1. Drainage Proposal

1.1 Site Particulars

1.1.1 The application site is abutting a local vehicular access leading to Kong Nga Po Road. possesses an area of approximately 1,763m^2.

1.1.2 There is an existing streamcourse to the South of the application site, and works have been done to widen the streamcourse and concrete blocks were place along the streamcourse to ensure capacity and flooding susceptibility of the adjoining areas would not be adversely affected by the proposed development. Photos of current condition of the streamcourse are shown in Figures 4.1 to 4.4. Figure 3 depicts the location of the camera and the direction of the photo.

1.2 Level and gradient of the subject site & proposed surface channel

1.2.1 The application site is mostly paved, an area of approximately 1,763m^2. The paved area will have a gradient sloping from North to South from about +26.4mPD to +26.3mPD.

1.2.2 In order to follow the topography of the application site, the proposed surface channel will be constructed following the gradient of the site. As demonstrated in the calculations in Paragraph 3 and 4 hereunder, a 300mm surface U-channel will be capable to drain the surface runoff accrued at the subject site.

1.3 Catchment area of the proposed drainage provision at the subject site.

1.3.1 For the internal catchment, with an area of approximately 1,763m^2, a 300mm surface U-Channel along the site peripheral is proposed to intercept the run-off of the site.

1.3.2 The intercepted stormwater from the site will then be discharged to the existing open streamcourse to the Northwest of the Site via a proposed 300mm surface U-channel.

1.3.3 It is noted that the land to the West of the application site commands only a slightly higher level, but with flowpaths mostly flowing away from the application site, whereas the land to the North, South, and East command a lower level. Therefore, we assume overland flow from adjacent land to be minimal

2 Runoff Estimation and Proposed Drainage Facilities

2.1 Proposed Drainage Facilities

2.1.1 Subject to the below calculations, it is determined that 300mm surface U-channel which is made of concrete along the site periphery is adequate to intercept storm water generated at the application site.

2.1.2 The intercepted stormwater from the site will then be discharged to the existing streamcourse to the South of the application site as shown in Figure 1.

2.1.3 The flow capacities of the proposed U-channel are calculated using the Chart for the Rapid Design of Channels. Runoff from corresponding Site Catchments (calculated based on a return period of 50 years), the capacity estimation are included below.

2.1.4 The calculations below shows that the proposed 300mm U-channel has adequate capacity to cater for the surface runoff generated at the application site.

2.1.5 A next set of calculations checks and confirms that the downstream watercourse has the capacity for the surface runoff generated at the application site and external catchment.

2.1.6 All the proposed drainage facilities, including the section of surface channel proposed in between the subject site to the streamcourse will be provided and maintained at the applicant's own expense. Also, surface U-channel will be cleaned at regular interval to avoid the accumulation of rubbish/debris which would affect the dissipation of storm water.

2.1.7 The provision of the proposed surface U-channel will follow the gradient of the application site. All the proposed drainage facilities will be constructed and maintained at the expense of the applicant.

3 Calculation 1: Drainage Calculation for the proposed Provision of Drainage Facilities at the Application Site

3.1 Runoff Estimation

3.1.1 Rational method is adopted for estimating the designed run-off

$$Q=0.278\ C \times I \times A$$

Table 1: Runoff Coefficients

Surface Characteristics	Runoff Coefficient
Asphalt	0.70-0.95
Concrete	0.80-0.95
Brick	0.70-0.85
Grassland (Heavy Soil)	
Flat	0.13-0.25
Steep	0.25-0.35
Grassland (Sandy Soil)	
Flat	0.05-0.15
Steep	0.15-0.2

Assuming that:

I. The total catchment area from the application site is about 1,763 m^2;

II. Approximately 1,763 m^2 is hard paved, and therefore the value of run-off co-efficient (k) is taken as 0.95.

Difference in Land Datum = 26.4m –26.3m = 0.1m
L = 50.6m
Average fall = 0.2m in 100m

According to the Brandsby-Williams Equation adopted from the "Stormwater Drainage Manual – Planning, Design and management" published by the Drainage Services Department (DSD),

Time of Concentration (t_c) = $0.14465[L/(H^{0.2}\times A^{0.1})]$
t_c = $0.14465[50.6/(0.2^{0.2}\times 1{,}763^{0.1})]$
t_c = 4.78 minutes

The rainfall intensity *i* is determined by using the Gumbel Solution:

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

Where *I* = Extreme mean intensity in mm/hr
td = Duration in minutes (td≤240)
a, b, c = Storm constants given in the table below

Table 2: Storm Constants for Different Return Periods of North District Area

Return Period T(years)	2	5	10	20	50
a	1004.5	1112.2	1157.7	1178.6	1167.6
b	17.24	18.86	19.04	18.49	16.76
c	0.644	0.614	0.597	0.582	0.561

i = $1167.6/[4.78+16.76]^{0.561}$

i = 208.6mm/hr

By Rational Method, Q = 0.95× 208.6mm/hr × 1,763/3600

Q = 97l/s = $0.097m^3/s$ = 5,823 l/min

In accordance with the Chart of the Rapid Design of Channels in "Geotechnical Manual for Slopes", 300mm surface U-channel in 1:100 gradient is considered adequate to dissipate all the stormwater accrued by the application site, as shown in Figure 2. The intercepted stormwater will then be discharged to the existing natural stream to the South of the application site as shown in Figure 1.

