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. Photos of current condition of the streamcourse are shown in Figures 4.1 to 4.4.

1.1.3 Calculations have been made to check the capacity of the current conditions of the streamcourse.

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

1.2.1 The application site is mostly flat grassland, an area of approximately 1,763m^2. The proposed development is paved area will have a gradient sloping from North to South from about +26.6mPD to +26.5mPD.

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 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 drained into a water storage tank. The stored water will then be pumped to the existing open streamcourse to the South of the Site.

1.3.3 It is noted that the land to the North, South, and East command a lower level. Although a portion of the land towards the South Western border commands a slightly higher, the majority of the land to the West commands a lower level. It is also noted that the land to the West is occupied by an open storage site that is completely fenced off with corrugated metal. 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 a proposed water storage tank. The stored water will then be pumped into the existing streamcourse to the South of the application site as shown in Figure 1, at a rate less than the runoff before the development.

2.1.3 The flow capacities of the proposed U-channel are calculated using the Chart for the Rapid Design of Channels.

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 In order to reduce the drainage impact on the existing natural stream, an underground storage tank is proposed to store the additional runoff due to the proposed development. A water tank s proposed to temporary store the runoff from the site.

2.1.6 The discharge from the proposed site will not be greater than the existing site including the external catchment. please refer to the calculation shown in Section 4. The total volume of the water tank is designed to be at least 316 m3 (Volume) with at least 10% buffer to cater for emergency situation, for a minimum volume of 347.6m3. The water tank will be at least 2m (Depth) x 173.8m^2 (Area)

2.1.7 Since Rational Method is not based on a total storm duration, but rather a period of rain that produces the peak runoff rate. The method cannot compute the runoff volumes unless the total storm duration is assumed. Therefore, 4 hours storm duration is proposed for the size design of the on-site water storage tank.

2.1.8 The surface runoff will be drained into the storage tank from the Catchpit with Sandtrap (CP2) via surface 300mm U-channel. Screens will be installed to prevent large debris from falling into the water storage tank.

2.1.9 A water pump will be used to pump water from the storage tank into the nearby streamcourse at a rate of less than 0.008m^3/s, the peak runoff rate before the propose development.

2.1.10 The final design of the storage tank will be confirmed during the detailed design stage after the planning application. The detailed design of the storage tank should be incorporated in the later "Drainage Proposal" and submitted to DSD for review.

2.1.11 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.

2.1.12 All the proposed drainage facilities, including the section of stepped 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.

2.1.13 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	=	26.6m –26.5m = 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	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	=	$474.6/[4.78+2.90]^{0.371}$
i	=	222.7mm/hr
By Rational Method, Q	=	0.95× 222.7mm/hr × 1,763/3600
Q	=	104l/s = $0.104m^3/s$ = 6,218 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 by 375mm stepped channel, as shown in Figure 1. A 375mm stepped channel, with α = 45 degrees, is considered adequate to dissipate all the stormwater accrued by the application site as shown in Figure 3

4 Calculation 1a: On-site Storage Tank Calculations

4.1 Since Rational Method is not based on a total storm duration, but rather a period of rain that produces the peak runoff rate. The method cannot compute the runoff volumes unless the total storm duration is assumed. Therefore, 4 hours storm duration is proposed to be used as to design the size of on-site storage tank. This duration is sufficient to cover the effective life of

many rainstorms (Royal Observatory, 1981). With reference to the IDF relationship of North District Area stated in Table 2d of the Stormwater Drainage Manual CORRIGENDUM No. 1/2024 (DSD, 2024), the rainfall intensity of 63.9mm/hr was adopted, which is based on 4 hours rainfall duration for 50 years return period

4.2 The existing site is primarily flat grassland, and the proposed development is mostly paved concrete. Thus, the runoff coefficients of 0.25 and 0.95 were adopted for the Site before and after the proposed development, respectively.

4.3 The abovementioned parameter and the estimated runoff volume of the Site before and after the proposed development under 50 return periods is summarised and calculated in the below Table 3.

