Appendix III

Drainage Proposal

DRAINAGE PROPOSAL

ON

LOT 407 S.A.ss.2 S.A and 408 S.B. ss.1 RP

IN D.D. 94

Kwu Tung

Prepared on January 28, 2024

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Appendix List

Appendix A	Design Calculation of Proposed Storm water Drainage System

1. INTRODUCTION

Reference is made to the planning application for the residential development at Lots 407S.A ss.2 S.A and 408 S.B. ss.1 RP in D.D. 94 , Kwu Tung, Sheung Shui. and we provide a storm water drainage proposal for the said proposed Villa.

This report covers the design principle and the design calculation of the proposed storm water drainage system on the catchment area of the captioned site .

This report covers the design principle and the design calculation of the proposed storm water drainage system on the captioned site.

2. DESIGN PRINCIPLE

The proposed storm water drainage system lies around the boundary of the captioned lot and it is designed to collect the storm water not only the captioned lot, and also the adjacent area of the lot. Two 225mm U-Channel is proposed for this storm water drainage system. One of the storm water channel is designed to be collected and diverted to an existing channel at the Western side of the captioned lot while another one is to be collected by a proposed storm water storage tank located at the northern part of the premises. For the drainage layout please refer to the drawing DS-01 attached with this submission.

The design calculation for showing the adequacy of proposed storm water drainage system can be found in Appendix A and B respectively.

APPENDIX A

Design Calculation

Proposed Storm water Drainage System

祥達顧問有限公司
Gender Consultants Limited

- Appendix ‘ A ‘ –

Project Title : Lots 407S.A ss.2 S.A and 408 S.B. ss.1 RP in D.D. 94
- Storm water catchment calculation for Catchment Area A

Reporting Date : January 27, 2024

Maximum total rainfall (mm) under Monthly Extract of Meteorological Observations in 2023

Month	Hong Kong Observatory										King's Park	Waglan Island^	
	Mean Pressure (hPa)	Air Temperature					Mean Dew Point (deg. C)	Mean Relative Humidity (%)	Mean Amount of Cloud (%)	Total Rainfall (mm)	Total Bright Sunshine (hours)	Prevailing Wind Direction (degrees)	Mean Wind Speed (km/h)
		Absolute Daily Max (deg. C)	Mean Daily Max (deg. C)	Mean (deg. C)	Mean Daily Min (deg. C)	Absolute Daily Min (deg. C)							
01	1020.3	24.7	19.4	17.0	14.9	9.8	10.4	67	68	18.2	134.1	010	24.8
02	1019.2	26.6	22.0	18.9	16.8	13.1	13.7	73	60	1.6	163.8	070	26.0
03	1017.0	29.0	24.2	21.3	19.4	16.4	16.5	76	61	70.3	156.8	080	22.1
04	1012.0	30.8	26.0	23.6	21.7	18.0	20.3	82	82	77.5	92.3	080	22.3
05	1009.9	34.7	29.2	26.6	24.9	20.2	23.1	81	75	182.8	131.9	080	19.8
06	1006.5	35.2	31.9	29.2	27.1	25.1	25.9	83	82	490.9	147.4	090	17.6
07	1006.0	36.1	33.0	30.1	28.0	26.2	25.8	78	74	175.2	219.2	230	18.6
08	1004.6	35.1	32.4	29.7	27.8	25.7	25.6	79	81	140.7	166.4	230#	14.9#
09	1008.0	34.4	31.2	28.5	26.9	24.8	24.9	81	74	1067.1	170.5	070	19.6
10	1014.0	34.6	29.1	26.4	24.8	22.0	21.7	76	79	546.0	138.9	070	28.4
11	1018.5	30.7	26.1	23.5	21.6	15.6	17.3	69	50	3.3	208.2	070	24.9

The above source was captured from HKO official website at below link :
http://www.hko.gov.hk/tc/cis/monthlyExtract.htm?y=2023

The maximum monthly rainfall is1067.1mm in September 2023

The maximum hourly rainfall, i = 1.482

Hard paved area is 518m^2 of Catchment Area A = 0.000518 km^2 as shown on Drawing n0. DS-1

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祥達顧問有限公司
Gender Consultants Limited

