Fieldcrest Subdivision

Stormwater Management Report

Project Location:
Part of Lot 13, Concession 10, Caradoc
Strathroy, Ontario

Prepared for:
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MTE File No.: 44465-104

Engineers, Scientists, Surveyors.

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1.0 Introduction

1.1 Overview

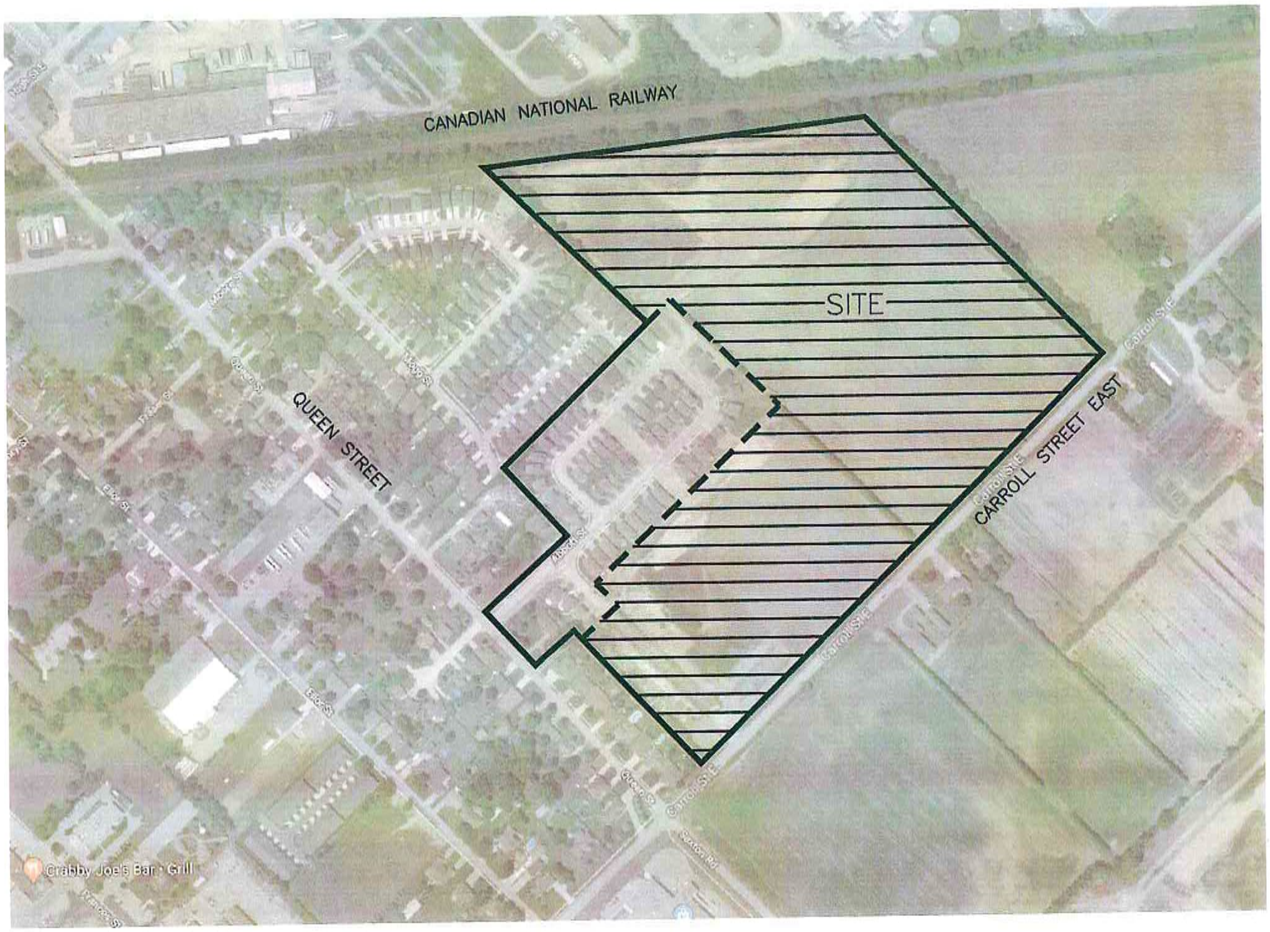
MTE has been retained by Fieldcrest Ltd to complete an overall Stormwater Management (SWM) report for their development lands located in Strathroy, Ontario. The property is approximately 21.7 hectares in size and is proposed to be developed as a residential subdivision with public roadways, a future school/townhouse block, park land, and a SWM facility.

1.2 Purpose of Study and Objectives

The purpose of this study is to develop a comprehensive stormwater management strategy for the current development proposal as per the Municipality of Strathroy-Caradoc standards.

The primary objectives of this study are as follows:

- Establish criteria for the management of stormwater runoff from this development site.
- Assess impacts of development on the peak flow runoff.
- Recommend a comprehensive plan for controlling the quantity and quality of stormwater runoff from the development site.



FIELDCREST SUBDIVISION

FIGURE 1

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LOCATION PLAN

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2.0 Existing Conditions and Background Information

2.1 Topographical Information

The development lands are approximately 21.7 hectares in size located in the south-east portion of Strathroy, Ontario.

Figure 1 illustrates the location of the development area. The site is part of Lot 13, Concession 10, Geographic Township of Caradoc, City of Strathroy. The area is bounded to the north by the CN Railway, existing agricultural lands to the east, Carroll Street to the south, and existing residential homes and Queen Street to the west. The site is mainly vacant. Some initial development has previously occurred on the site which consists of residential lots, Abbott Street, parts of Willis Avenue and Alexander Circle.

The drainage area is relatively flat and generally slopes north toward the CN Railway. There is a grade differential of approximately 3.0m between the high point along Carroll Street and the low point along the north property line adjacent to the CN Railway.

2.2 Pre-Development Conditions

Runoff from the site currently outlets to either the existing municipal drain located on the CN Railway ditch at the north boundary of the site or to Queen Street where it is collected by the existing municipal storm sewer system. Ultimately, all runoff from the site is directed to the Sydenham River.

For the purposes of modeling, the pre-development conditions of the site were assumed to be the conditions prior to the construction of the initial development phase. Thus, the pre-development site was modeled as being agricultural land. The pre-development catchment area was delineated into two sub-catchments.

Table 2.1 provides a brief description of each sub-catchment as well as the design parameters used in the hydrologic modeling.

Table 2-1 - Pre-Development Catchment Parameters

Sub-Catchment	Description	Area (ha.)	% Impervious	Initial Abstraction (mm)	Time to Peak (hrs)	Pervious CN
101	Agriculture	7.64	0	5	0.3	61
102	Agriculture	14.10	0	5	0.37	65
	Total	21.74	0	n/a	n/a	n/a

Figure 2 provides an illustration of the sub-catchment areas.

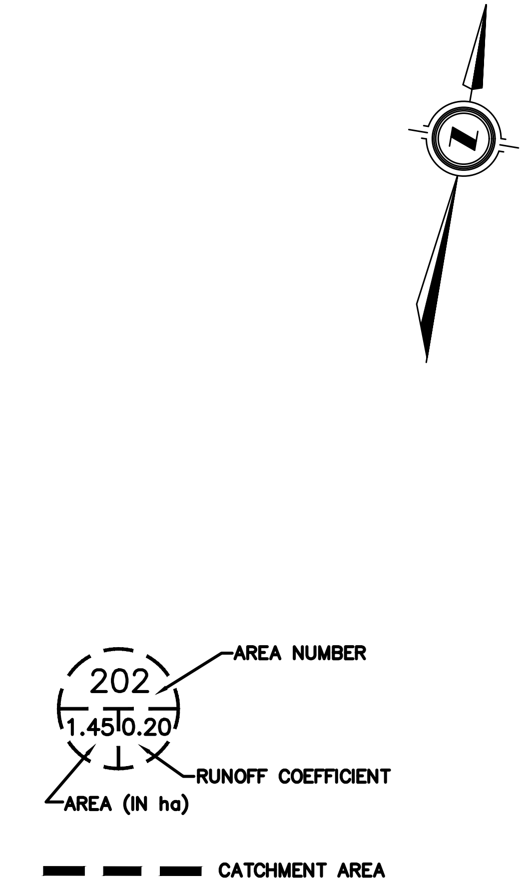

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FIGURE 2

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PRE–DEVELOPMENT
CATCHMENT AREAS

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P:\P\44465\104\FIGURES\FIGURE 2 PRE–DEV STORM.dwg

Curve number of 61 was used for catchment area 101 based on the hydrologic soil group data (group A) from the Ontario Ministry of Agriculture, Food and Rural Affairs AgMaps, and the curve number of 65 was calculated based on the hydrologic soil groups A and C for catchment 102. Using the design parameters listed in Table 2.1, the 25mm, 1:2, 1:5, 1:10, 1:25, 1:50, 1:100 year, and the regional storm event peak flows were established using Visual OTTHYMO (VO).

All storms were modeled as 3-hour Chicago Storms except for the 25mm event which was modeled as 4 hours and the regional event (250 year) with 4-hour duration. The Chicago Storm parameters for the design storms were obtained from the Municipality of Strathroy-Caradoc Servicing Standards 2021 (SCSS). SCSS provides an intensity-duration curve for the 2-year event. 2-year storm event A, B, and C parameters were obtained using VO IDF curve tool. A, B, and C parameters were used to create a 2-year 3-hour Chicago Storm with the peak ratio of 0.33. Please refer to Appendix 'A' for more detail.

The pre-development peak flow rates obtained from the VO model are outlined in Table 5.3.

2.2.1 Geotechnical Information

In August of 2006 Trow Associates completed a geotechnical investigation of the site. Eight boreholes were completed and observations concerning the soil types, stratigraphy, and groundwater elevations were noted. In December of 2008, Atkinson, Davis Inc. Consulting Geotechnical, Environmental & Materials Engineers carried out a supplementary geotechnical investigation. This fieldwork consisted of three additional boreholes.

Based on the results of the geotechnical investigations, the subsurface stratigraphy at the site generally consists of 250mm thick topsoil underlain by compact silt and fine sand. For further information, please refer to the Geotechnical Reports contained in Appendix "D".

3.0 Stormwater Management Criteria

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

- MOE/MNR Stormwater Quality Guidelines for New Development, May 1991.
- Stormwater Management Practices, Planning and Design Manual MOE, March 2003.
- St. Clair Region Conservation Authority Policies and Guidelines.
- Municipality of Strathroy-Caradoc.

3.1 Quantity Control

Under pre-development conditions approximately 14.1 ha of land drains toward a municipal drain on the CN Railway ditch while 7.6 ha drains toward Queen Street. It is proposed that under post-development conditions as much of the site as possible will be directed toward the existing municipal drain (CN Railway ditch) where flows will be controlled by the proposed SWM facility to pre-development levels. The neighbouring development south of Carol Street will convey approximately 170 l/s of controlled outflow to the subject site storm sewers, into the SWM facility and out to the existing municipal drain. Therefore, subject site allowable flows will be increased by 170 l/s.

A small portion of the site (~1.51 ha) will continue to flow to the Queen Street sewers/road allowance. No quantity controls are proposed for the runoff to Queen Street. This has been previously accepted and agreed to by the Municipality of Strathroy-Caradoc. Furthermore, the area outletting to Queen Street has been greatly reduced in size (pre-development area to Queen Street is 7.64 ha and post-development area to Queen Street is 1.51 ha).

3.2 Quality Control

The stormwater management facility proposed for the development will provide an Enhanced Level (Level 1) of water quality protection (as established by the MOE's Stormwater Management Guidelines 2003) for the 20.86 ha facility tributary drainage area.

Runoff from the area contributing to the Queen Street sewer system (~1.51 ha) is not controlled and will receive no quality treatment. This has been previously accepted and agreed to by the Municipality of Strathroy-Caradoc. It is also important to note, this area is relatively small and is mainly green space and roof top areas. The roadway and driveway area within this catchment is only 0.30 ha in size which does not warrant any separate quality treatment.

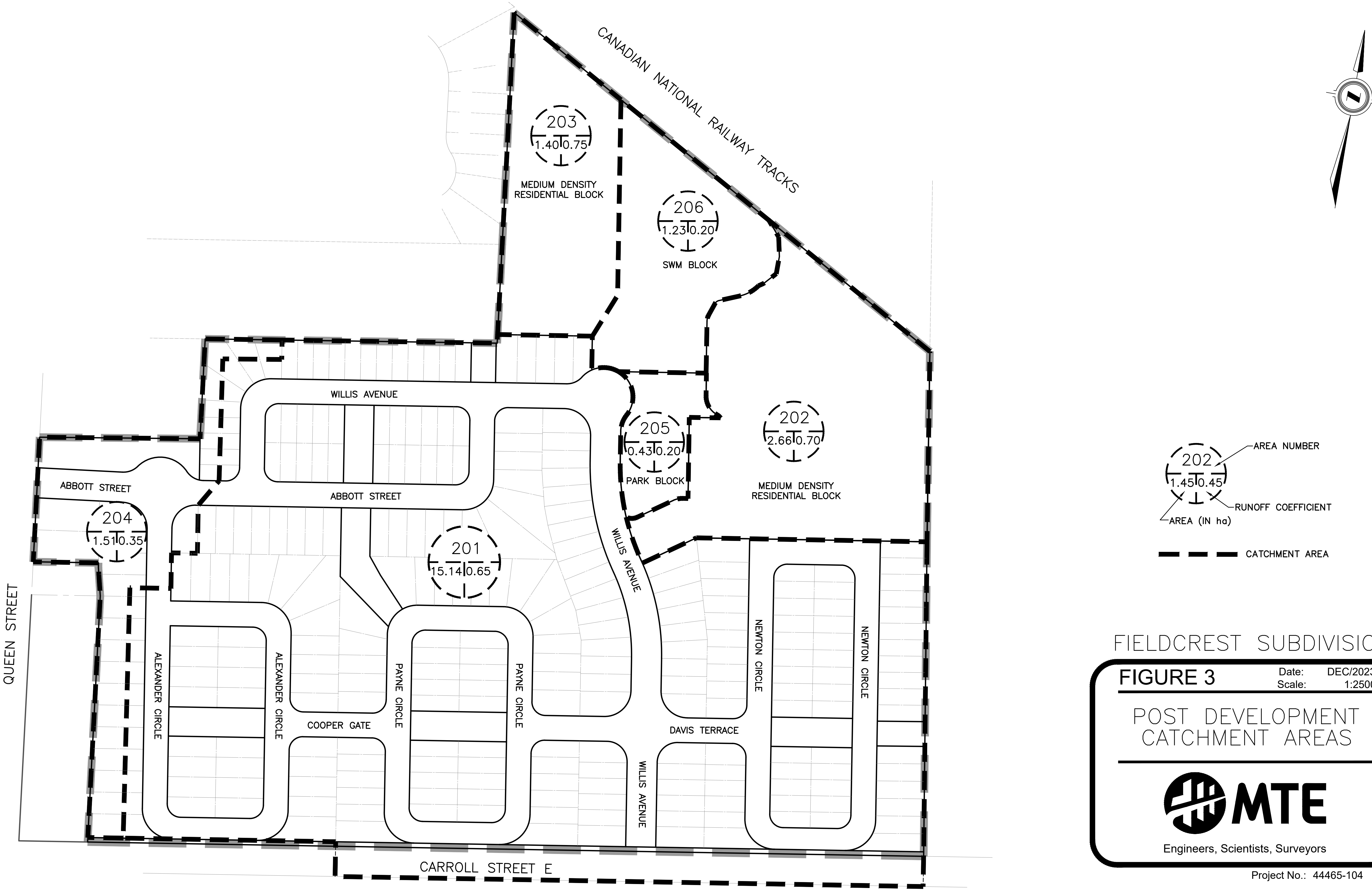
4.0 Proposed Development and SWM Strategy

4.1 Post-Development Conditions

Under post development conditions, the catchment area was delineated into six sub-catchments. Table 4.1 provides a brief description of each sub-catchment area as well as the design parameters used in the hydrologic modeling. A CN of 39 was used for all pervious areas except for catchment 201 where a CN value of 45 was used based on existing soil hydrologic soil groups A and C. Figure 3 provides an illustration of the post-development sub-catchment areas.

Table 4-1 - Post-Development Catchment Parameters

Sub-Catchment	Description	Area (ha.)	XIMP	TIMP	Slope (Perv. & Imp.)
201	Residential	15.14	0.54	0.64	2.0%
202	Medium Density	2.66	0.53	0.63	2.0%
203	Medium Density	1.40	0.69	0.79	2.0%
205	Park	0.43	n/a	n/a	2.0%
206	Pond Block	1.23	n/a	n/a	2.0%
	Total	20.86	n/a	n/a	n/a
FLOW TO QUEEN STREET STORM SEWERS / ROAD ALLOWANCE					
204	Residential	1.51	0.21	0.21	2.0%
TOTAL SITE:		**22.37**	**-**	**-**	**-**



FIELDCREST SUBDIVISION

FIGURE 3

Date: DEC/2023
Scale: 1:2500

POST DEVELOPMENT CATCHMENT AREAS

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5.0 Stormwater Management Design

5.1 Hydrologic Modelling

A hydrologic model was developed to provide a quantitative estimate of flows across the site under existing and proposed development conditions. The rainfall event simulation model VO was used to simulate response to the 25mm, 1:2yr, 1:5yr, 1:10yr, 1:25yr, 1:50yr, 1:100yr, and the Regional storm event. The 3-hour Chicago rainfall distribution, using the Municipality's intensity-duration-frequency (IDF) parameters was used for all events.

The hydrologic parameters for each of the areas are summarized in Appendix "A". The VO modelling output for both pre- and post-development are provided in Appendix "B".

5.2 Stormwater Quality Control

The proposed SWM facility has been designed as a wet pond with a permanent pool depth of 1.2m. These facilities offer the benefits of dilution and settling of sediment within the forebay and the wet pond components. A planting scheme will be prepared that carefully selects plant species and their location in and around the basin to stabilize banks, mitigate temperature increases, deter waterfowl from nesting within the area, and provide aesthetics and safety benefits.

The proposed SWM pond is divided into two cells. The first cell consists of a sediment forebay that will accept minor storm event flows from the proposed storm sewer. The second cell consists of the main wet pond/detention storage area of the pond. The sediment forebay has been provided at the storm sewer inlet location of the facility and is designed with a maximum and minimum depth of 1.2m and 0.8m respectfully. The maximum design depth is immediately following construction and after sediment clean-out operations. The minimum design operating depth of 0.8m is that which occurs prior to the required clean-out operations. Maintenance of at least the 0.8m of permanent pool in the forebay at all points in the sediment accumulation / clean-out cycle minimizes the potential for scour and re-suspension of previously settled sediments. The wet pond portion of the facility has also been designed with a 1.2m deep permanent pool feature.

Since most of the annual rainfall occurs in storms less than or equal to a 25mm event, most of the water borne sediment is also transported to the SWM facility in these frequent rainfall events. Therefore, the sediment forebay is designed targeting the smaller flows.

Since larger storm events will have large peak flows, there is potential for re-suspension of accumulated sediment. Thus, the smaller flows into the forebay have been separated from the larger flows which will enter the main pond directly. To achieve this objective, a berm has been proposed which will direct major overland around the forebay and directly into the main pond.

The forebay design is based on classic particle settling and flow dispersion equations as presented in the MOE 2003 "Stormwater Management Practices Planning and Design Manual". The methodology presented in that document suggests that the design flow for the forebay should be taken as the peak outflow from the facility. A forebay is typically designed to treat minor storm flows.

The design of the forebay should be based on the notion that the flow into the forebay equals the flow through the forebay, which equals the flow out of the forebay. In using this approach, the recommended settling velocity of 0.0003m/s (from MOE 2003) results in extremely large and un-achievable forebay lengths. Therefore, the forebay has been designed to satisfy the following four conditions:

- Settling length based on a settling velocity of 0.0003m/s using the main pond peak discharge for the 25mm event (as per MOE 2003).
- Settling length based on a settling velocity of 0.0055m/s using the forebay inflow/outflow for the 25mm event.
- Dispersion length such that, based on flow and depth of water, the velocity through the forebay is less than 0.5m/s.
- Velocity based on flow divided by cross-sectional area is less than 0.15m/s to prevent scouring.

The 2003 MOE document suggests that the clean-out frequency for the SWM facility be based on the sediment loading within the entire pond, however, it is recommended that the clean-out frequency be based on the loadings within the forebay only. While this typically results in more frequent clean-out, it is restricted to the forebay area only and avoids disturbance of the main pond. The clean-out frequency for the proposed SWM facility can be found in the forebay design calculations in Appendix ‘B’.

An Enhanced Level (formerly Level 1) of water quality protection (as defined by the MOE) is proposed. Quality control measures will take the form of a wet pond, servicing a total drainage area imperviousness of 60%. An Enhanced Level of water quality control (based on an imperviousness of 60%) requires a storage volume of 201m^3/ha. Of this volume, all but 40 m^3/ha represents the permanent pool requirement. Considering the total post-development drainage area of the Fieldcrest subdivision is 20.86 ha, this equates to a required permanent pool volume of 3,372 m^3 (20.86x (201.67-40)). The permanent pool volume provided in the main pond area totals 2,767 m^3. The permanent pool volume provided in the forebay totals 863 m^3. The combined permanent pool volume is 3,630 m^3 which exceeds the required volume of 3,372 m^3. Table 5.1 outlines the design of the proposed SWM facility. Appendix “B” contains design calculations for the sediment forebay, and the main pond draw down calculations.

Table 5-1 - Water Quality Control Details

General	Pond Characteristic
Wet pond Stormwater Management Facility	Enhanced Quality Control
Total Contributing Area	20.86 ha
Imperviousness (entire drainage area)	60%
Bottom Elevation	228.05
Storage	
Unit Area Storage Volume Requirements as per SWMMP (MOE 2003)	201.67 m^3/a
Required Total Volume (201.67m3/Ha)	3372.8m^3
Permanent Pool	
Required Permanent Pool Volume (161.67m3/Ha)	3,372.8m^3
Permanent Pool Volume Provided	3,630m^3
Permanent Pool Elevation	229.25
Extended Detention	
Minimum Required Volume (based on 40 m^3/ha)	834.5m^3
Extended Detention Volume Provided (based on 25 mm event)	3,720m^3
Approximate Drawdown Time	26.6hr
Extended Detention Elevation	230.01m
Peak Release Rate for Extended Detention (Quality)	0.073m^3/s
Forebay	
Required Forebay Length	45m
Actual Forebay Length	45m
Permanent Pool Elevation	229.25
Bottom Elevation	228.05
Outlet Controls	
Orifice Plates	
Orifice 1 Diameter (Extended Detention)	200mm
Orifice 1 Elevation (Extended Detention)	229.25m
Orifice 2 Diameter	600mm
Orifice 2 Elevation	229.75
Emergency Outlet Weir	
7.0 m wide Rip Rap Overflow Weir - Elevation	230.85

5.3 Stormwater Quantity Control

Flows for all storm events will be conveyed to the SWM facility by a combination of storm sewer and overland flow route (road right-of-way). A multi-stage outlet structure has been proposed for use in the SWM facility.

A 200mm diameter orifice located in the outlet manhole weir will provide control for the 25mm storm event. A single 600mm diameter orifice located in the outlet manhole weir will provide control for all events greater than the 25mm storm up to the regional design storm.

A 7.0m wide emergency overflow weir has been provided in the event of a system blockage. To follow pre-development conditions, the outlet from the proposed facility will be released into the existing municipal drain (ditch) running along the CN Railway.

The stage-storage-discharge relationship for the proposed SWM facility is shown below in Table 5.2. Further details concerning the stage-storage-discharge relationship of the SWM facility are provided in Appendix “B”.

