction Node No.
           .575       .639       .639      5.253 c.m/s
14     START
    1     1=Zero; 2=Define
18     CONFLUENCE
    1     Junction Node No.
           .575      5.253       .639       .000 c.m/s
35     COMMENT
    3     line(s) of comment
       *****************
       REALIGNED CHANNEL - SEGMENT 2
       *****************
 4     CATCHMENT
  200.000     ID No.ó 99999
     .970     Area in hectares
   80.416     Length (PERV) metres
    1.000     Gradient (%)
   10.000     Per cent Impervious
   80.416     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .032      5.253       .639       .000 c.m/s
           .308       .898       .367     C perv/imperv/total
35     COMMENT
    3     line(s) of comment
       *****************
       FLOW D/S OF AREA A20 - OUTLET B
       *****************
15     ADD RUNOFF
           .032      5.284       .639       .000 c.m/s
35     COMMENT
    3     line(s) of comment
       ************************
       EX RES. AND FUT DEVELOPMENT LANDS BY OTHERS WEST OF FIRST AV
       ************************
 4     CATCHMENT
   21.000     ID No.ó 99999
   35.460     Area in hectares
  487.000     Length (PERV) metres
     .200     Gradient (%)
    5.000     Per cent Impervious
  487.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .338      5.284       .639       .000 c.m/s
           .308       .911       .339     C perv/imperv/total
15     ADD RUNOFF
           .338      5.586       .639       .000 c.m/s
 9     ROUTE
     .000     Conduit Length
     .000     No Conduit defined
     .000     Zero lag
     .000     Beta weighting factor
     .000     Routing timestep
        0     No. of sub-reaches
           .338      5.586      5.586       .000 c.m/s
35     COMMENT
    3     line(s) of comment
       ************************
       FLOW U/S OF FIRST AVE CULVERT
       ************************
17     COMBINE
    1     Junction Node No.
           .338      5.586      5.586      5.586 c.m/s
14     START
    1     1=Zero; 2=Define
35     COMMENT
    3     line(s) of comment
       ***********
       PROP DEVELOPMENT SOUTH OF QUAKER, EAST OF RICE - POND P50
       ***********
 4     CATCHMENT
   52.000     ID No.ó 99999
    6.430     Area in hectares
  207.000     Length (PERV) metres
    1.000     Gradient (%)
   70.000     Per cent Impervious
  207.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .995       .000      5.586      5.586 c.m/s
           .308       .896       .719     C perv/imperv/total
15     ADD RUNOFF
           .995       .995      5.586      5.586 c.m/s
 9     ROUTE
     .000     Conduit Length
     .000     No Conduit defined
     .000     Zero lag
     .000     Beta weighting factor
     .000     Routing timestep
        0     No. of sub-reaches
           .995       .995       .995      5.586 c.m/s
17     COMBINE
    2     Junction Node No.
           .995       .995       .995       .995 c.m/s
14     START
    1     1=Zero; 2=Define
 4     CATCHMENT
   53.000     ID No.ó 99999
   11.340     Area in hectares
  275.000     Length (PERV) metres
    1.000     Gradient (%)
   70.000     Per cent Impervious
  275.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          1.776       .000       .995       .995 c.m/s
           .308       .908       .728     C perv/imperv/total
15     ADD RUNOFF
          1.776      1.776       .995       .995 c.m/s
 9     ROUTE
     .000     Conduit Length
     .000     No Conduit defined
     .000     Zero lag
     .000     Beta weighting factor
     .000     Routing timestep
        0     No. of sub-reaches
          1.776      1.776      1.776       .995 c.m/s
17     COMBINE
    2     Junction Node No.
          1.776      1.776      1.776      2.771 c.m/s
18     CONFLUENCE
    2     Junction Node No.
          1.776      2.771      1.776       .000 c.m/s
 4     CATCHMENT
   54.000     ID No.ó 99999
    1.280     Area in hectares
   92.000     Length (PERV) metres
    1.000     Gradient (%)
   60.000     Per cent Impervious
   92.000     Length (IMPERV)
     .000     %Imp. with Zero Dpth
        1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250     Manning "n"
   74.000     SCS Curve No or C
     .100     Ia/S Coefficient
    8.924     Initial Abstraction
        1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .179      2.771      1.776       .000 c.m/s
           .308       .900       .663     C perv/imperv/total
15     ADD RUNOFF
           .179      2.924      1.776       .000 c.m/s
27     HYDROGRAPH DISPLAY
    5     is # of Hyeto/Hydrograph chosen
       Volume  =  .8196629E+04 c.m
10     POND
    6 Depth - Discharge - Volume sets
       182.000        .000          .0
       182.800       .0190      5251.0
       183.150       .0230      7895.0
       183.500        .238     10751.0
       183.800        .396     13425.0
       184.000       1.028     15337.0
       Peak Outflow    =      .023 c.m/s
       Maximum Depth   =   183.132 metres
```

```
       Maximum Storage =     7762. c.m
              .179      2.924       .023       .000 c.m/s
17     COMBINE
     2     Junction Node No.
              .179      2.924       .023       .023 c.m/s
14     START
     1     1=Zero; 2=Define
35     COMMENT
     3     line(s) of comment
       ***********************
       EXISTING AREA ON QUAKER RD, EAST OF RICE RD
       ***********************
 4     CATCHMENT
       5.000     ID No.ó 99999
       1.870     Area in hectares
     112.000     Length (PERV) metres
       1.000     Gradient (%)
      50.000     Per cent Impervious
     112.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .211       .000       .023       .023 c.m/s
              .308       .900       .604     C perv/imperv/total
15     ADD RUNOFF
              .211       .211       .023       .023 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .211       .211       .211       .023 c.m/s