Project Title : Lots 407S.A ss.2 S.A and 408 S.B. ss.1 RP in D.D. 94
- Storm water catchment calculation

Reporting Date : January 27, 2024

-Continued -

Infiltration rate of rainfall (Hard paved area), C = 90% = 0.90

Surface Characteristics	*Runoff coefficient, C*
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 - 0.20

The above source was extracted from GEO Technical Guidance Note No. 39 (TGN 39)

According to the Storm water Drainage Manual (Fifth Edition, 2018) issued by Drainage Services Department (DSD), peak runoff is given by the following expression ;

$Q_p = 0.278\ CiA$

Daily rainfall from catchment area A of Villa at Lots 407S.A ss.2 S.A and 408 S.B. ss.1 RP in D.D. 94

Q1 = 0.278 x 0.85 x 1.482 x 0.000518 x 60 x60 x 24 = 15.67 m^3 / day

Conclusion

The estimated daily runoff on the proposed development will be round up to 16m3/day. In order to allow sufficient capacity of the rainwater for 3 days, the recommended dimension of the proposed Storm Water Storage Tank should be about (L) 6.00m x (W) 5.00m x (D) 3.00m with a concrete wall thickness of 0.25m.

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Project : Proposed Villa Application at Lots 407 S.A.ss.2S.A. and 408 S.B. ss.1 RP in DD94 Drainage Design

Subject : Calculation of Proposed Drainage

Date : 27.01.2024

Checking of Surface Channel

Catchment Area A = 518 m^2 to U – Channel B-1 (225 UC)

L = 12m

h = 0.12m

H = 0.12 x 100/12 = 1.00m (average fall per 100m run)

(where H < 1, a conservative value of 1 has been assumed)

t_c. = 0.14465 x 12/ ($1^{0.2}$ x $518^{0.1}$) = 0.93 min

For t^f , w = 45m, v = 3m/s (assumed)

t^f = 45/ (3x60) = 0.25 min

t = 0.93 + 0.25 = 1.18 min

From rainfall curve, use t = 1.2 min

i_{200} = 440mm / hr. (Fig.1, TGN 30)

K = 0.85 (TGN 39)

Flow for 200 years return periods,

Q_{200} = 0.85 x440 x 518/60 = 3229 litres / min <3800 litres/mim

Gradient of the design channel = 1 in 100

Proposed channel size = 225 UC (TGN 43)

Therefore, proposed 225mm UC is adequate for catchment Area of A .

Project : Proposed Villa Application at Lots 407 S.A.ss.2S.A. and 408 S.B. ss.1 RP in DD94 Drainage Design

Subject : Calculation of Proposed Drainage

Date : 27.01.2024

Checking of Surface Channel

Catchment Area B = 500 m^2 to U – Channel B-1 (225 UC)

L = 12m

h = 0.12m

H = 0.12 x 100/12 = 1.00m (average fall per 100m run)

(where H < 1, a conservative value of 1 has been assumed)

t_c. = 0.14465 x 12/ ($1^{0.2}$ x $500^{0.1}$) = 0.93 min

For t^f , w = 48m, v = 3m/s (assumed)

t^f = 48/ (3x60) = 0.27 min

t = 0.93 + 0.27 = 1.20 min

From rainfall curve, use t = 1.2 min

i_{200} = 440mm / hr. (Fig.1, TGN 30)

K = 0.85 (TGN 39)

Flow for 200 years return periods,

Q_{200} = 0.85 x440 x 500/60 = 3117 litres / min <3800 litres/mim

Gradient of the design channel = 1 in 100

Proposed channel size = 225 UC (TGN 43)

Therefore, proposed 225mm UC is adequate for catchment Area of B .

CALCULATION SHEET	Sheet No.	Rev
Project : DD94 Lots 4078s.Ass.2 S.A and 408 S.B ss.1 RP. Drainage Design	By: LNS	Date: 28/1/2024
Subject: Calculation of proposed Drainage System	Check: JS	Date:

7 Summary and Conclusions

The following table summarizes the calculations for the drainage system. It shows that the proposed drainage system is adequate.