Table 5-2 - Stage-Storage-Discharge Information

Elevation (m)	Discharge (m^3/s)	Active Storage Volume (m^3)	Remarks
229.25	0.0000	0	Orifice 1 Invert
229.35	0.0098	439	Contour
229.45	0.0277	895	Contour
229.55	0.0392	1369	Contour
229.65	0.0480	1860	Contour
229.75	0.0554	2368	Orifice 2 Invert
229.85	0.0813	2894	Contour
229.95	0.1407	3437	Contour
230.05	0.2261	3997	Contour
230.15	0.3283	4575	Contour
230.25	0.4345	5171	Contour
230.35	0.5198	5784	Contour
230.45	0.5910	6414	Contour
230.55	0.6539	7061	Contour
230.65	0.7111	7726	Contour
230.75	0.7639	8408	Contour
230.85	0.8131	9108	Emergency Weir Inv.

A summary of the peak flows for the pre-development and post-development conditions is summarized in Table 5.3. As shown, the post-development peak flows outletting from the SWM facility will be attenuated to below pre-development levels for all storm events.

Post development area 204 has been modelled in VO but due to the size of less than 2 ha, the catchment flows have also been calculated using the rational method to confirm the flows will be lower than pre-development flows.

Enough volume has been provided to store the regional storm event to a maximum elevation of 230.83m, or 1.58m above the permanent pool level. The VO output for the quantity control can be found in Appendix “C”.

A summary of the maximum ponding elevations for the SWM facility is provided in Table 5.4. The maximum pond depth (bottom of pond to maximum attenuation level) is 2.77m.

Table 5-3 - Summary of Peak Flows

FLOW TO QUEEN STREET SEWERS / ROAD ALLOWANCE								
Drainage Area	**25mm Storm Event (m^3/s)**	**2 Year Storm Event (m^3/s)**	**5 Year Storm Event (m^3/s)**	**10 Year Storm Event (m^3/s)**	**25 Year Storm Event (m^3/s)**	**50 Year Storm Event (m^3/s)**	**100 Year Storm Event (m^3/s)**	**Regional Storm Event (m^3/s)**
Pre-Development								
Area 1 (7.64 ha)	**0.035**	**0.139**	**0.148**	**0.210**	**0.303**	**0.387**	**0.464**	**0.606**
Post-Development								
Area 204 VO (1.51 ha)	**0.055**	**0.107**	**0.109**	**0.132**	**0.168**	**0.191**	**0.214**	**0.244**
Area 204 RM (1.51 ha)	**0.082**	**0.157**	**0.157**	**0.188**	**0.227**	**0.255**	**0.280**	**0.312**
FLOW TO CN RAILWAY DITCH / MUNICIPAL DRAIN								
Pre-Development								
Area 2 (14.10 ha)	**0.068**	**0.260**	**0.279**	**0.391**	**0.558**	**0.709**	**0.846**	**1.099**
Area 2 + External Flow (+170 l/s)	**0.238**	**0.430**	**0.449**	**0.561**	**0.728**	**0.879**	**1.016**	**1.269**
Post-Development								
Area 201 (15.14 ha)	1.182	2.455	2.473	3.036	3.785	4.323	4.799	5.498
Area 202 (2.66 ha)	0.236	0.474	0480	0.587	0.721	0.817	0.910	1.026
Area 203 (1.40 ha)	0.168	0.333	0.337	0.410	0.504	0.571	0.629	0.705
Area 205 (0.43 ha)	0.001	0.006	0.006	0.009	0.013	0.017	0.021	0.026

Area 206 (1.23 ha)	0.004	0.016	0.018	0.026	0.038	0.050	0.060	0.080
Total Release from SWM Facility:	**0.185**	**0.310**	**0.351**	**0.445**	**0.553**	**0.632**	**0.692**	**0.796**
TOTAL FLOW FROM SITE								
Pre-Development	**0.103**	**0.399**	**0.427**	**0.601**	**0.861**	**1.096**	**1.310**	**1.705**
Pre-Development + External Flow	**0.273**	**0.569**	**0.597**	**0.771**	**1.031**	**1.266**	**1.480**	**1.875**
Post-Development	**0.186**	**0.319**	**0.360**	**0.460**	**0.574**	**0.659**	**0.724**	**0.842**

Table 5-4 - Maximum Wet Pond Ponding Elevations

Storm Event	Maximum Ponding Elevation (m)	Total Depth (m)
25 mm Storm Event	230.01	1.96
2 Year Storm Event	230.14	2.09
5 Year Storm Event	230.18	2.13
10 Year Storm Event	230.27	2.22
25 Year Storm Event	230.40	2.35
50 Year Storm Event	230.52	2.47
100 Year Storm Event	230.62	2.57
Regional Storm Event	230.82	2.77

5.4 Stormwater Management Facility

The following list of SWM facility design characteristics outlines all significant design aspects and rationales.

- The SWM facility has been designed as a wet pond facility with sufficient permanent and active storage volumes to achieve an Enhanced (formerly Level 1) degree of protection.
- The SWM facility will control and attenuate the post-development outlet rates to below the pre-development levels for all storm events up to the (1:250 year) regional storm event.
- The outlet control structure for the SWM facility will be in the form of one 200mm orifice and one 600mm orifice. The 200mm control orifice has been designed to provide a minimum of 24 hours of drawdown time for the extended detention volume.
- An access/maintenance road of 4m width has been incorporated into the design of the SWM facility to ensure sufficient access to the inlet/outlet structures and forebay area for

ease of inspection and maintenance. The access road will have a turf stone surface (as per the municipal standards) and have a maximum cross-fall of 2.5% and a minimum inside radius of curvature not less than 9m.

- The design of the SWM facility incorporates internal side slopes of 5:1 throughout the facility wherever pedestrian access could be achieved. Also, a 1.0m 'safety bench' has been provided at the permanent pool level.
- Minimum freeboard of approximately 0.3m has been provided to the top of the berming around the northwest portion of the SWM facility above the regional storm high water level.
- Operation and maintenance of the SWM facility will be the responsibility of Municipality of Strathroy-Caradoc. Maintenance responsibilities include regular inspection of the basin. Sediment should be removed when the permanent pool depth is reduced to 0.8 within the forebay areas. It should be noted that the estimated sediment clean-out frequencies outlined in the forebay calculation sheets might be reduced during the interval prior to complete stabilization of the upstream contributing drainage areas.
- The forebay area has been provided with a 300mm depth of compacted Gran B which will provide a stable base for future clean-out operations.
- As the existing material under the SWM pond is partially sand, a 0.9m thick clay barrier has been factored into the design. This clay barrier will prevent any groundwater from entering and filling the facility. Furthermore, the clay barrier will prevent any un-treated water from within the pond from infiltrating into the ground.

6.0 Erosion and Sediment Control Measures

Available soils information indicates that the on-site surficial materials consist of sand, silt, and glacial tills. Precautions will be taken during construction to limit erosion and sedimentation. Erosion and Sediment Control Plans will be prepared and will accompany the future detailed design submission for subdivision development lands. The plans will detail the erosion and sediment control measures to be implemented during the future subdivision construction to limit erosion and sediment impacts associated with development.

Typically, the recommended construction sequence for erosion and sediment control measures will be as follows:

- Placement of all sediment control fencing where required.
- Construction of permanent stormwater management ponds and temporary sediment basins.
- Construction of temporary swales to direct runoff to sedimentation basins, with rock check dams as required to control velocities.
- Stripping and strategic placement of topsoil stockpiles. Placement of sediment control fencing around all stockpile areas; and
- Re-vegetation of completed areas as soon as possible after construction, including those areas not slated for construction within 90 days of stripping.

Where rock check dams are proposed to promote sedimentation and reduce velocities, clean aggregate is to be placed perpendicular to the direction of flow in the swale, with a small volume of excavation on the upstream side to provide storage for accumulated sediment.

Sediment control fencing shall consist of filter fabric attached to wire fencing and sealed at ground level. It will be installed at the perimeter of the work areas and intermittently on sloped areas where required. Sediment control fencing will also be placed around all topsoil and fill stockpiles.

Access to topsoil or fill storage areas will be located on the upstream side of storage piles. This will ensure continuity of the sediment control fencing in the downslope direction which is most vulnerable to erosion and sediment deposition. Further, topsoil and hydroseed will be placed on all exposed areas following the completion of grading activities.

Reports will be submitted to the SCRCA and the Municipality of Strathroy-Caradoc if required to keep them informed of the performance of the erosion and sedimentation control measures.

7.0 Operation and Maintenance

It is recommended that during construction of the SWM facility monitoring and inspection of the erosion and sediment controls be conducted to ensure the satisfactory performance of these measures.

Reporting of the inspection and monitoring results should be distributed to the SCRCA and the Municipality of Strathroy-Caradoc. If it is found that the erosion and sediment control measures are not working adequately, they shall be augmented to the satisfaction of the St. Clair Region Conservation Authority and the Municipality of Strathroy-Caradoc, based on field decisions.

Furthermore, it is recommended that the owner initiate a post-construction monitoring program to ensure the long-term effectiveness of the SWM facility. The post construction monitoring program should include:

- Periodic inspection of the SWM control facility and other erosion control works.
- Inspection of the SWM facility and its outlet after significant rainfall events (generally more than 10 mm of rainfall).
- Removal of debris that may accumulate and hinder functioning of the SWM facility.
- Implementation of remedial measures including erosion stabilization, repair of damaged vegetation and sediment removal, as required.

Frequency of the post construction monitoring will be at the discretion of the Municipality of Strathroy-Caradoc. It is recommended that a minimum of four (seasonal) inspections be made annually. An Operation, Maintenance and Monitoring Report will be submitted to the SCRCA and the Municipality of Strathroy-Caradoc under a separate cover if required.

8.0 Conclusions and Recommendations

Based on the foregoing analyses, it is concluded that:

- The main drainage outlet for the proposed Fieldcrest Subdivision is an existing municipal drain (drainage ditch) running along the south side of the CN Railway which abuts the subdivision to the north. Post-development release rates to the existing municipal drain will be controlled to below pre-development levels. Runoff from a small 1.51 ha area of the development will outlet to the existing municipal storm sewers on Queen Street. This area has been greatly reduced in size from the pre-development condition.
- The proposed SWM facility will provide enhanced quality control to 20.86 ha of the proposed subdivision. The remaining 1.51 ha which outlets to the existing municipal storm sewer on Queen Street will receive no treatment; however, this area is relatively small and mainly consists of green space and roof top areas.
- Sediment and Erosion controls will be implemented during construction as described in Section 6 of this report to minimize negative impacts of construction activities on the downstream stormwater receiver. Additional sediment and erosion control plans and reports will be completed during the detailed design of the subdivision lands.

All of which is respectfully submitted,

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Appendix A

Hydrologic Parameters

FIELDCREST SUBDIVISION
STORMWATER MANAGEMENT
Strathroy, Ontario

Project Number:	44465-104
Date:	June 13, 2024
Design By:	JJM
File:	Q:\44465\104\SWM 2022, 2023, 2024\44465-104 Master SWM Facility Design Sheet (June 2024 Revision).xlsx

HYDROLOGIC PARAMETERS
Pre-Development Conditions

Sub-Catchment Number	Area	SCS Curve Number		Percent Impervious	Land Use	Comment
		Pervious (AMC II)	Impervious			
	(ha)			*(%)*		
1	7.64	61	98	0	Agriculture	
2	14.1	65	98	0	Agriculture	
Total	**21.74**			**0.00**		

Post-Development Conditions

Sub-Catchment Number	Area	SCS Curve Number		Percent Impervious	Land Use	Comment
		Pervious (AMC II)	Impervious			
	(ha)			*(%)*		
201	15.14	45	98	0.64	Residential	
202	2.66	39	98	0.63	Medium Density	
203	1.40	39	98	0.79	Medium Density	
204	1.51	39	98	0.21	Residential	Uncontroled to Queen Street
205	0.43	39	98	0.00	Park	
206	1.23	39	98	0.00	Pond Block	
Total Site	**22.37**			**0.57**		
Total to SWM Facility	**20.86**			**0.60**		

20.86 0.60

IDF PARAMETERS
Strathroy-Caradoc

Frequency (Years)	A	B	C	Comment
25mm (4hr)	538.850	6.331	0.809	
2		Based on SCSD-14		
5	1137.257	7.184	0.830	
10	1425.011	7.382	0.843	
25	1835.352	7.844	0.858	
50	2225.884	8.620	0.871	
100	2561.151	9.093	0.888	

FIELDCREST SUBDIVISION
STORMWATER MANAGEMENT
Strathroy, Ontario

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Strathroy Caradoc IDF Parameters

Return Period (years)	A,B,C Parameters A	B	C
25mm (4hr)	538.850	6.331	0.809
2		Based on SCSD-14	
5	1137.257	7.184	0.830
10	1425.011	7.382	0.843
25	1835.352	7.844	0.858
50	2225.884	8.620	0.871
100	2561.151	9.093	0.888
250	3048.22	10.03	0.888

Pre-Development Flows (Visual OTTHYMO Model)

Coverage	**101**	**102**	**Allowable release rate (102 + External)**
Area (ha)	7.64	14.10	
		BP	
Return Period	25mm	25mm	25mm
Pre-Development Peak Flow (m^3/s)	0.035	0.068	0.238
Return Period	2 year	2 year	2 year
Pre-Development Peak Flow (m^3/s)	0.139	0.260	0.430
Return Period	5 year	5 year	5 year
Pre-Development Peak Flow (m^3/s)	0.148	0.279	0.449
Return Period	10 year	10 year	10 year
Pre-Development Peak Flow (m^3/s)	0.210	0.391	0.561
Return Period	25 year	25 year	25 year
Pre-Development Peak Flow (m^3/s)	0.303	0.558	0.728
Return Period	50 year	50 year	50 year
Pre-Development Peak Flow (m^3/s)	0.387	0.709	0.879
Return Period	100 year	100 year	100 year
Pre-Development Peak Flow (m^3/s)	0.464	0.846	1.016
Return Period	Regional Event	Regional Event	Regional Event
Pre-Development Peak Flow (m^3/s)	0.606	1.099	1.269

Post-Development Flows (Visual OTTHYMO Model)

Coverage	**201+202+203+205+206**	**201+202+203+205+206+External**	**204**	**204 (Rational Method)**	**Pond Discharge**
Area (ha)	20.86	20.86	1.51	1.51	
Return Period	25mm	25mm	25mm	25mm	25mm
Post-Development Peak Flow (m^3/s)	1.579	1.749	0.055	0.082	0.185
Return Period	2 year	2 year	2 year	2 year	2 year
Post-Development Peak Flow (m^3/s)	3.268	3.438	0.107	0.157	0.310
Return Period	5 year	5 year	5 year	5 year	5 year
Post-Development Peak Flow (m^3/s)	3.306	3.476	0.109	0.157	0.351
Return Period	10 year	10 year	10 year	10 year	10 year
Post-Development Peak Flow (m^3/s)	4.060	4.230	0.132	0.188	0.445
Return Period	25 year	25 year	25 year	25 year	25 year
Post-Development Peak Flow (m^3/s)	5.049	5.219	0.168	0.227	0.553
Return Period	50 year	50 year	50 year	50 year	50 year
Post-Development Peak Flow (m^3/s)	5.761	5.931	0.191	0.256	0.632
Return Period	100 year	100 year	100 year	100 year	100 year
Post-Development Peak Flow (m^3/s)	6.398	6.568	0.214	0.280	0.692
Return Period	Regional Event	Regional Event	Regional Event	Regional Event	Regional Event
Post-Development Peak Flow (m^3/s)	7.310	7.480	0.244	0.312	0.769

Appendix B

SWM Facility Design Details

MTE

FIELDCREST SUBDIVISION
STORMWATER MANAGEMENT
Strathroy, Ontario

Project Number:	44465-104
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Step 1: Choose Level of Water Quality Control

Enhanced 80% long-term S.S. removal

Step 2: Choose Type of Facility

Wet Pond

Step 3: Define Catchment area and Imperviousness

Catchment Area (ha)	**Imperviousness (%)**
20.8584647	60.00

Interpolated Storage Volume Requirement (m^3/ha)

201.67

Permanent Pool Required (m^3)

3372.12

Extended Detention Volume Required (m^3)

834.34

Table 3.2 Water Quality Storage Requirements based on Receiving Waters (from MOE Stormwater Management Planning and Design Manual, March 2003)

Protection Level	**SWMP Type**	**Storage Volume (m^3/ha) for Impervious Level**			
		35	**55**	**70**	**85**
Enhanced 80% long-term S.S. removal	*Wetlands*	80	105	120	140
	Hybrid Wet Pond/Wetland	110	150	175	195
	Wet Pond	140	190	225	250
Normal 70% long-term S.S. Removal	*Wetlands*	60	70	80	90
	Hybrid Wet Pond/Wetland	75	90	105	120
	Wet Pond	90	110	130	150
Basic 60% long-term S.S. Removal	*Wetlands*	60	60	60	60
	Hybrid Wet Pond/Wetland	60	70	75	80
	Wet Pond	60	75	85	95
	Dry Pond (Continuous Flow)	90	150	200	240

MTE

FIELDCREST SUBDIVISION
STORMWATER MANAGEMENT
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STAGE-STORAGE RELATIONSHIP

Stage	Active Depth	Forebay			Main Pond			Total Pond Volume	Active Storage Volume	Volume Summary	Ponding Elevation	Comments	Stage
		Area	Volume	Cumulative Volume	Area	Volume	Cumulative Volume						
m	m	m^2	m^3	m^3	m^2	m^3	m^3	m^3	m^3	m^3	m		m
228.05		405	0	0	1700	0	0	0					228.05
228.15		457	43	43	1801	175	175	218					228.15
228.25		510	48	91	1902	185	360	452					228.25
228.35		562	54	145	2003	195	555	701					228.35
228.45		615	59	204	2104	205	761	965					228.45
228.55		667	64	268	2205	215	976	1244					228.55
228.65		719	69	337	2306	226	1202	1539					228.65
228.75		772	75	412	2406	236	1437	1849					228.75
228.85		824	80	492	2507	246	1683	2175					228.85
228.95		876	85	577	2608	256	1939	2515					228.95
229.05		929	90	667	2709	266	2205	2871					229.05
229.15		981	95	762	2810	276	2481	3243					229.15
229.25		1033	101	863	2911	286	2767	3630		3372		Permanent Pool	229.25
229.25	0.00				4301	0	2767	3630	0				229.25
229.35	0.10				4475	439	3205	4068	439				229.35
229.45	0.20				4649	456	3662	4525	895				229.45
229.55	0.30				4823	474	4135	4998	1369				229.55
229.65	0.40				4997	491	4626	5489	1860				229.65
229.75	0.50				5171	508	5135	5998	2368				229.75
229.85	0.60				5345	526	5660	6523	2894				229.85
229.95	0.70				5519	543	6203	7066	3437				229.95
230.05	0.80				5693	561	6764	7627	3997	3720	230.01	25mm Event	230.05
230.15	0.90				5867	578	7342	8205	4575	4467	230.14	1:2 Year Event	230.15
230.25	1.00				6041	595	7937	8800	5171	4697	230.18	1:5 Year Event	230.25
230.35	1.10				6214	613	8550	9413	5784	5241	230.27	1:10 Year Event	230.35
230.45	1.20				6388	630	9180	10043	6414	6075	230.40	1:25 Year Event	230.45
230.55	1.30				6562	648	9828	10691	7061	6830	230.52	1:50 Year Event	230.55
230.65	1.40				6736	665	10493	11356	7726	7497	230.62	1:100 Year Event	230.65
230.75	1.50				6910	682	11175	12038	8408				230.75
230.85	1.60				7084	700	11875	12738	9108	8860	230.82	1:250 Year Event (Regional)	230.85
230.95	1.70				7258	717	12592	13455	9825				230.95
231.05	1.80				7432	735	13326	14189	10560				231.05

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Orifice Calculations

$Q_o=C_d*A_o*(2*g*H_o)$^0.5

	Orifice 1	Orifice 2	Orifice 3
C_d	0.63	0.63	0.63
Invert (m)	229.25	229.75	500.00
Width (m)			
Diameter/Height (m)	0.200	0.600	
Type (H/V)	V	V	V

C_d	Description
0.63	Orifice Plate
0.80	Orifice Tube

Weir Calculations

$Q_w = 2/3*C_d*(2g)^{1/2}*L*H_w^{3/2} + 8/15*C_d*(2g)^{1/2}*\tan\theta*H_w^{5/2}$

C_d	0.50
Invert (m)	230.85
Length (m)	7.000
Side Slope (H:V)	4
Side Slope (rad)	1.326

STAGE-DISCHARGE RELATIONSHIP

Stage	Active Volume	Orifice 1 Area	Orifice 1 H_o	Orifice 1 Flow	Orifice 2 Area	Orifice 2 H_o	Orifice 2 Flow	Orifice 3 Area	Orifice 3 H_o	Orifice 3 Flow	Weir Flow	Total Flow
m	m^3	m^2	m	m^3/s	m^2	m	m^3/s	m^2	m	m^3/s	m^3/s	m^3/s
229.25	0	0.00	0.00	0.0000	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0000
229.35	439	0.02	0.05	0.0098	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0098
229.45	895	0.03	0.10	0.0277	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0277
229.55	1369	0.03	0.20	0.0392	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0392
229.65	1860	0.03	0.30	0.0480	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0480
229.75	2368	0.03	0.40	0.0554	0.00	0.00	0.0000	0.00	0.00	0.0000	0.0000	0.0554
229.85	2894	0.03	0.50	0.0620	0.03	0.05	0.0193	0.00	0.00	0.0000	0.0000	0.0813
229.95	3437	0.03	0.60	0.0679	0.08	0.10	0.0728	0.00	0.00	0.0000	0.0000	0.1407
230.05	3997	0.03	0.70	0.0733	0.14	0.15	0.1528	0.00	0.00	0.0000	0.0000	0.2261
230.15	4575	0.03	0.80	0.0784	0.20	0.20	0.2499	0.00	0.00	0.0000	0.0000	0.3283
230.25	5171	0.03	0.90	0.0832	0.25	0.25	0.3513	0.00	0.00	0.0000	0.0000	0.4345
230.35	5784	0.03	1.00	0.0877	0.28	0.30	0.4322	0.00	0.00	0.0000	0.0000	0.5198
230.45	6414	0.03	1.10	0.0919	0.28	0.40	0.4990	0.00	0.00	0.0000	0.0000	0.5910
230.55	7061	0.03	1.20	0.0960	0.28	0.50	0.5579	0.00	0.00	0.0000	0.0000	0.6539
230.65	7726	0.03	1.30	0.1000	0.28	0.60	0.6112	0.00	0.00	0.0000	0.0000	0.7111
230.75	8408	0.03	1.40	0.1037	0.28	0.70	0.6601	0.00	0.00	0.0000	0.0000	0.7639
230.85	9108	0.03	1.50	0.1074	0.28	0.80	0.7057	0.00	0.00	0.0000	0.0000	0.8131

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FOREBAY DESIGN CALCULATIONS
MOE SWM Planning and Design Manual, 2003

Forebay Design Flows

Flow into forebay during the 1:2-year return period event	3.515	m^3/s
Flow into forebay during the 25 mm - 4 hour design storm event	1.749	m^3/s
Peak flow from main pond outlet for the 25mm design storm (from MIDUSS)	0.185	m^3/s

Forebay Characteristics

b =	12.5	*m*	bottom width
y =	1.25	*m*	depth
z =	5	:1	side slope
w =	18.8	*m*	average width
R =	0.93	*m*	hydraulic radius
A =	23.4	m^2	cross-sectional area

1. Length Calculation Based on Settling Velocity

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

Equation 4.5: Forebay Settling Length

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

Q_p =	1.75	m^3/s	peak flow rate through forebay
v_s =	0.0055	*m/s*	settling velocity
r =	0.92		length-to-width ratio
L =	17.1	*m*	required settling length
L =	*17.2*	*m*	*trial length*

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

Q_p =	0.185	m^3/s	peak flow rate through forebay
v_s =	0.0003	*m/s*	settling velocity
r =	1.75		length-to-width ratio
L =	32.9	*m*	required settling length
L =	*32.9*	*m*	*trial length*

Table 1: Average settling velocities

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

2. Length Calculation Based on Flow Dispersion Length

Q =	3.52	m^3/s	inlet flow rate
d =	1.25	*m*	depth of permanent pool in forebay
V_f =	0.50	*m/s*	desired velocity in forebay (typical value ≤ 0.50 *m/s*)
L =	45.0	m	required length of dispersion

Equation 4.6: Dispersion Length

3. Required Forebay Length

L =	**45.0**	***m***	**design length**
r =	2.40		design length-to-width ratio (typical minimum of 2.0)

4. Scour Velocity

v_s =	0.15	*m/s*	scour velocity (typical value = 0.15 *m/s*)
v =	**0.150**	***m/s***	**actual velocity**

OK The actual velocity through the forebay is less than the scour velocity.

