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 1,935m^2.

1.1.2 There is a natural open stream directly to the north of the application site. All proposed work will be performed at least 3m away from the streamcourse.

1.1.3 The application site is vacant and unpaved

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

1.2.1 The application site is mostly unpaved, an area of approximately 1,935m^2. The proposed paved area will have a gradient sloping from southwest to northeast from about +16.8mPD to +16.2mPD.

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 2 and 3 hereunder, a 375mm surface U-channel will be capable to drain the surface runoff accrued at the subject site and the surface runoff from the external catchment that may potentially flow overland to the 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 1,935m^2, a 375mm surface U-Channel along the site peripheral is proposed to intercept the run-off of the site and external catchment.

1.3.2 The intercepted stormwater from the site will then be discharged to the existing natural streamcourse to the North of the Site via a proposed 375mm surface U-channel.

1.3.3 It is noted that the land to the Southwest of the application site commands a higher level whereas the land to the north and East command a lower level. The external catchment area is estimated to be approximately 1,989m^2

1.3.4 The Internal and External Catchment Areas are shown in Figure 1.

2 Calculation 1: Runooff Calculation for the External Catchment to the Southwest

2.1 Runoff Estimation

2.1.1 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 external catchment area is about 1,989 m^2;
II. The area is primarily is steep grassland, and therefore the value of run-off co-efficient (k) is take as 0.25.

Difference in Land Datum	=	29.2m –16.2m = 13.0m
L	=	90m
Average fall	=	14.4m 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	=	$0.14465[90/(14.4^{0.2}\times 1{,}989^{0.1})]$
t_c	=	3.57 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	439.1	448.1	454.9	462.3	474.6
b	4.10	3.67	3.44	3.21	2.90
c	0.484	0.437	0.412	0.392	0.371

i	=	$474.6/[3.57+2.90]^{0.371}$
i	=	237.4mm/hr

By Rational Method, Q	=	0.25× 237.4mm/hr × 1,989/3600
Q	=	33l/s = 0.033m^3/s = 1,967 l/min

3 Calculation 2: 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 1,935 m^2;
II. Approximately 1,935 m^2 is hard paved, and therefore the value of run-off co-efficient (k) is taken as 0.95.

Difference in Land Datum = 16.8m –16.2m = 0.2m
L = 73.3m
Average fall = 0.82m 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 = $0.14465[73.3/(0.82^{0.2}\times 1{,}935^{0.1})]$
t_c = 5.18 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	439.1	448.1	454.9	462.3	474.6
b	4.10	3.67	3.44	3.21	2.90
c	0.484	0.437	0.412	0.392	0.371

i = $474.6/[5.18+2.90]^{0.371}$
i = 218.6mm/hr

By Rational Method, Q = 0.95× 218.6mm/hr × 1,935/3600
Q = 112l/s = $0.112m^3/s$ = 6,698 l/min

Total Runoff = Runoff from External Catchment + Application Site = 1,967 l/min + 6,698 l/min

Total Runoff = 8,665 l/min

In accordance with the Chart of the Rapid Design of Channels in "Geotechnical Manual for Slopes", 375mm surface U-channel in 1:100 gradient is considered adequate to dissipate all the stormwater accrued by external catchment and the application site, as shown in Figure 3. The intercepted stormwater will then be discharged to the existing natural stream to the north of the application site as shown in Figure 2.