Summary table for the surface drainage channel assessment and design

Channel No.	Existing or Proposed	Type	Length (m)	Size (rn)	Gradient (1: 100)-	Total Area of Catchment (m2)	Available Capacity (I/min)	Required Capacity (l/min)	Remarks
UC B-1	Proposed	UC	48	225	100	500	3800	3117	OK
UC-A-1	Proposed	UC	45	225	100	518	3800	3229	OK

Project : Proposed Drainage Design

1. Equations and Assumptions

1.1 Surface drainage design is in accordance with Geotechnical Manual for Slopes (2nd Edition, 1984).

1.2 Slope drainage is designed to a frequency of 1 in 200 rainfall return period.

1.3 Time of Concentration = time of entry + time of flow

i.e. $t_c = t_e + t_f$

1.4 Time of entry is calculated based on the modified form of Bransby-Williams Equation:

$$t_, \quad 0.14465 \times L / (H^{0.2} \times A^{0.1})$$

Eqn. 8.2 Geotechnical Manual for Slopes

where e time of entry (min) ,

A = area of catchment (m^2) ,

H = average fall (m per 100m) from the summit of catchment to the point of design,

L = distance in metre measured on the line of natural flow between the design section and that point of catchment from which water would take the longest time to reach the design section (m)

1.5 Time of flow is calculated from the measured water flow length in channel divided by the assumed flow velocity.

i.e. $t_f = w / v$

where t_f = time of flow (min) ,

w = measured water flow length in channel (m) ,

v = assumed water flow velocity (m/s)

1.6 Runoff coefficient for the slope is assumed to be 1.0 for vegetated ground surface.

Geotechnical Manual for Slopes (p. 96)

1.7 Peak stormwater is determined by the "Rational Method" using the following formula:

$$Q = KiA/60$$

Eqn. 8.7 Geotechnical Manual for Slopes

Where Q = Maximum runoff (litres/min) ,

K = runoff coefficient (K = 1.0)

, i = design mean intensity of rainfall (mm/hr) ,

A = Area of catchment (m^2) .

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.