17     COMBINE
     2     Junction Node No.
              .211       .211       .211       .217 c.m/s
18     CONFLUENCE
     2     Junction Node No.
              .211       .217       .211       .000 c.m/s
35     COMMENT
     3     line(s) of comment
       ***********************
       EXISTING AREA ON QUAKER RD, EAST OF RICE RD
       ***********************
 4     CATCHMENT
       6.000     ID No.ó 99999
       1.920     Area in hectares
     113.000     Length (PERV) metres
        .200     Gradient (%)
      65.000     Per cent Impervious
     113.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .279       .217       .211       .000 c.m/s
              .308       .906       .697     C perv/imperv/total
15     ADD RUNOFF
              .279       .486       .211       .000 c.m/s
35     COMMENT
     3     line(s) of comment
       ***********
       FIRST AVE FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
       ***********
 4     CATCHMENT
     201.000     ID No.ó 99999
       2.430     Area in hectares
     127.000     Length (PERV) metres
       1.000     Gradient (%)
      65.000     Per cent Impervious
     127.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .344       .486       .211       .000 c.m/s
              .308       .898       .692     C perv/imperv/total
15     ADD RUNOFF
              .344       .816       .211       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .344       .816       .816       .000 c.m/s
17     COMBINE
     1     Junction Node No.
              .344       .816       .816      6.402 c.m/s
35     COMMENT
     3     line(s) of comment
       ***********************
       FLOW D/S OF FIRST AVE CULVERT - OUTLET C
       ***********************
18     CONFLUENCE
     1     Junction Node No.
              .344      6.402       .816       .000 c.m/s
35     COMMENT
     3     line(s) of comment
       ***********
       REALIGNED CHANNEL - SEGMENT 3
       ***********
 4     CATCHMENT
     300.000     ID No.ó 99999
       3.180     Area in hectares
     146.000     Length (PERV) metres
        .200     Gradient (%)
      15.000     Per cent Impervious
     146.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .119      6.402       .816       .000 c.m/s
              .308       .910       .399     C perv/imperv/total
15     ADD RUNOFF
              .119      6.521       .816       .000 c.m/s
 4     CATCHMENT
     301.000     ID No.ó 99999
        .720     Area in hectares
      69.000     Length (PERV) metres
        .200     Gradient (%)
      10.000     Per cent Impervious
      69.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .020      6.521       .816       .000 c.m/s
              .308       .892       .367     C perv/imperv/total
15     ADD RUNOFF
              .020      6.541       .816       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
           0     No. of sub-reaches
              .020      6.541      6.541       .000 c.m/s
17     COMBINE
     1     Junction Node No.
              .020      6.541      6.541      6.541 c.m/s
14     START
     1     1=Zero; 2=Define
35     COMMENT
     3     line(s) of comment
       ***********
       PROP DEVELOPMENT NORTH OF SEGMENT 3 - POND P30
       ***********
 4     CATCHMENT
      30.000     ID No.ó 99999
       8.470     Area in hectares
     238.000     Length (PERV) metres
        .200     Gradient (%)
        .100     Per cent Impervious
     238.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .113       .000      6.541      6.541 c.m/s
              .308       .906       .309     C perv/imperv/total
15     ADD RUNOFF
              .113       .113      6.541      6.541 c.m/s
 4     CATCHMENT
      31.000     ID No.ó 99999
      10.420     Area in hectares
     264.000     Length (PERV) metres
       1.000     Gradient (%)
      75.000     Per cent Impervious
     264.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
           1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             1.743       .113      6.541      6.541 c.m/s
              .308       .907       .758     C perv/imperv/total
15     ADD RUNOFF
             1.743      1.763      6.541      6.541 c.m/s
27     HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
       Volume  =  .6276292E+04 c.m
 4     CATCHMENT
      32.000     ID No.ó 99999
        .690     Area in hectares
      68.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      68.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
           1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
```

```
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .102      1.763      6.541      6.541 c.m/s
              .308       .898       .662     C perv/imperv/total
15     ADD RUNOFF
              .102      1.840      6.541      6.541 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .6549078E+04 c.m
10     POND
       5 Depth - Discharge - Volume sets
       178.800        .000          .0
       179.300       .0260      1520.0
       180.100       .0440      4649.0
       180.600        .414      7069.0
       180.800       1.204      8137.0
       Peak Outflow    =      .114 c.m/s
       Maximum Depth   =   180.194 metres
       Maximum Storage =     5104. c.m
              .102      1.840       .114      6.541 c.m/s
17     COMBINE
      1     Junction Node No.
              .102      1.840       .114      6.569 c.m/s
14     START
      1     1=Zero; 2=Define
35     COMMENT
      3     line(s) of comment
       ***********
       PROP DEVELOPMENT SOUTH OF SEGMENT 3 - POND P31
       ***********
 4     CATCHMENT
      33.000     ID No.ó 99999
      12.960     Area in hectares
     294.000     Length (PERV) metres
       1.000     Gradient (%)
      75.000     Per cent Impervious
     294.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             2.171       .000       .114      6.569 c.m/s
              .308       .910       .759     C perv/imperv/total
15     ADD RUNOFF
             2.171      2.171       .114      6.569 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .5876996E+04 c.m
 4     CATCHMENT
      34.000     ID No.ó 99999
        .660     Area in hectares
      66.000     Length (PERV) metres
       1.000     Gradient (%)
      60.000     Per cent Impervious
      66.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .098      2.171       .114      6.569 c.m/s
              .308       .898       .662     C perv/imperv/total
15     ADD RUNOFF
              .098      2.245       .114      6.569 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .6138025E+04 c.m