4 Conclusion

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

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

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

Figure 1 Catchment Areas and Flowpath

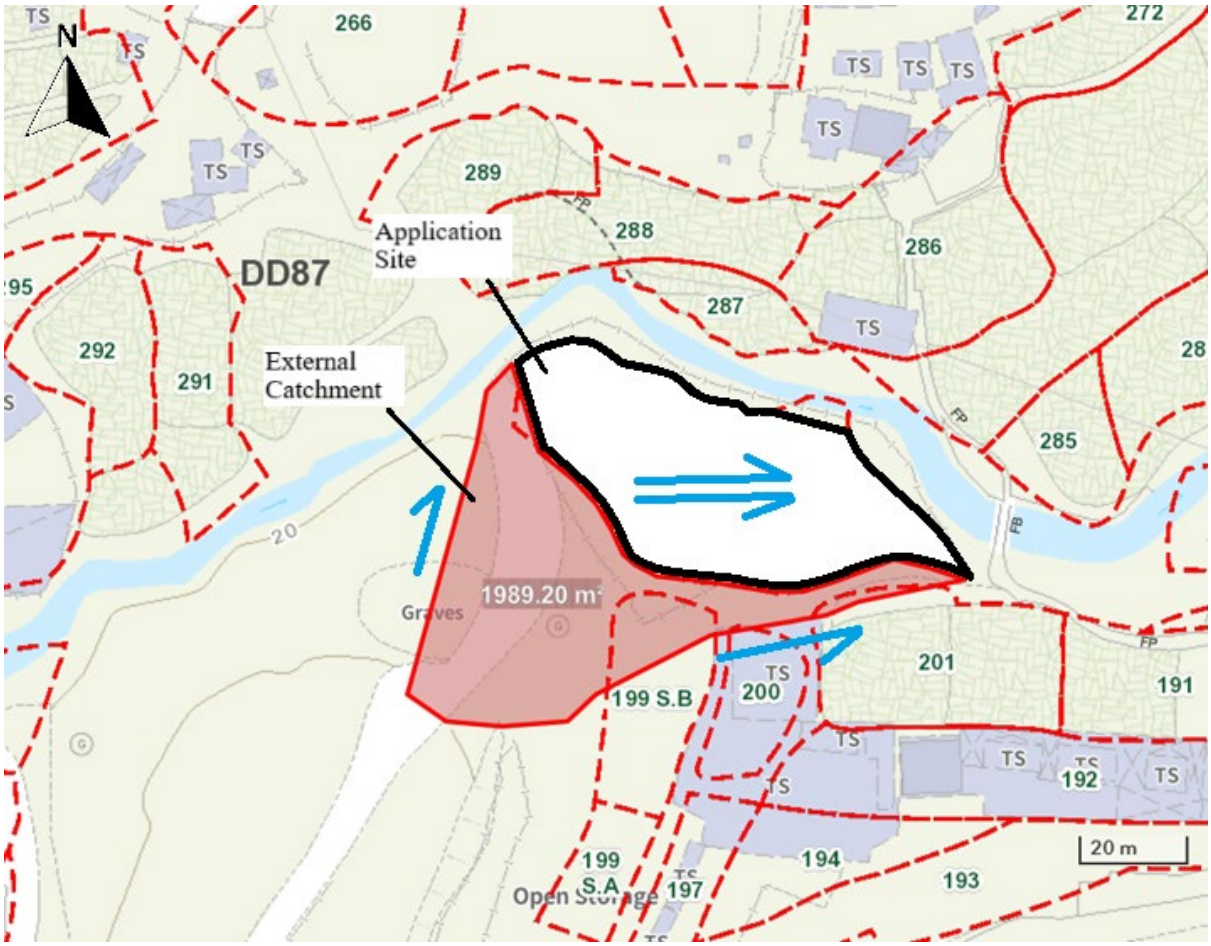

Figure 2 Drainage Plan

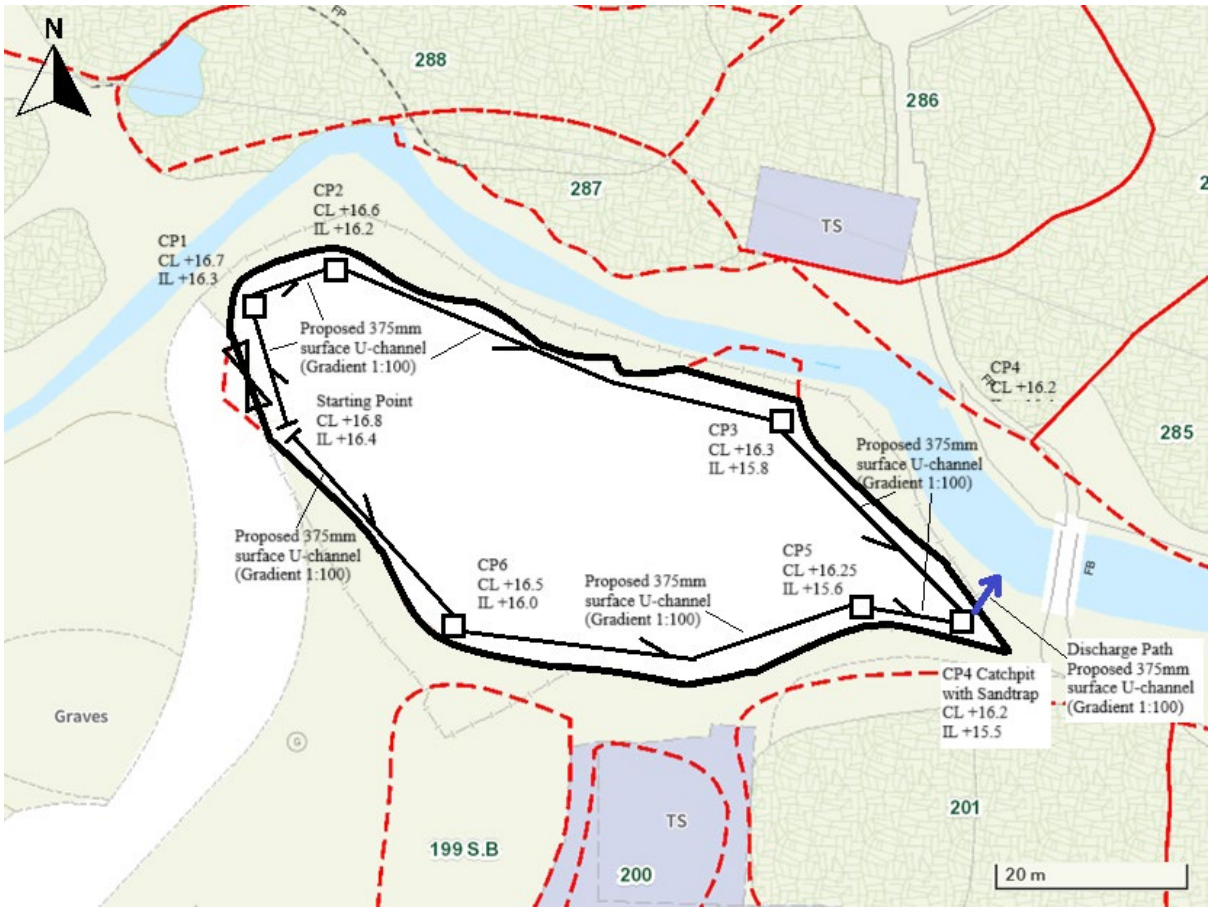

