URBAN GREEN

Section 12A Rezoning Application for Proposed Columbarium on Various Lots in D.D.41 Sha Tau Kok, New Territories

Drainage Impact Assessment Report

Reference: P036/02 Issue 1
Date: 11 November 2025
Confidential

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Issue	Prepared By	Date	Checked by	Date	Approved By	Date
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1 Introduction

1.1 Background

The Applicant intends to operate a columbarium located at various Lots in D.D. 41, Sha Tau Kok, New Territories (hereafter as “the Site”).

The Applicant proposes to rezone the Site to "Other Specified Uses" annotated "Columbarium" (“OU (Columbarium)”) under Section 12A of Town Planning Ordinance (TPO).

Owing to concerns on possible drainage impact arising from the proposed redevelopment, Urban Green Consultants Ltd. (UGC) has been commissioned to conduct a Drainage Impact Assessment (DIA) to demonstrate the acceptability of drainage impact upon the surrounding environment. This DIA Report has been prepared as a supporting document.

1.2 Study Objectives

The objectives of this DIA are to assess the possible drainage impacts may be caused by the Proposed Development and to recommend the mitigation measures to alleviate such impacts if necessary.

1.3 Report Structure

The remaining chapters of this report are shown below:

Chapter 2 – Site Context

Chapter 3 – Drainage Analysis

Chapter 4 – Recommendations

Chapter 5 – Conclusion

2 Site Context

2.1 Site Location and Its Environs

The Site is located in Sha Tau Kok and to the north of Sha Tau Kok Road. Currently, to the north and west of the Site are village houses of Tong To Tsuen. Vegetated slopes are located to the east and south of the Site. The Site area is about 13,382m^2. Figure 2.1 shows the Site location and its environs.

2.2 Site Characteristics and Proposed Use

The Proposed Development will include area for columbarium, office, multi-function rooms and toilets. Proper landscape and tree planting areas are planned at the remaining area of the Site. The development plan is presented in Appendix A.

2.3 Existing Drainage Condition

A site survey was conducted in July 2025 to collect the updated information of the drainage characteristics, catchments, topography and existing drainage facilities in the vicinity. The land-based survey was conducted with reference to the survey map to identify the existing drainage facilities, flow path and the surface type within the Site and its surroundings.

Drainage plans (plan no.: 3-NE-17B-1, 3-NE-12D-3 and 3-NE-12D-4) were obtained from Drainage Services Department (DSD) in July 2023 and 19 May 2025 to gather the background information on drainage infrastructure in the vicinity of the Site. Based on the drainage plans, the site is not currently served by any form of DSD's drainage facility. However, one existing stream to the southwest of the Site and one to the east of the Site with approx. 3-4m width were identified as shown in Figure 2.1. The surface runoff from the Site may be discharged into Stream 1 and Stream 2 via underground circular pipes and u-channels.

3 Drainage Analysis

3.1 Assessment Methodology and Assumptions

This DIA has adopted the Rational Method for runoff estimation:

$$Q_p = 0.278\ i \sum C_j\ A_j$$

where
Q_p is peak runoff (m^3/s);
i is rainfall intensity (mm/hr);
A_j is the j^{th} catchment (km^2);
C_j is the runoff coefficient of the j^{th} catchment (dimensionless).

The details of the Rational Method can be referred to the *Stormwater Drainage Manual* (SDM) (DSD, 2018).

Based on a 1:50 year flood protection standard in the SDM and the estimated time of concentration, the appropriate rainfall intensities (i) were calculated based on linear interpolation of the intermediate table values.

The assumptions of this DIA are summarised below:

- Rainstorm return period – 1 in 50 years
- Runoff coefficient for concrete – 0.95
- Runoff coefficient for flatted grassland (heavysoil) – 0.25
- Runoff coefficient for steep grassland (heavysoil) – 0.35

The capacities of the proposed concrete lined U-channels and circular pipes were checked by comparing with magnitudes of different combinations of the catchments. The Manning's roughness coefficient of 0.015 for concrete-lined circular pipes (fair condition) and 0.016 for surface channel (fair condition) as stated in Table 13 of SDM was assumed for the underground pipes as referred in the SDM.