10     POND
      6 Depth - Discharge - Volume sets
       178.300        .000          .0
       178.900       .0350      1927.0
       179.600       .0540      4692.0
       179.800        .150      5590.0
       180.000        .321      6538.0
       180.300       1.922      8059.0
       Peak Outflow    =      .107 c.m/s
       Maximum Depth   =   179.709 metres
       Maximum Storage =     5183. c.m
              .098      2.245       .107      6.569 c.m/s
17     COMBINE
      1     Junction Node No.
              .098      2.245       .107      6.606 c.m/s
14     START
      1     1=Zero; 2=Define
18     CONFLUENCE
      1     Junction Node No.
              .098      6.606       .107       .000 c.m/s
35     COMMENT
      3     line(s) of comment
       ************************
       REALIGNED CHANNEL - SEGMENT 3
       ************************
 4     CATCHMENT
     302.000     ID No.ó 99999
       1.610     Area in hectares
     104.000     Length (PERV) metres
        .200     Gradient (%)
      10.000     Per cent Impervious
     104.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
              .043      6.606       .107       .000 c.m/s
              .308       .901       .368     C perv/imperv/total
35     COMMENT
      3     line(s) of comment
       ****************************
       FLOW U/S OF NIAGARA ST CULVERT - OUTLET D
       ****************************
15     ADD RUNOFF
              .043      6.649       .107       .000 c.m/s
14     START
      1     1=Zero; 2=Define
```

```
35     COMMENT
     3     line(s) of comment
       ************************************************************
       100-YEAR STORM EVENT
       ************************************************************
 2     STORM
          1      1=Chicago;2=Huff;3=User;4=Cdn1hr;5=Historic
    1020.000     Coefficient  a
       4.700     Constant  b    (min)
        .731     Exponent  c
        .450     Fraction to peak  r
     240.000     Duration ó  240 min
              73.203 mm     Total depth
 3     IMPERVIOUS
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .015     Manning "n"
      98.000     SCS Curve No or C
        .100     Ia/S Coefficient
        .518     Initial Abstraction
35     COMMENT
     3     line(s) of comment
       *******************
       EXISTING RES. WEST OF SEGMENT 1
       *******************
 4     CATCHMENT
       1.000     ID No.ó 99999
      17.520     Area in hectares
     343.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     343.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.731       .000       .000       .000 c.m/s
             .368       .925       .563     C perv/imperv/total
15     ADD RUNOFF
            1.731      1.731       .000       .000 c.m/s
35     COMMENT
     3     line(s) of comment
       *****************
       REALIGNED CHANNEL - SEGMENT 1
       *****************
 4     CATCHMENT
     100.000     ID No.ó 99999
       2.020     Area in hectares
     116.000     Length (PERV) metres
        .400     Gradient (%)
      15.000     Per cent Impervious
     116.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .101      1.731       .000       .000 c.m/s
             .368       .905       .448     C perv/imperv/total
35     COMMENT
     3     line(s) of comment
       *****************
       FLOW AT FUT ROADWAY CULVERT - SEGMENT 1
       *****************
15     ADD RUNOFF
             .101      1.832       .000       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0      No. of sub-reaches
             .101      1.832      1.832       .000 c.m/s
17     COMBINE
     1     Junction Node No.
             .101      1.832      1.832      1.832 c.m/s
14     START
     1     1=Zero; 2=Define
35     COMMENT
     3     line(s) of comment
       *****************
       PROP DEVELOPMENT NORTH OF SEGMENT 1 - POND P10
       *****************
 4     CATCHMENT
      10.000     ID No.ó 99999
       4.050     Area in hectares
     164.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     164.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .735       .000      1.832      1.832 c.m/s
             .367       .909       .747     C perv/imperv/total
15     ADD RUNOFF
             .735       .735      1.832      1.832 c.m/s
 4     CATCHMENT
      11.000     ID No.ó 99999
       1.000     Area in hectares
```

```
      82.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
      82.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .054       .735      1.832      1.832 c.m/s
             .367       .912       .422     C perv/imperv/total
15     ADD RUNOFF
             .054       .783      1.832      1.832 c.m/s
10     POND
      6 Depth - Discharge - Volume sets
       184.800        .000          .0
       185.750       .0210         1.0
       186.000       .0230       503.0
       186.250       .0260      1091.0
       186.500       .0280      1765.0
       186.700      1.244       2370.0
       Peak Outflow    =      .105 c.m/s
       Maximum Depth   =   186.513 metres
       Maximum Storage =     1804. c.m
             .054       .783       .105      1.832 c.m/s
17     COMBINE
     1     Junction Node No.
             .054       .783       .105      1.857 c.m/s
14     START
     1     1=Zero; 2=Define
18     CONFLUENCE
     1     Junction Node No.
             .054      1.857       .105       .000 c.m/s
35     COMMENT
     3     line(s) of comment
       *****************
       REALIGNED CHANNEL - SEGMENT 1
       *****************
 4     CATCHMENT
     101.000     ID No.ó 99999
        .610     Area in hectares
      64.000     Length (PERV) metres
       1.000     Gradient (%)
      10.000     Per cent Impervious
      64.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .038      1.857       .105       .000 c.m/s