5. Weir Flow From Forebay

L =	22.373	*m*	length of crest of weir
α =	1.65		coefficient
H =	0.3	*m*	head
Q =	**6.07**	m^3/s	**discharge**

Equation 4.4: Weir Flow

OK The weir flow from the forebay exceeds the flow entering the forebay

6. Estimated Cleanout Frequencies

a) Forebay

Forebay volume	863	m^3
Estimated TSS removal efficiency	80%	
Impervious level	60%	
Estimated annual sediment loading	2.2	m^3/ha
Contributing area	20.86	*ha*
Annual sediment volume	37	m^3/yr
Cleanout frequency for 33% volume reduction	**7.8**	***years***

Table 2: Annual sediment loading

Impervious Level	Annual Loading
%	m^3/ha
35%	0.6
55%	1.9
70%	2.8
85%	3.8

b) Stormwater Management Pond

Wetpond volume (excluding forebay)	2767	m^3
Estimated TSS removal efficiency	30%	
Impervious level	60%	
Estimated annual sediment loading	2.2	m^3/ha
Contributing area	20.86	*ha*
Annual sediment volume	14	m^3/yr
Cleanout frequency for 33% volume reduction	**66.3**	***years***

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FALLING HEAD DRAWDOWN CALCULATION
MOE SWM Planning and Design Manual, 2003

$$t = \frac{0.66C_2h^{1.5} + 2C_3h^{0.5}}{2.75A_O}$$ Equation 4.11

where				
	t =	95605.35	*s*	
		26.6	*hr*	drawdown time
	A_p =	5623.024	m^2	surface area of the pond
	C =	0.63		discharge coefficient
	d =	200	*mm*	diameter of the orifice
	A_O =	0.031416	m^2	cross-sectional area of the orifice
	g =	9.81	m/s^2	gravitational acceleration constant
	h_1 =	230.010	*m*	starting water elevation above the orifice
	h_2 =	229.250	*m*	ending water elevation above the orifice
	h =	0.76	*m*	maximum water elevation above the orifice
	C_2 =	1739.506		slope coefficient from the area-depth linear regression
	C_3 =	4301		intercept from the area-depth linear regression

	ELEVATION *m*	STAGE *m*	AREA m^2	COMMENTS
1	229.250	0	4301.0	Permanent pool
2	229.350	0.1	4475.0	
3	229.450	0.2	4648.9	
4	229.550	0.3	4822.9	
5	229.650	0.4	4996.8	
6	229.750	0.5	5170.8	
7	229.850	0.6	5344.7	
8	229.950	0.7	5518.7	
9	230.050	0.8	5692.6	Extended detention

DRAWDOWN TIME: 95605 *s*
26.6 *hr*

Regression Output:

m_1 =	1739.51	slope coefficient from the area-depth linear regression
b =	4301.00	intercept from the area-depth linear regression
se_1 =	0.00	standard error for coefficient m_1
se_b =	0.00	standard error for constant b
R^2 =	1.0000	coefficient of determination
se_y =	0.00	standard error of the *y* estimate
F =	2.91E+32	F statistic
df =	7	degrees of freedom
ss_{reg} =	1815528	regression sum of squares
ss_{resid} =	0	residual sum of squares

Appendix C

Hydrologic Modelling Output

MTE

2

2
AREA [ha] - 14.100

1

1
AREA [ha] - 7.640

```
====================================================================================================

      V    V   I    SSSSS  U   U    A    L               (v 6.2.2015)
      V    V   I    SS     U   U   A A   L
       V  V    I     SS    U   U  AAAAA  L
       V  V    I      SS   U   U  A   A  L
        VV     I    SSSSS  UUUUU  A   A  LLLLL

       OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
      O   O    T      T    H   H   Y Y   MM MM  O   O
      O   O    T      T    H   H    Y    M   M  O   O
       OOO     T      T    H   H    Y    M   M   OOO
Developed and Distributed by Smart City Water Inc
```


```
                  *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\39fefd4d-
  Summary filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\39fefd4d-

DATE: 12/15/2023                          TIME: 03:35:46

USER:


COMMENTS: ____________________________________________________________

----------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 100-Year Chicago SC            **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=2561.151
| Ptotal= 76.21 mm |                          B=   9.093
--------------------                          C=   0.880
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =  0.33
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	4.61	0.75	37.56	1.50	16.61	2.25	6.40
0.08	5.13	0.83	92.64	1.58	14.21	2.33	5.98
0.17	5.79	0.92	249.64	1.67	12.38	2.42	5.61
0.25	6.63	1.00	119.41	1.75	10.96	2.50	5.29
0.33	7.76	1.08	65.98	1.83	9.81	2.58	5.00
0.42	9.33	1.17	43.53	1.92	8.87	2.67	4.73
0.50	11.65	1.25	31.69	2.00	8.10	2.75	4.50
0.58	15.39	1.33	24.57	2.08	7.44	2.83	4.29
0.67	22.19	1.42	19.89	2.17	6.88	2.92	4.10

```
-----------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=  14.10   Curve Number   (CN)= 65.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.37

     Unit Hyd Qpeak  (cms)=   1.456

     PEAK FLOW       (cms)=   0.846 (i)
     TIME TO PEAK    (hrs)=   1.417
     RUNOFF VOLUME    (mm)=  24.379
     TOTAL RAINFALL   (mm)=  76.212
     RUNOFF COEFFICIENT   =   0.320

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=   7.64   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.30

     Unit Hyd Qpeak  (cms)=   0.973

     PEAK FLOW       (cms)=   0.464 (i)
     TIME TO PEAK    (hrs)=   1.333
     RUNOFF VOLUME    (mm)=  21.700
     TOTAL RAINFALL   (mm)=  76.212
     RUNOFF COEFFICIENT   =   0.285

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
====================================================================================================

      V    V   I    SSSSS  U   U    A    L               (v 6.2.2015)
      V    V   I    SS     U   U   A A   L
       V  V    I     SS    U   U  AAAAA  L
       V  V    I      SS   U   U  A   A  L
        VV     I    SSSSS  UUUUU  A   A  LLLLL

       OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
      O   O    T      T    H   H   Y Y   MM MM  O   O
      O   O    T      T    H   H    Y    M   M  O   O
       OOO     T      T    H   H    Y    M   M   OOO
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```


```
                  *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\96ea0864-
  Summary filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\96ea0864-

DATE: 12/15/2023                          TIME: 03:35:46

USER:


COMMENTS: ____________________________________________________________

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  ************************************************
  ** SIMULATION : 10-Year Chicago SC             **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1425.011
| Ptotal= 51.88 mm |                          B=   7.382
--------------------                          C=   0.843
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =  0.33
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	3.64	0.75	24.58	1.50	11.53	2.25	4.88
0.08	4.00	0.83	59.70	1.58	10.01	2.33	4.59
0.17	4.46	0.92	170.84	1.67	8.84	2.42	4.34
0.25	5.04	1.00	77.13	1.75	7.91	2.50	4.11
0.33	5.80	1.08	42.35	1.83	7.16	2.58	3.91
0.42	6.84	1.17	28.29	1.92	6.55	2.67	3.72
0.50	8.36	1.25	20.95	2.00	6.03	2.75	3.56
0.58	10.76	1.33	16.52	2.08	5.59	2.83	3.41
0.67	15.04	1.42	13.60	2.17	5.21	2.92	3.27

```
-----------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=  14.10   Curve Number   (CN)= 65.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.37

     Unit Hyd Qpeak  (cms)=   1.456
```

```
     PEAK FLOW       (cms)=   0.391 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=  11.963
     TOTAL RAINFALL   (mm)=  51.876
     RUNOFF COEFFICIENT   =   0.231

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| NASHYD   (  0001)|   Area    (ha)=   7.64   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.30

     Unit Hyd Qpeak  (cms)=   0.973

     PEAK FLOW       (cms)=   0.210 (i)
     TIME TO PEAK    (hrs)=   1.417
     RUNOFF VOLUME    (mm)=  10.496
     TOTAL RAINFALL   (mm)=  51.876
     RUNOFF COEFFICIENT   =   0.202

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
==============================================================================================================

       V    V   I    SSSSS  U   U    A    L               (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO     TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                    *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\44d490e2-
  Summary filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\44d490e2-

DATE: 12/15/2023                             TIME: 03:35:46

USER:

COMMENTS: ____________________________________________________________

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  **************************************************
  ** SIMULATION : 250-Year Chicago SC              **
  **************************************************

--------------------
| CHICAGO STORM    |     IDF curve parameters: A=3048.220
| Ptotal= 90.50 mm |                           B=  10.030
--------------------                           C=   0.888
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  4.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    3.63 |  1.00   25.78 |  2.00   14.23 |  3.00    5.29
                 0.08    3.91 |  1.08   43.79 |  2.08   12.55 |  3.08    5.02
                 0.17    4.25 |  1.17  106.49 |  2.17   11.20 |  3.17    4.78
                 0.25    4.66 |  1.25  274.73 |  2.25   10.11 |  3.25    4.55
                 0.33    5.15 |  1.33  136.49 |  2.33    9.20 |  3.33    4.35
                 0.42    5.75 |  1.42   76.63 |  2.42    8.43 |  3.42    4.17
                 0.50    6.51 |  1.50   50.75 |  2.50    7.78 |  3.50    4.00
```

```
                 0.58    7.49 |  1.58   36.94 |  2.58    7.22 |  3.58    3.84
                 0.67    8.80 |  1.67   28.58 |  2.67    6.73 |  3.67    3.70
                 0.75   10.64 |  1.75   23.07 |  2.75    6.30 |  3.75    3.56
                 0.83   13.37 |  1.83   19.21 |  2.83    5.92 |  3.83    3.44
                 0.92   17.76 |  1.92   16.38 |  2.92    5.59 |  3.92    3.32

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| NASHYD   (  0002)|   Area    (ha)=  14.10   Curve Number   (CN)= 65.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.37

     Unit Hyd Qpeak  (cms)=   1.456

     PEAK FLOW       (cms)=   1.099 (i)
     TIME TO PEAK    (hrs)=   1.750
     RUNOFF VOLUME    (mm)=  32.885
     TOTAL RAINFALL   (mm)=  90.502
     RUNOFF COEFFICIENT   =   0.363

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB             |
| NASHYD   (  0001)|   Area    (ha)=   7.64   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.30

     Unit Hyd Qpeak  (cms)=   0.973

     PEAK FLOW       (cms)=   0.606 (i)
     TIME TO PEAK    (hrs)=   1.667
     RUNOFF VOLUME    (mm)=  29.479
     TOTAL RAINFALL   (mm)=  90.502
     RUNOFF COEFFICIENT   =   0.326

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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==============================================================================================================

       V    V   I    SSSSS  U   U    A    L               (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO     TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                    *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\4cc3ac72-
  Summary filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\4cc3ac72-

DATE: 12/15/2023                             TIME: 03:35:47

USER:

COMMENTS: ____________________________________________________________

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  **************************************************
  ** SIMULATION : 25mm 4 Hour Chicago SC           **
  **************************************************

--------------------
| CHICAGO STORM    |     IDF curve parameters: A= 538.850
| Ptotal= 25.05 mm |                           B=   6.331
```

```
--------------------                                C=   0.809
                     used in:   INTENSITY =  A / (t + B)^C

                     Duration of storm  =  4.00 hrs
                     Storm time step    =  5.00 min
                     Time to peak ratio =  0.33

                TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.00    1.41 |  1.00    6.88 |  2.00    4.27 |  3.00    1.93
                0.08    1.50 |  1.08   10.87 |  2.08    3.86 |  3.08    1.85
                0.17    1.60 |  1.17   25.65 |  2.17    3.52 |  3.17    1.78
                0.25    1.72 |  1.25   75.61 |  2.25    3.24 |  3.25    1.71
                0.33    1.87 |  1.33   33.19 |  2.33    3.01 |  3.33    1.65
                0.42    2.04 |  1.42   18.44 |  2.42    2.80 |  3.42    1.59
                0.50    2.25 |  1.50   12.55 |  2.50    2.63 |  3.50    1.54
                0.58    2.52 |  1.58    9.47 |  2.58    2.48 |  3.58    1.49
                0.67    2.87 |  1.67    7.59 |  2.67    2.34 |  3.67    1.45
                0.75    3.34 |  1.75    6.34 |  2.75    2.22 |  3.75    1.40
                0.83    4.01 |  1.83    5.45 |  2.83    2.11 |  3.83    1.36
                0.92    5.05 |  1.92    4.78 |  2.92    2.02 |  3.92    1.33

-------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0002)|   Area    (ha)=  14.10   Curve Number   (CN)= 65.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.37

    Unit Hyd Qpeak  (cms)=   1.456

    PEAK FLOW       (cms)=   0.068 (i)
    TIME TO PEAK    (hrs)=   1.833
    RUNOFF VOLUME    (mm)=   2.562
    TOTAL RAINFALL   (mm)=  25.048
    RUNOFF COEFFICIENT   =   0.102

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0001)|   Area    (ha)=   7.64   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.30

    Unit Hyd Qpeak  (cms)=   0.973

    PEAK FLOW       (cms)=   0.035 (i)
    TIME TO PEAK    (hrs)=   1.750
    RUNOFF VOLUME    (mm)=   2.202
    TOTAL RAINFALL   (mm)=  25.048
    RUNOFF COEFFICIENT   =   0.088

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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===============================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****

  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\76c52370-
```

```
  Summary filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\76c52370-

DATE: 12/15/2023                           TIME: 03:35:46

USER:


COMMENTS: ____________________________________________________________


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  ************************************************
  ** SIMULATION : 25-Year Chicago SC            **
  ************************************************

--------------------
| CHICAGO STORM      |     IDF curve parameters: A=1835.352
| Ptotal= 61.64 mm |                             B=   7.844
--------------------                             C=   0.858
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    4.06 |  0.75   29.44 |  1.50   13.47 |  2.25    5.51
                 0.08    4.48 |  0.83   72.48 |  1.58   11.63 |  2.33    5.17
                 0.17    5.01 |  0.92  205.33 |  1.67   10.22 |  2.42    4.87
                 0.25    5.69 |  1.00   93.76 |  1.75    9.11 |  2.50    4.61
                 0.33    6.59 |  1.08   51.29 |  1.83    8.21 |  2.58    4.37
                 0.42    7.83 |  1.17   34.00 |  1.92    7.48 |  2.67    4.16
                 0.50    9.65 |  1.25   24.97 |  2.00    6.86 |  2.75    3.97
                 0.58   12.53 |  1.33   19.55 |  2.08    6.34 |  2.83    3.79
                 0.67   17.74 |  1.42   15.98 |  2.17    5.90 |  2.92    3.63

-------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0002)|   Area    (ha)=  14.10   Curve Number   (CN)= 65.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.37

    Unit Hyd Qpeak  (cms)=   1.456

    PEAK FLOW       (cms)=   0.558 (i)
    TIME TO PEAK    (hrs)=   1.500
    RUNOFF VOLUME    (mm)=  16.584
    TOTAL RAINFALL   (mm)=  61.640
    RUNOFF COEFFICIENT   =   0.269

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0001)|   Area    (ha)=   7.64   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.30

    Unit Hyd Qpeak  (cms)=   0.973

    PEAK FLOW       (cms)=   0.303 (i)
    TIME TO PEAK    (hrs)=   1.333
    RUNOFF VOLUME    (mm)=  14.641
    TOTAL RAINFALL   (mm)=  61.640
    RUNOFF COEFFICIENT   =   0.238

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
=============================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
```

```
      O   O    T       T    H   H   Y Y   MM MM  O   O
      O   O    T       T    H   H    Y    M   M  O   O
       OOO     T       T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\a8a1b28e-
  Summary filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\a8a1b28e-


DATE: 12/15/2023                          TIME: 03:35:46

USER:


COMMENTS: ____________________________________________________________


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  ************************************************
  ** SIMULATION : 2-year Chicago SC from IDF    **
  ************************************************

--------------------
| CHICAGO STORM    |     IDF curve parameters: A=2016.901
| Ptotal= 39.86 mm |                           B=  11.250
--------------------                           C=   0.956
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    1.54 |  0.75   20.31 |  1.50    7.84 |  2.25    2.37
                 0.08    1.77 |  0.83   53.33 |  1.58    6.48 |  2.33    2.17
                 0.17    2.08 |  0.92  140.32 |  1.67    5.47 |  2.42    1.99
                 0.25    2.48 |  1.00   69.17 |  1.75    4.69 |  2.50    1.84
                 0.33    3.03 |  1.08   37.56 |  1.83    4.09 |  2.58    1.71
                 0.42    3.83 |  1.17   23.92 |  1.92    3.60 |  2.67    1.60
                 0.50    5.07 |  1.25   16.75 |  2.00    3.20 |  2.75    1.49
                 0.58    7.14 |  1.33   12.48 |  2.08    2.87 |  2.83    1.40
                 0.67   11.08 |  1.42    9.73 |  2.17    2.60 |  2.92    1.32

-----------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=  14.10   Curve Number   (CN)= 65.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.37

     Unit Hyd Qpeak  (cms)=   1.456

     PEAK FLOW      (cms)=   0.260 (i)
     TIME TO PEAK   (hrs)=   1.500
     RUNOFF VOLUME   (mm)=   7.080
     TOTAL RAINFALL  (mm)=  39.861
     RUNOFF COEFFICIENT   =   0.178

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0001)|   Area    (ha)=   7.64   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.30

     Unit Hyd Qpeak  (cms)=   0.973

     PEAK FLOW      (cms)=   0.139 (i)
     TIME TO PEAK   (hrs)=   1.417
     RUNOFF VOLUME   (mm)=   6.159
     TOTAL RAINFALL  (mm)=  39.861
     RUNOFF COEFFICIENT   =   0.155
```

```
     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
=========================================================================================================

      V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
      V    V   I    SS     U   U   A A   L
       V  V    I     SS    U   U  AAAAA  L
       V  V    I      SS   U   U  A   A  L
        VV     I    SSSSS  UUUUU  A   A  LLLLL

       OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
      O   O    T      T    H   H   Y Y   MM MM  O   O
      O   O    T      T    H   H    Y    M   M  O   O
       OOO     T      T    H   H    Y    M   M   OOO
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                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\e66ada73-
  Summary filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\e66ada73-


DATE: 12/15/2023                          TIME: 03:35:46

USER:


COMMENTS: ____________________________________________________________


---------------------------------------------------------------------------------------------------------
  ************************************************
  ** SIMULATION : 50-Year Chicago SC            **
  ************************************************

--------------------
| CHICAGO STORM    |     IDF curve parameters: A=2225.884
| Ptotal= 69.59 mm |                           B=   8.620
--------------------                           C=   0.871
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    4.36 |  0.75   33.91 |  1.50   15.21 |  2.25    6.00
                 0.08    4.84 |  0.83   83.50 |  1.58   13.06 |  2.33    5.62
                 0.17    5.44 |  0.92  228.89 |  1.67   11.42 |  2.42    5.28
                 0.25    6.21 |  1.00  107.76 |  1.75   10.13 |  2.50    4.98
                 0.33    7.24 |  1.08   59.36 |  1.83    9.10 |  2.58    4.72
                 0.42    8.66 |  1.17   39.24 |  1.92    8.25 |  2.67    4.48
                 0.50   10.76 |  1.25   28.68 |  2.00    7.55 |  2.75    4.26
                 0.58   14.11 |  1.33   22.32 |  2.08    6.95 |  2.83    4.07
                 0.67   20.20 |  1.42   18.14 |  2.17    6.44 |  2.92    3.89

-----------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0002)|   Area    (ha)=  14.10   Curve Number   (CN)= 65.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.37

     Unit Hyd Qpeak  (cms)=   1.456

     PEAK FLOW      (cms)=   0.709 (i)
     TIME TO PEAK   (hrs)=   1.417
     RUNOFF VOLUME   (mm)=  20.713
     TOTAL RAINFALL  (mm)=  69.587
     RUNOFF COEFFICIENT   =   0.298

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-----------------------------------------------------------------------------
```

```
--------------------
| CALIB              |
| NASHYD   (  0001)|   Area    (ha)=   7.64   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.30

     Unit Hyd Qpeak  (cms)=   0.973

     PEAK FLOW       (cms)=   0.387 (i)
     TIME TO PEAK    (hrs)=   1.333
     RUNOFF VOLUME    (mm)=  18.371
     TOTAL RAINFALL   (mm)=  69.587
     RUNOFF COEFFICIENT   =   0.264

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
==============================================================================================================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2015)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
```

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```
                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\VO2\voin.dat
  Output  filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\a5415d02-
  Summary filename: C:\Users\BPavlovic\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\a5415d02-


DATE: 12/15/2023                           TIME: 03:35:46

USER:



COMMENTS: ____________________________________________________________

--------------------------------------------------------------------------------------------------------------
  **************************************************
  ** SIMULATION : 5-Year Chicago SC               **
  **************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=1137.257
| Ptotal= 44.35 mm |                          B=   7.184
--------------------                          C=   0.830
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =  0.33
```

