Drainage Proposal

1 Runoff from Site

1.1 Runoff Estimation

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

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

Assuming that:

I. Most of the 1,457m^2 are Covered warehouse and concrete areas, and therefore the value of run-off co-efficient (k) is taken as 1.

II.

Difference in Land Datum	=	23.3m –23.2m = 0.1 m
L	=	42.5m
Average fall	=	0.24m 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	=	$0.14465[42.5/(0.1^{0.2}\times 1{,}457^{0.1})]$
t_c	=	3.96 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

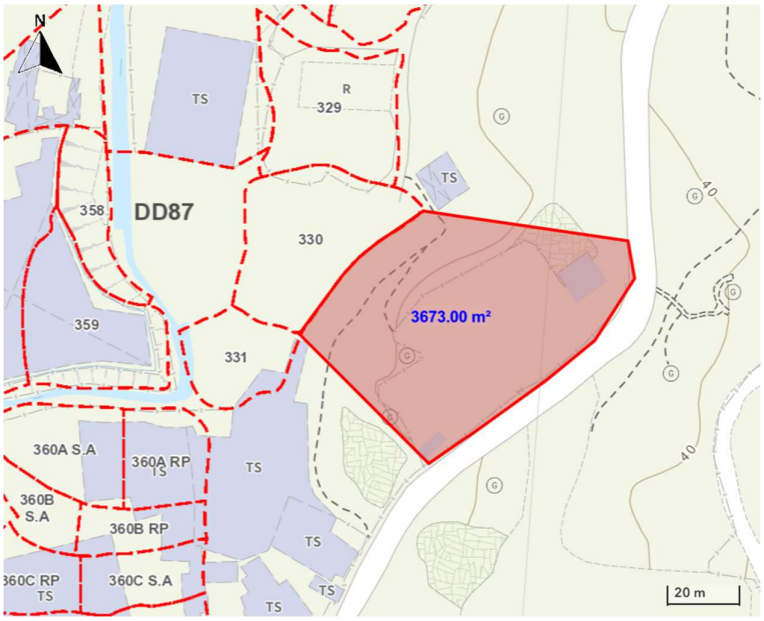
i	=	$474.6/[3.96 +2.90]^{0.371}$
i	=	232.3mm/hr

By Rational Method, Q	=	1× 232.3mm/hr × 1,457 /3600
Q	=	134.8l/s = 0.135m^3/s = 8,087 l/min

2 Runoff from Upstream Catchment Area

2.1 Runoff Estimation

Figure 1: Upstream Catchment Area



2.2 Assuming that:

I. The Upstream catchment area is about 3,673m^2; A layout plan of the assumed catchment area is indicated in Figure 1

II. Most of the 3,673m^2 is a steep grassland, and therefore the value of run-off co-efficient (k) is taken as 0.30.

III.

Difference in Land Datum	=	37.6m –23.2m = 14.4m
L	=	60m
Average fall	=	24m 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	=	$0.14465[60/(24^{0.2}\times 3{,}673^{0.1})]$
t_c	=	2.02 minutes
i	=	$474.6/[2.02+2.90]^{0.371}$
i	=	262.7mm/hr
By Rational Method, Q	=	0.30 0× 262.7mm/hr × 3,673 /3600
Q	=	80.4l/s = 0.080m^3/s = 4,825 l/min

3 Total Runoff

3.1 Total Runoff Q = 0.135 +0.080 = 0.215 m^3/s

3.2 Total Runoff Q = 8,087 +4,825 = 12,912 l/min

3.3 The proposed surface channel will be constructed following the proposed gradient of 1:100. As demonstrated in the calculation hereunder, 450mm surface U-channel will be capable to drain the surface runoff accrued at the subject site.

4 Checking the Capacity of the 450mm Diameter underground pipe

Manning Equation

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

$$R = \frac{\pi r^2}{2\pi r}$$

$$R = \frac{r}{2}$$

Diameter	=	0.45m
r	=	0.45m/2 = 0.225m
R	=	0.225m/2 = 0.1125m
n	=	0.012 $s/m^{1/3}$
		(Table 13 of Stormwater Drainage Manual)
V	=	$[0.15^{2/3}]\times[0.01^{0.5}]/0.012$
V	=	1.94m/sec

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

A	=	πr^2
A	=	$\pi\times 0.225^2$
A	=	$0.159m^2$
Q_{Max}	=	$1.94m/sec \times 0.159m^2$
Q_{Max}	=	$0.309m^3/sec$
$0.309m^3/sec$	>	$0.215m^3/sec$
Q_{Max}	>	Q

A 450mm diameter pipe has sufficient capacity to discharge the runoff estimation from the catchment area