             .367       .914       .422     C perv/imperv/total
15     ADD RUNOFF
             .038      1.890       .105       .000 c.m/s
 9     ROUTE
        .000     Conduit Length
        .000     No Conduit defined
        .000     Zero lag
        .000     Beta weighting factor
        .000     Routing timestep
          0      No. of sub-reaches
             .038      1.890      1.890       .000 c.m/s
17     COMBINE
     1     Junction Node No.
             .038      1.890      1.890      1.890 c.m/s
14     START
     1     1=Zero; 2=Define
35     COMMENT
     3     line(s) of comment
       *****************
       PROP DEVELOPMENT SOUTH OF SEGMENT 1 - POND P11
       *****************
 4     CATCHMENT
      12.000     ID No.ó 99999
       2.680     Area in hectares
     134.000     Length (PERV) metres
       1.000     Gradient (%)
      35.000     Per cent Impervious
     134.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .262       .000      1.890      1.890 c.m/s
             .367       .914       .559     C perv/imperv/total
15     ADD RUNOFF
             .262       .262      1.890      1.890 c.m/s
 4     CATCHMENT
      13.000     ID No.ó 99999
       6.980     Area in hectares
     216.000     Length (PERV) metres
       1.000     Gradient (%)
      70.000     Per cent Impervious
     216.000     Length (IMPERV)
        .000     %Imp. with Zero Dpth
          1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250     Manning "n"
      74.000     SCS Curve No or C
        .100     Ia/S Coefficient
       8.924     Initial Abstraction
          1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.307       .262      1.890      1.890 c.m/s
```

```
          .368       .908       .746     C perv/imperv/total
15     ADD RUNOFF
         1.307      1.567      1.890      1.890 c.m/s
 4     CATCHMENT
      14.000      ID No.ó 99999
        .670      Area in hectares
      67.000      Length (PERV) metres
       1.000      Gradient (%)
      60.000      Per cent Impervious
      67.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
           1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
           1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .124      1.567      1.890      1.890 c.m/s
          .367       .914       .695     C perv/imperv/total
15     ADD RUNOFF
          .124      1.659      1.890      1.890 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .5247869E+04 c.m
10     POND
      5 Depth - Discharge - Volume sets
       184.800        .000          .0
       185.300       .0140      1142.0
       186.100       .0240      3519.0
       186.500        .287      4978.0
       186.800       1.922      6222.0
       Peak Outflow    =       .143 c.m/s
       Maximum Depth   =   186.281 metres
       Maximum Storage =     4180. c.m
          .124      1.659       .143      1.890 c.m/s
35     COMMENT
      3     line(s) of comment
       *****************
       FLOW U/S OF RICE RD CULVERT - OUTLET A1
       *****************
17     COMBINE
      1     Junction Node No.
          .124      1.659       .143      1.908 c.m/s
14     START
      1     1=Zero; 2=Define
35     COMMENT
      3     line(s) of comment
       ***********************
       PROP DEVELOPMENT SOUTH OF QUAKER RD & WEST OF RICE RD. - PON
       ***********************
 4     CATCHMENT
      40.000      ID No.ó 99999
       8.210      Area in hectares
     234.000      Length (PERV) metres
       1.000      Gradient (%)
      25.000      Per cent Impervious
     234.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
           1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
           1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .607       .000       .143      1.908 c.m/s
          .367       .911       .503     C perv/imperv/total
15     ADD RUNOFF
          .607       .607       .143      1.908 c.m/s
 9     ROUTE
        .000      Conduit Length
        .000      No Conduit defined
        .000      Zero lag
        .000      Beta weighting factor
        .000      Routing timestep
           0      No. of sub-reaches
          .607       .607       .607      1.908 c.m/s
17     COMBINE
      2     Junction Node No.
          .607       .607       .607       .607 c.m/s
14     START
      1     1=Zero; 2=Define
 4     CATCHMENT
      41.000      ID No.ó 99999
        .690      Area in hectares
      68.000      Length (PERV) metres
       1.000      Gradient (%)
      35.000      Per cent Impervious
      68.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
           1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
           1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .078       .000       .607       .607 c.m/s
          .367       .914       .559     C perv/imperv/total
15     ADD RUNOFF
          .078       .078       .607       .607 c.m/s
 4     CATCHMENT
      42.000      ID No.ó 99999
      12.640      Area in hectares
     290.000      Length (PERV) metres
       1.000      Gradient (%)
      70.000      Per cent Impervious
     290.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
           1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
```

```
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
           1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         2.409       .078       .607       .607 c.m/s
          .368       .921       .755     C perv/imperv/total
15     ADD RUNOFF
         2.409      2.475       .607       .607 c.m/s
 9     ROUTE
        .000      Conduit Length
        .000      No Conduit defined
        .000      Zero lag
        .000      Beta weighting factor
        .000      Routing timestep
           0      No. of sub-reaches
         2.409      2.475      2.475       .607 c.m/s
17     COMBINE
      2     Junction Node No.
         2.409      2.475      2.475      3.082 c.m/s
14     START
      1     1=Zero; 2=Define
 4     CATCHMENT
      43.000      ID No.ó 99999
        .330      Area in hectares
      47.000      Length (PERV) metres
       1.000      Gradient (%)
      35.000      Per cent Impervious
      47.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
           1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
           1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .039       .000      2.475      3.082 c.m/s
