WESLAKE INC.
CONSULTING CIVIL ENGINEERS MUNICIPAL AND ENVIRONMENTAL PLANNERS
10 - 120 Lancing Drive, Hamilton, Ontario, L8W 3A1
Phone: (905) 574-2300 Fax: (905) 574-3303
101 - 446 Grey Street, Brantford, Ontario, N3S 7L6
Phone: (519) 750-1039 Fax: (519) 750-0293
Web Site: www.weslake.com e-mail: info@weslake.com

June 15, 2004
File No. 1690

Mr. Jerry Heeringa
G. L. Heeringa Ltd.
21 Leslie Drive
Stoney Creek, Ontario
L8G 2P9

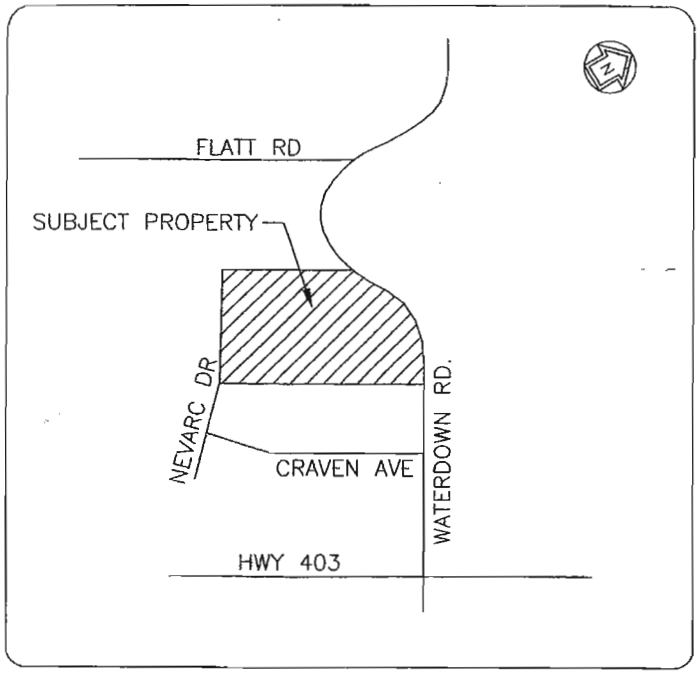
Dear Sir:

Re: Proposed Fellowship Canadian Reformed Church – Burlington, Ontario
Stormwater Management Report

1. INTRODUCTION

This letter report has been prepared to outline the detailed stormwater management aspects of the proposed church site. Figure 1 shows the location of the site.

Figure 1 – Key Plan



The report was prepared for the following purposes:

- To simulate the rainfall-runoff processes related to the site for both existing and proposed conditions;

- To estimate the increase in peak discharge for a 5-year rainstorm event; and
- To establish proposed mitigating measures in terms of quantity control and effectiveness.

Various discussions and analyses were required to achieve the above objectives and the results are summarized in the following sections:

2. Site Plan Description
3. Methodology
4. Quantity Control
5. Conclusions and Recommendations

2. SITE PLAN DESCRIPTION

The proposed church development is situated on the west side of Waterdown Road between Craven Road and Flatt Road, part way up the Niagara Escarpment. The 1.5-hectare site is currently comprised of a mainly grassed surface with an existing dwelling, gravel driveway and various out buildings, all of which will be removed during development of the site.

With respect to existing drainage, the site is broken up into three areas, which are illustrated on Drawing 1. Area 1 currently drains in a north-to-south direction, is collected by an existing drainage swale along the south property line and discharges into a 300mm dia. CSP along Nevare Drive. Area 2 drains via sheet flow in an easterly direction and collects in an existing drainage ditch along Waterdown Road. Area 3 also drains in a north-to-south direction towards a ravine on the western edge of the property. This drainage area will remain virtually unchanged during development of the site. All three areas drain into a tributary of Grindstone Creek and are within the Conservation Halton Watershed.

Site development will consist of a church building with associated parking, driveway and landscaped areas. The hydrological regime of the site and the downstream receiving system may be affected by the development. It is, therefore, important that a hydrological analysis be carried out to evaluate the situation. Subsequent sections are included to address this issue.

3. METHODOLOGY

Simulations of the rainfall-runoff process always include some uncertainties. Factors such as temporal and spatial rainfall distributions, complexities of overland flows, interactions between surface and subsurface flows as well as man-made and natural channel routings contribute to these uncertainties.