The capacities of the two existing streams at the discharge points of the Site were estimated and compared with the total runoff generated from the identified catchments. Value of n used for estimating the stream capacity by using Manning's Equation was assumed to be 0.040 (bad condition for canals with rough stony beds, weeds on earth banks).

3.2 Design Parameters

Based on the geographical characteristics of the Site and its surroundings, 48 catchments (Catchments A to M, AA to AW and BA to BL) were identified and its nearby areas as shown in Figure 3.1.

The surface runoff from catchment A to M will be collected by a series of the proposed U-channels and underground pipes. Surface runoff from catchments AA to AW and catchments BA to BL will be collected by existing Stream 1 and Stream 2, respectively. Surface runoff from catchments A to E, G and J to M will be eventually discharged into Stream 1 via external underground circular pipes CA1 – CA3. Meanwhile, surface runoff from catchments F to I will be discharged into Stream 2 via external underground circular pipe CB1, as shown in Figure 3.2.

As the surface runoff from catchments C to F and I will flow towards the Site, opening will be provided between the wall and proposed manholes to collect the surface runoff. The surface runoff from catchment A, B, G, H and J to L will then be collected by the proposed drainage system within the Site. Figure 3.3 shows the section of the proposed manhole.

The surface runoff from the Site and relevant catchments has been estimated and presented in Appendix B. The surface runoff from all relevant sub-catchments will be collected by U-channels, circular pipes and finally the two existing streams.

3.3 Assessment Results

Runoffs and capacities at the concerned locations of the proposed U-channels, proposed circular pipes and existing streams were estimated and tabulated in Table 3.1 and Table 3.2.

Table 3.1 Estimated Runoffs to Stream 1 and Capacities of the Channels/Pipes/Existing Stream 1

Channel Segment	Diameter / Width, m	Depth, m	Gradient	Catchment Runoff, m3/s	Capacity, m3/s	% of capacity flow	Sufficient Capacity?
A1 - A2	0.500	0.500	0.005	0.155	0.307	51%	Y
A2 - A3	0.500	0.500	0.005	0.155	0.307	51%	Y
A3 - A4	0.500	0.500	0.005	0.155	0.307	51%	Y
A4 - A5	0.750	0.750	0.005	0.484	0.905	54%	Y
A5 - A6	0.750	0.750	0.010	0.484	1.280	38%	Y
A6 - A7	0.750	0.750	0.010	0.484	1.280	38%	Y
A7 - A8	0.750	0.750	0.010	0.484	1.280	38%	Y
A8 - A9	0.750	0.750	0.010	0.484	1.280	38%	Y

Channel Segment	Diameter / Width, m	Depth, m	Gradient	Catchment Runoff, m3/s	Capacity, m3/s	% of capacity flow	Sufficient Capacity?
A9 - A10	0.750	0.750	0.010	0.484	1.280	38%	Y
A10 - A11	0.750	0.750	0.010	0.484	1.280	38%	Y
A11 - A12	0.750	0.750	0.050	0.484	2.862	17%	Y
A12 - A13	0.750	0.750	0.050	0.484	2.862	17%	Y
A13 - A14	0.750	0.750	0.050	0.692	2.862	24%	Y
A14 - A15	0.750	0.750	0.050	0.692	2.862	24%	Y
A15 - A16	0.750	0.750	0.010	0.721	1.280	56%	Y
A16 - A17	0.750	0.750	0.010	0.739	1.280	58%	Y
A17 - A18	0.750	0.750	0.010	0.788	1.280	62%	Y
A18 - A19	0.750	0.750	0.010	0.788	1.280	62%	Y
A19 - A20	0.750	0.750	0.010	0.788	1.280	62%	Y
C1 - C2	0.750	0.750	0.005	0.484	0.905	54%	Y
C2 - C3	0.750	0.750	0.100	0.484	4.047	12%	Y
C3 - C4	0.750	0.750	0.200	0.692	5.724	12%	Y
C4 - C5	0.750	0.750	0.100	0.692	4.047	17%	Y
C5 - C6	0.750	0.750	0.050	0.692	2.862	24%	Y
C6 - C7	0.750	0.750	0.050	0.692	2.862	24%	Y
C7 - C8	0.750	0.750	0.010	0.692	1.280	54%	Y
C8 - C9	0.750	0.750	0.010	0.692	1.280	54%	Y
C9 - C10	0.750	0.750	0.010	0.721	1.280	56%	Y
C10 - C11	0.750	0.750	0.010	0.739	1.280	58%	Y
C11 - C12	0.750	0.750	0.010	0.788	1.280	62%	Y
C12 - A20	0.750	0.750	0.010	0.788	1.280	62%	Y
CA1	0.750	--	0.020	0.838	1.364	61%	Y
CA2	0.750	--	0.020	0.838	1.364	61%	Y
CA3	0.750	--	0.020	0.838	1.364	61%	Y