          .367       .911       .557     C perv/imperv/total
15     ADD RUNOFF
          .039       .039      2.475      3.082 c.m/s
 4     CATCHMENT
      44.000      ID No.ó 99999
       6.400      Area in hectares
     207.000      Length (PERV) metres
       1.000      Gradient (%)
      70.000      Per cent Impervious
     207.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
           1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
           1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
         1.193       .039      2.475      3.082 c.m/s
          .368       .906       .744     C perv/imperv/total
15     ADD RUNOFF
         1.193      1.226      2.475      3.082 c.m/s
 9     ROUTE
        .000      Conduit Length
        .000      No Conduit defined
        .000      Zero lag
        .000      Beta weighting factor
        .000      Routing timestep
           0      No. of sub-reaches
         1.193      1.226      1.226      3.082 c.m/s
17     COMBINE
      2     Junction Node No.
         1.193      1.226      1.226      4.308 c.m/s
14     START
      1     1=Zero; 2=Define
18     CONFLUENCE
      2     Junction Node No.
         1.193      4.308      1.226       .000 c.m/s
 4     CATCHMENT
      45.000      ID No.ó 99999
       1.030      Area in hectares
      83.000      Length (PERV) metres
       1.000      Gradient (%)
      60.000      Per cent Impervious
      83.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
           1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
           1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          .184      4.308      1.226       .000 c.m/s
          .367       .912       .694     C perv/imperv/total
15     ADD RUNOFF
          .184      4.453      1.226       .000 c.m/s
27     HYDROGRAPH DISPLAY
      5     is # of Hyeto/Hydrograph chosen
       Volume  =  .1443723E+05 c.m
10     POND
      6 Depth - Discharge - Volume sets
       186.000        .000          .0
       186.800       .0550      4048.0
       187.300       .0730      7091.0
       187.500        .170      8424.0
       187.800        .257     10552.0
       188.000        .880     12094.0
       Peak Outflow    =       .430 c.m/s
       Maximum Depth   =   187.856 metres
       Maximum Storage =    10981. c.m
          .184      4.453       .430       .000 c.m/s
17     COMBINE
      2     Junction Node No.
          .184      4.453       .430       .430 c.m/s
```

```
14     START
     1     1=Zero; 2=Define
35     COMMENT
     3     line(s) of comment
       **********************
       EXISTING AREA ON QUAKER RD, WEST OF RICE RD
       **********************
 4     CATCHMENT
       2.000      ID No.ó 99999
       9.020      Area in hectares
     245.000      Length (PERV) metres
       1.000      Gradient (%)
      40.000      Per cent Impervious
     245.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.013       .000       .430       .430 c.m/s
             .368       .912       .586     C perv/imperv/total
15     ADD RUNOFF
            1.013      1.013       .430       .430 c.m/s
 9     ROUTE
        .000      Conduit Length
        .000      No Conduit defined
        .000      Zero lag
        .000      Beta weighting factor
        .000      Routing timestep
          0       No. of sub-reaches
            1.013      1.013      1.013       .430 c.m/s
17     COMBINE
     2     Junction Node No.
            1.013      1.013      1.013      1.074 c.m/s
14     START
     1     1=Zero; 2=Define
18     CONFLUENCE
     2     Junction Node No.
            1.013      1.074      1.013       .000 c.m/s
35     COMMENT
     3     line(s) of comment
       **********************
       EXISTING AREA ON QUAKER RD, WEST OF RICE RD
       **********************
 4     CATCHMENT
       3.000      ID No.ó 99999
       5.680      Area in hectares
     195.000      Length (PERV) metres
       1.000      Gradient (%)
      40.000      Per cent Impervious
     195.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .632      1.074      1.013       .000 c.m/s
             .367       .903       .582     C perv/imperv/total
15     ADD RUNOFF
             .632      1.706      1.013       .000 c.m/s
 9     ROUTE
        .000      Conduit Length
        .000      No Conduit defined
        .000      Zero lag
        .000      Beta weighting factor
        .000      Routing timestep
          0       No. of sub-reaches
             .632      1.706      1.706       .000 c.m/s
17     COMBINE
     2     Junction Node No.
             .632      1.706      1.706      1.706 c.m/s
14     START
     1     1=Zero; 2=Define
35     COMMENT
     3     line(s) of comment
       **********************
       PROP DEVELOPMENT SOUTH OF QUAKER RD, EAST OF RICE RD
       **********************
 4     CATCHMENT
      50.000      ID No.ó 99999
       3.420      Area in hectares
     151.000      Length (PERV) metres
       1.000      Gradient (%)
      10.000      Per cent Impervious
     151.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .148       .000      1.706      1.706 c.m/s
             .367       .912       .422     C perv/imperv/total
15     ADD RUNOFF
             .148       .148      1.706      1.706 c.m/s
 4     CATCHMENT
      51.000      ID No.ó 99999
       1.980      Area in hectares
     115.000      Length (PERV) metres
       1.000      Gradient (%)
      10.000      Per cent Impervious
     115.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
```

```
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .092       .148      1.706      1.706 c.m/s
             .368       .916       .422     C perv/imperv/total
15     ADD RUNOFF
             .092       .240      1.706      1.706 c.m/s
 9     ROUTE
        .000      Conduit Length
        .000      No Conduit defined
        .000      Zero lag
        .000      Beta weighting factor
        .000      Routing timestep
          0       No. of sub-reaches
             .092       .240       .240      1.706 c.m/s
17     COMBINE
     2     Junction Node No.
             .092       .240       .240      1.925 c.m/s
14     START
     1     1=Zero; 2=Define
35     COMMENT
     3     line(s) of comment
       **********************
       EXISTING AREA WEST OF RICE RD AND SOUTH OF QUAKER ROAD
       **********************
 4     CATCHMENT
       4.000      ID No.ó 99999
      13.940      Area in hectares
     305.000      Length (PERV) metres
       1.000      Gradient (%)
      40.000      Per cent Impervious
     305.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            1.566       .000       .240      1.925 c.m/s