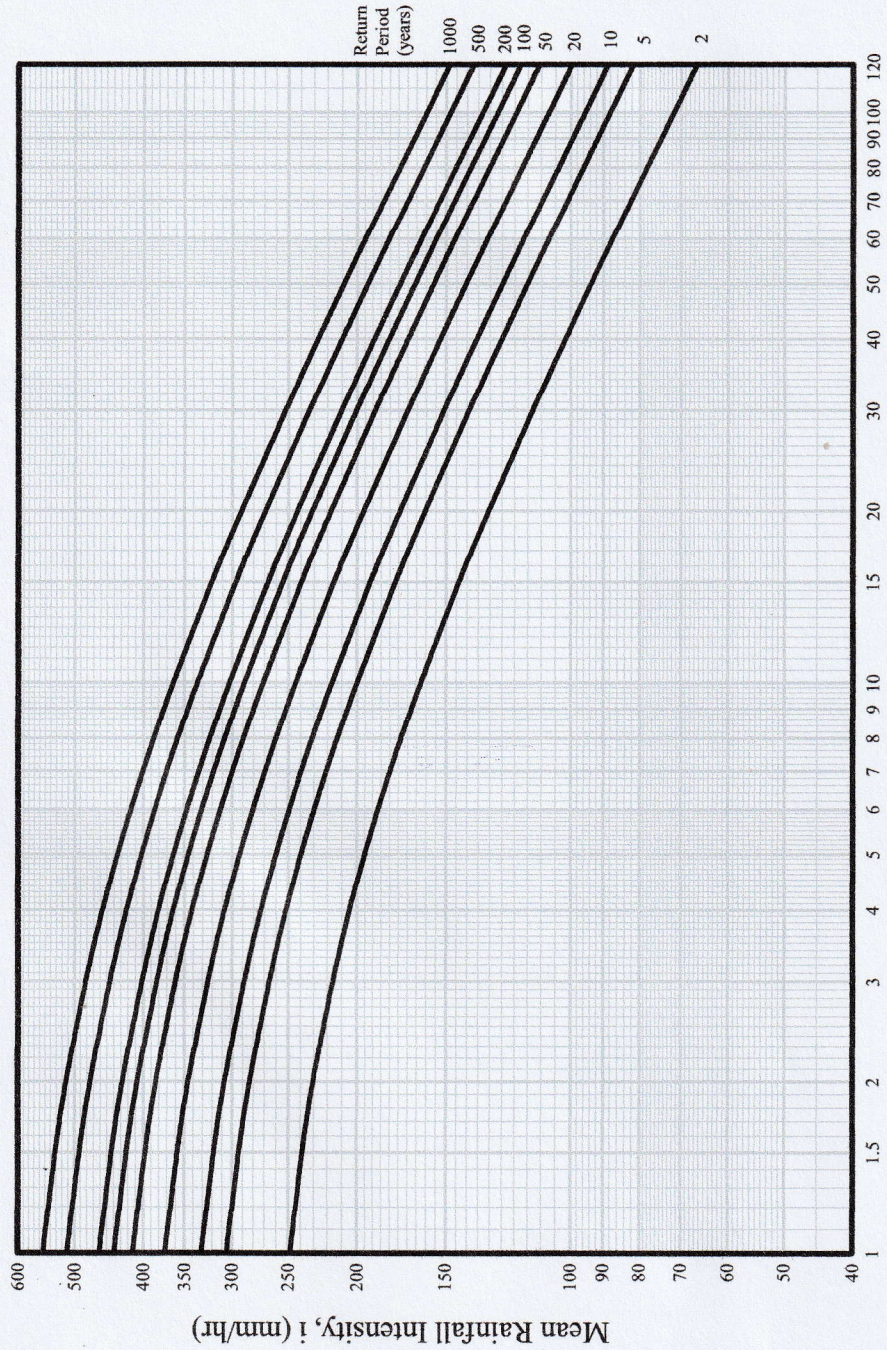


Figure 1 – Updated Intensity-Duration-Frequency Curves

Notes:
1. These IDF curves are to supersede those given in Figure 8.2 of the Geotechnical Manual for Slopes (GCO, 1984).
2. These IDF curves have not incorporated any projected climate change effects. Except for temporary slope drainage design, the mean rainfall intensity given by these IDF curves shall be increased by 13.8% for incorporating climate change effects.
3. The mathematical formulae of these IDF curves are shown in Table 1 of Annex TGN 30 A1.