Table 3

Scenario Under 50 Years Return Period	**Area, m^2**	**Runoff Coefficient**	**Rainfall Intensity, mm/hr**	**Peak Runoff Rate m^3/s**	**Duration, hours**	**Estimated Runoff Volume, m^3**
Before Development	1,763	0.25	63.9	0.008	4	113
After Development		0.95		0.030	4	428
					Incremental Runoff	**316**

4.4 The total volume of the water tank is designed to be at least 316 m3 (Volume) with at least **10% buffer** to cater for emergency situation, for a minimum volume of **347.6m3**.

4.5 A water pump will be used to pump water from the storage tank into the nearby streamcourse at a rate of less than 0.008m^3/s, the peak runoff rate before the propose development. Thus, there is no additional flooding risk caused by the proposed development.

5 Checking the Capacity of the Streamcourse in Current Conditions

Manning Equation

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

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

L = 2.6m
D = 0.9m
R = [2.6×0.9]/[2×0.9+2.6]
R = 0.53m
n = 0.014 $s/m^{1/3}$
(Table 13 of Stormwater Drainage Manual, concrete lined channels)
V = $[0.53^{2/3}]\times[0.01^{0.5}]/0.014$
V = 4.69m/sec

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

A = L × D
A = 2.6 × 0.9

A	=	$2.34m^2$
Q_{Max}	=	$4.69m/sec \times 2.34m^2$
Q_{Max}	=	$10.97m^3/sec$
$10.97m^3/sec$	>	$0.008m^3/sec$
Q_{Max}	>	Q

The streamcourse has sufficient capacity to receive runoff from the site.

6 Conclusion

6.1 All proposed works will be at least 3m away from the top of the bank of the existing streamcourse. All proposed works in the vicinity of the streamcourse will not create any adverse drainage impacts, both during and after construction.

6.2 The applicant has assessed the potential drainage impact due to the proposed hard paving works and with the proposal of the underground stormwater storage tank with pump system, there will be no net increase of runoff. Thus, there is no additional flooding risk caused by the proposed development.