             .367       .923       .590     C perv/imperv/total
15     ADD RUNOFF
            1.566      1.566       .240      1.925 c.m/s
 9     ROUTE
        .000      Conduit Length
        .000      No Conduit defined
        .000      Zero lag
        .000      Beta weighting factor
        .000      Routing timestep
          0       No. of sub-reaches
            1.566      1.566      1.566      1.925 c.m/s
17     COMBINE
     2     Junction Node No.
            1.566      1.566      1.566      3.491 c.m/s
14     START
     1     1=Zero; 2=Define
18     CONFLUENCE
     2     Junction Node No.
            1.566      3.491      1.566       .000 c.m/s
35     COMMENT
     3     line(s) of comment
       ****************
       RICE ROAD FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
       ****************
 4     CATCHMENT
     501.000      ID No.ó 99999
       1.570      Area in hectares
     102.000      Length (PERV) metres
       1.000      Gradient (%)
      70.000      Per cent Impervious
     102.000      Length (IMPERV)
        .000      %Imp. with Zero Dpth
          1       Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
        .250      Manning "n"
      74.000      SCS Curve No or C
        .100      Ia/S Coefficient
       8.924      Initial Abstraction
          1       Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .314      3.491      1.566       .000 c.m/s
             .367       .915       .751     C perv/imperv/total
15     ADD RUNOFF
             .314      3.754      1.566       .000 c.m/s
 9     ROUTE
        .000      Conduit Length
        .000      No Conduit defined
        .000      Zero lag
        .000      Beta weighting factor
        .000      Routing timestep
          0       No. of sub-reaches
             .314      3.754      3.754       .000 c.m/s
35     COMMENT
     3     line(s) of comment
       ****************
       FLOW D/S OF RICE RD CULVERT - OUTLET A2
       ****************
17     COMBINE
     1     Junction Node No.
             .314      3.754      3.754      5.662 c.m/s
14     START
     1     1=Zero; 2=Define
35     COMMENT
     3     line(s) of comment
       ****************
       PROP DEVELOPMENT SOUTH OF QUAKER RD - QUALLITY CONTROL ONLY
       ****************
 4     CATCHMENT
      20.100      ID No.ó 99999
```

```
      .780     Area in hectares
    72.000     Length (PERV) metres
     1.000     Gradient (%)
    35.000     Per cent Impervious
    72.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .087       .000      3.754      5.662 c.m/s
            .366       .914       .558     C perv/imperv/total
15     ADD RUNOFF
            .087       .087      3.754      5.662 c.m/s
 4     CATCHMENT
    20.000     ID No.ó 99999
     3.210     Area in hectares
   146.000     Length (PERV) metres
     1.000     Gradient (%)
    85.000     Per cent Impervious
   146.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .720       .087      3.754      5.662 c.m/s
            .368       .913       .831     C perv/imperv/total
15     ADD RUNOFF
            .720       .807      3.754      5.662 c.m/s
 9     ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .720       .807       .807      5.662 c.m/s
17     COMBINE
     1     Junction Node No.
            .720       .807       .807      6.417 c.m/s
14     START
     1     1=Zero; 2=Define
18     CONFLUENCE
     1     Junction Node No.
            .720      6.417       .807       .000 c.m/s
35     COMMENT
     3     line(s) of comment
       *****************
       REALIGNED CHANNEL - SEGMENT 2
       *****************
 4     CATCHMENT
   200.000     ID No.ó 99999
      .970     Area in hectares
    80.416     Length (PERV) metres
     1.000     Gradient (%)
    10.000     Per cent Impervious
    80.416     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .053      6.417       .807       .000 c.m/s
            .367       .912       .422     C perv/imperv/total
35     COMMENT
     3     line(s) of comment
       *****************
       FLOW D/S OF AREA A20 - OUTLET B
       *****************
15     ADD RUNOFF
            .053      6.464       .807       .000 c.m/s
35     COMMENT
     3     line(s) of comment
       ************************
       EX RES. AND FUT DEVELOPMENT LANDS BY OTHERS WEST OF FIRST AV
       ************************
 4     CATCHMENT
    21.000     ID No.ó 99999
    35.460     Area in hectares
   487.000     Length (PERV) metres
      .200     Gradient (%)
     5.000     Per cent Impervious
   487.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .559      6.464       .807       .000 c.m/s
            .368       .922       .395     C perv/imperv/total
15     ADD RUNOFF
            .559      6.890       .807       .000 c.m/s
 9     ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
            .559      6.890      6.890       .000 c.m/s
35     COMMENT
     3     line(s) of comment
       ************************
       FLOW U/S OF FIRST AVE CULVERT
       ************************
17     COMBINE
     1     Junction Node No.
             .559      6.890      6.890      6.890 c.m/s
14     START
     1     1=Zero; 2=Define
35     COMMENT
     3     line(s) of comment
       ***********
       PROP DEVELOPMENT SOUTH OF QUAKER, EAST OF RICE - POND P50
       ***********
 4     CATCHMENT
    52.000     ID No.ó 99999
     6.430     Area in hectares
   207.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   207.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           1.198       .000      6.890      6.890 c.m/s
            .368       .906       .744     C perv/imperv/total
15     ADD RUNOFF
           1.198      1.198      6.890      6.890 c.m/s
 9     ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
           1.198      1.198      1.198      6.890 c.m/s
17     COMBINE
     2     Junction Node No.
           1.198      1.198      1.198      1.198 c.m/s
14     START
     1     1=Zero; 2=Define
 4     CATCHMENT
    53.000     ID No.ó 99999
    11.340     Area in hectares
   275.000     Length (PERV) metres
     1.000     Gradient (%)
    70.000     Per cent Impervious
   275.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           2.157       .000      1.198      1.198 c.m/s