Channel Segment	Diameter / Width, m	Depth, m	Gradient	Catchment Runoff, m3/s	Capacity, m3/s	% of capacity flow	Sufficient Capacity?
Stream 1	Top: 4m Bottom: 2m	1.3	0.1	14.920	25.193	59%	Y

Table 3.2 Estimated Runoffs to Stream 2 and Capacities of the Channels/ Pipes / Existing Stream 2

Channel Segment	Diameter / Width, m	Depth, m	Gradient	Catchment Runoff, m3/s	Capacity, m3/s	% of capacity flow	Sufficient Capacity?
A1 - B1	0.375	0.375	0.005	0.072	0.143	50%	Y
B1 - B2	0.375	0.375	0.005	0.072	0.143	50%	Y
B2 -B3	0.375	0.375	0.005	0.072	0.143	50%	Y
B3 - B4	0.500	0.500	0.005	0.240	0.307	78%	Y
B4 - B5	0.500	0.500	0.100	0.267	1.373	19%	Y
B5 - B6	0.500	0.500	0.100	0.267	1.373	19%	Y
B6 - B7	0.500	0.500	0.100	0.267	1.373	19%	Y
B7 - B8	0.500	0.500	0.100	0.267	1.373	19%	Y
B8 - B9	0.500	0.500	0.100	0.267	1.373	19%	Y
B9 - B10	0.500	0.500	0.100	0.267	1.373	19%	Y
B10 - B11	0.500	0.500	0.100	0.267	1.373	19%	Y
D1 - D2	0.375	0.375	0.100	0.168	0.637	26%	Y
D2 - D3	0.375	0.375	0.100	0.168	0.637	26%	Y
D3 - B11	0.375	0.375	0.200	0.168	0.901	19%	Y
CB1	0.500	--	0.014	0.267	0.391	68%	Y
Stream 2	Top:3m Bottom:1m	1.3	0.050	5.112	10.425	49%	Y

With the provision of the proposed drainage system, the surface runoff will eventually discharge into the two existing streams as shown in Figure 3.2. The Proposed

Development would not cause any adverse drainage impacts or increase in the flooding susceptibility of the surrounding areas.

3.4 Climate Change

Climate change projections for Hong Kong estimate the increases in rainfall intensity of 11.1% and 16.0% for the Mid-21st Century (2041-2060) and End of 21st Century (2081-2100) respectively. To assess the impact to the surface water drainage system, both uplift percentages were applied to the rainfall intensity to estimate the increase runoff and quantify any projected capacity requirement. This was completed for both the existing and proposed scenarios. The assessment outputs have been included in Appendix C. Analysis indicated that the proposed stormwater drainage system and downstream watercourses would have sufficient capacity for the additional runoff from the proposed site development combined with a 16.0% increase in rainfall intensity due to climate change.

3.5 Tidal Effect

According to Table 8 of the Stormwater Drainage Manual and the updated vide Corrigendum No.1/2024 published by DSD, the closest tide station with design water level is Tai Po Kau. The design extreme sea levels for 50 years return period is 4.41 mPD, which is lower than the outcoming level of proposed underground circular pipe (i.e. 4.80 mPD for CA3 and 5.78mPD for CB1). Hence, the proposed scheme would not be affected by tidal effect obstructing the discharge of the surface runoff from the subject lots.

4 Recommendations

4.1 Construction stage

For the construction stage, the engineer and contractor will be appointed by the Project Proponent to prepare drainage proposal for temporary works or temporary mitigation measures and monitoring requirements / programme, which will be submitted to DSD for approval before the commencement of the construction works. The approved drainage impact mitigation measures and the monitoring requirements / programme during the construction stage will be implemented to ensure that the expected drainage performance of the project is achieved.