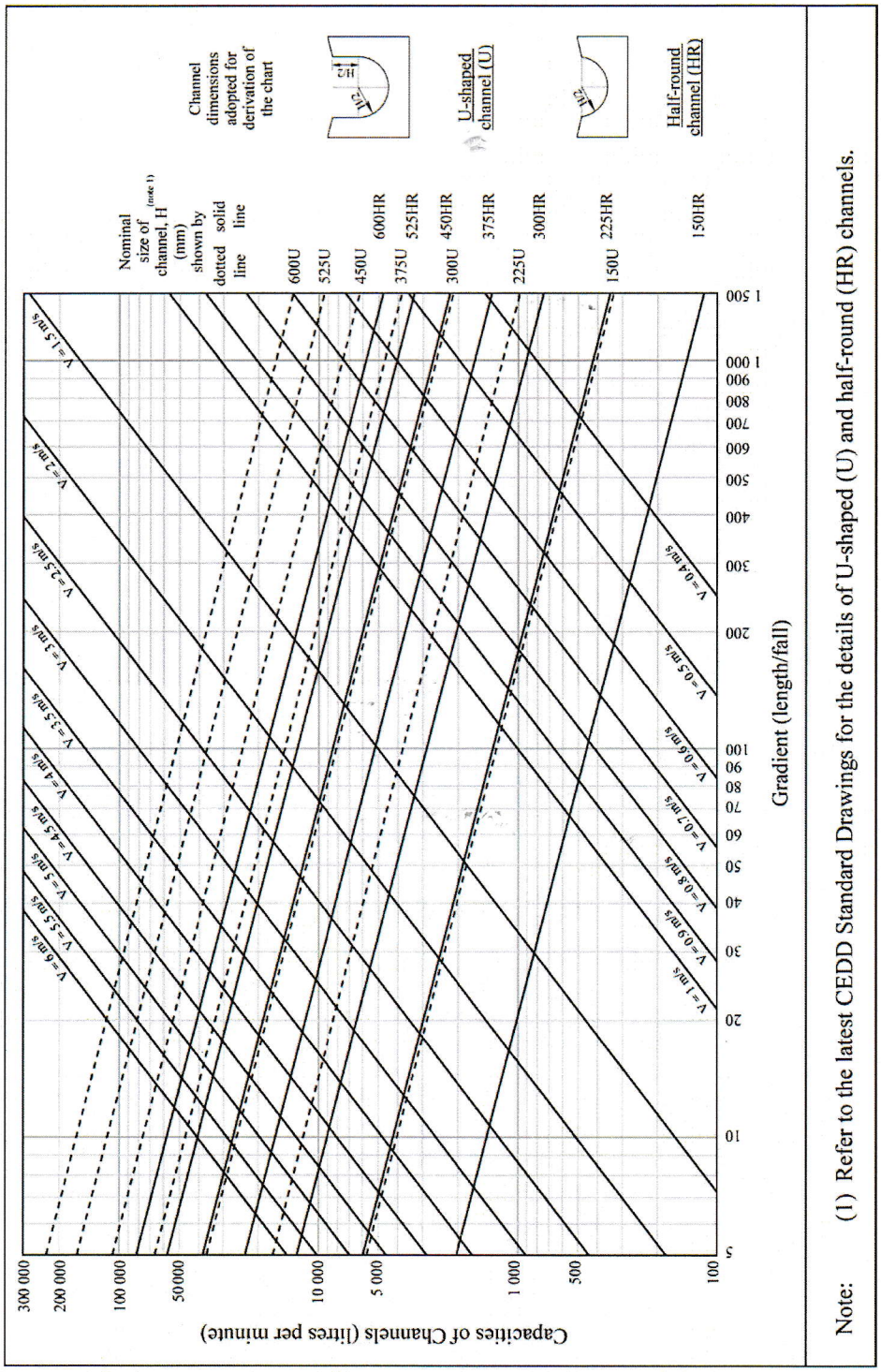
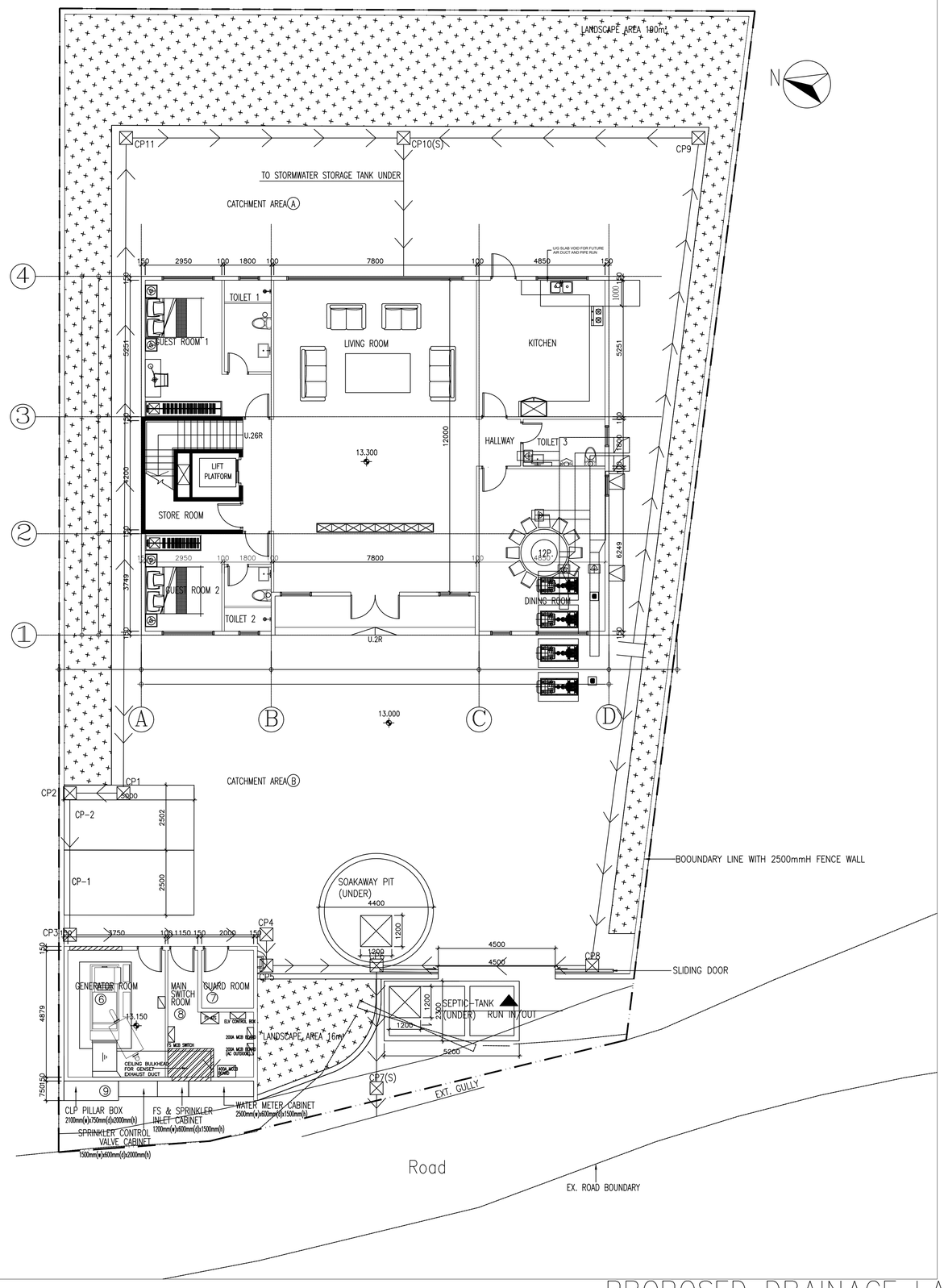