            .368       .919       .753     C perv/imperv/total
15     ADD RUNOFF
           2.157      2.157      1.198      1.198 c.m/s
 9     ROUTE
      .000     Conduit Length
      .000     No Conduit defined
      .000     Zero lag
      .000     Beta weighting factor
      .000     Routing timestep
         0     No. of sub-reaches
           2.157      2.157      2.157      1.198 c.m/s
17     COMBINE
     2     Junction Node No.
           2.157      2.157      2.157      3.355 c.m/s
18     CONFLUENCE
     2     Junction Node No.
           2.157      3.355      2.157       .000 c.m/s
 4     CATCHMENT
    54.000     ID No.ó 99999
     1.280     Area in hectares
    92.000     Length (PERV) metres
     1.000     Gradient (%)
    60.000     Per cent Impervious
    92.000     Length (IMPERV)
      .000     %Imp. with Zero Dpth
         1     Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
      .250     Manning "n"
    74.000     SCS Curve No or C
      .100     Ia/S Coefficient
     8.924     Initial Abstraction
         1     Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            .225      3.355      2.157       .000 c.m/s
            .367       .913       .695     C perv/imperv/total
15     ADD RUNOFF
            .225      3.539      2.157       .000 c.m/s
27     HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
       Volume  =  .1040810E+05 c.m
10     POND
     6 Depth - Discharge - Volume sets
       182.000        .000          .0
       182.800       .0190      5251.0
       183.150       .0230      7895.0
       183.500        .238     10751.0
       183.800        .396     13425.0
       184.000       1.028     15337.0
       Peak Outflow    =      .132 c.m/s
       Maximum Depth   =   183.327 metres
```

```
    Maximum Storage =     9342. c.m
           .225      3.539       .132       .000 c.m/s
17   COMBINE
   2     Junction Node No.
           .225      3.539       .132       .132 c.m/s
14   START
   1     1=Zero; 2=Define
35   COMMENT
   3     line(s) of comment
    ***********************
    EXISTING AREA ON QUAKER RD, EAST OF RICE RD
    ***********************
 4   CATCHMENT
    5.000      ID No.ó 99999
    1.870      Area in hectares
  112.000      Length (PERV) metres
    1.000      Gradient (%)
   50.000      Per cent Impervious
  112.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
     .100      Ia/S Coefficient
    8.924      Initial Abstraction
        1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .266       .000       .132       .132 c.m/s
           .367       .916       .642     C perv/imperv/total
15   ADD RUNOFF
           .266       .266       .132       .132 c.m/s
 9   ROUTE
     .000      Conduit Length
     .000      No Conduit defined
     .000      Zero lag
     .000      Beta weighting factor
     .000      Routing timestep
        0      No. of sub-reaches
           .266       .266       .266       .132 c.m/s
17   COMBINE
   2     Junction Node No.
           .266       .266       .266       .274 c.m/s
18   CONFLUENCE
   2     Junction Node No.
           .266       .274       .266       .000 c.m/s
35   COMMENT
   3     line(s) of comment
    ***********************
    EXISTING AREA ON QUAKER RD, EAST OF RICE RD
    ***********************
 4   CATCHMENT
    6.000      ID No.ó 99999
    1.920      Area in hectares
  113.000      Length (PERV) metres
     .200      Gradient (%)
   65.000      Per cent Impervious
  113.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
     .100      Ia/S Coefficient
    8.924      Initial Abstraction
        1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .339       .274       .266       .000 c.m/s
           .368       .914       .723     C perv/imperv/total
15   ADD RUNOFF
           .339       .594       .266       .000 c.m/s
35   COMMENT
   3     line(s) of comment
    ***********
    FIRST AVE FROM QUAKER RD TO CITY OF WELLAND MUNICIPAL BOUNDA
    ***********
 4   CATCHMENT
  201.000      ID No.ó 99999
    2.430      Area in hectares
  127.000      Length (PERV) metres
    1.000      Gradient (%)
   65.000      Per cent Impervious
  127.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
     .100      Ia/S Coefficient
    8.924      Initial Abstraction
        1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .433       .594       .266       .000 c.m/s
           .367       .915       .723     C perv/imperv/total
15   ADD RUNOFF
           .433       .991       .266       .000 c.m/s
 9   ROUTE
     .000      Conduit Length
     .000      No Conduit defined
     .000      Zero lag
     .000      Beta weighting factor
     .000      Routing timestep
        0      No. of sub-reaches
           .433       .991       .991       .000 c.m/s
17   COMBINE
   1     Junction Node No.
           .433       .991       .991      7.881 c.m/s
35   COMMENT
   3     line(s) of comment
    ***********************
    FLOW D/S OF FIRST AVE CULVERT - OUTLET C
    ***********************
18   CONFLUENCE
   1     Junction Node No.
           .433      7.881       .991       .000 c.m/s
```

```
35   COMMENT
   3     line(s) of comment
    ***********
    REALIGNED CHANNEL - SEGMENT 3
    ***********
 4   CATCHMENT
  300.000      ID No.ó 99999
    3.180      Area in hectares
  146.000      Length (PERV) metres
     .200      Gradient (%)
   15.000      Per cent Impervious
  146.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
     .100      Ia/S Coefficient
    8.924      Initial Abstraction
        1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .148      7.881       .991       .000 c.m/s
           .368       .924       .451     C perv/imperv/total
15   ADD RUNOFF
           .148      8.029       .991       .000 c.m/s
 4   CATCHMENT
  301.000      ID No.ó 99999
     .720      Area in hectares
   69.000      Length (PERV) metres
     .200      Gradient (%)
   10.000      Per cent Impervious
   69.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
     .100      Ia/S Coefficient
    8.924      Initial Abstraction
        1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .030      8.029       .991       .000 c.m/s