4.2 Operation Stage

Upon detailed design stage, the Project Proponent will appoint the engineer and contractor to design and construct the proposed drainage system. The detailed arrangement of the proposed drainage system and new drainage connections will be further investigated at the detailed design stage. Detailed information of the proposed drainage system will be prepared and submitted to the DSD and relevant parties during the detailed design stage.

The applicant undertakes to properly construct and maintain the proposed drainage works; and to rectify the drainage system if inadequate or ineffective is found during operation.

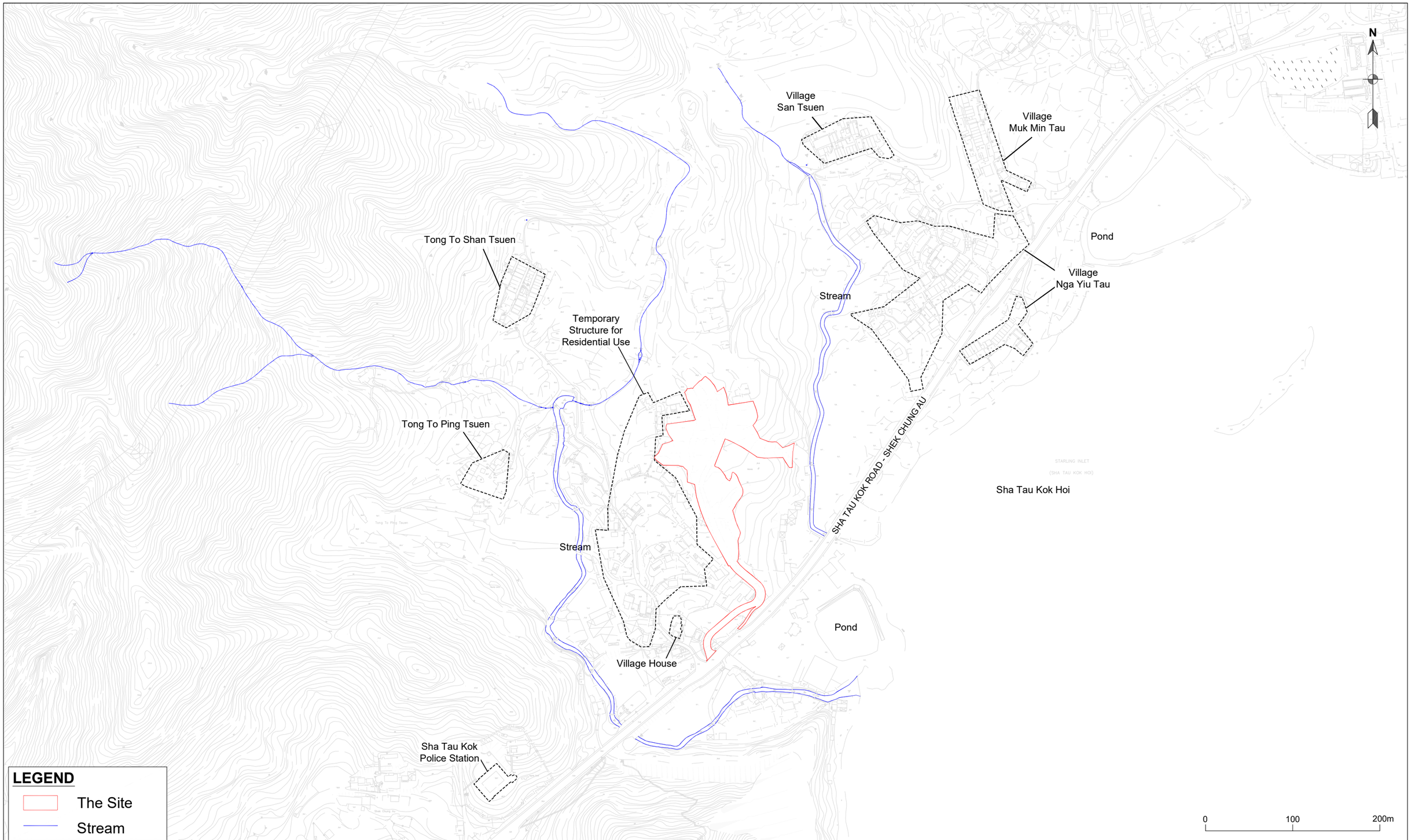
5 Conclusion

A Drainage Impact Assessment (DIA) has been conducted by Urban Green Consultants Ltd. (UGC) to serve as a supporting document for the Proposed Development at the Site at Sha Tau Kok, New Territories.