To alleviate the magnitude of these issues, the following steps were used as part of the methodology of the hydrological assessments related to the project:

3.1 Precipitation Data

According to the City of Burlington Specifications and Criteria, historical rainfall data can be used to establish synthetic precipitation events.

Based on the above, and given the characteristics of the development, the Chicago type distribution was chosen to illustrate the precipitation pattern for the area. In addition, return periods of 5 years and 100 years were selected for design purposes. The parameters associated with these design storms are listed in Table 1. Figures 2 and 3 are the hyetographs for each design storm.

Table 1 – Design Storm Parameters

Storm event	a	b	c
5-year	697.40	5	0.764
100-year	1114.20	5	0.761

Figure 2 – 5-year Storm Hyetograph

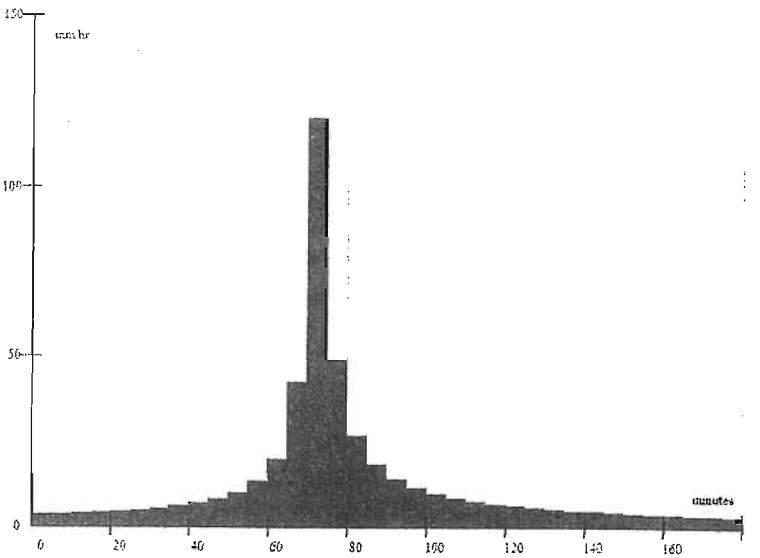
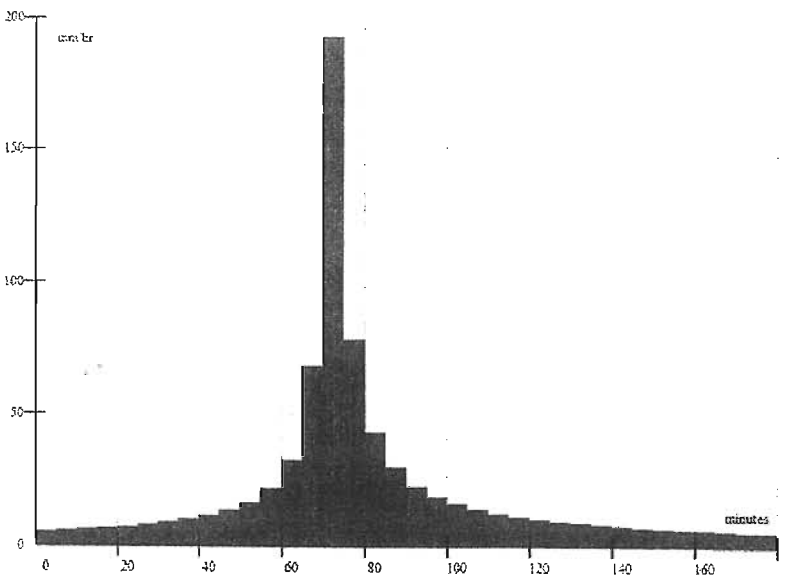


Figure 3 – 100-year Storm Hyetograph



It should be noted that the intensity of these storms can be calculated using the following formula:

$$i = \frac{a}{(T+b)^c}$$

Where: i = storm intensity
T = storm duration

3.2 Drainage Area Characteristics

Tables 2 and 3 and Drawing 1 summarize and illustrate the changes in drainage area characteristics. Since the existing Drainage Area 3 will remain virtually unchanged under proposed conditions (Area 8), the analyses will concentrate on the existing and proposed hydrologic conditions at the 300mm dia. outlet at Nevare Drive. Preliminary grades for the proposed development have been assumed.