Figure 3 Chart of the Rapid Design of Channels

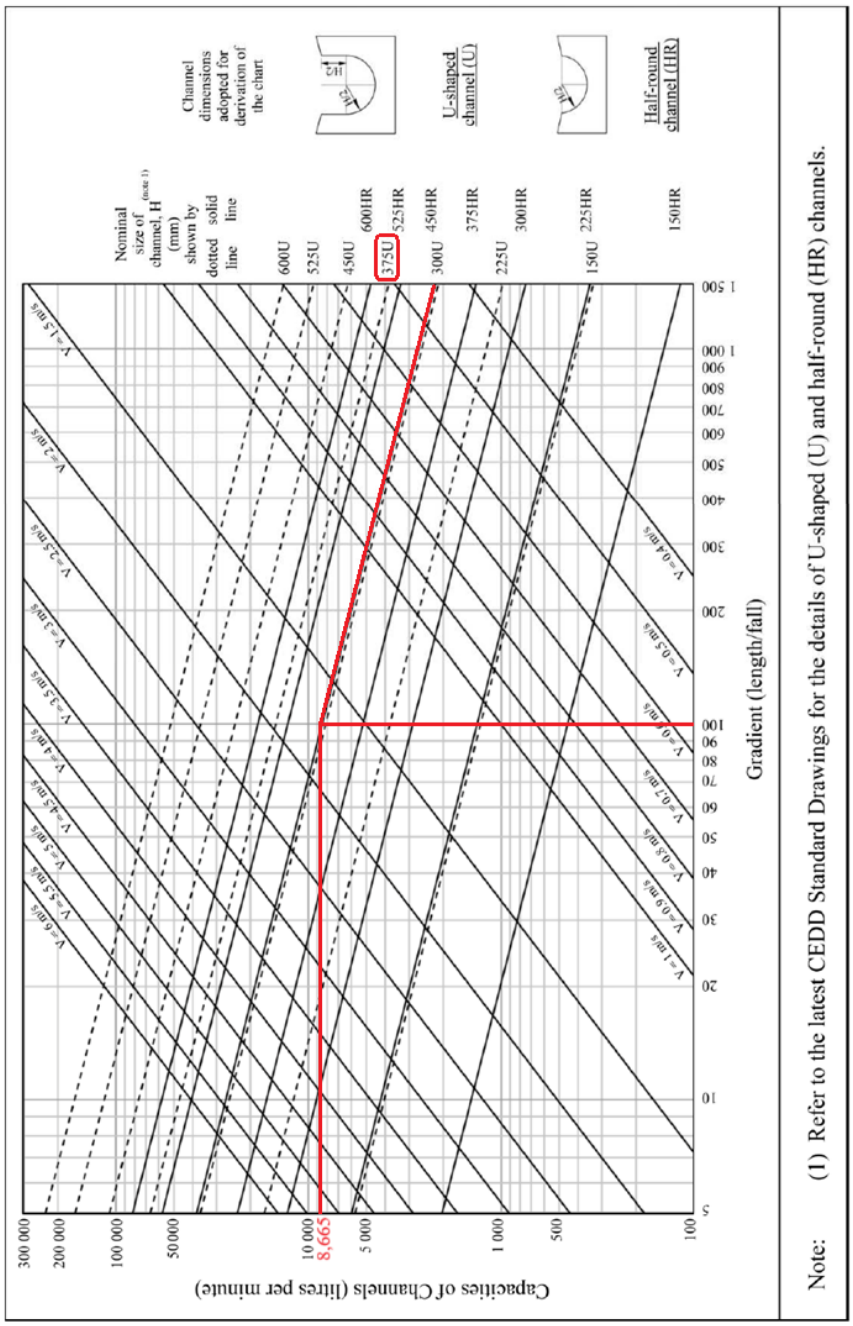

Figure 1 - Chart for the rapid design of U-shaped and half-round channels up to 600 mm

Note: (1) Refer to the latest CEDD Standard Drawings for the details of U-shaped (U) and half-round (HR) channels.

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