Figure 1 - Chart for the rapid design of U-shaped and half-round channels up to 600 mm

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



PROPOSED DRAINAGE LAYOUT PLAN

N.T.S

CATCHPIT / SANDTRAP NO.	C.L. (m.P.D.)	I.L. (m.P.D.)
CP1	13.80	13.42
CP2	13.80	13.03
CP3	13.80	12.91
CP4	13.80	12.74
CP5	13.80	12.72
CP6	13.80	12.62
CP7(S)	13.80	12.50
CP8	13.80	12.70
CP9	13.80	12.90
CP10(S)	13.80	12.52
CP11	13.80	13.30
EXT GULLY	13.02	12.40

Ref.:

1. DO NOT SCALE DRAWING. FIGURED DIMENSIONS ARE TO BE FOLLOWED. READ THIS DRAWING IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS. THE ARCHITECT SHALL BE NOTIFIED IMMEDIATELY OF ANY DISCREPANCY IS FOUND THEREIN.
2. THIS DRAWING SHALL NOT BE USED FOR CONSTRUCTION PURPOSES UNLESS OTHERWISE CERTIFIED. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF WORK.

Legend

- Lot Boundary
- House Boundary
- Existing Open Channel
- Septic Tank (Septic Tank)
- Level (+Level)
- Proposed 225 Covered U-Channel (Min Fall 1:100)
- CP1 — Proposed Catchpit
- CP4(S) — Proposed Catchpit with Trap

NOTES

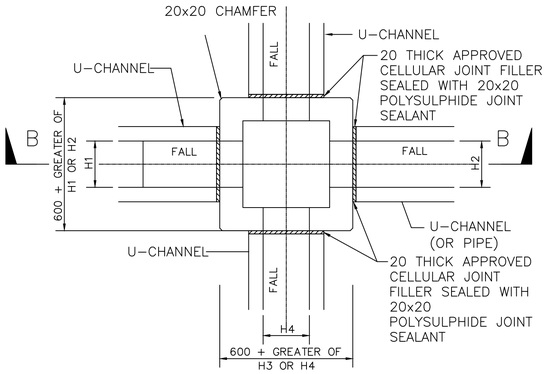
1. CATCHPITS CP1, CP2, CP3, CP4, CP5, CP6, CP7(S), CP8, CP9, CP10, CP11(S) SHALL BE MAINTAINED BY THE SUBJECT LOT OWNER.
2. CATCHPIT WITH TRAP CP7(S), CP11(S) SHOULD BE REGULARLY DESILTED BY THE LOT OWNER TO PREVENT SAND AND SILT FROM BEING WASHED DOWN INTO THE EXISTING DRAINAGE SYSTEM DOWNSTREAM.