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.00	3.29	0.75	21.03	1.50	10.08	2.25	4.38
0.08	3.61	0.83	50.18	1.58	8.78	2.33	4.13
0.17	4.01	0.92	142.78	1.67	7.78	2.42	3.90
0.25	4.51	1.00	64.63	1.75	6.99	2.50	3.71
0.33	5.17	1.08	35.80	1.83	6.35	2.58	3.53
0.42	6.08	1.17	24.12	1.92	5.82	2.67	3.37
0.50	7.38	1.25	17.99	2.00	5.37	2.75	3.22
0.58	9.42	1.33	14.28	2.08	4.99	2.83	3.09
0.67	13.03	1.42	11.82	2.17	4.66	2.92	2.97

```
--------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0002)|   Area    (ha)=  14.10   Curve Number   (CN)= 65.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.37

     Unit Hyd Qpeak  (cms)=   1.456

     PEAK FLOW       (cms)=   0.279 (i)
     TIME TO PEAK    (hrs)=   1.500
     RUNOFF VOLUME    (mm)=   8.792
     TOTAL RAINFALL   (mm)=  44.354
     RUNOFF COEFFICIENT   =   0.198

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------
--------------------
| CALIB              |
| NASHYD   (  0001)|   Area    (ha)=   7.64   Curve Number   (CN)= 61.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.30

     Unit Hyd Qpeak  (cms)=   0.973

     PEAK FLOW       (cms)=   0.148 (i)
     TIME TO PEAK    (hrs)=   1.417
     RUNOFF VOLUME    (mm)=   7.674
     TOTAL RAINFALL   (mm)=  44.354
     RUNOFF COEFFICIENT   =   0.173

     (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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```
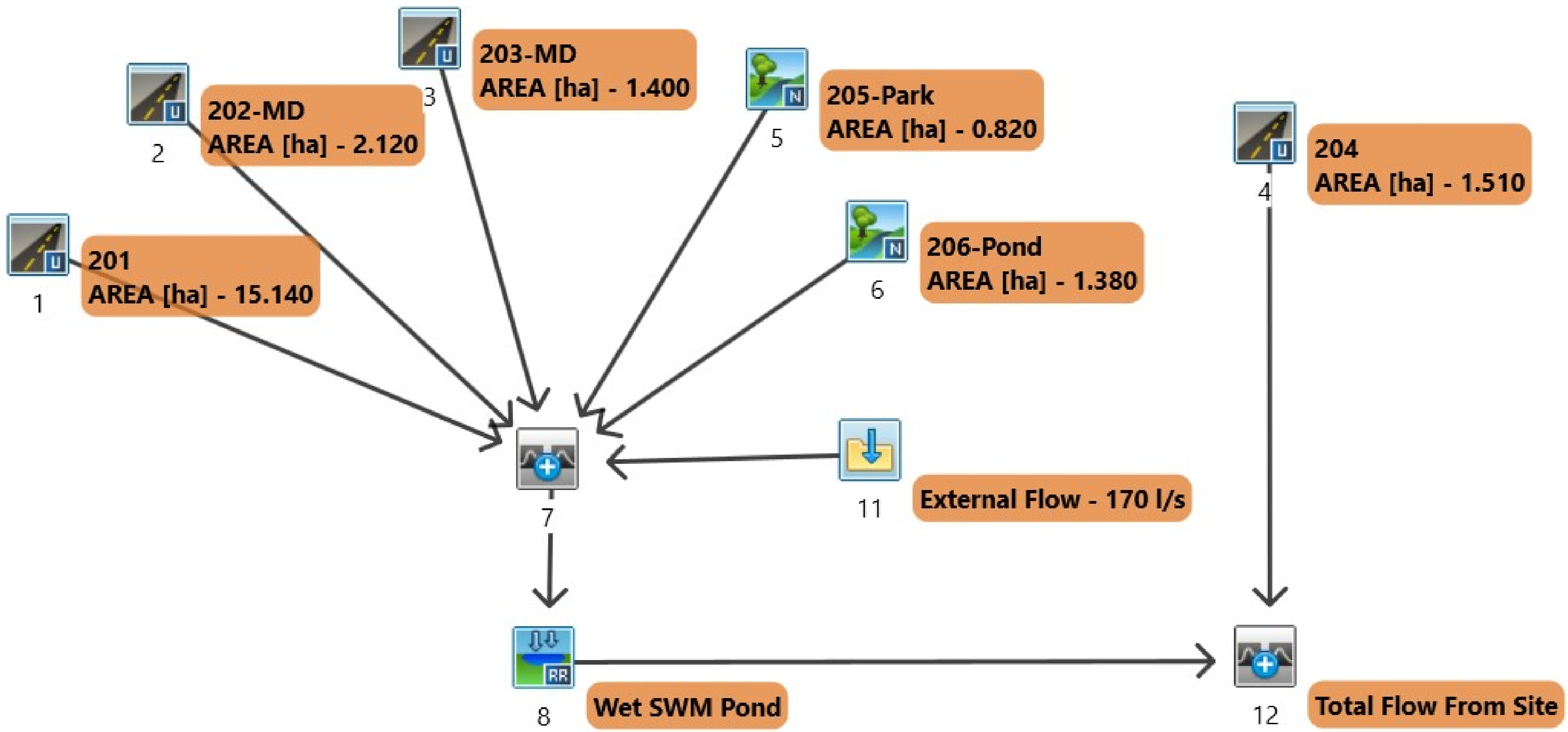



202-MD
AREA [ha] - 2.120
203-MD
AREA [ha] - 1.400
205-Park
AREA [ha] - 0.820
204
AREA [ha] - 1.510
201
AREA [ha] - 15.140
206-Pond
AREA [ha] - 1.380
External Flow - 170 l/s
Wet SWM Pond
Total Flow From Site
1
2
3
4
5
6
7
8
11
12

```
           over (min)        5.00         9.00
     Storage Coeff.  (min)=       3.63 (ii)    8.87 (ii)
     Unit Hyd. Tpeak (min)=       5.00         9.00
     Unit Hyd. peak  (cms)=       0.28         0.13
                                                          *TOTALS*
     PEAK FLOW       (cms)=       2.39         0.14         2.455 (iii)
     TIME TO PEAK    (hrs)=       1.03         1.20          1.05
     RUNOFF VOLUME    (mm)=      37.86         4.63         22.58
     TOTAL RAINFALL   (mm)=      39.86        39.86         39.86
     RUNOFF COEFFICIENT   =       0.95         0.12          0.57


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  45.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0002)|   Area    (ha)=   2.66
|ID= 1 DT= 1.0 min |   Total Imp(%)=  63.00   Dir. Conn.(%)=  53.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       1.68         0.98
     Dep. Storage     (mm)=       2.00         5.00
     Average Slope     (%)=       2.00         2.00
     Length            (m)=     133.17        40.00
     Mannings n           =      0.013        0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   1.0 MIN. TIME STEP.


                               ---- TRANSFORMED HYETOGRAPH ----
               TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
              0.017    1.54 | 0.767   20.31 | 1.517    7.84 |  2.27    2.37
              0.033    1.54 | 0.783   20.31 | 1.533    7.84 |  2.28    2.37
              0.050    1.54 | 0.800   20.31 | 1.550    7.84 |  2.30    2.37
              0.067    1.54 | 0.817   20.31 | 1.567    7.84 |  2.32    2.37
              0.083    1.54 | 0.833   20.31 | 1.583    7.84 |  2.33    2.37
              0.100    1.77 | 0.850   53.33 | 1.600    6.48 |  2.35    2.17
              0.117    1.77 | 0.867   53.33 | 1.617    6.48 |  2.37    2.17
              0.133    1.77 | 0.883   53.33 | 1.633    6.48 |  2.38    2.17
              0.150    1.77 | 0.900   53.33 | 1.650    6.48 |  2.40    2.17
              0.167    1.77 | 0.917   53.33 | 1.667    6.48 |  2.42    2.17
              0.183    2.08 | 0.933  140.32 | 1.683    5.47 |  2.43    1.99
              0.200    2.08 | 0.950  140.32 | 1.700    5.47 |  2.45    1.99
              0.217    2.08 | 0.967  140.32 | 1.717    5.47 |  2.47    1.99
              0.233    2.08 | 0.983  140.32 | 1.733    5.47 |  2.48    1.99
```

```
              0.250    2.08 | 1.000  140.32 | 1.750    5.47 |  2.50    1.99
              0.267    2.48 | 1.017   69.17 | 1.767    4.69 |  2.52    1.84
              0.283    2.48 | 1.033   69.17 | 1.783    4.69 |  2.53    1.84
              0.300    2.48 | 1.050   69.17 | 1.800    4.69 |  2.55    1.84
              0.317    2.48 | 1.067   69.17 | 1.817    4.69 |  2.57    1.84
              0.333    2.48 | 1.083   69.17 | 1.833    4.69 |  2.58    1.84
              0.350    3.03 | 1.100   37.56 | 1.850    4.09 |  2.60    1.71
              0.367    3.03 | 1.117   37.56 | 1.867    4.09 |  2.62    1.71
              0.383    3.03 | 1.133   37.56 | 1.883    4.09 |  2.63    1.71
              0.400    3.03 | 1.150   37.56 | 1.900    4.09 |  2.65    1.71
              0.417    3.03 | 1.167   37.56 | 1.917    4.09 |  2.67    1.71
              0.433    3.83 | 1.183   23.93 | 1.933    3.60 |  2.68    1.60
              0.450    3.83 | 1.200   23.92 | 1.950    3.60 |  2.70    1.60
              0.467    3.83 | 1.217   23.92 | 1.967    3.60 |  2.72    1.60
              0.483    3.83 | 1.233   23.92 | 1.983    3.60 |  2.73    1.60
              0.500    3.83 | 1.250   23.92 | 2.000    3.60 |  2.75    1.60
              0.517    5.07 | 1.267   16.75 | 2.017    3.20 |  2.77    1.49
              0.533    5.07 | 1.283   16.75 | 2.033    3.20 |  2.78    1.49
              0.550    5.07 | 1.300   16.75 | 2.050    3.20 |  2.80    1.49
              0.567    5.07 | 1.317   16.75 | 2.067    3.20 |  2.82    1.49
              0.583    5.07 | 1.333   16.75 | 2.083    3.20 |  2.83    1.49
              0.600    7.14 | 1.350   12.48 | 2.100    2.87 |  2.85    1.40
              0.617    7.14 | 1.367   12.48 | 2.117    2.87 |  2.87    1.40
              0.633    7.14 | 1.383   12.48 | 2.133    2.87 |  2.88    1.40
              0.650    7.14 | 1.400   12.48 | 2.150    2.87 |  2.90    1.40
              0.667    7.14 | 1.417   12.48 | 2.167    2.87 |  2.92    1.40
              0.683   11.08 | 1.433    9.73 | 2.183    2.60 |  2.93    1.32
              0.700   11.08 | 1.450    9.73 | 2.200    2.60 |  2.95    1.32
              0.717   11.08 | 1.467    9.73 | 2.217    2.60 |  2.97    1.32
              0.733   11.08 | 1.483    9.73 | 2.233    2.60 |  2.98    1.32
              0.750   11.08 | 1.500    9.73 | 2.250    2.60 |  3.00    1.32

     Max.Eff.Inten.(mm/hr)=     140.32        11.14
                over (min)        5.00         8.00
     Storage Coeff.  (min)=       2.15 (ii)    7.49 (ii)
     Unit Hyd. Tpeak (min)=       5.00         8.00
     Unit Hyd. peak  (cms)=       0.36         0.15
                                                          *TOTALS*
     PEAK FLOW       (cms)=       0.46         0.02         0.474 (iii)
     TIME TO PEAK    (hrs)=       1.03         1.17          1.03
     RUNOFF VOLUME    (mm)=      37.86         3.70         21.80
     TOTAL RAINFALL   (mm)=      39.86        39.86         39.86
     RUNOFF COEFFICIENT   =       0.95         0.09          0.55


       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
            CN*  =  39.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.
```

| CALIB |
| STANDHYD (0003) | Area (ha)= 1.40
| ID= 1 DT= 1.0 min | Total Imp(%)= 79.00 Dir. Conn.(%)= 69.00

		IMPERVIOUS	PERVIOUS (i)
Surface Area	(ha)=	1.11	0.29
Dep. Storage	(mm)=	2.00	5.00
Average Slope	(%)=	2.00	2.00
Length	(m)=	96.61	40.00
Mannings n	=	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.017	1.54	0.767	20.31	1.517	7.84	2.27	2.37
0.033	1.54	0.783	20.31	1.533	7.84	2.28	2.37
0.050	1.54	0.800	20.31	1.550	7.84	2.30	2.37
0.067	1.54	0.817	20.31	1.567	7.84	2.32	2.37
0.083	1.54	0.833	20.31	1.583	7.84	2.33	2.37
0.100	1.77	0.850	53.33	1.600	6.48	2.35	2.17
0.117	1.77	0.867	53.33	1.617	6.48	2.37	2.17
0.133	1.77	0.883	53.33	1.633	6.48	2.38	2.17
0.150	1.77	0.900	53.33	1.650	6.48	2.40	2.17
0.167	1.77	0.917	53.33	1.667	6.48	2.42	2.17
0.183	2.08	0.933	140.32	1.683	5.47	2.43	1.99
0.200	2.08	0.950	140.32	1.700	5.47	2.45	1.99
0.217	2.08	0.967	140.32	1.717	5.47	2.47	1.99
0.233	2.08	0.983	140.32	1.733	5.47	2.48	1.99
0.250	2.08	1.000	140.32	1.750	5.47	2.50	1.99
0.267	2.48	1.017	69.17	1.767	4.69	2.52	1.84
0.283	2.48	1.033	69.17	1.783	4.69	2.53	1.84
0.300	2.48	1.050	69.17	1.800	4.69	2.55	1.84
0.317	2.48	1.067	69.17	1.817	4.69	2.57	1.84
0.333	2.48	1.083	69.17	1.833	4.69	2.58	1.84
0.350	3.03	1.100	37.56	1.850	4.09	2.60	1.71
0.367	3.03	1.117	37.56	1.867	4.09	2.62	1.71
0.383	3.03	1.133	37.56	1.883	4.09	2.63	1.71
0.400	3.03	1.150	37.56	1.900	4.09	2.65	1.71
0.417	3.03	1.167	37.56	1.917	4.09	2.67	1.71
0.433	3.83	1.183	23.93	1.933	3.60	2.68	1.60
0.450	3.83	1.200	23.92	1.950	3.60	2.70	1.60
0.467	3.83	1.217	23.92	1.967	3.60	2.72	1.60
0.483	3.83	1.233	23.92	1.983	3.60	2.73	1.60
0.500	3.83	1.250	23.92	2.000	3.60	2.75	1.60
0.517	5.07	1.267	16.75	2.017	3.20	2.77	1.49
0.533	5.07	1.283	16.75	2.033	3.20	2.78	1.49
0.550	5.07	1.300	16.75	2.050	3.20	2.80	1.49
0.567	5.07	1.317	16.75	2.067	3.20	2.82	1.49
0.583	5.07	1.333	16.75	2.083	3.20	2.83	1.49
0.600	7.14	1.350	12.48	2.100	2.87	2.85	1.40
0.617	7.14	1.367	12.48	2.117	2.87	2.87	1.40
0.633	7.14	1.383	12.48	2.133	2.87	2.88	1.40
0.650	7.14	1.400	12.48	2.150	2.87	2.90	1.40
0.667	7.14	1.417	12.48	2.167	2.87	2.92	1.40
0.683	11.08	1.433	9.73	2.183	2.60	2.93	1.32
0.700	11.08	1.450	9.73	2.200	2.60	2.95	1.32
0.717	11.08	1.467	9.73	2.217	2.60	2.97	1.32
0.733	11.08	1.483	9.73	2.233	2.60	2.98	1.32
0.750	11.08	1.500	9.73	2.250	2.60	3.00	1.32

		IMPERVIOUS	PERVIOUS (i)	*TOTALS*
Max.Eff.Inten.(mm/hr)=		140.32	15.42	
over (min)		5.00	6.00	
Storage Coeff.	(min)=	1.78 (ii)	5.60 (ii)	
Unit Hyd. Tpeak	(min)=	5.00	6.00	
Unit Hyd. peak	(cms)=	0.39	0.20	
PEAK FLOW	(cms)=	0.33	0.01	0.333 (iii)
TIME TO PEAK	(hrs)=	1.03	1.13	1.03
RUNOFF VOLUME	(mm)=	37.86	4.35	27.47
TOTAL RAINFALL	(mm)=	39.86	39.86	39.86
RUNOFF COEFFICIENT	=	0.95	0.11	0.69

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 39.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| STORE HYD(0011) | AREA (ha)= 10.00
| ID= 1 DT=10.0min | QPEAK (cms)= 0.17
TPEAK (hrs)= 0.00
VOLUME (mm)= 25.50

TIME hrs	FLOW cms	TIME hrs	FLOW cms	TIME hrs	FLOW cms	TIME hrs	FLOW cms	TIME hrs	FLOW cms
0.00	0.17	0.83	0.17	1.67	0.17	2.50	0.17	3.33	0.17
0.17	0.17	1.00	0.17	1.83	0.17	2.67	0.17	3.50	0.17
0.33	0.17	1.17	0.17	2.00	0.17	2.83	0.17	3.67	0.17
0.50	0.17	1.33	0.17	2.17	0.17	3.00	0.17	3.83	0.17
0.67	0.17	1.50	0.17	2.33	0.17	3.17	0.17	4.00	0.17

| ADD HYD (0007) |

```
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0001):    15.14   2.455     1.05     22.58
      + ID2= 2 (  0011):    10.00   0.170     0.00     25.50
        ====================================================
        ID = 3 (  0007):    25.14   2.625     1.05     23.33

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0007)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0007):    25.14   2.625     1.05     23.33
      + ID2= 2 (  0002):     2.66   0.474     1.03     21.80
        ====================================================
        ID = 1 (  0007):    27.80   3.088     1.03     23.19

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0007)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0007):    27.80   3.088     1.03     23.19
      + ID2= 2 (  0003):     1.40   0.333     1.03     27.47
        ====================================================
        ID = 3 (  0007):    29.20   3.421     1.03     23.39

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0007)|
|   3 +  2 =  1    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 3 (  0007):    29.20   3.421     1.03     23.39
      + ID2= 2 (  0005):     0.43   0.006     1.17      2.76
        ====================================================
        ID = 1 (  0007):    29.63   3.425     1.03     23.09

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0007)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0007):    29.63   3.425     1.03     23.09
      + ID2= 2 (  0006):     1.23   0.016     1.17      2.76
        ====================================================
        ID = 3 (  0007):    30.86   3.438     1.03     22.28

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------

--------------------
| RESERVOIR(  0008)|     OVERFLOW IS OFF
| IN= 2---> OUT= 1 |
| DT=  5.0 min     |     OUTFLOW    STORAGE   |  OUTFLOW    STORAGE
--------------------      (cms)     (ha.m.)   |   (cms)     (ha.m.)
                          0.0000     0.0000   |    0.3280     0.4575
                          0.0100     0.0439   |    0.4340     0.5171
                          0.0280     0.0895   |    0.5200     0.5784
                          0.0390     0.1369   |    0.5910     0.6414
                          0.0480     0.1860   |    0.6540     0.7061
                          0.0550     0.2368   |    0.7110     0.7726
                          0.0810     0.2894   |    0.7640     0.8408
                          0.1410     0.3437   |    0.8130     0.9108
                          0.2260     0.3997   |    0.0000     0.0000

                               AREA     QPEAK     TPEAK       R.V.
                               (ha)     (cms)     (hrs)       (mm)
   INFLOW : ID= 2 (  0007)     30.860     3.438      1.03      22.28
  OUTFLOW: ID= 1 (  0008)      30.860     0.310      2.02      21.51

                  PEAK   FLOW   REDUCTION [Qout/Qin](%)=  9.01
                  TIME SHIFT OF PEAK FLOW         (min)= 59.00
                  MAXIMUM  STORAGE   USED       (ha.m.)=  0.4467

     **** WARNING : SELECTED ROUTING TIME STEP DENIED.
--------------------------------------------------------------------------------

--------------------
| CALIB            |
| STANDHYD (  0004)|   Area    (ha)=   1.51
|ID= 1 DT= 1.0 min |   Total Imp(%)=  21.00   Dir. Conn.(%)=  21.00
--------------------
                               IMPERVIOUS    PERVIOUS (i)
     Surface Area     (ha)=       0.32          1.19
     Dep. Storage     (mm)=       2.00          5.00
     Average Slope     (%)=       2.00          2.00
     Length            (m)=     100.33         40.00
     Mannings n          =      0.013         0.250

         NOTE:  RAINFALL WAS TRANSFORMED TO   1.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.017    1.54 | 0.767   20.31 | 1.517    7.84 |  2.27    2.37
```

0.033	1.54	0.783	20.31	1.533	7.84	2.28	2.37
0.050	1.54	0.800	20.31	1.550	7.84	2.30	2.37
0.067	1.54	0.817	20.31	1.567	7.84	2.32	2.37
0.083	1.54	0.833	20.31	1.583	7.84	2.33	2.37
0.100	1.77	0.850	53.33	1.600	6.48	2.35	2.17
0.117	1.77	0.867	53.33	1.617	6.48	2.37	2.17
0.133	1.77	0.883	53.33	1.633	6.48	2.38	2.17
0.150	1.77	0.900	53.33	1.650	6.48	2.40	2.17
0.167	1.77	0.917	53.33	1.667	6.48	2.42	2.17
0.183	2.08	0.933	140.32	1.683	5.47	2.43	1.99
0.200	2.08	0.950	140.32	1.700	5.47	2.45	1.99
0.217	2.08	0.967	140.32	1.717	5.47	2.47	1.99
0.233	2.08	0.983	140.32	1.733	5.47	2.48	1.99
0.250	2.08	1.000	140.32	1.750	5.47	2.50	1.99
0.267	2.48	1.017	69.17	1.767	4.69	2.52	1.84
0.283	2.48	1.033	69.17	1.783	4.69	2.53	1.84
0.300	2.48	1.050	69.17	1.800	4.69	2.55	1.84
0.317	2.48	1.067	69.17	1.817	4.69	2.57	1.84
0.333	2.48	1.083	69.17	1.833	4.69	2.58	1.84
0.350	3.03	1.100	37.56	1.850	4.09	2.60	1.71
0.367	3.03	1.117	37.56	1.867	4.09	2.62	1.71
0.383	3.03	1.133	37.56	1.883	4.09	2.63	1.71
0.400	3.03	1.150	37.56	1.900	4.09	2.65	1.71
0.417	3.03	1.167	37.56	1.917	4.09	2.67	1.71
0.433	3.83	1.183	23.93	1.933	3.60	2.68	1.60
0.450	3.83	1.200	23.92	1.950	3.60	2.70	1.60
0.467	3.83	1.217	23.92	1.967	3.60	2.72	1.60
0.483	3.83	1.233	23.92	1.983	3.60	2.73	1.60
0.500	3.83	1.250	23.92	2.000	3.60	2.75	1.60
0.517	5.07	1.267	16.75	2.017	3.20	2.77	1.49
0.533	5.07	1.283	16.75	2.033	3.20	2.78	1.49
0.550	5.07	1.300	16.75	2.050	3.20	2.80	1.49
0.567	5.07	1.317	16.75	2.067	3.20	2.82	1.49
0.583	5.07	1.333	16.75	2.083	3.20	2.83	1.49
0.600	7.14	1.350	12.48	2.100	2.87	2.85	1.40
0.617	7.14	1.367	12.48	2.117	2.87	2.87	1.40
0.633	7.14	1.383	12.48	2.133	2.87	2.88	1.40
0.650	7.14	1.400	12.48	2.150	2.87	2.90	1.40
0.667	7.14	1.417	12.48	2.167	2.87	2.92	1.40
0.683	11.08	1.433	9.73	2.183	2.60	2.93	1.32
0.700	11.08	1.450	9.73	2.200	2.60	2.95	1.32
0.717	11.08	1.467	9.73	2.217	2.60	2.97	1.32
0.733	11.08	1.483	9.73	2.233	2.60	2.98	1.32
0.750	11.08	1.500	9.73	2.250	2.60	3.00	1.32

```
Max.Eff.Inten.(mm/hr)=     140.32          4.40
          over (min)         5.00         27.00
Storage Coeff.  (min)=       1.82 (ii)    26.43 (ii)
Unit Hyd. Tpeak (min)=       5.00         27.00
Unit Hyd. peak  (cms)=       0.39          0.04
                                                      *TOTALS*
     PEAK FLOW       (cms)=       0.11          0.01          0.107 (iii)
     TIME TO PEAK    (hrs)=       1.03          1.53           1.03
     RUNOFF VOLUME    (mm)=      37.86          2.81          10.16
     TOTAL RAINFALL   (mm)=      39.86         39.86          39.86
     RUNOFF COEFFICIENT   =       0.95          0.07           0.25

       (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN* =  39.0    Ia = Dep. Storage  (Above)
      (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
           THAN THE STORAGE COEFFICIENT.
     (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

--------------------------------------------------------------------------------

--------------------
| ADD HYD  (  0012)|
|   1 +  2 =  3    |         AREA    QPEAK    TPEAK     R.V.
--------------------         (ha)    (cms)    (hrs)     (mm)
        ID1= 1 (  0004):     1.51    0.107     1.03    10.16
      + ID2= 2 (  0008):    30.86    0.310     2.02    21.51
        ==================================================
        ID = 3 (  0012):    32.37    0.319     1.95    20.98

     NOTE:  PEAK FLOWS DO NOT INCLUDE BASEFLOWS IF ANY.
--------------------------------------------------------------------------------
=====================================================================================
=======================

       V    V   I    SSSSS  U   U    A    L              (v 6.2.2016)
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O
        OOO     T      T    H   H    Y    M   M   OOO
Developed and Distributed by Smart City Water Inc
```



```
                   *****  D E T A I L E D   O U T P U T *****


  Input   filename: C:\Program Files (x86)\Visual OTTHYMO 6.2\V02\voin.dat

  Output  filename:
C:\Users\JMonster\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\1538
```

```
477b-e07a-4522-9a4b-f0cddc649a99\sce
  Summary filename:
C:\Users\JMonster\AppData\Local\Civica\VH5\4f708a6b-515a-4ba2-98e2-df6985b4da56\1538
477b-e07a-4522-9a4b-f0cddc649a99\sce


DATE: 06/13/2024                          TIME: 04:37:37

USER:



COMMENTS: ____________________________________________________________


-----------------------------------------------------------------------------------
----------------------
  ************************************************
  ** SIMULATION : 50-Year Chicago SC           **
  ************************************************

--------------------
| CHICAGO STORM    |    IDF curve parameters: A=2225.884
| Ptotal= 69.59 mm |                          B=   8.620
--------------------                          C=   0.871
                        used in:   INTENSITY =  A / (t + B)^C

                        Duration of storm  =  3.00 hrs
                        Storm time step    =  5.00 min
                        Time to peak ratio =  0.33

                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                 0.00    4.36 |  0.75   33.91 |   1.50   15.21 |  2.25    6.00
                 0.08    4.84 |  0.83   83.50 |   1.58   13.06 |  2.33    5.62
                 0.17    5.44 |  0.92  228.89 |   1.67   11.42 |  2.42    5.28
                 0.25    6.21 |  1.00  107.76 |   1.75   10.13 |  2.50    4.98
                 0.33    7.24 |  1.08   59.36 |   1.83    9.10 |  2.58    4.72
                 0.42    8.66 |  1.17   39.24 |   1.92    8.25 |  2.67    4.48
                 0.50   10.76 |  1.25   28.68 |   2.00    7.55 |  2.75    4.26
                 0.58   14.11 |  1.33   22.32 |   2.08    6.95 |  2.83    4.07
                 0.67   20.20 |  1.42   18.14 |   2.17    6.44 |  2.92    3.89


------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0005)|   Area    (ha)=   0.43   Curve Number   (CN)= 39.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.11
```

```
    Unit Hyd Qpeak  (cms)=   0.149

    PEAK FLOW       (cms)=   0.017 (i)
    TIME TO PEAK    (hrs)=   1.083
    RUNOFF VOLUME    (mm)=   8.865
    TOTAL RAINFALL   (mm)=  69.587
    RUNOFF COEFFICIENT   =   0.127

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
--------------------
| CALIB            |
| NASHYD   (  0006)|   Area    (ha)=   1.23   Curve Number   (CN)= 39.0
|ID= 1 DT= 5.0 min |   Ia      (mm)=   5.00   # of Linear Res.(N)= 3.00
--------------------   U.H. Tp(hrs)=   0.11

    Unit Hyd Qpeak  (cms)=   0.427

    PEAK FLOW       (cms)=   0.050 (i)
    TIME TO PEAK    (hrs)=   1.083
    RUNOFF VOLUME    (mm)=   8.865
    TOTAL RAINFALL   (mm)=  69.587
    RUNOFF COEFFICIENT   =   0.127

    (i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0001)|   Area    (ha)=  15.14
|ID= 1 DT= 1.0 min |   Total Imp(%)=  64.00   Dir. Conn.(%)=  54.00
--------------------
                          IMPERVIOUS    PERVIOUS (i)
    Surface Area    (ha)=       9.69         5.45
    Dep. Storage    (mm)=       2.00         5.00
    Average Slope    (%)=       2.00         2.00
    Length           (m)=     317.70        40.00
    Mannings n          =      0.013        0.250

        NOTE:  RAINFALL WAS TRANSFORMED TO   1.0 MIN. TIME STEP.