4 Checking the Capacity of the 2 Widened Drainage Channel

Manning Equation

$$V = \frac{R^{\frac{2}{3}} \times S_f^{0.5}}{n}$$

$$R = \frac{L \times D}{2D + L}$$

L = 2.2m

D = 0.7m

R = [2.2×0.7]/[2×0.7+2.2]

R = 0.43m

n = 0.014 $s/m^{1/3}$

(Table 13 of Stormwater Drainage Manual)

V = $[0.43^{2/3}]\times[0.01^{0.5}]/0.014$

V = 1.62m/sec

Maximum Capacity $Q_{Max} = V \times A$

A = L × D

A = 2.2 × 0.7

A = $1.54m^2$

Q_{Max} = 1.62m/sec × $1.54m^2$

Q_{Max} = $2.50m^3/sec$

$2.50m^3/sec$ > $0.097m^3/sec$

Q_{Max} > Q

The runoff estimation is only a small fraction of the existing drainage channel's capacity

5 Conclusion

5.1 The applicant will be responsible for the construction and ongoing maintenance of the drainage facilities.

5.2 Potential drainage impacts that may arise from the Site after construction of the Proposed Development have been assessed. Thus, the stormwater system will have sufficient capacity to receive stormwater runoff from the Proposed Development and surrounding catchments.

5.3 Adequate measures are provided at the resources of the applicant to prevent the site from being eroded and flooded

5.4 External catchment is taken into account such that flooding susceptibility of the adjoining areas would not be adversely affected by the proposed development.