Table 2 – Drainage Characteristics (Existing Conditions)

Sub-area	Area (ha)	% IMP	Description
1	0.62	34.00	Mainly grass with building and driveway
2	0.05	27.00	Mainly grass with driveway
3	0.83	27.00	Grass/ravine

Table 3 – Drainage Characteristics (Proposed Conditions)

Sub-area	Area (ha)	% IMP	Description
1	0.03	10.00	Grass
2	0.21	57.10	Parking/grass
3	0.23	74.00	Building/parking
4	0.12	68.00	Building/parking
5	0.13	48.0	Parking/grass
6	0.78	10.0	Grass/ravine

4. QUANTITY CONTROL

4.1 Computer Modeling

Modeling was carried out using the latest version of the MIDUSS computer simulation program. A factor that influenced this choice was the fact that MIDUSS includes design tools for determining not only pipe sizes, but also storage requirements for on-site controls.

Further, it should be noted that a duration of 3 hours, in terms of precipitation events, was used for all simulations. This assumption was appropriate since the time of concentration associated with the site is much less than the stated duration.

4.2 Hydrological Regime

Appendix "A" includes all input/output files. Without stormwater management controls, the development would result in an increase in the magnitude of the peak flows at the existing 300mm dia. outlet. Table 4 summarizes these changes.

Table 4 – Peak Flow Summary

Storm Event	Existing Conditions (m^3/s)	Proposed Conditions without stormwater management (m^3/s)	Percentage of Change
5-year	0.054	0.098	+ 181%
100-year	0.096	0.173	+ 180%

Based on the above, it is obvious that certain stormwater management measures are required to maintain the peak flows at pre-development levels.

4.3 Quantity Control Measures

As previously mentioned, on-site storage is an option for reducing peak runoff. Parking lot storage will be used for this development as outlined below. Rooftop storage is not feasible in this instance due the design of the church roof.

4.3.1 Parking Lot Storage

Parking lot storage is a form of on-site control, which uses shallow ponding in the parking area. This is created through grading design and installation of inlet control devices (ICDs) at the interface of the catchbasin wall and catchbasin lead. Drawing 1 provides details of this concept. Table 5 describes the stage-discharge relationship corresponding to the designs.

Table 5 – Stage-Discharge Relationships

Parking Area	Ponding Depth (m)	Actual Elevation (m)	Required Storage (m^3)	Discharge (m^3/s)
1	0.00	132.00	0.0	0.014
	0.15	132.15	2.9	0.015
	0.30	132.30	14.5	0.016
2	0.00	132.20	0.0	0.014
	0.15	132.35	3.9	0.015
	0.30	132.50	18.0	0.016
3	0.00	132.30	0.0	0.014
	0.15	132.45	3.4	0.015
	0.30	132.60	24.2	0.016

4.3.2 Results

Computations were performed based on the above information to determine the effectiveness of the proposed on-site controls. Detailed calculations are included in Appendix "A". Schematic No. 1 on Drawing 1 shows the hydrological arrangement between the sub-areas and the stormwater management measures. Table 6 is included to describe the effectiveness of the proposed on-site controls at the 300mm dia. outlet at Nevare Drive.

Table 6 – Effectiveness of On-Site Stormwater Management Measures

Storm Event	Existing Conditions (m^3/s)	Proposed Conditions without Stormwater Management (m^3/s)	Proposed Conditions with Stormwater Management (m^3/s)	Percentage Reduction
5-year	0.054	0.098	0.056	42.9
100-year	0.096	0.173	0.170	59.5

The results show that the proposed parking lot storage would maintain/reduce peak flows generated by the development to pre-development levels.

4.4 Quality Control

It is recognized that sediment may enter the infrastructures during construction. To that end, an erosion and sediment control plan is included herewith, which details the proposed methods to prevent sediment from entering the infrastructures and/or leaving the site.

Post-construction quality control of the runoff will be provided by the existing grass-lined ditches located downstream of the site.

5. CONCLUSIONS & RECOMMENDATIONS

Based on the foregoing, it is concluded that it is feasible to provide adequate drainage for the site by maintaining the existing 300mm dia. outlet and maintaining/reducing the peak flows generated by the site through parking lot storage controls.

It is, therefore, recommended that:

- A detailed grading and site servicing plan along with an erosion and sediment control plan be prepared and implemented in accordance with the stormwater management concepts recommended in Section 4; and
- This document be accepted as stormwater management guidelines for the project.

Respectfully submitted,

Yours very truly,

WESLAKE INC.

Tai D. Bui, Ph.D., P.Eng.

TDB:kc
Attach.
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