           .367       .911       .422     C perv/imperv/total
15   ADD RUNOFF
           .030      8.057       .991       .000 c.m/s
 9   ROUTE
     .000      Conduit Length
     .000      No Conduit defined
     .000      Zero lag
     .000      Beta weighting factor
     .000      Routing timestep
        0      No. of sub-reaches
           .030      8.057      8.057       .000 c.m/s
17   COMBINE
   1     Junction Node No.
           .030      8.057      8.057      8.057 c.m/s
14   START
   1     1=Zero; 2=Define
35   COMMENT
   3     line(s) of comment
    ***********
    PROP DEVELOPMENT NORTH OF SEGMENT 3 - POND P30
    ***********
 4   CATCHMENT
   30.000      ID No.ó 99999
    8.470      Area in hectares
  238.000      Length (PERV) metres
     .200      Gradient (%)
     .100      Per cent Impervious
  238.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
     .100      Ia/S Coefficient
    8.924      Initial Abstraction
        1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
           .188       .000      8.057      8.057 c.m/s
           .368       .916       .368     C perv/imperv/total
15   ADD RUNOFF
           .188       .188      8.057      8.057 c.m/s
 4   CATCHMENT
   31.000      ID No.ó 99999
   10.420      Area in hectares
  264.000      Length (PERV) metres
    1.000      Gradient (%)
   75.000      Per cent Impervious
  264.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
     .100      Ia/S Coefficient
    8.924      Initial Abstraction
        1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
          2.113       .188      8.057      8.057 c.m/s
           .367       .917       .779     C perv/imperv/total
15   ADD RUNOFF
          2.113      2.151      8.057      8.057 c.m/s
27   HYDROGRAPH DISPLAY
   5     is # of Hyeto/Hydrograph chosen
    Volume  =  .8226000E+04 c.m
 4   CATCHMENT
   32.000      ID No.ó 99999
     .690      Area in hectares
   68.000      Length (PERV) metres
    1.000      Gradient (%)
   60.000      Per cent Impervious
   68.000      Length (IMPERV)
     .000      %Imp. with Zero Dpth
        1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
     .250      Manning "n"
   74.000      SCS Curve No or C
```

```
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .127      2.151      8.057      8.057 c.m/s
             .367       .914       .695     C perv/imperv/total
15    ADD RUNOFF
             .127      2.246      8.057      8.057 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .8577177E+04 c.m
10    POND
     5 Depth - Discharge - Volume sets
      178.800        .000          .0
      179.300       .0260      1520.0
      180.100       .0440      4649.0
      180.600        .414      7069.0
      180.800       1.204      8137.0
      Peak Outflow    =      .250 c.m/s
      Maximum Depth   =   180.379 metres
      Maximum Storage =     5999. c.m
             .127      2.246       .250      8.057 c.m/s
17    COMBINE
     1     Junction Node No.
             .127      2.246       .250      8.089 c.m/s
14    START
     1     1=Zero; 2=Define
35    COMMENT
     3     line(s) of comment
      ***********
      PROP DEVELOPMENT SOUTH OF SEGMENT 3 - POND P31
      ***********
 4    CATCHMENT
     33.000     ID No.ó 99999
     12.960     Area in hectares
    294.000     Length (PERV) metres
      1.000     Gradient (%)
     75.000     Per cent Impervious
    294.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
            2.640       .000       .250      8.089 c.m/s
             .368       .922       .783     C perv/imperv/total
15    ADD RUNOFF
            2.640      2.640       .250      8.089 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .7430276E+04 c.m
 4    CATCHMENT
     34.000     ID No.ó 99999
       .660     Area in hectares
     66.000     Length (PERV) metres
      1.000     Gradient (%)
     60.000     Per cent Impervious
     66.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .122      2.640       .250      8.089 c.m/s
             .367       .914       .695     C perv/imperv/total
15    ADD RUNOFF
             .122      2.731       .250      8.089 c.m/s
27    HYDROGRAPH DISPLAY
     5     is # of Hyeto/Hydrograph chosen
      Volume  =  .7766209E+04 c.m
10    POND
     6 Depth - Discharge - Volume sets
      178.300        .000          .0
      178.900       .0350      1927.0
      179.600       .0540      4692.0
      179.800        .150      5590.0
      180.000        .321      6538.0
      180.300       1.922      8059.0
      Peak Outflow    =      .221 c.m/s
      Maximum Depth   =   179.883 metres
      Maximum Storage =     5982. c.m
             .122      2.731       .221      8.089 c.m/s
17    COMBINE
     1     Junction Node No.
             .122      2.731       .221      8.131 c.m/s
14    START
     1     1=Zero; 2=Define
18    CONFLUENCE
     1     Junction Node No.
             .122      8.131       .221       .000 c.m/s
35    COMMENT
     3     line(s) of comment
      ***********************
      REALIGNED CHANNEL - SEGMENT 3
      ***********************
 4    CATCHMENT
    302.000     ID No.ó 99999
      1.610     Area in hectares
    104.000     Length (PERV) metres
       .200     Gradient (%)
     10.000     Per cent Impervious
    104.000     Length (IMPERV)
       .000     %Imp. with Zero Dpth
         1      Option 1=SCS CN/C; 2=Horton; 3=Green-Ampt; 4=Repeat
       .250     Manning "n"
     74.000     SCS Curve No or C
       .100     Ia/S Coefficient
      8.924     Initial Abstraction
         1      Option 1=Trianglr; 2=Rectanglr; 3=SWM HYD; 4=Lin. Reserv
             .057      8.131       .221       .000 c.m/s
             .367       .910       .422     C perv/imperv/total
35    COMMENT
     3     line(s) of comment
      ***************************
      FLOW U/S OF NIAGARA ST CULVERT - OUTLET D
      ***************************
15    ADD RUNOFF
             .057      8.188       .221       .000 c.m/s
14    START
     1     1=Zero; 2=Define
```