6.3 Flooding susceptibility of the adjoining areas would not be adversely affected by the proposed development

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

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

Figure 1 Drainage Plan

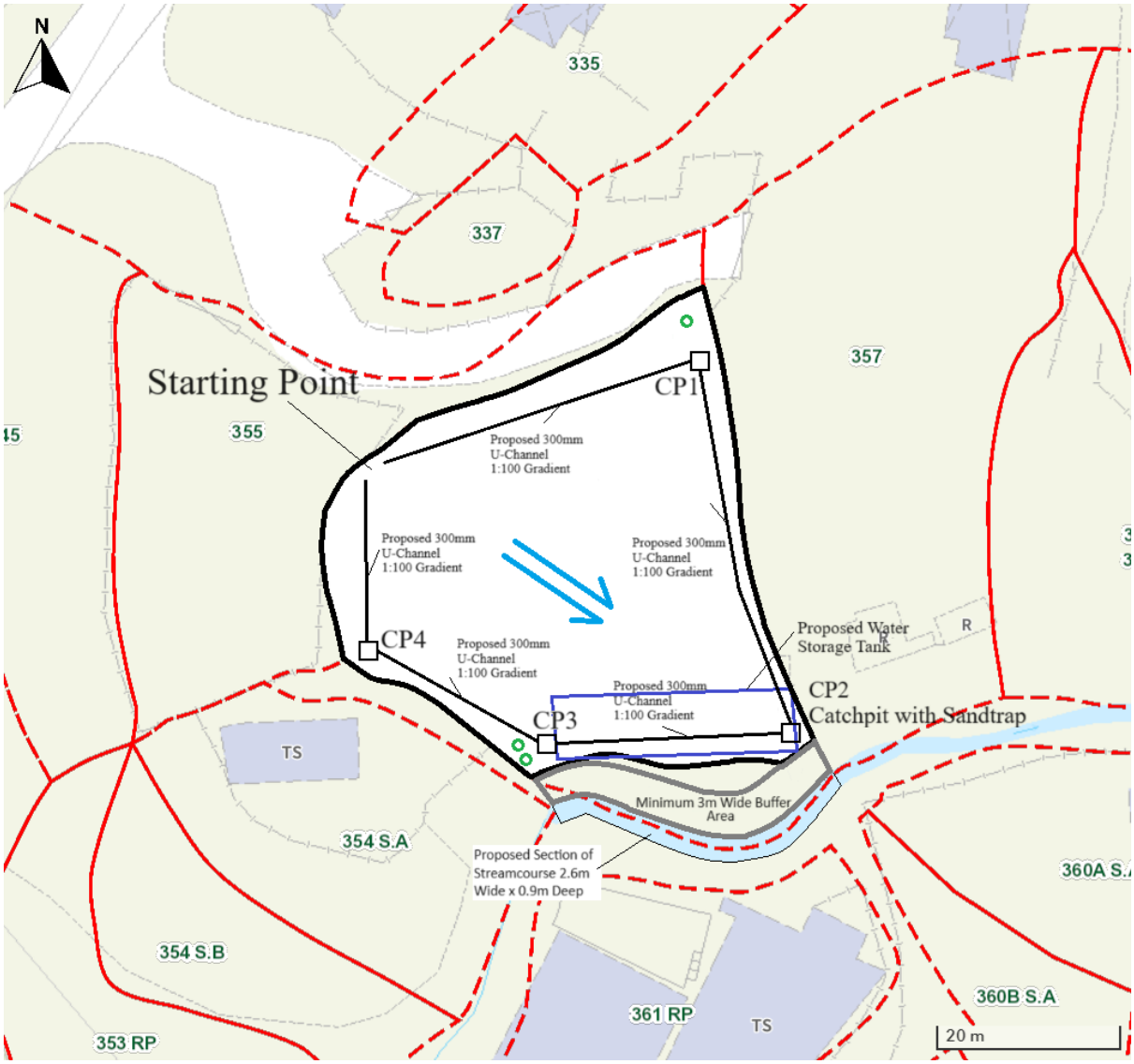

Figure 2 Cross Section of Streamcourse and Buffer Area

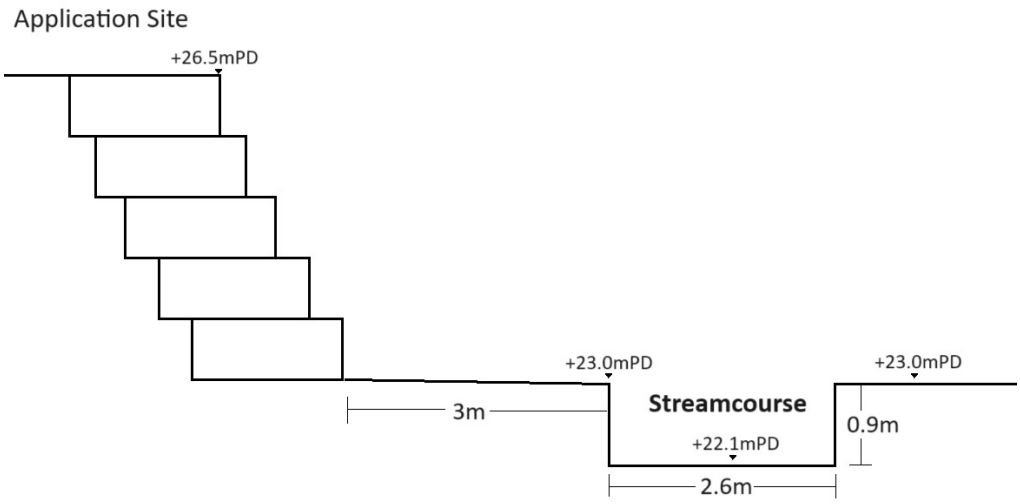

Figure 3 Chart for the Rapid Designs of Channels (Application Site)

