Appendix 10.1

Thorntons recycling

Surface Water Catchment Calculations

Flood Studies Report

The Flood Studies Report (FSR) provides a method for obtaining estimated of flood discharge for ungauged catchments through the use of catchment characteristics to give the mean annual flood, QBAR. The method is based on the consideration of more than 500 catchments in Britain and Ireland, including the catchment and meteorological characteristics.

The 6-term general equation is expressed as follows:

$$Q_{BAR} = C\,[AREA^{0.94} \times STMFRQ^{0.27} \times SOIL^{1.23} \times RSMD^{1.03} \times S1085^{0.16} \times (1+LAKE)^{-0.85}] \quad \textbf{[Eq. 10.1]}$$

where

Q_{BAR} = mean annual peak flow (m^3/s);

C = constant, for Ireland given as 0.0172;

AREA = area of catchment (km^2);

STMFRQ = stream frequency (junctions per km^2);

SOIL = soil index determined from soil survey maps and si derived from the following formula;

$$SOIL = \frac{(0.15S_1 + 0.3S_2 + 0.4S_3 + 0.45S_4 + 0.5S_5)}{S_1 + S_2 + S_3 + S_4 + S_5} \quad \textbf{[Eq.10.2]}$$

where S1 to S5 denote the proportions of the catchment covered by each soil class 1 to 5. Soil class 1 has the highest infiltration capacity and hence the lowest runoff potential, while soil class 5 has the lowest infiltration capacity and hence the highest runoff potential.

RSMD = the net 1-day rainfall of 5 years return period less soil moisture deficit, taken from FSR data maps;

S1085 = the stream slope measured between two points situated at distances that are 10% and 85% of the stream length as measured from the catchment outlet along the longest stream length;

LAKE = the fraction of the catchment draining through a lake or reservoir.

Institute of Hydrology

The above expression is difficult to apply to catchments of less than 20km2, particularly in quantifying the STMFRQ and S1085 terms. The Institute of Hydrology (IOH) provide the following 3-term Model for catchments of less than 22 km2 in area.

$$Q_{BAR} = 0.00066 \times AREA^{0.92} \times SAAR^{1.22} \times SOIL^{2.0} \quad \textbf{[Eq. 10.3]}$$

where

SAAR = Standard Average Annual Rainfall (mm).

This expression was adapted by Dublin Corporation to quantify the permissible outflow for developments up to 24 hectares in area. The adapted model is as follows:

$$Q_{BAR} = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17} \quad \textbf{[Eq. 10.4]}$$

For the pre-development condition of the proposal site:

AREA = 17.5 ha = 0.175 km^2;

SAAR = 841mm (per Met Éireann data);

SOIL = 0.45, assuming 9.5ha of low permeability and 8.0ha of moderate permeability;

QBAR = 0.109m^3/s

If the entire site is considered to be exhibit low infiltration, then the mean annual peak flow for the site is 0.135m^3/s.

The same model is used to determine the mean annual peak flow for the catchment.

For the catchment:

AREA = 8.5 km^2;

SAAR = 841mm (per Met Éireann data);

SOIL = 0.43, assuming 2.5 km^2 of low permeability (peat) and 6.0 km^2 of moderate permeability, based on GSI Draft Quaternary Geology Map, April 2004;

Q_{BAR} = 3.062m^3/s.

This was checked against the unmodified IOH expression for small catchments, Eq. 10.3. The mean annual peak flow for the catchment using this expression was 3.226m3/s, which is comparable to the result using the modified expression. The lower figure indicates higher proportions of flow from the site and hence greater impacts from the development. It is therefore considered to be a more conservative figure and is used to assess the impact of the site on surface water in the area.

For the post-development condition of the proposal site:

AREA = 17.5 ha = 0.175 km^2;

SAAR = 841mm (per Met Éireann data);

SOIL = 0.48, assuming 14ha of low permeability and 3.5ha of moderate permeability;

$Q_{BAR} = 0.123 m^3/s$

Rational Method

The Rational Method provides an expression for relating rainfall to runoff and takes the following form:

$Q_p = CiA$ **[Eq. 10.5]**

where

Q_p = peak discharge due to a particular rain event (m^3/s);

C = runoff coefficient, taken as 1.0 to represent completely impermeable ground;

i = rainfall intensity (mm/hr)

A = catchment area (km^2).

This expression was used to estimate the peak discharge from the site for storms of various intensities and durations. The most intense annual storm for Mullingar as reported by Met Éireann is 6.3mm in 15 minutes. This gives a peak discharge from the surface water collection system of 0.137m^3/s, taking account of the roofs and hardstanding areas of the various components of the site that contribute to the surface water collection system.

In order to quantify the volume of the proposed soakaway, the response of the facility's surface water collection system to an extreme storm event was assessed. The Met Éireann figure for the 20-year return daily rainfall event for Mullingar is 60mm, and this was used to quantify the volume of rainfall collection by the system. The Rational Method indicates that 955m^3 of water would be collected over 24 hours. The soakaway is designed to provide 1,000m^3 of storage. Given that discharge would continue throughout the storm at 109l/s, the soakaway is sized to accommodate more severe storms than the 20-year daily event.

Note:

The following references were used in compiling this Appendix:

- Engineering Hydrology 4th Ed., EM Wilson, Macmillan 1990;
- Stormwater Management Policy for Developers, Dublin Corporation Drainage Division, January 1999;
- Met Éireann meteorological data for Mullingar;
- GSI Draft Quaternary Geology Map of Co. Westmeath, April 2004.