Figure 1 Drainage Plan

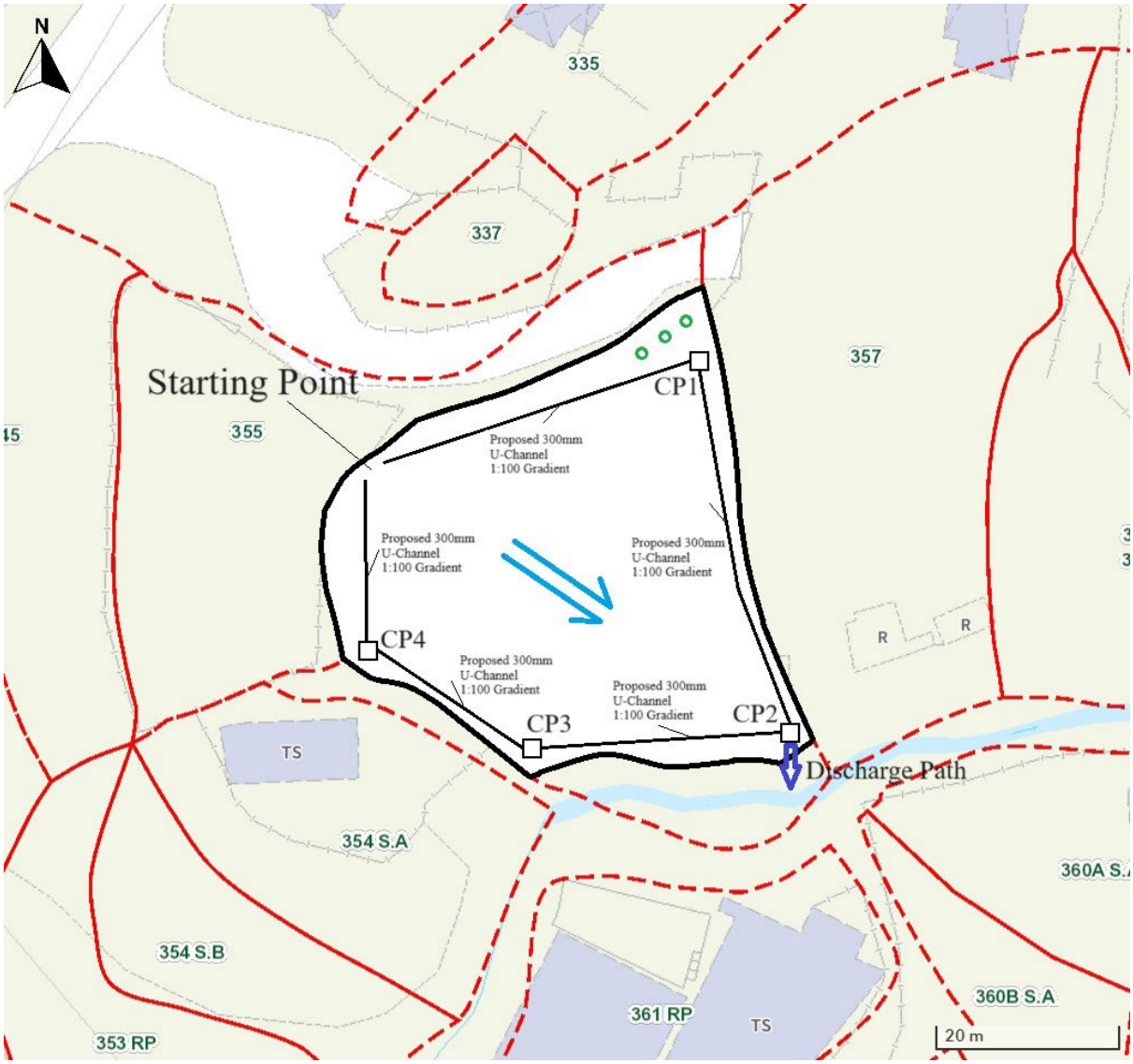

Figure 2 Chart for the Rapid Designs of Channels (Application Site)