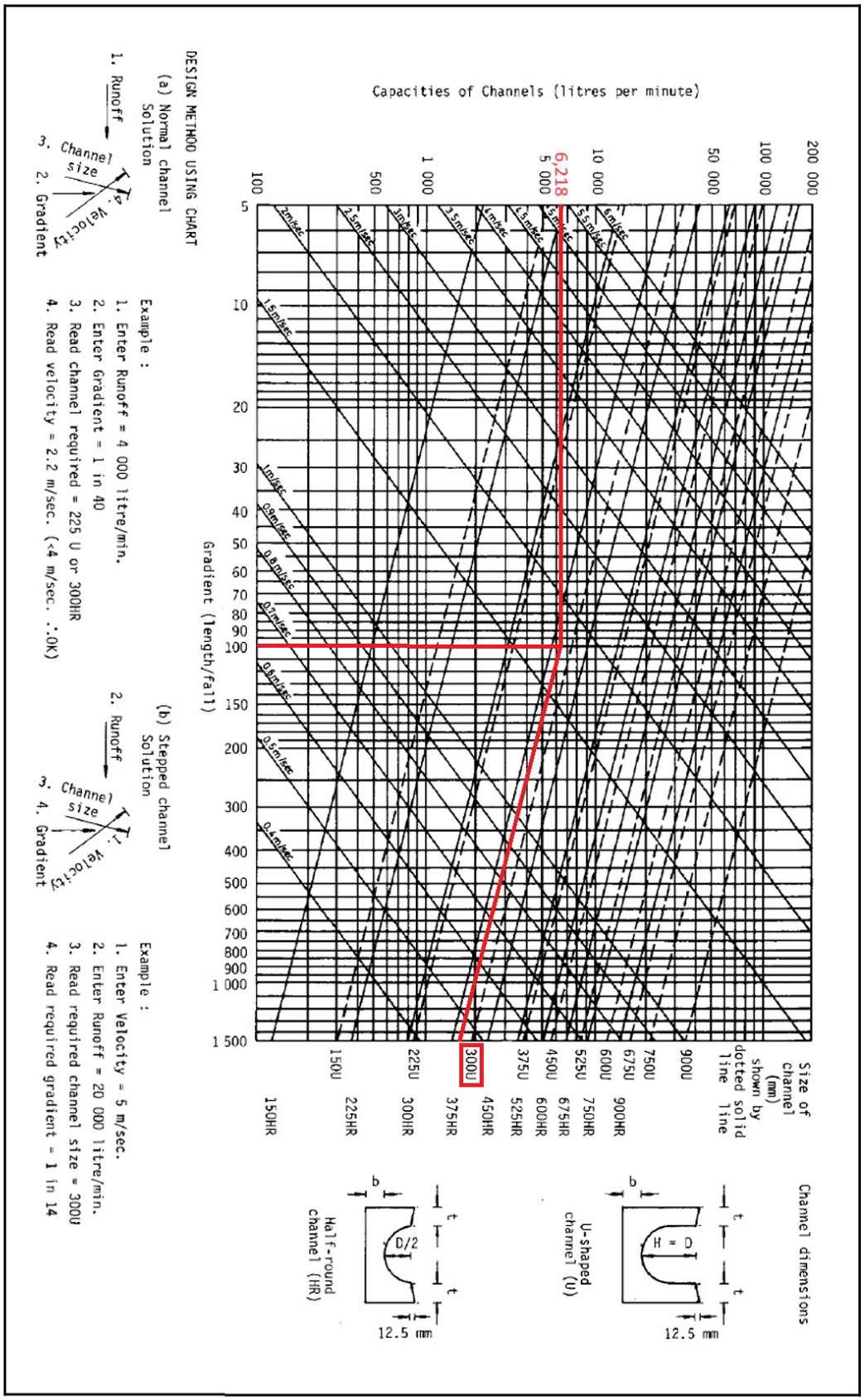

Chart for the Rapid Design of Channels in the Geotechnical Manual for Slopes (Second Edition) (GCO, 1984)

Figure 4.1

Figure 4.2

Figure 4.3

Figure 4.4