Rev.	Date	Description

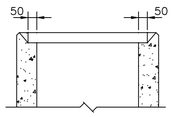
Project
PROPOSED STORMWATER DRAINAGE SYSTEM FOR LOT 407SA SS2 SA %408SB SS1 RP IN DD94, KWU TUNG

Drawing Title :
STORMWATER DRAINAGE LAYOUT

Drawn : ZS		Scale :	
Date : DEC 2022		Checked :	
Job Ref. –		Drawing No. DS-01	Rev. –



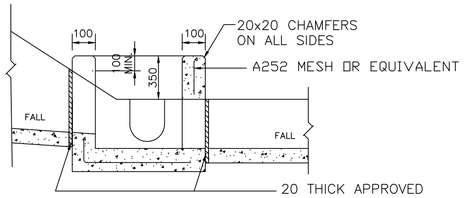
PLAN



TOP SECTION FOR HEAVY DUTY COVER

STANDARD CATCHPIT DETAILS

N.T.S.



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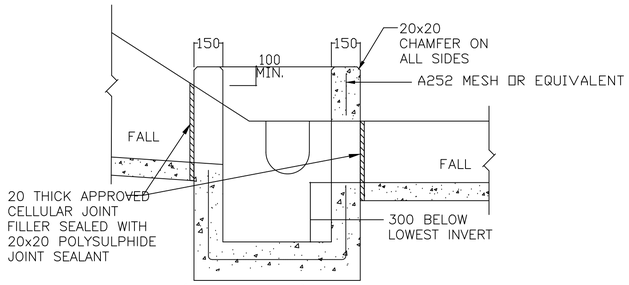
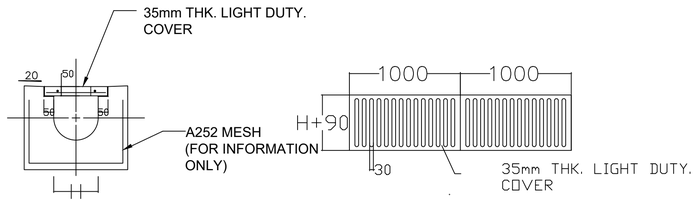


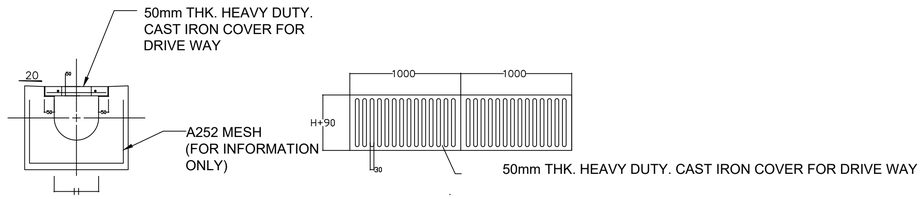
(WITH TRAP)

SECTION B – B



TYPICAL SECTION PLAN OF COVERED CHANNEL

U-CHANNEL WITH LIGHT DUTY IRON COVER



TYPICAL SECTION PLAN OF COVERED CHANNEL

U-CHANNEL WITH HEAVY DUTY IRON COVER AT DRIVEAY (UP TO H OF 525)

Ref.:

1. DO NOT SCALE DRAWING. FIGURED DIMENSIONS ARE TO BE FOLLOWED. READ THIS DRAWING IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS. THE ARCHITECT SHALL BE NOTIFIED IMMEDIATELY OF ANY DISCREPANCY IS FOUND THEREIN.
2. THIS DRAWING SHALL NOT BE USED FOR CONSTRUCTION PURPOSES UNLESS OTHERWISE CERTIFIED. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF WORK.