For collecting surface runoff within the Site, a series of U-channels and underground circular pipes should be designed and constructed. The detailed arrangement of the drainage system shall require further investigation at the detailed design stage.

The drainage analysis has demonstrated that subject to the implementation of the proposed drainage systems, the Proposed Development would not cause adverse drainage impacts or increase in the flooding susceptibility of the adjacent areas.

Figures



Section 12A Rezoning Application for Proposed Columbarium on Various Lots in D.D.41, Sha Tau Kok, New Territories

Site Location and Its Envrions

Figure 2.1

Rev. 0

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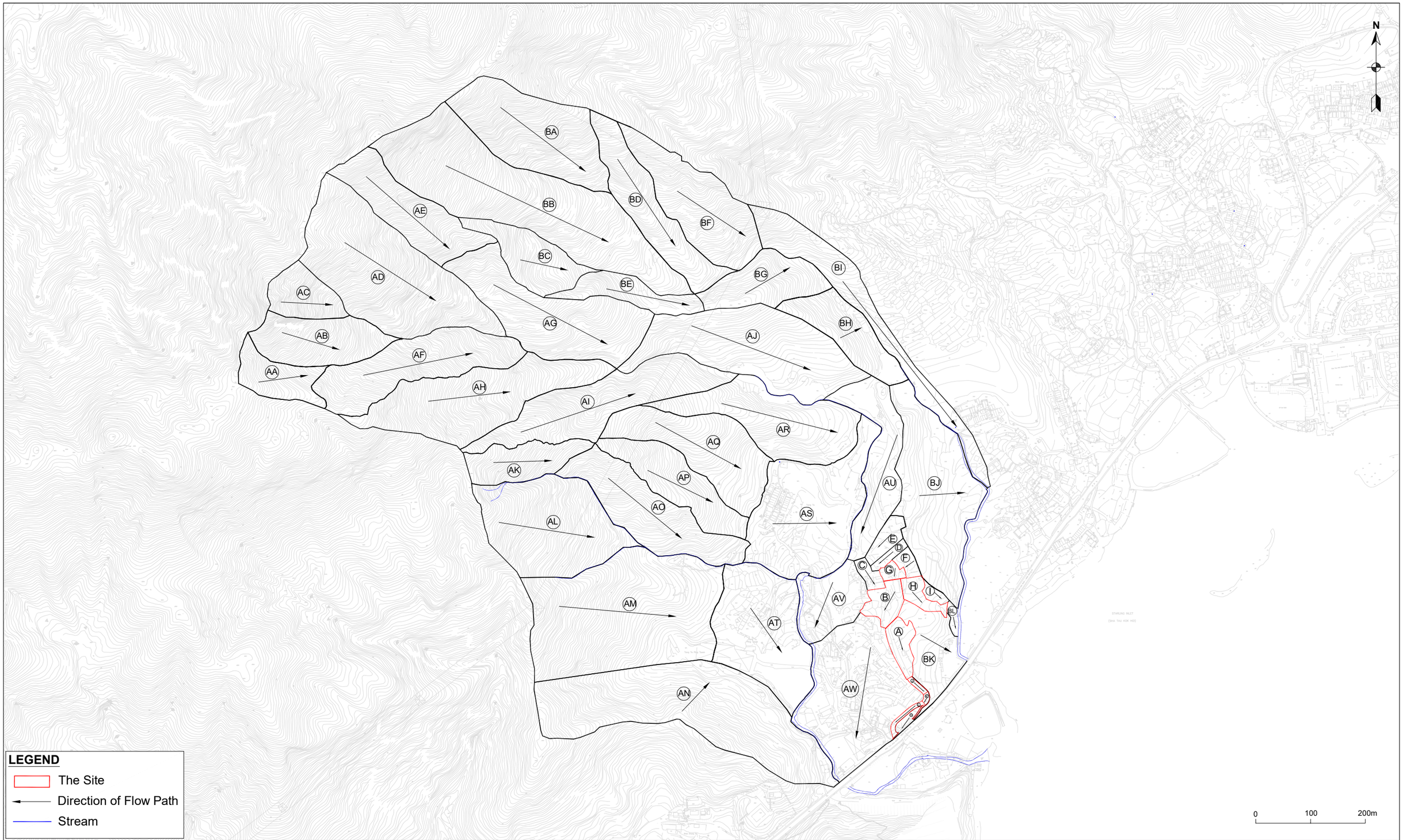