                              ---- TRANSFORMED HYETOGRAPH ----
                 TIME    RAIN |  TIME    RAIN |'  TIME    RAIN |  TIME    RAIN
                  hrs   mm/hr |   hrs   mm/hr |'   hrs   mm/hr |   hrs   mm/hr
                0.017    4.36 | 0.767   33.91 | 1.517   15.21 |  2.27    6.00
                0.033    4.36 | 0.783   33.91 | 1.533   15.21 |  2.28    6.00
                0.050    4.36 | 0.800   33.91 | 1.550   15.21 |  2.30    6.00
                0.067    4.36 | 0.817   33.91 | 1.567   15.21 |  2.32    6.00
                0.083    4.36 | 0.833   33.91 | 1.583   15.21 |  2.33    6.00
```

0.100	4.84	0.850	83.50	1.600	13.06	2.35	5.62
0.117	4.84	0.867	83.50	1.617	13.06	2.37	5.62
0.133	4.84	0.883	83.50	1.633	13.06	2.38	5.62
0.150	4.84	0.900	83.50	1.650	13.06	2.40	5.62
0.167	4.84	0.917	83.50	1.667	13.06	2.42	5.62
0.183	5.44	0.933	228.89	1.683	11.42	2.43	5.28
0.200	5.44	0.950	228.89	1.700	11.42	2.45	5.28
0.217	5.44	0.967	228.89	1.717	11.42	2.47	5.28
0.233	5.44	0.983	228.89	1.733	11.42	2.48	5.28
0.250	5.44	1.000	228.89	1.750	11.42	2.50	5.28
0.267	6.21	1.017	107.76	1.767	10.13	2.52	4.98
0.283	6.21	1.033	107.76	1.783	10.13	2.53	4.98
0.300	6.21	1.050	107.76	1.800	10.13	2.55	4.98
0.317	6.21	1.067	107.76	1.817	10.13	2.57	4.98
0.333	6.21	1.083	107.76	1.833	10.13	2.58	4.98
0.350	7.24	1.100	59.36	1.850	9.10	2.60	4.72
0.367	7.24	1.117	59.36	1.867	9.10	2.62	4.72
0.383	7.24	1.133	59.36	1.883	9.10	2.63	4.72
0.400	7.24	1.150	59.36	1.900	9.10	2.65	4.72
0.417	7.24	1.167	59.36	1.917	9.10	2.67	4.72
0.433	8.66	1.183	39.24	1.933	8.25	2.68	4.48
0.450	8.66	1.200	39.24	1.950	8.25	2.70	4.48
0.467	8.66	1.217	39.24	1.967	8.25	2.72	4.48
0.483	8.66	1.233	39.24	1.983	8.25	2.73	4.48
0.500	8.66	1.250	39.24	2.000	8.25	2.75	4.48
0.517	10.76	1.267	28.68	2.017	7.55	2.77	4.26
0.533	10.76	1.283	28.68	2.033	7.55	2.78	4.26
0.550	10.76	1.300	28.68	2.050	7.55	2.80	4.26
0.567	10.76	1.317	28.68	2.067	7.55	2.82	4.26
0.583	10.76	1.333	28.68	2.083	7.55	2.83	4.26
0.600	14.11	1.350	22.32	2.100	6.95	2.85	4.07
0.617	14.11	1.367	22.32	2.117	6.95	2.87	4.07
0.633	14.11	1.383	22.32	2.133	6.95	2.88	4.07
0.650	14.11	1.400	22.32	2.150	6.95	2.90	4.07
0.667	14.11	1.417	22.32	2.167	6.95	2.92	4.07
0.683	20.20	1.433	18.14	2.183	6.44	2.93	3.89
0.700	20.20	1.450	18.14	2.200	6.44	2.95	3.89
0.717	20.20	1.467	18.14	2.217	6.44	2.97	3.89
0.733	20.20	1.483	18.14	2.233	6.44	2.98	3.89
0.750	20.20	1.500	18.14	2.250	6.44	3.00	3.89

```
Max.Eff.Inten.(mm/hr)=     228.89         40.03
          over (min)         5.00          8.00
Storage Coeff.  (min)=       2.98 (ii)     7.29 (ii)
Unit Hyd. Tpeak (min)=       5.00          8.00
Unit Hyd. peak  (cms)=       0.31          0.15
                                                     *TOTALS*
PEAK FLOW       (cms)=       4.08          0.43        4.323 (iii)
TIME TO PEAK    (hrs)=       1.03          1.15         1.03
RUNOFF VOLUME    (mm)=      67.59         13.97        42.93
TOTAL RAINFALL   (mm)=      69.59         69.59        69.59
```

```
    RUNOFF COEFFICIENT   =       0.97          0.20           0.62


      (i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
           CN*  =  45.0    Ia = Dep. Storage  (Above)
     (ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
          THAN THE STORAGE COEFFICIENT.
    (iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

-------------------------------------------------------------------------------
--------------------
| CALIB            |
| STANDHYD (  0002)|   Area    (ha)=   2.66
|ID= 1 DT= 1.0 min |   Total Imp(%)=  63.00   Dir. Conn.(%)=  53.00
--------------------
                              IMPERVIOUS    PERVIOUS (i)
    Surface Area     (ha)=        1.68          0.98
    Dep. Storage     (mm)=        2.00          5.00
    Average Slope     (%)=        2.00          2.00
    Length            (m)=      133.17         40.00
    Mannings n          =       0.013         0.250