Rev.	Date	Description

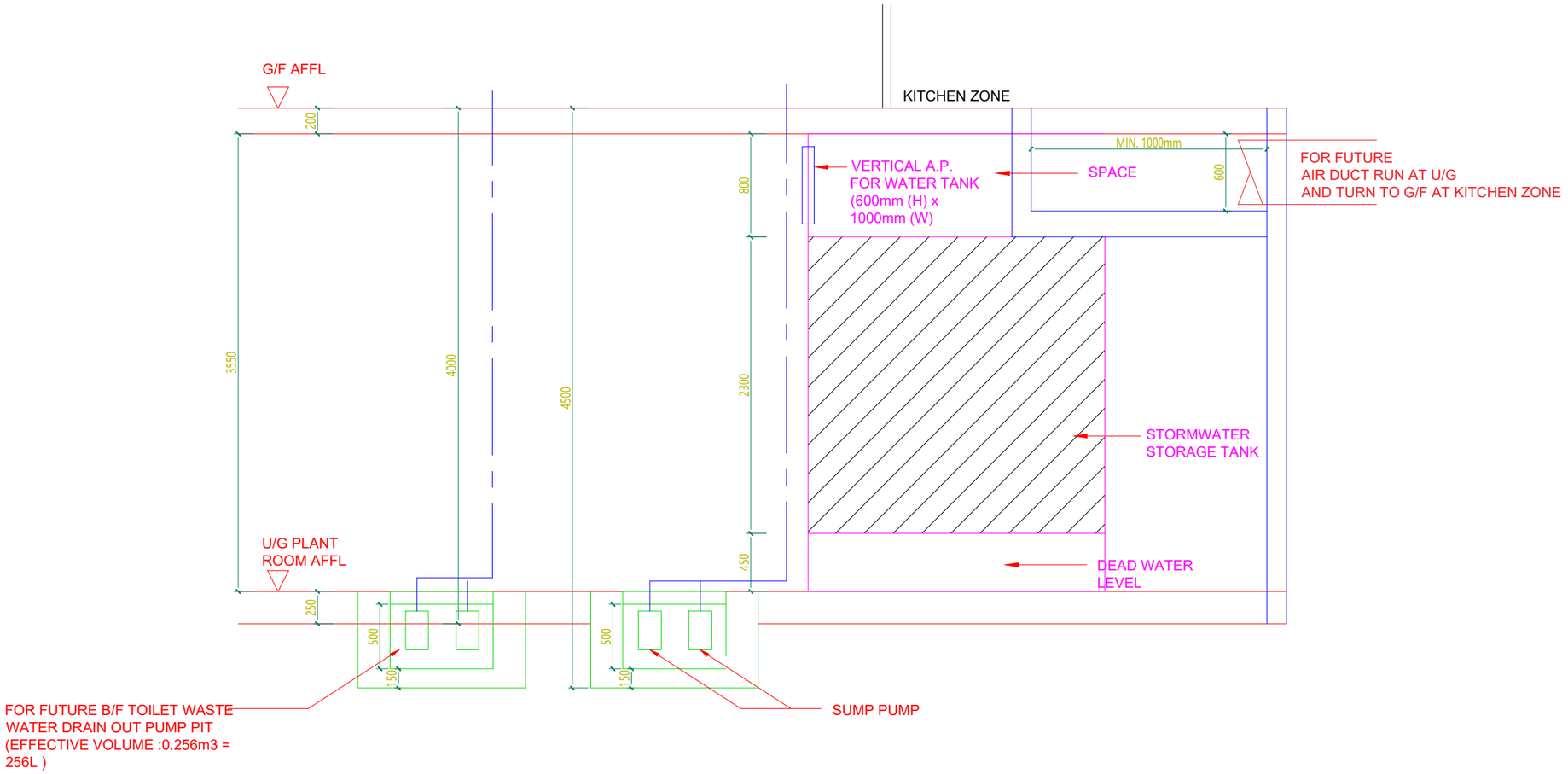
Project

PROPOSED STORMWATER DRAINAGE SYSTEM FOR LOT 407SA SS2 SA %408SB SS1 RP IN DD94, KWU TUNG

Drawing Title :

STORMWATER DRAINAGE DETAIL

Drawn :	ZS	**Scale :**	
Date :	DEC 2022	**Checked :**	
Job Ref.	–	**Drawing No.** DS-02	**Rev.** –



POTABLE AND FLUSHING TANK AND PUMP ROOM + STORM WATER STORAGE PUMP ROOM SECTION DRAWING