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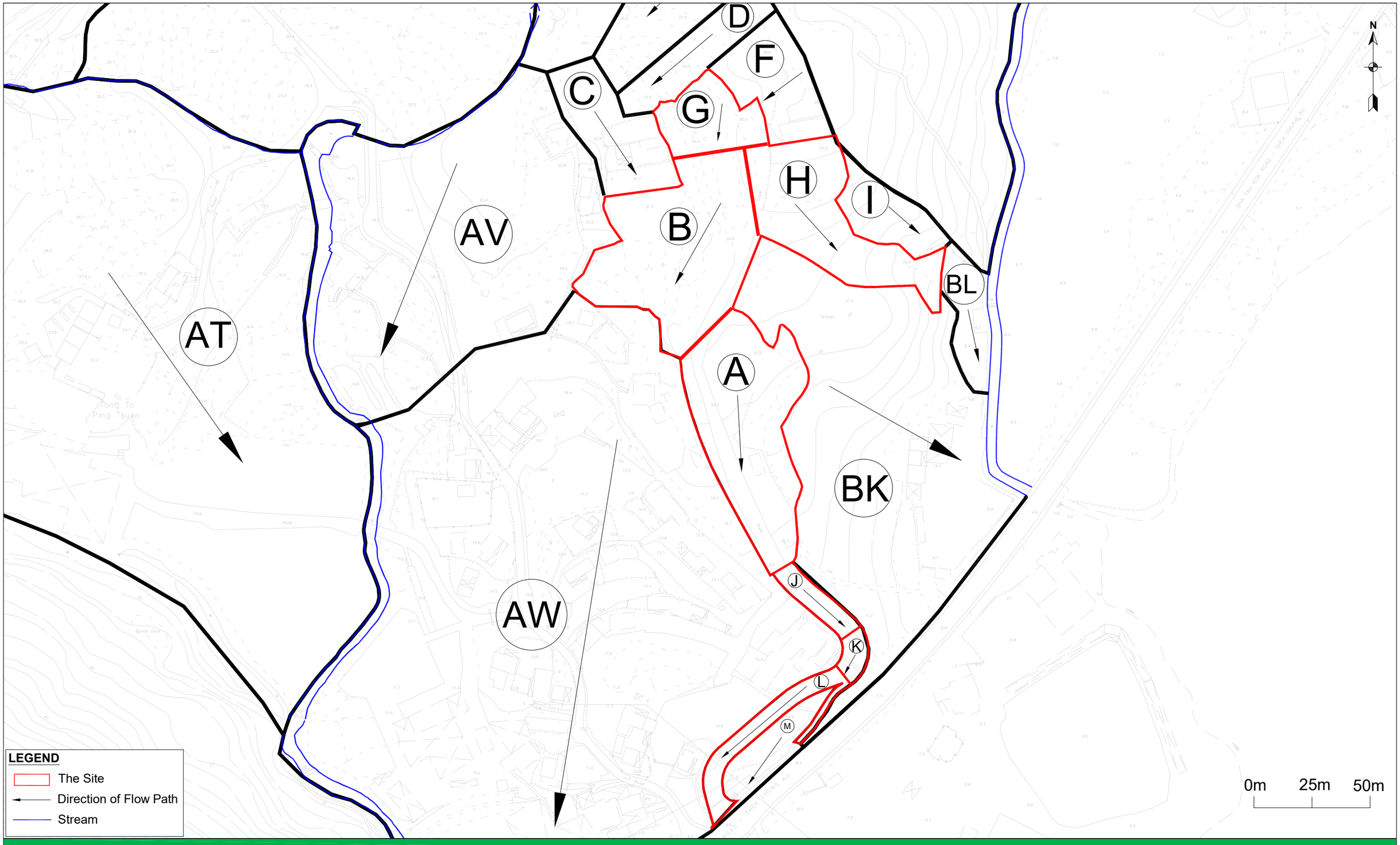
S12A Rezoning Application for Proposed Columbarium on Various Lots in D.D.41, Sha Tau Kok, New Territories