Figure 2: Drainage Plan

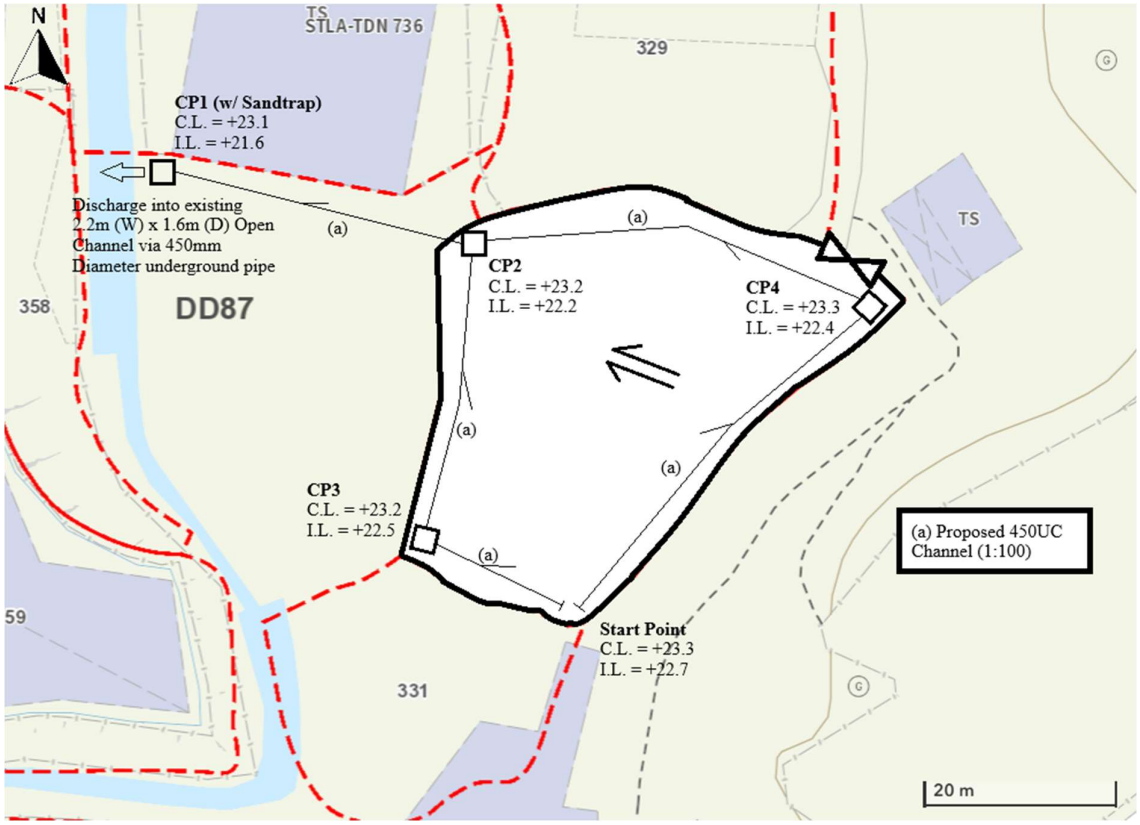


Figure 3 Chart for the Rapid Design of U-shaped and half-round channels

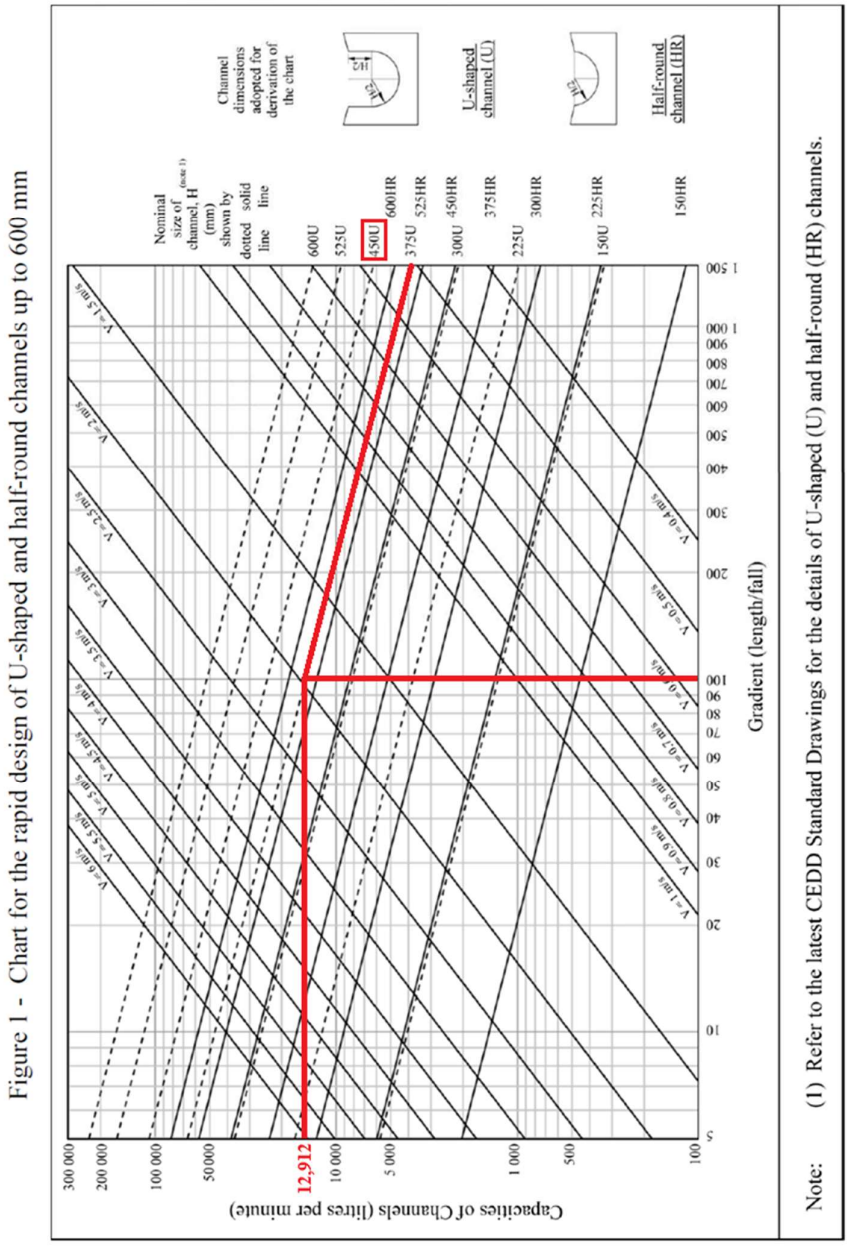


Figure 1 - Chart for the rapid design of U-shaped and half-round channels up to 600 mm