        NOTE:  RAINFALL WAS TRANSFORMED TO   1.0 MIN. TIME STEP.
```

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.017	4.36	0.767	33.91	1.517	15.21	2.27	6.00
0.033	4.36	0.783	33.91	1.533	15.21	2.28	6.00
0.050	4.36	0.800	33.91	1.550	15.21	2.30	6.00
0.067	4.36	0.817	33.91	1.567	15.21	2.32	6.00
0.083	4.36	0.833	33.91	1.583	15.21	2.33	6.00
0.100	4.84	0.850	83.50	1.600	13.06	2.35	5.62
0.117	4.84	0.867	83.50	1.617	13.06	2.37	5.62
0.133	4.84	0.883	83.50	1.633	13.06	2.38	5.62
0.150	4.84	0.900	83.50	1.650	13.06	2.40	5.62
0.167	4.84	0.917	83.50	1.667	13.06	2.42	5.62
0.183	5.44	0.933	228.89	1.683	11.42	2.43	5.28
0.200	5.44	0.950	228.89	1.700	11.42	2.45	5.28
0.217	5.44	0.967	228.89	1.717	11.42	2.47	5.28
0.233	5.44	0.983	228.89	1.733	11.42	2.48	5.28
0.250	5.44	1.000	228.89	1.750	11.42	2.50	5.28
0.267	6.21	1.017	107.76	1.767	10.13	2.52	4.98
0.283	6.21	1.033	107.76	1.783	10.13	2.53	4.98
0.300	6.21	1.050	107.76	1.800	10.13	2.55	4.98
0.317	6.21	1.067	107.76	1.817	10.13	2.57	4.98
0.333	6.21	1.083	107.76	1.833	10.13	2.58	4.98
0.350	7.24	1.100	59.36	1.850	9.10	2.60	4.72
0.367	7.24	1.117	59.36	1.867	9.10	2.62	4.72
0.383	7.24	1.133	59.36	1.883	9.10	2.63	4.72

0.400	7.24	1.150	59.36	1.900	9.10	2.65	4.72
0.417	7.24	1.167	59.36	1.917	9.10	2.67	4.72
0.433	8.66	1.183	39.24	1.933	8.25	2.68	4.48
0.450	8.66	1.200	39.24	1.950	8.25	2.70	4.48
0.467	8.66	1.217	39.24	1.967	8.25	2.72	4.48
0.483	8.66	1.233	39.24	1.983	8.25	2.73	4.48
0.500	8.66	1.250	39.24	2.000	8.25	2.75	4.48
0.517	10.76	1.267	28.68	2.017	7.55	2.77	4.26
0.533	10.76	1.283	28.68	2.033	7.55	2.78	4.26
0.550	10.76	1.300	28.68	2.050	7.55	2.80	4.26
0.567	10.76	1.317	28.68	2.067	7.55	2.82	4.26
0.583	10.76	1.333	28.68	2.083	7.55	2.83	4.26
0.600	14.11	1.350	22.32	2.100	6.95	2.85	4.07
0.617	14.11	1.367	22.32	2.117	6.95	2.87	4.07
0.633	14.11	1.383	22.32	2.133	6.95	2.88	4.07
0.650	14.11	1.400	22.32	2.150	6.95	2.90	4.07
0.667	14.11	1.417	22.32	2.167	6.95	2.92	4.07
0.683	20.20	1.433	18.14	2.183	6.44	2.93	3.89
0.700	20.20	1.450	18.14	2.200	6.44	2.95	3.89
0.717	20.20	1.467	18.14	2.217	6.44	2.97	3.89
0.733	20.20	1.483	18.14	2.233	6.44	2.98	3.89
0.750	20.20	1.500	18.14	2.250	6.44	3.00	3.89

Max.Eff.Inten.(mm/hr)=	228.89	32.00	
over (min)	5.00	7.00	
Storage Coeff. (min)=	1.77 (ii)	6.16 (ii)	
Unit Hyd. Tpeak (min)=	5.00	7.00	
Unit Hyd. peak (cms)=	0.39	0.18	
			TOTALS
PEAK FLOW (cms)=	0.77	0.07	0.817 (iii)
TIME TO PEAK (hrs)=	1.02	1.12	1.03
RUNOFF VOLUME (mm)=	67.59	11.39	41.17
TOTAL RAINFALL (mm)=	69.59	69.59	69.59
RUNOFF COEFFICIENT =	0.97	0.16	0.59

(i) CN PROCEDURE SELECTED FOR PERVIOUS LOSSES:
CN* = 39.0 Ia = Dep. Storage (Above)
(ii) TIME STEP (DT) SHOULD BE SMALLER OR EQUAL
THAN THE STORAGE COEFFICIENT.
(iii) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

| CALIB |
| STANDHYD (0003)| Area (ha)= 1.40
|ID= 1 DT= 1.0 min | Total Imp(%)= 79.00 Dir. Conn.(%)= 69.00

	IMPERVIOUS	PERVIOUS (i)
Surface Area (ha)=	1.11	0.29
Dep. Storage (mm)=	2.00	5.00
Average Slope (%)=	2.00	2.00
Length (m)=	96.61	40.00
Mannings n =	0.013	0.250

NOTE: RAINFALL WAS TRANSFORMED TO 1.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
0.017	4.36	0.767	33.91	1.517	15.21	2.27	6.00
0.033	4.36	0.783	33.91	1.533	15.21	2.28	6.00
0.050	4.36	0.800	33.91	1.550	15.21	2.30	6.00
0.067	4.36	0.817	33.91	1.567	15.21	2.32	6.00
0.083	4.36	0.833	33.91	1.583	15.21	2.33	6.00
0.100	4.84	0.850	83.50	1.600	13.06	2.35	5.62
0.117	4.84	0.867	83.50	1.617	13.06	2.37	5.62
0.133	4.84	0.883	83.50	1.633	13.06	2.38	5.62
0.150	4.84	0.900	83.50	1.650	13.06	2.40	5.62
0.167	4.84	0.917	83.50	1.667	13.06	2.42	5.62
0.183	5.44	0.933	228.89	1.683	11.42	2.43	5.28
0.200	5.44	0.950	228.89	1.700	11.42	2.45	5.28
0.217	5.44	0.967	228.89	1.717	11.42	2.47	5.28
0.233	5.44	0.983	228.89	1.733	11.42	2.48	5.28
0.250	5.44	1.000	228.89	1.750	11.42	2.50	5.28
0.267	6.21	1.017	107.76	1.767	10.13	2.52	4.98
0.283	6.21	1.033	107.76	1.783	10.13	2.53	4.98
0.300	6.21	1.050	107.76	1.800	10.13	2.55	4.98
0.317	6.21	1.067	107.76	1.817	10.13	2.57	4.98
0.333	6.21	1.083	107.76	1.833	10.13	2.58	4.98
0.350	7.24	1.100	59.36	1.850	9.10	2.60	4.72
0.367	7.24	1.117	59.36	1.867	9.10	2.62	4.72
0.383	7.24	1.133	59.36	1.883	9.10	2.63	4.72
0.400	7.24	1.150	59.36	1.900	9.10	2.65	4.72
0.417	7.24	1.167	59.36	1.917	9.10	2.67	4.72
0.433	8.66	1.183	39.24	1.933	8.25	2.68	4.48
0.450	8.66	1.200	39.24	1.950	8.25	2.70	4.48
0.467	8.66	1.217	39.24	1.967	8.25	2.72	4.48
0.483	8.66	1.233	39.24	1.983	8.25	2.73	4.48
0.500	8.66	1.250	39.24	2.000	8.25	2.75	4.48
0.517	10.76	1.267	28.68	2.017	7.55	2.77	4.26
0.533	10.76	1.283	28.68	2.033	7.55	2.78	4.26
0.550	10.76	1.300	28.68	2.050	7.55	2.80	4.26
0.567	10.76	1.317	28.68	2.067	7.55	2.82	4.26
0.583	10.76	1.333	28.68	2.083	7.55	2.83	4.26
0.600	14.11	1.350	22.32	2.100	6.95	2.85	4.07
0.617	14.11	1.367	22.32	2.117	6.95	2.87	4.07
0.633	14.11	1.383	22.32	2.133	6.95	2.88	4.07
0.650	14.11	1.400	22.32	2.150	6.95	2.90	4.07
0.667	14.11	1.417	22.32	2.167	6.95	2.92	4.07
0.683	20.20	1.433	18.14	2.183	6.44	2.93	3.89

Appendix D

Geotechnical Investigations

MTE

ATKINSON, DAVIES INC.
Consulting Geotechnical, Environmental & Materials Engineers

60 Meg Drive, Unit 12, London, Ontario, N6E 3T6 (519)685-6400 FAX(519)685-0943
www.atkinsondavies.com atkinsondavies@atkinsondavies.com

December 4, 2008

Ref.: 1-4285

The Hampton Group Inc.
c/o R. W. Stratford Consulting Inc.
650 Waterloo Street, Suite 101
London, Ontario
N6B 2R4

Attention: Mr. Bob Stratford

Dear Mr. Stratford:

Re: Geotechnical Investigation for a Planned Storm Water Management (SWM) Facility, Kensington Village Subdivision, 369 Queen Street, Strathroy, Ontario

We have completed this project in accordance with your instructions and authorization. This report contains a record of our findings and presents geotechnical recommendations for the design and construction of the proposed SWM facility.

FIELD WORK

The field work was carried out on November 14, 2008, and consisted of three boreholes located as shown on Enclosure 2. The holes were advanced to depths of 3.5 metres using a power auger machine equipped with conventional soil sampling equipment.

Standard penetration tests were performed at frequent intervals of depth, as detailed in Appendix 'A', and the results are recorded on the borehole logs as *N* values. The split-spoon samples were stored in airtight containers, which were transferred to our laboratory for classification, testing and storage.

The field work was supervised by a technologist, and the level of the ground surface at each borehole location was referenced to a local benchmark, taken as a cut cross on a sidewalk located as shown on Enclosure 2. The client provided a geodetic elevation of 230.34 metres for the benchmark.

SUBSURFACE CONDITIONS

Descriptions of the strata encountered in each borehole are given on the borehole logs comprising Enclosures 3 to 5. The following notes are intended only to amplify this data.

Beneath the surface layer of topsoil, measuring 250mm thick, Borehole 2 contacted compact silt and fine sand, which was penetrated at a depth of 0.9 metres. The underlying soil consists of loose to compact sand with occasional silt seams, and the boreholes were terminated within the sand at depths of 3.5 metres.

At the completion of drilling, water levels were measured in the boreholes at depths of 1.4 metres.

Grain size distribution analyses were performed on samples of the sand materials in Boreholes 1 and 2, and test results are shown graphically on Enclosures 6.

DISCUSSION AND RECOMMENDATIONS

Beneath the surface layer of topsoil, measuring 250mm thick, Borehole 2 contacted compact silt and fine sand, which was penetrated at a depth of 0.9 metres. The underlying soil consists of loose to compact sand with occasional silt seams, and the boreholes were terminated within the sand at depths of 3.5 metres.

Excavation and Ground Water Control

The soil revealed at this site which is not excessively wet can be classified as a Type 3 soil in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. Saturated and submerged soil can be classified as a Type 4 soil.

The sides of open excavations within a Type 3 soil must be carried out using side slopes not steeper than 1 vertical to 1 horizontal from the bottom of the excavation. Type 4 soil can be dewatered to be classified as a Type 3 soil, or adequately braced, otherwise side slopes of 1 vertical to 3 horizontal or flatter should be used for excavations intersecting Type 4 soil.

Groundwater levels were measured in the boreholes at depths of 1.4 metres (El. 228.4 to El. 229.1). It is considered that the groundwater can be controlled within open excavations by the use of gravity drainage and filtered sumps to a depth of about one metre below the groundwater table. Groundwater lowering in excess of one metre will likely require the use of a temporary dewatering system. Based on the grain size analysis results from the sand samples tested (Enclosure 6), well-pointing should be a feasible method of dewatering.

<u>Storm Water Management Facility</u>

It is understood that design elevations of the pond bases are between El. 228.25 and El. 228.35, and the design permanent pool water level is at El. 229.35. The SWM facility is to be constructed in the area represented by the location of Boreholes 1 and 2, where the water table was contacted at El. 228.4 and El. 228.8 respectively. If the design volume of water to be stored is determined from the zone above the water table, and the permanent water level of the pond is allowed to fluctuate to stabilize near the groundwater level (i.e. storm water allowed to infiltrate), it is considered that the facility could be designed without an impermeable liner. If part of the design volume of water to be stored is located below the water table, or if the permanent water level must be maintained at a design level above the water table, then an impermeable liner must be provided over the bases and side slopes of the facility to above the high groundwater level, which may be taken as 0.3 metres above the measured levels. A suitable synthetic liner should be used to ensure an impermeable barrier, and to resist the hydrostatic uplift forces below the liner the minimum thickness of overburden placed on top of the liner must not be less than the depth the pond base is located below the high groundwater level. For example, a pond base level placed one metre below the anticipated high groundwater level (i.e. 0.3 metres above measured levels), excavation to a depth of 1.7 metres below the measured water level is required to place the liner and the one metre thickness of overburden material, and temporary dewatering of the site will be required.

Construction of berms could consist of placing excavated soil in maximum 300mm thick lifts and compacting to a minimum of 95% MSPDD. Inside slopes should not be steeper than 5 horizontal to 1 vertical and outer slopes not steeper than 4:1. In order to provide stable side slopes, sidewalls below the high groundwater level shall be covered with a filter fabric such as Terrafix 270R, Mirafi 140NS, Amoco 4535, or equivalent and 300mm of rig rap (minimum 150mm size). Berm surfaces above the high groundwater level should be protected from erosion by providing topsoil and vegetation.

We trust this report is sufficient for your design requirements, however if further discussion is required please contact our office. The Statement of Limitation, Appendix 'B', should be read in connection with the report.

Yours very truly,

ATKINSON, DAVIES INC.

Stephen W. Burt, P.Eng.

C.J.W. Atkinson, P.Eng.

LICENSED PROFESSIONAL ENGINEER
S. W. BURT
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
C. J. W. ATKINSON
PROVINCE OF ONTARIO

SWB/jmw
Enclosures

THE STANDARD PENETRATION TEST

In order to determine the relative density of non-cohesive soils, such as sands and gravels, the standard penetration test has been adopted. The test also gives an indication of the consistency of cohesive soils.

A two inch (50.8mm) external diameter thick-walled sample tube is driven into the ground at the bottom of the borehole by means of a 140 lb. (635 kg) hammer falling freely through 30 inches (760mm). The tube is first driven an initial 6 inches (150mm) to allow for the presence of disturbed material at the bottom of the borehole. The number of standard blows (N) required to drive the sampler a further 12 inches (300mm) is recorded. The sample tube is one originally developed by Raymond Concrete Pile Company in the United States, where a sufficient number of tests have been made in conjunction with field investigations to show that the results, although essentially empirical, may be applied to foundation design.

For Sands:-

Values of N	**Density**
Less than 10	*Loose*
Between 10 and 30	*Compact*
Between 30 and 50	*Dense*
Greater than 50	*Very dense*

STATEMENT OF LIMITATION

The conclusions and recommendations in this report are based on information determined at the borehole locations and on geological data of a general nature which may be available for the area investigated. Soil and groundwater conditions between and beyond the boreholes may differ from those encountered at the borehole locations and conditions may become apparent during construction which could not be detected or anticipated at the time of the soil investigation. The passage of time also must be considered, and it must be recognized that, due to natural occurrences or direct or indirect human intervention at the site or distant from it, actual conditions discovered may quickly change. The information contained within this report in no way reflects the environmental aspect of the site or soil, unless specifically reported upon.

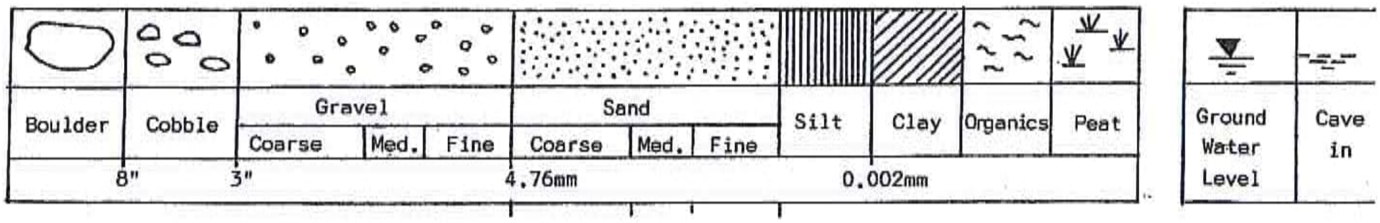
The comments given in this report on potential construction problems and possible methods of construction are intended only for the guidance of the designer. The number of test holes may not be sufficient to determine all of the factors that may affect construction methods and costs (e.g. the thickness of surficial topsoil and fill layers can vary markedly and unpredictably). The contractors bidding on this project or undertaking the construction should therefore make their own interpretations of the presented factual information and draw their own conclusions as to how the subsurface conditions may affect their work.

We recommend that we be retained to ensure that all necessary stripping, subgrade preparation and compaction requirements are met, and to confirm that the soil conditions do not deviate materially from those encountered in the boreholes. **In cases where this recommendation is not followed, the company's responsibility is limited to interpreting accurately the information encountered at the boreholes.**

This report is applicable only to the project described in the introduction, constructed substantially in accordance with details of alignment and elevation quoted in the text.

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE

Soil Components and Ground Water Conditions



U.S. Standard Sieve Size: No.4 No.10 No.40 No.200

SAMPLE TYPES

AS	Auger sample	RC	Rock core	TP	Piston, thin-walled tube sample
CS	Sample from casing	%	Recovery	TW	Open, thin-walled tube sample
ChS	Chunk sample	SS	Split-spoon sample	WS	Wash sample

SAMPLER ADVANCED BY: static weight : w
" pressure : p
" tapping : t

OBSERVATIONS MADE WHILE CORING: Steady pressure; No pressure; Intermittant pressure; Washwater returns; Washwater last

SOIL PROPERTIES

W%	Water content	γ	Natural bulk density (unit weight)	k	Coefficient of permeability
LL%	Liquid limit	e	Void ratio	C	Shear strength — in terms of total stress
PL%	Plastic limit	RD	Relative density	ϕ	Angle of int. friction — in terms of total stress
PI%	Plasticity index	c_v	Coeff. of consolidation	C'	Cohesion — in terms of effective stress
LI	Liquidity index	m_v	Coeff. of volume compressibility	ϕ'	Angle of int. friction — in terms of effective stress

UNDRAINED SHEAR STRENGTH
- DERIVED FROM -

TRIAXIAL / UNCONFINED COMPRESSION TEST: ◎ ● St

LABORATORY / FIELD VANE TEST: X St + St

POCKET PENETROMETER TEST: ▲

Strain of failure is represented by direction of stem: 20% (up), 5% (right), 10% (down), 15% (left)

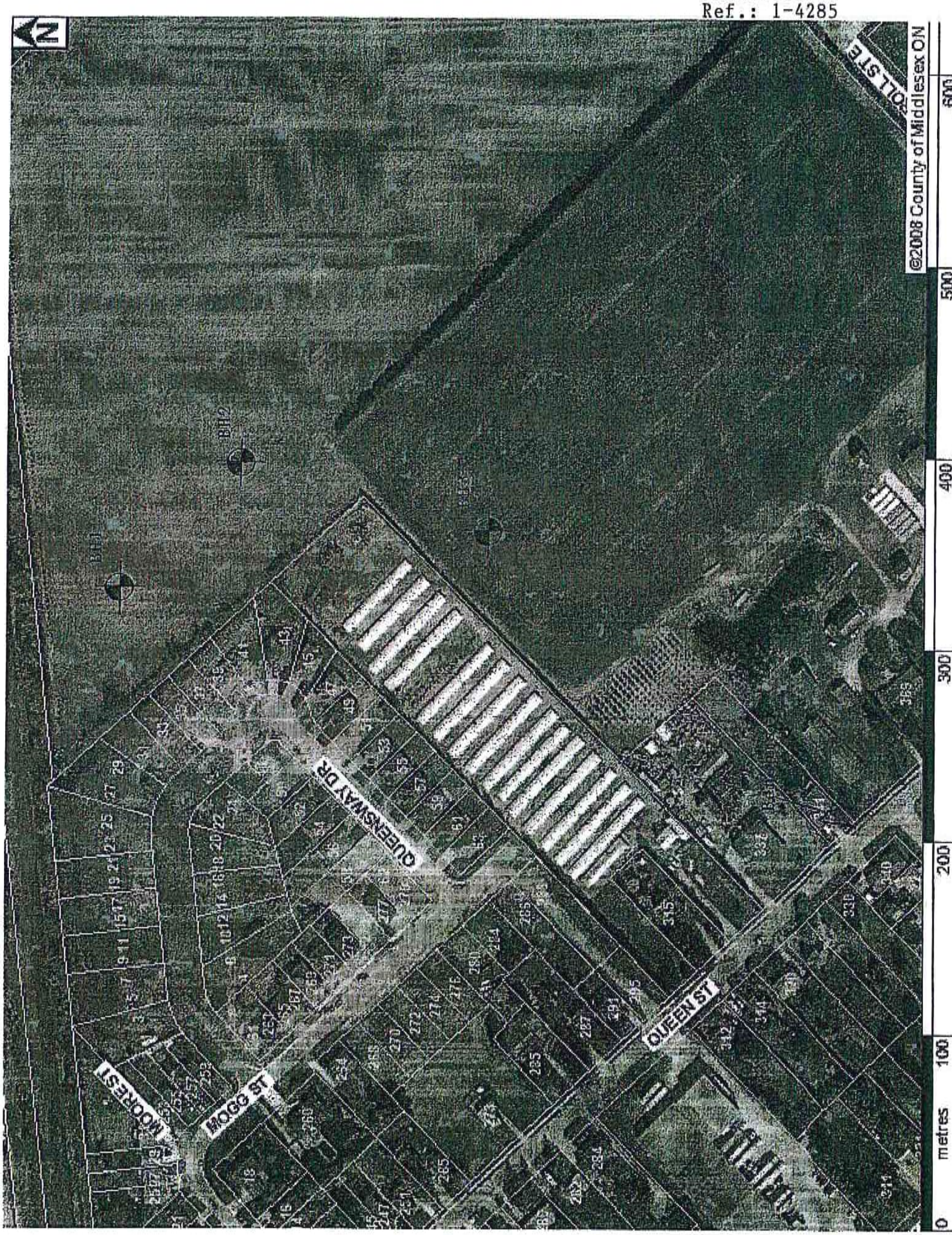
$$St : \text{sensitivity} = \frac{\text{shear strength in undisturbed state}}{\text{shear strength in remoulded state}}$$

SOIL DESCRIPTION

COHESIONLESS SOILS:	RD:
Very loose	0 - 15%
Loose	15 - 35%
Compact	35 - 65%
Dense	65 - 85%
Very dense	85 - 100%

COHESIVE SOILS:	C p.s.f.
Very soft	less than 250
Soft	250 - 500
Firm	500 - 1000
Stiff	1000 - 2000
Very stiff	2000 - 4000
Hard	over 4000

Enclosure: 2
Ref.: 1-4285



Atkinson Davies Inc. *CONSULTING SOILS AND MATERIALS ENGINEERS*

12 - 60 Meg Drive, London, ON, N6E 3T6 Phone: 519-685-6400 Fax: 519-685-0943

REF. NO.: 1-4285
CLIENT: The Hampton Group Inc.
PROJECT: Kensington Village Subdivision
LOCATION: 369 Queen St & 437 Carroll St E, Strathroy
DATUM ELEVATION: Cut Cross on Sidewalk, 230.34m

LOG OF BOREHOLE NO. 1

Encl. No. 3 (Sheet 1 of 1)
DRILLING DATA: D50 Rig
METHOD: Solid Stem Augers
DIAMETER: 150mm
DATE: Nov 14, 2008

Elev. metres	Depth metres	DESCRIPTION	NUMBER	TYPE	"N" Blows/ft
229.83	0	250mm TOPSOIL.			
		Loose, rusty brown, silty fine SAND with silt seams.			
229	1	Compact, fine to medium SAND, trace to some silt.	1	ss	10
			2	ss	15
228	2		3	ss	14
227	3		4	ss	10
		End of Borehole. Wet cave-in at 1.4m depth at completion.			

SUBSURFACE PROFILE; SYMBOL; GROUND WATER

● Penetration Resistance Blows/ft: 20 40 60 80
Undrained Shear Strength kPa ▲ Field Vane Test ★ Compression Test: 20 40 60 80

PLASTIC LIMIT % | NATURAL WATER % | LIQUID LIMIT %

Atkinson Davies Inc. *CONSULTING SOILS AND MATERIALS ENGINEERS*
12 - 60 Meg Drive, London, ON, N6E 3T6 Phone: 519-685-6400 Fax: 519-685-0943

REF. NO.: 1-4285
CLIENT: The Hampton Group Inc.
PROJECT: Kensington Village Subdivision
LOCATION: 369 Queen St & 437 Carroll St E, Strathroy
DATUM ELEVATION: Cut Cross on Sidewalk, 230.34m

LOG OF BOREHOLE NO.
2

Encl. No. 4 (Sheet 1 of 1)
DRILLING DATA: D50 Rig
METHOD: Solid Stem Augers
DIAMETER: 150mm
DATE: Nov 14, 2008

SUBSURFACE PROFILE									● Penetration Resistance Blows/ft (20 40 60 80); Undrained Shear Strength kPa ▲ Field Vane Test ★ Compression Test (20 40 60 80)	PLASTIC LIMIT %	NATURAL WATER %	LIQUID LIMIT %
Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft					
230.18	0	250mm TOPSOIL.										
		Compact, rusty brown, SILT & fine SAND.										
	1	Compact, silty fine SAND with silt seams.		▼	1	ss	15	●				
					2	ss	11	●				
					3	ss	19	●				
					4	ss	14	●				
		End of Borehole. Wet cave-in at 1.4m depth at completion.										

Elevation scale: 230, 229, 228, 227. Depth scale: 0, 1, 2, 3.

Atkinson Davies Inc. *CONSULTING SOILS AND MATERIALS ENGINEERS*

12 - 60 Meg Drive, London, ON, N6E 3T6 Phone: 519-685-6400 Fax: 519-685-0943

LOG OF BOREHOLE NO. 3

REF. NO.: 1-4285
CLIENT: The Hampton Group Inc.
PROJECT: Kensington Village Subdivision
LOCATION: 369 Queen St & 437 Carroll St E, Strathroy
DATUM ELEVATION: Cut Cross on Sidewalk, 230.34m

Encl. No. 5 (Sheet 1 of 1)
DRILLING DATA: D50 Rig
METHOD: Solid Stem Augers
DIAMETER: 150mm
DATE: Nov 14, 2008

SUBSURFACE PROFILE

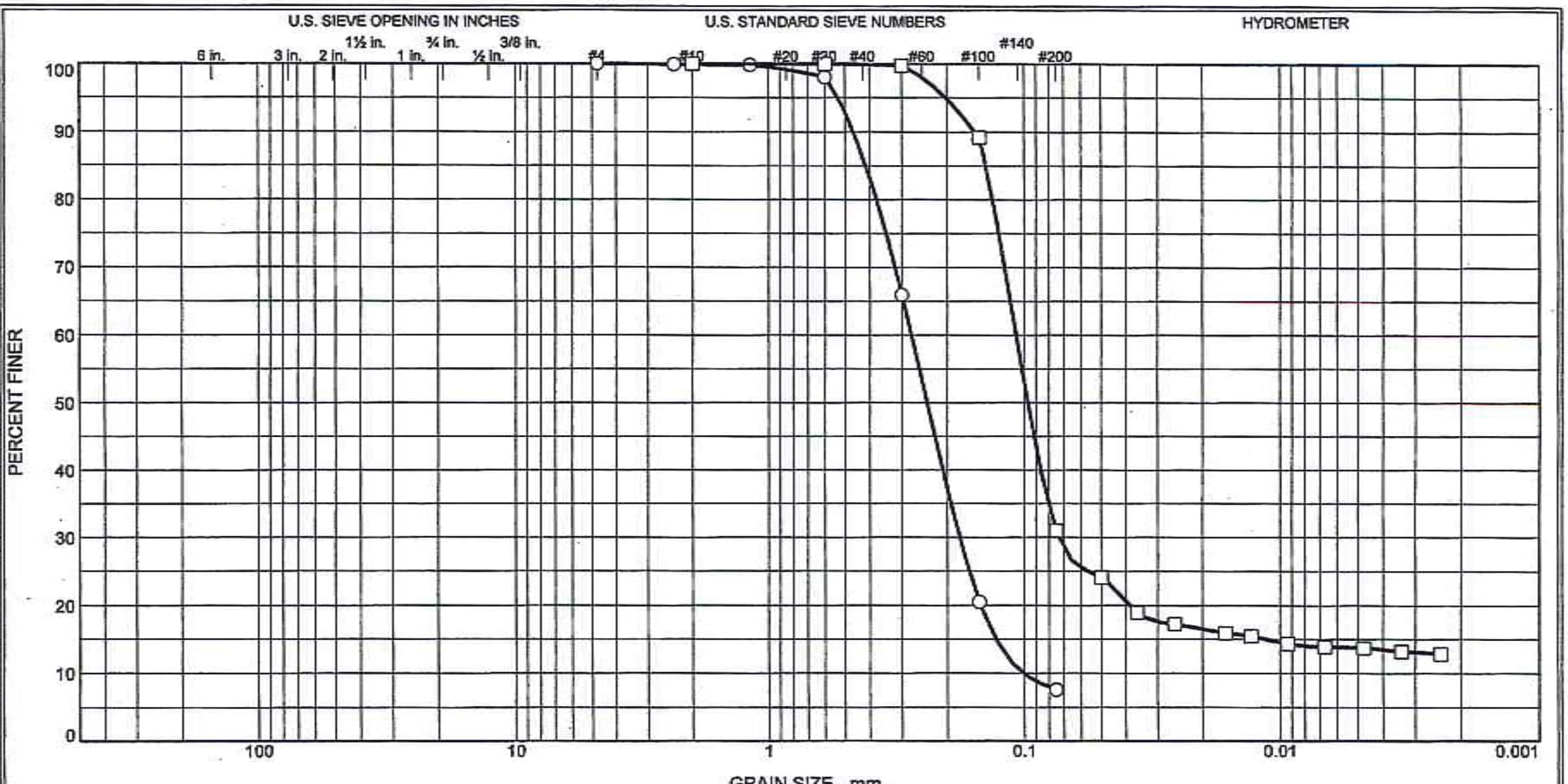
● Penetration Resistance Blows/ft (20, 40, 60, 80)

Undrained Shear Strength kPa ▲ Field Vane Test ★ Compression Test (20, 40, 60, 80)

Elev. metres	Depth metres	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	"N" Blows/ft	PLASTIC LIMIT %	NATURAL WATER %	LIQUID LIMIT %
230.53	0	250mm TOPSOIL.								
230		Loose, rusty brown, fine SAND, some silt.								
	1				1	ss	6			
229		Compact to dense, fine to medium SAND, trace to some silt, occasional silt seam.		▼						
					2	ss	16			
	2									
228					3	ss	34			
	3				4	ss	15			
		End of Borehole. Wet cave-in at 1.4m depth at completion.								

LOG OF BOREHOLE 1-4285.GPJ ATK_DAV.GDT 1/12/08

Enclosure: 6
Ref.: 1-4285



% Stone	% Cobble	% Gravel			% Sand					% Silt	% Clay
		Coarse	Medium	Fine	V. Crs.	Coarse	Medium	Fine	V. Fine		

	Location	Source	Sample #	Depth/Elev.	Material Description
O	Borehole 1		Sample 4	3.3m / 94.0	Fine to medium SAND, trace of silt.
□	Borehole 2		Sample 3		Silty fine SAND, some clay

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indictive of apparently identical samples.

Project No. 1-4285 **Client** The Hampton Group Inc. **Figure:**

GRAIN SIZE ANALYSIS REPORT

Kensington Village Subdivision, Strathroy

Atkinson, Davies Inc.

London, ON

Tested By: A.S. **Checked By:** S.B.

Trow

Geotechnical Investigation
Proposed Kensington Village Subdivision, Strathroy, Ontario

Prepared for:

Hampton Group
784 Richmond Street, 2nd Floor
London, Ontario N6A 3H5

Attention: Mr. Dave Tennant Jr.

Trow Associates Inc.

15 Cuddy Boulevard
London, Ontario N5V 3Y3
Telephone: (519) 453-1480
Facsimile: (519) 453-1551
Email: london@trow.com

LNGE00008677A
August, 2006

Table of Contents

1. Introduction

As requested, Trow Associates Inc. (Trow) has conducted a geotechnical investigation in conjunction with a proposed subdivision to be located just west of the intersection of Queen Street and Carroll Street in Strathroy, Ontario. This report summarizes the results of the investigation, and provides geotechnical engineering guidelines to assist with the design and construction of the proposed project.

1.1 Terms of Reference

The geotechnical investigation was generally done in accordance with our proposal P06-162 dated July 14, 2006. Written authorization to proceed with the investigation was received from Mr. Dave Tennant Jr. on July 25, 2006.

The purpose of the investigation was to examine the subsoil and groundwater conditions at the site by advancing a series of sampled boreholes at the locations illustrated on the attached Borehole Location Plan (Drawing 1).

Based on an interpretation of the factual borehole data, and a review of soil and groundwater information from test holes advanced at and near the site, Trow Associates Inc. has provided engineering guidelines for the geotechnical design and construction of the proposed residential subdivision. More specifically, this report provides comments on excavations, dewatering, site preparation, foundations, bedding, backfill and pavement recommendations.

This report is provided on the basis of the terms of reference presented above and on the assumption that the design will be in accordance with applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning geotechnical aspects of the codes and standards, this office should be contacted to review the design.

The information in this report in no way reflects on the environmental aspects of the soil. Should specific information in this regard be needed, additional testing may be required.

2. Methodology

The fieldwork was carried out on August 3 & 10, 2006. In general, the geotechnical investigation consisted of the drilling of eight boreholes at the locations denoted on Drawing 1 as BH1 to BH8, inclusive.

Underground utility locates were carried out for the site prior to excavation work being carried out. The boreholes were advanced using a hand held power auger equipped with solid stem augers, and were terminated at depths of about 3.65 m.

Representative samples of the subsurface soils at the various borehole locations were collected from the auger flights. The stratigraphy in the boreholes was examined and logged in the field by Trow geotechnical personnel.

