Geotechnical Engineering Office, Civil Engineering and Development Department
The Government of the Hong Kong Special Administrative Region

GEO Technical Guidance Note No. 39 (TGN 39)
Guidelines for Estimation of Surface Runoff from Natural Terrain Catchments for Drainage Design Purposes

1. SCOPE

1.1 This Technical Guidance Note (TGN) supplements the guidance on the design of surface drainage given in GEO (1984) to cater for surface runoff from natural terrain catchments.

1.2 Any feedback on this TGN should be directed to Chief Geotechnical Engineer/Standards & Testing of the GEO.

2. TECHNICAL POLICY

2.1 The technical recommendations referred to in this TGN were agreed by GEO Geotechnical Control Conference on 17 December 2013.

3. RELATED DOCUMENTS

3.1 DSD (2013). *Stormwater Drainage Manual (with Eurocodes incorporated) - Planning, Design and Management (Fourth Edition)*. Drainage Services Department, Hong Kong, 172 p.

3.2 Fugro Scott Wilson Joint Venture (2013). *Review of Methods in Estimating Surface Runoff from Natural Terrain" (GEO Report No. 292)*. Geotechnical Engineering Office, Hong Kong, 98 p.

3.3 GEO (1984). *Geotechnical Manual for Slopes (Second Edition)*. Geotechnical Engineering Office, Hong Kong, 302 p. (Reprinted, 2011)

3.4 GEO (2011). *New Intensity-Duration-Frequency Curves for Slope Drainage Design.* GEO TGN No. 30, Geotechnical Engineering Office, Hong Kong, 4 p.

4. BACKGROUND

4.1 Natural hillside hazard mitigation works entail the design and construction of drainage provisions to effectively convey surface runoff from natural terrain catchments to safe discharge points.

4.2 Current guidelines on surface runoff estimation are applicable primarily to man-made slopes (GEO, 1984). A study has been undertaken to review the methodology for determining surface runoff from natural terrain catchments.

5. TECHNICAL RECOMMENDATIONS

5.1 The following approaches are recommended for the estimation of surface runoff from

natural terrain catchments for surface drainage design purposes:

(a) The Rational Method should be adopted to estimate surface runoff from natural terrain catchments, as follows:

$$Q = CiA / 3600 \qquad \text{----------} \quad (1)$$

where Q = peak runoff (litres/s)
i = design rainfall intensity (mm/hr)
A = area of catchment (m^2)
C = runoff coefficient (dimensionless)

(b) The Bransby-Williams equation, with due consideration of the presence of any prominent natural stream channels (which should be accounted for by means of suitable hydraulics equations), should be used for determining the time of concentration (t_c), as follows:

$$t_c = \frac{0.14465L}{H^{0.2}A^{0.1}} \qquad \text{----------} \quad (2)$$

where t_c = time of concentration (min)
A = catchment area (m^2)
H = average slope (m/100m), measured along the line of natural flow, from the summit of the catchment to the point under consideration
L = distance (on plan) measured along the line of natural flow between the summit and the point under consideration (m)

(c) Weighted average runoff coefficient to account for the relative proportions of different ground conditions (e.g. steep natural soil slopes, areas of soil surface underlain by shallow rock layer, etc.) should be used. The values of runoff coefficient (C) for different ground conditions as recommended by DSD (2013) should be adopted (see Annex TGN 39 A1) in determining the weighted average runoff coefficient. The effects of antecedent rainfall should also be considered. In considering such effects, the value of C for areas underlain by a shallow rock layer should be taken as unity whereas an increase of 50% should be allowed for in the C value for permeable ground conditions. The increased value of C due to antecedent rainfall should be capped at 1.0.

(d) The rainfall intensity should be assessed based on the Intensity-Duration-Frequency curves given in TGN 30 (GEO, 2011), with a 200-year return period for slope drainage design.

5.2 A worked example on runoff estimation using the recommended approach can be found in FSWJV (2013).

6. **ANNEX**

6.1 TGN 39 A1 – Values of Runoff Coefficient recommended in DSD (2013).

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Values of Runoff Coefficient Recommended in DSD (2013)

Surface Characteristics	*Runoff coefficient, C* [Note 1]
Asphalt	0.70 - 0.95
Concrete	0.80 - 0.95
Brick	0.70 - 0.85
Grassland (heavy soil [Note 2])	
Flat	0.13 - 0.25
Steep	0.25 - 0.35
Grassland (sandy soil)	
Flat	0.05 - 0.15
Steep	0.15 - 0.20

Notes

(1) For steep natural hillsides or areas where a shallow soil surface is underlain by an impervious rock layer, a higher C value of 0.4 - 0.9 may be applicable.

(2) Heavy soil refers to fine-grained soil composed largely of silt and clay.