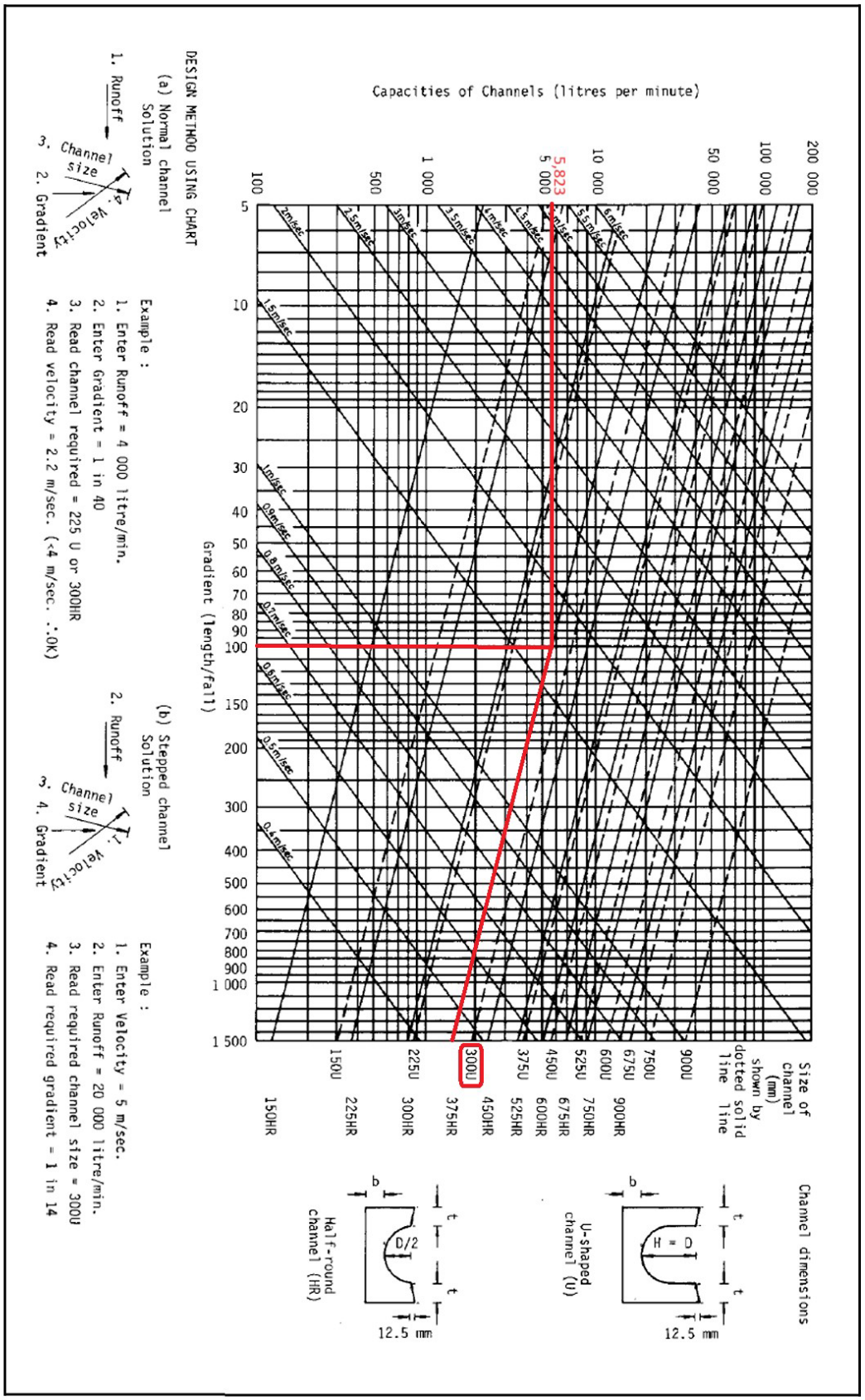

Chart for the Rapid Design of Channels in the Geotechnical Manual for Slopes (Second Edition) (GCO, 1984)

Figure 3 Photo Location

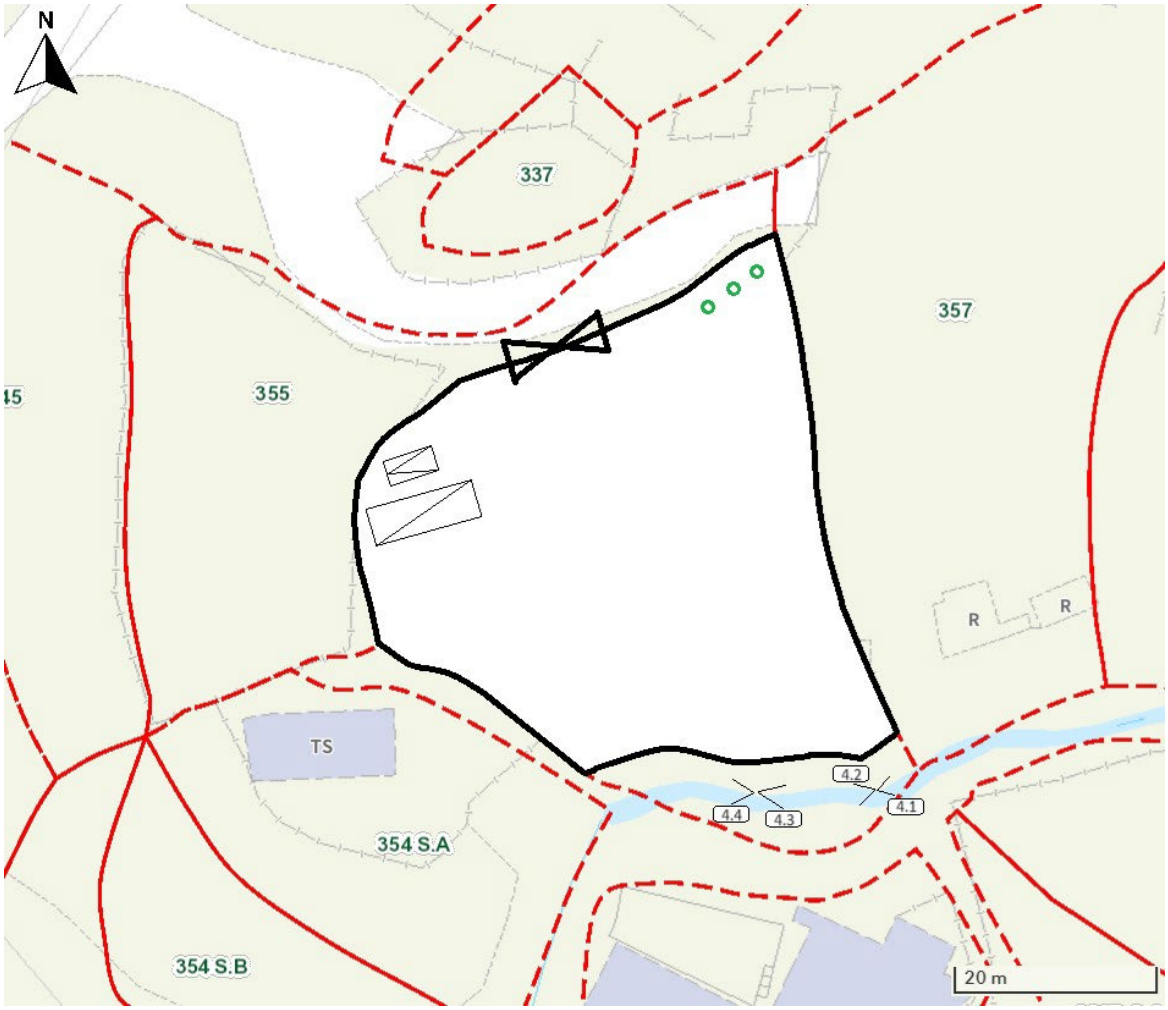

Figure 4.1

Figure 4.2

Figure 4.3

Figure 4.4