Representative samples of the various soil strata encountered at the test locations were taken to our laboratory in London for further examination by a geotechnical engineer and laboratory classification testing. Laboratory testing for this investigation comprised of routine moisture content determinations, with results presented on the borehole logs.

Samples remaining after the classification testing will be stored for a period of three months following the date of sampling (i.e., until November, 2006). After this time, they will be discarded unless prior arrangements have been made for longer storage.

Following the drilling, the elevations of the boreholes were surveyed; ground surface elevations of the boreholes were referenced to the top of a steel bar located just east of Carroll Street along the property line between the residences at 312 and 316 Carroll Street. The location and elevation of the assumed benchmark are detailed on Drawing 1.

3. Site and Subsurface Conditions

3.1 Site Description

At the time of the investigation, the study area was characterized by agricultural land. The study area is divided into two separate fields by a row of trees. In general, the site is relatively flat; elevations at the site are similar to the surrounding streets. Local relief at the site is estimated at about 1.5 metres.

3.2 Site Physiography

Overburden deposits in the study area were formed by numerous glacial events during the Wisconsinan ice age approximately 15,000 to 25,000 years before present. Thick glacial ice sheets advanced several times into the southern part of the province from various directions and then receded creating the present configuration of moraines, abandoned spillways, drumlins, eskers, abandoned shorelines, and various stillwater sediment deposits. The surficial deposits were mapped and categorized into a number of physiographic regions by Chapman and Putnam (1984).

The physiographic mapping for the area indicates that the site is situated in the physographic region known as the Caradoc Sand Plains. The Caradoc Sand Plains physiographic region generally consists of a series of small plains which are covered with sand or other light texture, water laid deposits. (Chapman and Putnam, 1984)

Groundwater information provided by MOE indicates that there is a shallow overburden aquifer, with depths of less than 18 m as well as intermediate aquifers (18 to 45 m deep). The shallow overburden aquifer is the primary source for potable wells in the area. Bedrock depths (generally limestone) range between about 45 metres and 60 metres.

3.3 Soil Stratigraphy

The detailed stratigraphy encountered in each borehole and the results of routine laboratory tests carried out on representative samples of the subsoils are given of the attached borehole logs. It must be noted that boundaries of soil indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect transition zones for the purposes of geotechnical design and should not be interpreted as exact planes of geological change.

The subsurface soil conditions encountered in the boreholes are detailed on the Borehole Logs provided in Appendix A, and summarized as follows.

3.3.1 Topsoil

Each borehole was surfaced with a layer of topsoil. The topsoil, generally described as dark brown to black sand/silt loam, loose and moist with rootlets, extended to depths ranging between about 0.3 m and 0.6 m.

3.3.2 Silty Sand

The predominant native mineral soil encountered beneath the topsoil was silty sand. The sand was generally described as brown, fine to medium grained, and loose to compact (based on drilling resistance). Moisture contents of the silty sand soil (presented graphically on the Borehole Logs) ranged between about 6.1 and 28.5 percent, reflecting moist to wet conditions.

3.4 Groundwater Conditions

Evidence of free groundwater was encountered at each of the borehole locations at depths ranging between about 1.5 m and 2.4 m below the ground surface. It is noted that insufficient time was allowed for the measurement of the depth to the stabilized groundwater table prior to backfilling the borehole.

It is further noted that the depth to the groundwater table may vary in response to climatic or seasonal conditions, and, as such, may differ at the time of construction, with higher levels in wet seasons.

4. Discussion and Recommendations

4.1 General

It is understood that the proposed development will consist primarily of single family residential dwellings. The residential subdivision is expected to have complete municipal servicing, and will be accessed with paved local roads.

The following sections of this report provides geotechnical comments and recommendations regarding site preparation, excavations and dewatering, foundations and basement design, and pavement design. In addition, preliminary comments regarding stormwater infiltration are provided.

4.2 Site Preparation

Prior to placement of foundations, pipe bedding and/or engineered fill, all surficial topsoil, vegetation and/or otherwise deleterious materials should be stripped. In general, this will require the removal of up to about 0.6 m of topsoil. The surficial topsoil may be stockpiled on site for possible reuse as landscaping fill.

Following the removal of the topsoil and prior to fill placement, the exposed subgrade should be inspected by a geotechnical engineer. Any loose or soft zones noted in the inspection should be over-excavated and replaced with approved fill.

In the building areas where the grade will be raised, the fill material should comprise imported granular or approved onsite (excavated) material. The fill material should be inspected and approved by a geotechnical engineer and should be placed in maximum 300 mm (12 inch) thick lifts and uniformly compacted to 100 percent Standard Proctor Maximum Dry Density (SPMDD) within 2 percent of optimum moisture content. The geometric requirements for engineered fill are provided on Drawing 2.

Based on the *in situ* moisture contents recorded from the borehole samples, the excavated onsite soils below depths of about 1.8 m are expected to be wet of optimum moisture content for compaction. This material may be suitable for reuse as engineered fill, but may require drying and/or blending with dryer materials prior to placement. Regardless, the material should be examined and approved by a geotechnical engineer prior to reuse.

In areas along the proposed roadways, fill material used to raise grades may comprise onsite excavated soils, or imported granular fill approved by an engineer. The fill should be placed in maximum 300 mm (12 inch) thick lifts and uniformly compacted to 98 percent SPMDD within 2 percent of optimum moisture content in order to provide adequate stability for the new pavements.

In situ compaction testing should be carried out during the fill placement to ensure that the specified compaction is being achieved.

If imported fill material is utilized at the site, verification of the suitability of the fill may be required from an environmental standpoint. Conventional geotechnical testing will not determine the suitability of the material in this regard. Analytical testing and environmental site assessment may be required at the source. This will best be assessed prior to the selection of the material source. A quality assurance program should be implemented to ensure that the fill material will comply with the current Ministry of Environment standards for placement and transportation. The disposal of excavated materials must conform to the MOE Guidelines and requirements. Trow can be of assistance if an assessment of the materials is required.

4.3 Excavation and Dewatering

Side slopes of temporary excavations must conform to Regulation 213/91 of the Occupational Health and Safety Act of Ontario. The predominant sand soils encountered throughout the site are classified as Type 3 soil. Temporary excavation sidewalls which extend through Type 3 soil must be cut back at an inclination of 1 horizontal to 1 vertical from the base of the excavation. In the event excessive groundwater infiltration through the trench walls is encountered, flatter slopes may be required.

Localized base improvement may be required for services bedded in wet silty soils especially in wet weather seasons. Some areas of crushed stone bedding enclosed with a geotextile may be required upon the recommendation of a geotechnical engineer when additional information becomes available through field inspections during the construction stage.

Based on the soil texture encountered during the investigation, groundwater infiltration should be anticipated within the service trench excavations below depths of about 1.8 metres. Groundwater infiltration can likely be accommodated using conventional sump pumping techniques; however, if groundwater infiltration persists, more extensive dewatering measures may be required. Trow would be pleased to provide further information in this regard, upon request.

The collected water should be discharged a sufficient distance away from the excavated area to prevent the discharge water from returning to the excavation. Sediment control measures should be provided at the discharge point of the dewatering system. Caution should also be taken to avoid any adverse impacts to the environment.

For projects requiring positive groundwater control with a removal rate exceeding 50,000 litres per day, a Permit to Take Water (PTTW) will be required. Permit to take water applications will need to be approved by the Ministry of Environment according to Sections 34 and 98 of the Ontario Water Resources Act R.S.O. 1990 and the Water Taking and Transfer Regulation O. Reg. 387/04. It is noted that a standard geotechnical investigation will not determine all the groundwater parameters which may be required to support the application. Accordingly, a detailed hydrogeological assessment from a quantitative point of view may be required to estimate the quantity of water to be removed. Trow can assist if the need arises.

4.4 Building Foundations

The proposed residential units can be supported on conventional spread and strip footings founded below the topsoil, fill or unsuitable soils on the natural competent subgrade soils, or engineered fill.

An allowable bearing pressure of 145 kPa (3000 psf) can be used for design for footings set below a typical depth of approximately 1.2 m (4 ft) below existing grade. All footings exposed to seasonal freezing conditions should be protected from frost action by at least 1.2 m (4 ft) of soil cover or equivalent insulation.

Footings at different elevations should be located such that the higher footings are set below a line drawn up at 10 horizontal to 7 vertical from the near edge of the lower footing. This concept should also be applied to service excavation, etc. to ensure that undermining is not a problem.

If the grades are to be raised or restored due to unsuitable soils, engineered fill can be used over the competent subgrade, as described in the previous Section 4.2. For footings placed on engineered fill, it is recommended that the strip footings be widened to 500 mm (20 inches), and contain nominal concrete reinforcing steel. Verification of the soil conditions and the extent of reinforcement is best determined by the geotechnical engineer, at the time of excavation.

Provided that the footing bases are not disturbed due to construction activity, precipitation, freezing and thawing action, etc., and the aforementioned bearing pressures are not exceeded, the total and differential settlements of footings designed in accordance with the recommendations of this report and with careful attention to construction detail are expected to be less than 25 mm and 20 mm (1 and ¾ inch) respectively.

It should be noted that the recommended bearing capacities have been calculated by Trow from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of underground conditions becomes available. For example, if more specific information becomes available with respect to conditions between boreholes when foundation construction is underway. The interpretation between the boreholes and the recommendations of this report must therefore be checked through field inspections provided by Trow to validate the information for use during the construction stage.

4.5 Basements

The basement floors can be cast slab-on-grade provided the subgrade is stripped of all topsoil and other obviously objectionable material. The subgrade should then be proof-rolled thoroughly. Any soft spots detected should be dug out and replaced with clean compactable excavated material placed in accordance with the requirements outlined in the previous Section 4.2.

A 200 mm (8 inch) compacted layer of 19 mm (¾ inch) clear stone should be placed between the prepared subgrade and the floor slab to serve as a moisture barrier.

The installation and requirement of vapour barrier under the floor slab, where applicable, should conform to the flooring manufacturer's and designer's requirements. Moisture emission testing is recommended to determine the concrete condition prior to flooring installation. It should be noted that shallow 'perched' groundwater was noted at this site. Ongoing liaison from this office will be required.

All basement walls should be damp-proofed and must be designed to resist a horizontal earth pressure 'p' at any depth 'h' below the surface as given by the following expression:

$$p = K(\gamma h + q)$$

where: p = lateral earth pressure in kPa (psf) acting at a depth h:
K = earth pressure coefficient, assumed to be 0.45;
γ = unit weight of backfill, a value of 20.4 kN/m^3 (130 pcf) may be assumed;
h = depth to point of interest in m (ft) and,
q = equivalent value of any surcharge on the ground surface.

If basements are planned, installation of perimeter drains is required. The above expression assumes that the perimeter drainage system prevents the build-up of any hydrostatic pressure behind the wall. Suggestions for permanent perimeter drainage are given on Drawing 3.

4.6 Pipe Bedding and Trench Backfill

The subgrade soils beneath the water and sewer pipes which will service the site are generally expected to comprise of native sand. For services constructed on the native mineral soil or engineered fill, the bedding should conform to OPS Standards. The bedding course may be thickened if portions of the subgrade become wet during excavation. Bedding aggregate should be placed around the pipe to at least 300 mm (12 inch) above the pipe, and be compacted to a minimum 95 percent SPMDD.

Water and sewer lines installed outside of heated areas should be provided with a minimum 1.2 m (4 ft) of soil cover for frost protection.

The trenches above the specified pipe bedding should be backfilled with inorganic on-site soils placed in 300 mm thick lifts and uniformly compacted to at least 95% SPMDD. For trench backfill within 1 metre below the roadway subbase, the fill should be uniformly compacted to at least 98% SPMDD. A program of *in situ* density testing should be set up to ensure that satisfactory levels of compaction are achieved.

Based on the results of this investigation, the majority of the excavated native sand, silt or potential engineered fill material may be used for construction backfill provided reasonable care is exercised in handling. In this regard the material should be within 3 percent of the optimum moisture as determined in the standard Proctor density test, and stockpiling of material for prolonged periods of time should be avoided. This is particularly important if construction is carried out in wet or otherwise adverse weather.

Soils excavated from below the stabilized groundwater table may be too wet for reuse as backfill unless adequate time is allowed for drying, or if the material is blended with approved dry fill; otherwise, it may be stockpiled onsite for reuse as landscape fill.

As noted previously, disposal of excavated materials off site should conform to current Ministry of Environment guidelines.

4.7 Pavement Design

Areas to be paved should be stripped of all topsoil, organics and other obviously unsuitable material. The exposed subgrade must then be proof-rolled. Any soft spots revealed by this or any other observations must be over-excavated and backfilled with approved material. All fill required to backfill service trenches, or to raise the subgrade to design levels must conform to requirements discussed previously. Preferably, the natural inorganic excavated soils should be used to maintain uniform subgrade conditions, provided adequate compaction can be achieved.

Provided the preceding recommendations are followed, the pavement thickness design requirements given in the following table are recommended for the anticipated specified street classifications (local roads) and anticipated subgrade conditions.

Recommended Pavement Structure Thickness

Pavement Layer	Compaction Requirements	Natural or Recompacted Sand Subgrade	Natural or Recompacted Silty Subgrade
Asphaltic Concrete	97% Marshall Density	35 mm HL-3 45 mm HL-8	35 mm HL-3 45 mm HL-8
Granular 'A' (Base)	100% SPMDD*	200 mm	150 mm
Granular 'B' (Subbase)	100% SPMDD*	* see note (4) below	300 mm

*Notes: 1) SPMDD denotes Standard Proctor Maximum Dry Density.
2) The subgrade must be compacted to 98% SPMDD.
3) The above recommendations are minimum requirements.
4) The native sand may be considered as part of the subbase, subject to onsite inspection by Trow. Where sand is not considered suitable, the pavement structure provided for silty subgrade soils should be utilized.

Other granular configurations may also be possible provided the granular base equivalency (GBE) thickness is maintained. These recommendations on thickness design are not intended to support heavy and concentrated construction traffic, particularly where only a portion of the pavement section is installed.

If construction is undertaken under adverse weather conditions (i.e., wet or freezing conditions) subgrade preparation and granular sub-base requirements should be reviewed by the geotechnical engineer. As well, if only a portion of the pavement will be in place during construction, the granular subbase may have to be thickened, and/or the subgrade improved with a geotextile separator.

Samples of both the Granular 'A' and Granular 'B' aggregates should be checked for conformance to OPSS 1010 prior to utilization on site, and during construction. The Granular 'B' subbase and the Granular 'A' base courses must be compacted to 100 percent SPMDD.

The asphaltic concrete paving materials should conform to the requirements of OPSS 1150. The asphalt should be placed in accordance with OPSS 310 and compacted to at least 97 percent of the Marshall mix design bulk density.

Good drainage provisions will optimize pavement performance. The finished pavement surface should be free of depressions and should be sloped (preferably at a minimum grade of two percent) to provide effective surface drainage toward catchbasins. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas. In low areas, subdrains may be required to intercept excess subsurface moisture and prevent subgrade softening, as shown on Drawing 4, depending upon soil conditions at the time of construction. This is particularly important in heavier traffic areas at the site entrances. The locations and extent of subdrainage required within the paved areas should be reviewed by this office in conjunction with the proposed grading.

A program of *in situ* density testing must be carried out to verify that satisfactory levels of compaction are being achieved.

To minimize the effects of differential settlements of service trench fill, it is recommended that wherever practical, placement of binder asphalt be delayed for approximately six months after the granular sub-base is put down. The surface course asphalt should be delayed for a further one year. Prior to the surface asphalt being placed, it is recommended that a pavement evaluation be carried out on the base asphalt to identify repair areas or areas requiring remedial works prior to surface asphalt being placed.

4.8 Curbs and Sidewalks

The concrete for the curbs and gutters should be proportioned, mixed placed and cured in accordance with the requirements of OPSS 353 and OPSS 1350.

During cold weather, the freshly placed concrete should be covered with insulating blankets to protect against freezing.

The subgrade for the sidewalks should comprise of undisturbed natural soil or well-compacted fill. A minimum 150 mm thick layer of compacted (100 percent SPMDD) Granular 'A' should be placed below the sidewalk slabs. Construction traffic should be kept off the placed curbs and sidewalks as they are not designed to withstand heavy traffic load.

4.9 Stormwater Infiltration

The natural subgrade soils at the site generally comprise of sand, which is generally found to be silty in the upper zones, and containing trace silt as depth increases. Groundwater was encountered below depths of about 1.5 m to 2.4 m in the test holes during Trow's fieldwork. Based on the above information, and Trow's experience with similar soil conditions in the area, consideration may be given to stormwater infiltration in using infiltration drywells or infiltration galleries.

For reference, the following information is provided regarding the design and construction of infiltration structures:

- Factors influencing the capacity of the infiltration trench include the prevailing groundwater level, the permeability of the subsoil and the geometry of the well. Other time dependent factors such as silting, air binding, bacteriological and chemical effects of recharge water which could modify capacity with time should be considered in the design.
- The Ministry of Environment guidelines indicate that dry wells should be constructed with a minimum separation between the bottom of the well to the seasonally high water table of 1 m. Based on the groundwater observations and previous work done in the area, the depth to water is expected to be range between about 1.5 m and 2.4 m below existing grades.
- It is important to note that any structures installed at less than 1.2 m depth, will be subjected to freeze-thaw cycles which may decrease their effectiveness, particularly in winter.
- Once the design depths for the infiltration structures are established, it is recommended that a percolation test be carried out to confirm the insitu percolation rate of the undisturbed subgrade soils.

Trow would be pleased to provide additional information in this regard, if required.

4.10 Inspection and Testing Requirements

An effective inspection and testing program is an essential part of construction monitoring. The Inspection and Testing Program for residential subdivision developments typically include the following items:

- Subgrade examination prior to engineered fill placement;
- Inspection and Materials testing during engineered fill placement (full-time supervision is recommended) and site servicing works, including soil sampling, laboratory testing (moisture contents and Standard Proctor density test on the pipe bedding, trench backfill and engineered fill material), monitoring of fill placement, and insitu density testing;
- Inspection and Materials testing during the road construction, including subgrade examination of the road subgrade soils following site servicing, laboratory testing (grain size analyses and Standard Proctor density tests on the Granular A and B material placed on site roadways), insitu density testing, and concrete sampling and testing for curbs.
- Inspection and Materials testing for base and surface asphalt, including laboratory testing on asphalt sampling to confirm conformance to project specifications and standards;
- Footing Base Examinations for residential footings set on engineered fill to confirm its suitability to support the design bearing pressures; and,
- Visual examination of concrete reinforcing steel placement in footings set on engineered fill.

5. General Comments

The comments given in this report are intended only for the guidance of design engineers. The number of test holes required to determine the localized underground conditions between test holes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

Trow Associates Inc. should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not afforded the privilege of making this review, Trow Associates Inc. will assume no responsibility for interpretation of the recommendations in this report.

We trust that this report is satisfactory to your present requirements and we look forward to assisting you in the completion of this project. Should you have any questions, please contact the undersigned at your convenience.

All the foregoing and attachments respectfully submitted,

Trow Associates Inc.

LICENSED PROFESSIONAL ENGINEER
Aug 14/06
R.A. WALKER
PROVINCE OF ONTARIO

John Lobbezoo, B. Eng.
Geotechnical Services

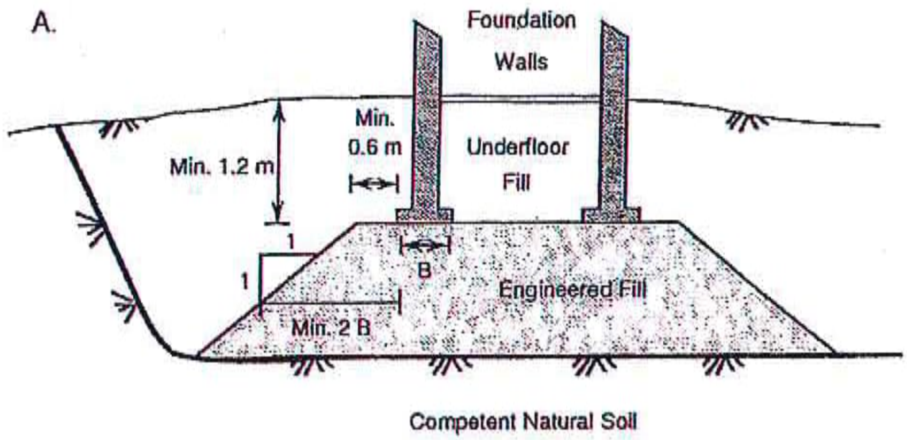
Rebecca Walker, P. Eng.
Head, Geotechnical & Materials Testing Division

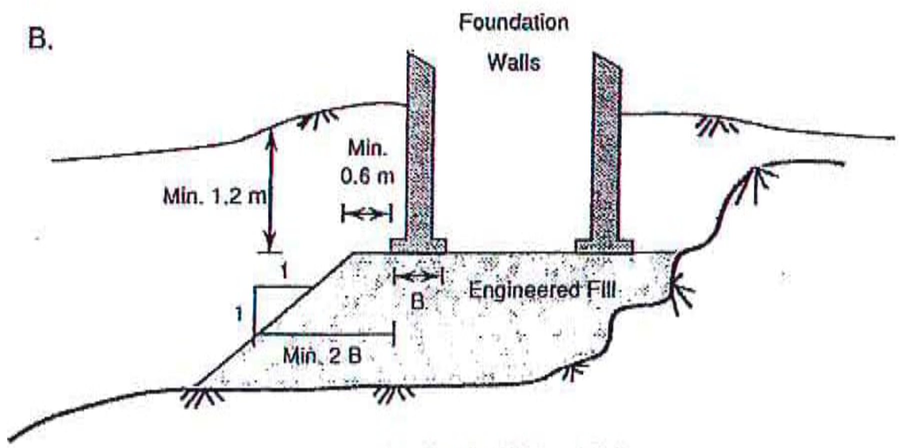
Distribution: Hampton Group – Mr. Dave Tennant Jr. (3 copies)

Drawings

GEOMETRIC REQUIREMENTS FOR FOUNDATIONS ON ENGINEERED FILL

Schematic (Not to Scale)





SECTION VIEW

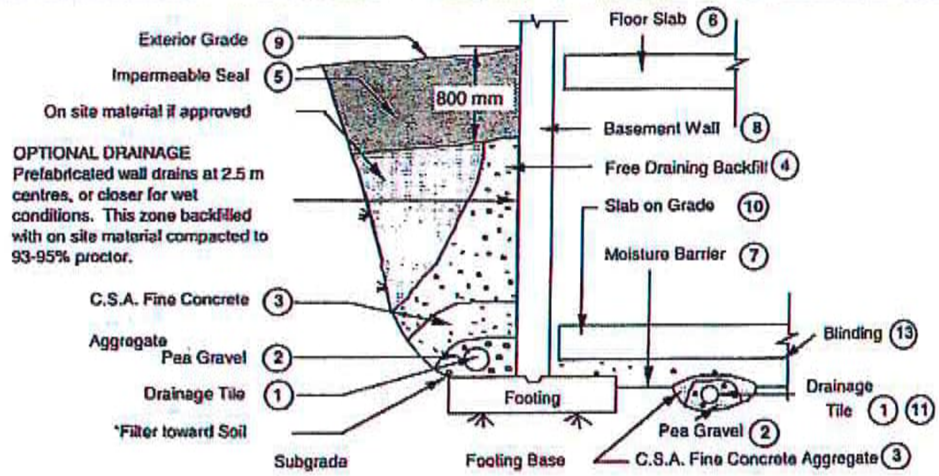
Section A – Typical Section of Slab-on-Grade Building
Section B – Typical Section of Building with Basement

Refer to Detailed Notes on following page.

NOTES FOR ENGINEERED FILL PLACMENT:

1. The area must be stripped of all topsoil contaminated fill material, and other unsuitable soils, and proof rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a Trow Engineer prior to placement of engineered fill.
2. In areas where engineered fill is placed on a slope, the fill should be benched into the approved subgrade soils. Trow would be pleased to provide additional comments and recommendations in this regard, if required.
3. All excavations must be carried out in accordance with the Occupational Health and Safety Regulation of Ontario (Construction Projects - O.Reg. 213.91)
4. Material used for engineered fill must be free of topsoil, organics, frost and frozen material, and otherwise unsuitable or compressible soils, as determined by a Geotechnical Engineer. Any material proposed for use as engineered fill must be examined and approved by Trow, prior to use onsite. Clean compactable granular fill is preferred.
5. Approved engineered fill should be placed in maximum 300 mm thick lifts, and uniformly compacted to 100% Standard Proctor dry density throughout. For best compaction results, engineered fill should be within 3 percent of its optimum moisture content, as determined by the Standard Proctor density test.
6. Full time geotechnical monitoring, inspection and insitu density (compaction) testing by Trow is required during placement of the engineered fill.
7. Site grades should be maintained during area grading activities to promote drainage, and to minimize ponding of surface water on the engineered fill mat. Rutting by construction equipment should be kept to a minimum, where possible. Additional work to ensure suitability of engineered fill may be required if fill is placed in extreme (hot/cold) weather.
8. The fill must be placed such that the specified geometry is achieved. Refer to sketches (previous page) for minimum requirements. Proper environmental protection will be required, such as providing frost penetration during construction, and after the completion of the engineered fill mat.
9. An allowable bearing pressure of 145 kPa (3000 psf) may be used provided that all conditions outlined above, and in the Geotechnical Report are adhered to.
10. These guidelines are to be read in conjunction with the attached Geotechnical Report (Trow Project No. LNGE00008677A).
11. For foundations set on engineered fill, a minimum footing width of 500 mm (20 inches) is recommended. Strip and pad footings set on engineered fill should be provided with nominal steel reinforcement. The extent of reinforcement is best determined in the field, by a Geotechnical Engineer.

BASEMENT DRAINAGE DRAWING
(NOT TO SCALE)

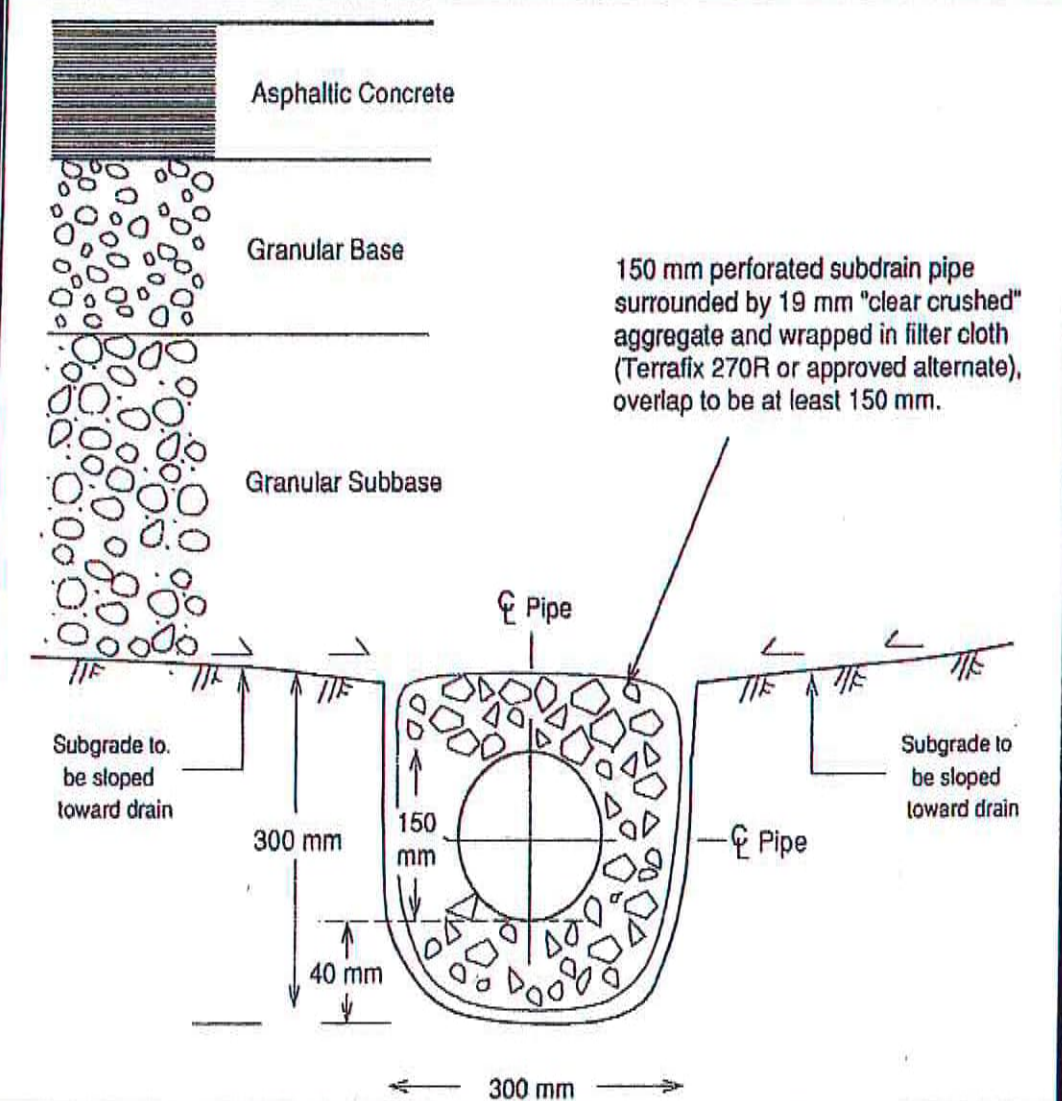


NOTES:

1. Drainage tile to consist of 100 mm (4 in.) diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet. Invert to be minimum of 150 mm (6 in.) below underside of floor slab.
2. Pea gravel 150 mm (6 in.) top and sides of drain. If drain is not on footing, place 100 mm (4 in.) of pea gravel below drain. 20 mm (3/4 in.) clear stone may be used provided if it is covered by an approved porous geotextile fabric membrane (Terrafix 270R or equivalent).
3. C.S.A. fine concrete aggregate to act as filter material. Minimum 300 mm (12 in.) top and side of drain. This may be replaced by an approved porous geotextile membrane (Terrafix 270R or equivalent).
4. Free-draining backfill - OPSS Granular B or equivalent compacted to 93 to 95 (maximum) percent Standard Proctor density. Do not compact closer than 1.8 m (6 ft) from wall with heavy equipment. Use hand controlled light compaction equipment within 1.8 m (6 ft) of wall.
5. Impermeable backfill seal of compacted clay, clayey silt or equivalent. If original soil is free-draining, seal may be omitted.
6. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
7. Moisture barrier to consist of compacted 20 mm (3/4 in.) clear stone or equivalent free-draining material. Layer to be 200 mm (8 in.) minimum thickness.
8. Basement walls to be damp-proofed.
9. Exterior grade to slope away from wall.
10. Slab on grade should not be structurally connected to wall or footing.
11. Underfloor drain invert to be at least 300 mm (12 in.) below underside of floor slab. Drainage tile placed in parallel rows 6 to 8 m (20 to 25 ft.) centres one way. Place drain on 100 mm (4 in.) of pea gravel with 150 mm (6 in.) of pea gravel top and sides. CSA fine concrete aggregate to be provided as filter material or an approved porous geotextile membrane (as in 2 above) may be used.
12. Do not connect the underfloor drains to perimeter drains.
13. If the 20 mm (3/4 in.) clear stone requires surface binding, use 6 mm (1/4 in.) clear stone chips.

Note:
a) Underfloor drainage can be deleted where not required (see report).
b) Free draining backfill, item 4 may be replaced by wall drains, as indicated, if more economical.

PAVEMENT SUBDRAIN DETAIL



NOTES:

1. All dimensions in millimetres.
2. All subdrains to be set on at least 1% grade draining to a positive outlet.

Scale: NTS

Appendix A

Borehole Logs

NOTES ON SAMPLE DESCRIPTIONS

1. All descriptions included in this report follow the 'modified' Massachusetts Institute of Technology (M.I.T.) soil classification system. The laboratory grain-size analysis also follows this classification system. Others may designate the Unified Classification System as their source; a comparison of the two is shown for your information. Please note that, with the exception of those samples where the grain size analysis has been carried out, all samples are classified visually and the accuracy of the visual examination is not sufficient to differentiate between the classification systems or exact grain sizing. The M.I.T. system has been modified and the TROW classification includes a designation for cobbles above the 75 mm size and boulders above the 200 mm size.

UNIFIED SOIL CLASSIFICATION	Fines (silt and clay)		Sand			Gravel	Cobbles
			Fine	Medium	Coarse	Fine / Coarse	
M.I.T. SOIL CLASSIFICATION	Clay	Silt	Sand			Gravel	
			Fine	Medium	Coarse		
Sieve Sizes			200	40	10	4 / 3/4	
Particle Size (mm)	0.002	0.06	0.075 / 0.2	0.6	2.0	5.0 / 20	80

2. **Fill:** Where fill is designated on the borehole log, it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description therefore, may not be applicable as a general description of the site fill material. All fills should be expected to contain obstructions such as large concrete pieces or subsurface basements, floors, tanks, even though none of these obstructions may have been encountered in the borehole. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact and correct composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. The fill at this site has been monitored for the presence of methane gas and the results are recorded on the borehole logs. The monitoring process neither indicates the volume of gas than can be potentially generated nor pinpoints the source of the gas. These readings are to advise of a potential or existing problem (if they exist) and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic waste that renders the material unacceptable for deposition in any but designated land fill sites; unless specifically stated, the fill on the site has not been tested for contaminants that may be considered hazardous. This testing and a potential hazard study can be carried out if you so request. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common, but not detectable using conventional geotechnical procedures.

3. **Glacial Till:** The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process, the fill must be considered heterogeneous in composition and as such, may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (75 to 200 mm in diameter) or boulders (greater than 200 mm diameter) and therefore, contractors may encounter them during excavation, even if they are not indicated on the borehole logs. It should be appreciated that normal sampling equipment can not differentiate the size or type of obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited area; therefore, caution is essential when dealing with sensitive excavations or dewatering programs in till material.

Trow
London Branch

BOREHOLE LOG

BH1

PROJECT Proposed Kensington Village Subdivision, Strathroy, Ontario — PROJECT NO. LNGE00008677A

CLIENT Hampton Group — DATUM Local

DRILL TYPE/METHOD Handheld Power Auger — DATES: Boring Aug. 3/2006 — Water Level Aug. 3/06

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	RECOVERY (mm) or (%)	N VALUE (blows) or RQD (%)	OTHER TESTS	SHEAR STRENGTH / Atterberg Limits and Moisture
0	100.25	TOPSOIL, dark brown sandy silt loam, rootlets, loose, moist								
	99.95	SILTY SAND, brown, fine to medium grained, moist, loose to compact			AS	S1				
					AS	S2				
		-becoming grey/brown, very moist to wet below 2.0m depth		∇	AS	S3				
					AS	S4				
	96.60	End of Borehole at 3.65m depth								

SHEAR STRENGTH: ✚ S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane; 40, 80 kPa

Atterberg Limits and Moisture: W_P W W_L

● SPT N Value × Dynamic Cone: 10, 20, 30, 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole logs must be read in conjunction with Trow Report LNGE0008677A. For definition of terms used on logs, see sheets prior to logs.

2) Apparent groundwater 2.1m depth at time of drilling.

SAMPLE LEGEND
- ⊠ AS Auger Sample
- SS Split Spoon
- ST Shelby Tube
- Rock Core (eg. BQ, NQ, etc.)
- VN Vane Sample

OTHER TESTS
- G Specific Gravity
- H Hydrometer
- S Sieve Analysis
- γ Unit Weight
- P Field Permeability
- K Lab Permeability
- C Consolidation
- CD Consolidated Drained Triaxial
- CU Consolidated Undrained Triaxial
- UU Unconsolidated Undrained Triaxial
- UC Unconfined Compression
- DS Direct Shear

WATER LEVELS
- ∇ Apparent
- Measured
- Artesian (see Notes)

Trow
London Branch

BOREHOLE LOG

BH2

Sheet 1 of 1

PROJECT: **Proposed Kensington Village Subdivision, Strathroy, Ontario** PROJECT NO. **LNGE00008677A**

CLIENT: **Hampton Group** DATUM: **Local**

DRILL TYPE/METHOD: **Handheld Power Auger** DATES: Boring **Aug. 3/2006** Water Level **Aug. 3/06**

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	SAMPLE NUMBER
0	99.34	TOPSOIL, dark brown sandy silt loam, rootlets, loose, moist	
	99.04	SILTY SAND, brown, fine to medium grained, moist, loose to compact	S1
		-becoming light brown, very moist to wet below 1.5m depth	S2
			S3
			S4
	95.69	End of Borehole at 3.65m depth	

SHEAR STRENGTH: ◆ S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane; 40, 80 kPa

Atterberg Limits and Moisture: W_P W W_L

● SPT N Value × Dynamic Cone: 10, 20, 30, 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole logs must be read in conjunction with Trow Report LNGE0008677A. For definition of terms used on logs, see sheets prior to logs.

2) Apparent groundwater 1.5m depth at time of drilling.

SAMPLE LEGEND
- AS Auger Sample
- SS Split Spoon
- ST Shelby Tube
- Rock Core (eg. BQ, NQ, etc.)
- VN Vane Sample

OTHER TESTS
- G Specific Gravity
- H Hydrometer
- S Sieve Analysis
- γ Unit Weight
- P Field Permeability
- K Lab Permeability
- C Consolidation
- CD Consolidated Drained Triaxial
- CU Consolidated Undrained Triaxial
- UU Unconsolidated Undrained Triaxial
- UC Unconfined Compression
- DS Direct Shear

WATER LEVELS
- Apparent
- Measured
- Artesian (see Notes)

Trow
London Branch

BOREHOLE LOG

BH3
Sheet 1 of 1

PROJECT Proposed Kensington Village Subdivision, Strathroy, Ontario — PROJECT NO. LNGE00008677A
CLIENT Hampton Group — DATUM Local
DRILL TYPE/METHOD Handheld Power Auger — DATES: Boring Aug. 3/2006 — Water Level Aug. 3/06

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	WELL LOG	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY (mm) or (%)	N VALUE (blows) or RQD (%)	OTHER TESTS
0	99.30	TOPSOIL, dark brown sandy silt loam, rootlets, loose, moist						
	99.00	SILTY SAND, brown, medium grained, moist, loose to compact						
				AS	S1			
1								
				AS	S2			
2		-becoming light brown, very moist to wet below 1.9m depth	∇					
				AS	S3			
3								
				AS	S4			
	95.65	End of Borehole at 3.65m depth						
4								
5								

SHEAR STRENGTH
✚ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
40 80 kPa
Atterberg Limits and Moisture
W_p W W_L
● SPT N Value × Dynamic Cone
10 20 30 40

NOTES
1) Borehole interpretation requires assistance by Trow before use by others. Borehole logs must be read in conjunction with Trow Report LNGE0008677A. For definition of terms used on logs, see sheets prior to logs.

2) Apparent groundwater 2.0m depth at time of drilling.

SAMPLE LEGEND
⊠ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
◫ Rock Core (eg. BQ, NQ, etc.) ◫ VN Vane Sample

OTHER TESTS
G Specific Gravity — C Consolidation
H Hydrometer — CD Consolidated Drained Triaxial
S Sieve Analysis — CU Consolidated Undrained Triaxial
γ Unit Weight — UU Unconsolidated Undrained Triaxial
P Field Permeability — UC Unconfined Compression
K Lab Permeability — DS Direct Shear

WATER LEVELS
∇ Apparent ▼ Measured ▲ Artesian (see Notes)

Trow
London Branch

BOREHOLE LOG

BH4
Sheet 1 of 1

PROJECT Proposed Kensington Village Subdivision, Strathroy, Ontario — PROJECT NO. LNGE00008677A
CLIENT Hampton Group — DATUM Local
DRILL TYPE/METHOD Handheld Power Auger — DATES: Boring Aug. 3/2006 — Water Level Aug. 3/06

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	RECOVERY (mm) or (%)	N VALUE (blows) or RQD (%)	OTHER TESTS
0	99.02	TOPSOIL, dark brown sandy silt loam, rootlets, loose, moist						
	98.72	SILTY SAND, brown, fine to medium grained, moist, loose to compact		⊠	S1			
		-becoming light brown, very moist to wet below 1.5m depth	▽	⊠	S2			
				⊠	S3			
				⊠	S4			
	95.37	End of Borehole at 3.65m depth						

SHEAR STRENGTH
✚ S Field Vane Test (#=Sensitivity)
▲ Penetrometer ■ Torvane
40 80 kPa
Atterberg Limits and Moisture
W_P W W_L
● SPT N Value X Dynamic Cone
10 20 30 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole logs must be read in conjunction with Trow Report LNGE0008677A. For definition of terms used on logs, see sheets prior to logs.

2) Apparent groundwater 1.5m depth at time of drilling.

SAMPLE LEGEND
⊠ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
◫ Rock Core (eg. BQ, NQ, etc.) ◫ VN Vane Sample

OTHER TESTS
G Specific Gravity — C Consolidation
H Hydrometer — CD Consolidated Drained Triaxial
S Sieve Analysis — CU Consolidated Undrained Triaxial
γ Unit Weight — UU Unconsolidated Undrained Triaxial
P Field Permeability — UC Unconfined Compression
K Lab Permeability — DS Direct Shear

WATER LEVELS
▽ Apparent ▼ Measured ▲ Artesian (see Notes)

Trow

London Branch

BOREHOLE LOG

BH5

Sheet 1 of 1

PROJECT: Proposed Kensington Village Subdivision, Strathroy, Ontario — PROJECT NO. LNGE00008677A

CLIENT: Hampton Group — DATUM: Local

DRILL TYPE/METHOD: Handheld Power Auger — DATES: Boring Aug. 10/2006 — Water Level Aug. 10/06

DEPTH (m)	ELEVATION (m) 98.59	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	N VALUE (blows) or RQD (%)	OTHER TESTS	SHEAR STRENGTH / Atterberg Limits and Moisture
0	98.29	TOPSOIL, dark brown sandy silt loam, rootlets, loose, moist								
		SILTY SAND, brown, fine to medium grained, moist, loose to compact -rust staining to 1.2m depth			AS	S1				
1		-moist to very moist from 1.2m depth			AS	S2				
		-wet from 1.8m depth		∇						
2					AS	S3				
3					AS	S4				
	94.94	End of Borehole at 3.65m depth								
4										
5										

SHEAR STRENGTH: ✚ S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane; 40, 80 kPa

Atterberg Limits and Moisture: W_P W W_L

● SPT N Value × Dynamic Cone: 10, 20, 30, 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole logs must be read in conjunction with Trow Report LNGE0008677A. For definition of terms used on logs, see sheets prior to logs.

2) Apparent groundwater 1.8m depth at time of drilling.

SAMPLE LEGEND

- ⊠ AS Auger Sample
- SS Split Spoon
- ST Shelby Tube
- Rock Core (eg. BQ, NQ, etc.)
- VN Vane Sample

OTHER TESTS

- G Specific Gravity
- H Hydrometer
- S Sieve Analysis
- γ Unit Weight
- P Field Permeability
- K Lab Permeability
- C Consolidation
- CD Consolidated Drained Triaxial
- CU Consolidated Undrained Triaxial
- UU Unconsolidated Undrained Triaxial
- UC Unconfined Compression
- DS Direct Shear

WATER LEVELS

∇ Apparent — Measured — Artesian (see Notes)

Trow
London Branch

BOREHOLE LOG

BH6
Sheet 1 of 1

PROJECT: Proposed Kensington Village Subdivision, Strathroy, Ontario   PROJECT NO. LNGE00008677A
CLIENT: Hampton Group   DATUM: Local
DRILL TYPE/METHOD: Handheld Power Auger   DATES: Boring Aug. 10/2006   Water Level Aug. 10/06

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	WELL LOG	SAMPLE TYPE	SAMPLE NUMBER	RECOVERY (mm) or (%)	N VALUE (blows) or RQD (%)	OTHER TESTS
0	98.63	TOPSOIL, dark brown sandy silt loam, rootlets, loose, moist						
	98.23	SILTY SAND, brown, fine to medium grained, moist, loose to compact -rust staining to 0.9m depth		AS	S1			
				AS	S2			
		-wet from 1.8m depth	∇					
				AS	S3			
				AS	S4			
	94.98	End of Borehole at 3.65m depth						

SHEAR STRENGTH: ◆ S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane; 40, 80 kPa
Atterberg Limits and Moisture: W_P W W_L
● SPT N Value × Dynamic Cone: 10, 20, 30, 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole logs must be read in conjunction with Trow Report LNGE0008677A. For definition of terms used on logs, see sheets prior to logs.

2) Apparent groundwater 1.8m depth at time of drilling.

SAMPLE LEGEND
- AS Auger Sample
- SS Split Spoon
- ST Shelby Tube
- Rock Core (eg. BQ, NQ, etc.)
- VN Vane Sample

OTHER TESTS
- G Specific Gravity
- H Hydrometer
- S Sieve Analysis
- γ Unit Weight
- P Field Permeability
- K Lab Permeability
- C Consolidation
- CD Consolidated Drained Triaxial
- CU Consolidated Undrained Triaxial
- UU Unconsolidated Undrained Triaxial
- UC Unconfined Compression
- DS Direct Shear

WATER LEVELS
- ∇ Apparent
- ▼ Measured
- ▲ Artesian (see Notes)

Trow
London Branch

BOREHOLE LOG

BH7
Sheet 1 of 1

PROJECT Proposed Kensington Village Subdivision, Strathroy, Ontario PROJECT NO. LNGE00008677A
CLIENT Hampton Group DATUM Local
DRILL TYPE/METHOD Handheld Power Auger DATES: Boring Aug. 10/2006 Water Level Aug. 10/06

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY (mm) or (%)	SAMPLES N VALUE (blows) or RQD (%)	OTHER TESTS	SHEAR STRENGTH / Atterberg Limits and Moisture / SPT N Value
0	99.32	TOPSOIL, dark brown sandy silt loam, rootlets, loose, moist								
	98.72	SILTY SAND, brown, fine to medium grained, moist, loose to compact -rust staining to 0.9m depth				S1				
1										
		-very moist to wet from 1.5m depth		⊻		S2				
2						S3				
3						S4				
	95.67	End of Borehole at 3.65m depth								
4										
5										

SHEAR STRENGTH: S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane; 40, 80 kPa
Atterberg Limits and Moisture: W_P W W_L
● SPT N Value × Dynamic Cone: 10, 20, 30, 40

NOTES

1) Borehole interpretation requires assistance by Trow before use by others. Borehole logs must be read in conjunction with Trow Report LNGE0008677A. For definition of terms used on logs, see sheets prior to logs.

2) Apparent groundwater 1.6m depth at time of drilling.

SAMPLE LEGEND
AS Auger Sample; SS Split Spoon; ST Shelby Tube; Rock Core (eg. BQ, NQ, etc.); VN Vane Sample

OTHER TESTS
G Specific Gravity; C Consolidation
H Hydrometer; CD Consolidated Drained Triaxial
S Sieve Analysis; CU Consolidated Undrained Triaxial
γ Unit Weight; UU Unconsolidated Undrained Triaxial
P Field Permeability; UC Unconfined Compression
K Lab Permeability; DS Direct Shear

WATER LEVELS
⊻ Apparent; Measured; Artesian (see Notes)

Trow
London Branch

BOREHOLE LOG

BH8

Sheet 1 of 1

PROJECT Proposed Kensington Village Subdivision, Strathroy, Ontario — PROJECT NO. LNGE00008677A

CLIENT Hampton Group — DATUM Local

DRILL TYPE/METHOD Handheld Power Auger — DATES: Boring Aug. 10/2006 — Water Level Aug. 10/06

DEPTH (m)	ELEVATION (m)	STRATA DESCRIPTION	STRATA PLOT	WELL LOG	SAMPLES TYPE	SAMPLES NUMBER	RECOVERY (mm) or (%)	N VALUE (blows) or RQD (%)	OTHER TESTS
0	100.03	TOPSOIL, dark brown sandy silt loam, rootlets, loose, moist							
	99.63	SILTY SAND, brown, fine to medium grained, moist, loose to compact			AS	S1			
1					AS	S2			
2		-very moist below 2.1m depth		▽	AS	S3			
3					AS	S4			
	96.38	End of Borehole at 3.65m depth							
4									
5									

SHEAR STRENGTH: S Field Vane Test (#=Sensitivity); ▲ Penetrometer; ■ Torvane; 40, 80 kPa

Atterberg Limits and Moisture: W_P W W_L

● SPT N Value × Dynamic Cone: 10, 20, 30, 40

NOTES

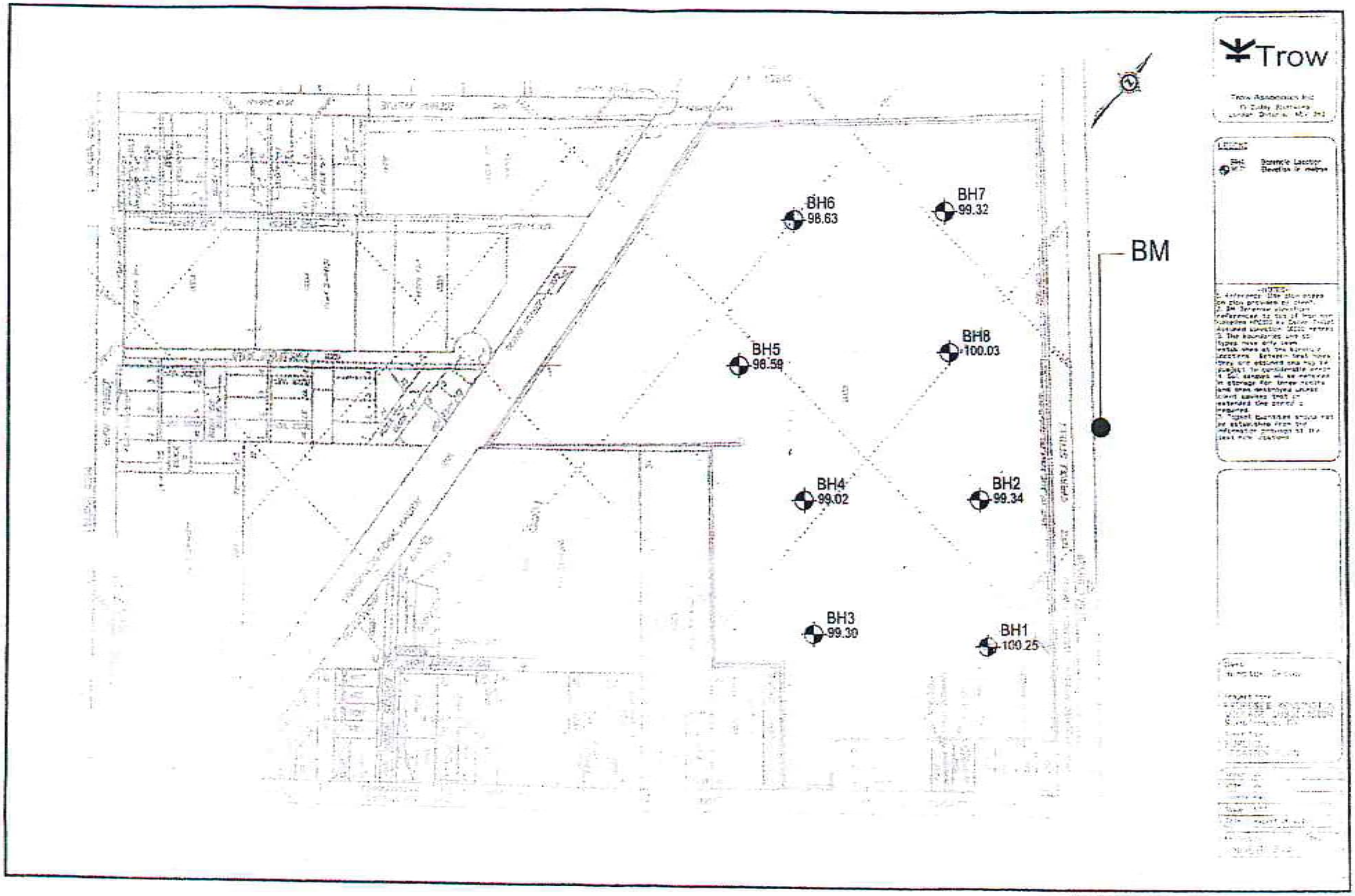
1) Borehole interpretation requires assistance by Trow before use by others. Borehole logs must be read in conjunction with Trow Report LNGE0008677A. For definition of terms used on logs, see sheets prior to logs.

2) Apparent groundwater 2.4m depth at time of drilling.

SAMPLE LEGEND
⊠ AS Auger Sample ▨ SS Split Spoon ■ ST Shelby Tube
▥ Rock Core (eg. BQ, NQ, etc.) ◫ VN Vane Sample

OTHER TESTS
G Specific Gravity — C Consolidation
H Hydrometer — CD Consolidated Drained Triaxial
S Sieve Analysis — CU Consolidated Undrained Triaxial
γ Unit Weight — UU Unconsolidated Undrained Triaxial
P Field Permeability — UC Unconfined Compression
K Lab Permeability — DS Direct Shear

WATER LEVELS
▽ Apparent — Measured — Artesian (see Notes)


Trow
BH6
98.63
BH7
99.32
BM
BH5
98.59
BH8
100.03
BH4
99.02
BH2
99.34
BH3
99.30
BH1
100.25