Identified Catchment Areas

Figure 3.1A

Rev. 0



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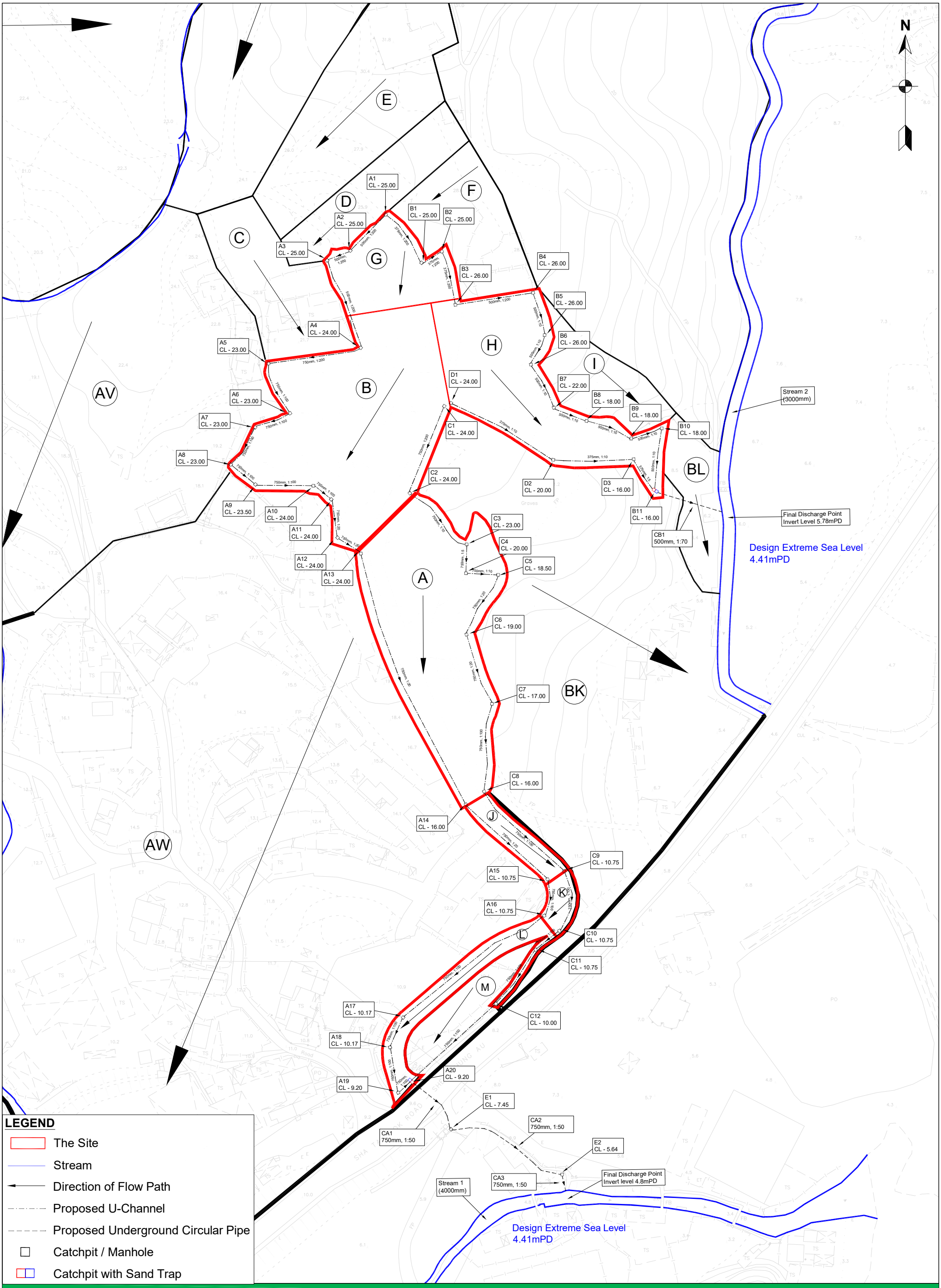
S12A Rezoning Application for Proposed Columbarium on Various Lots in D.D.41, Sha Tau Kok, New Territories

Identified Catchment Areas

Figure 3.1B

Rev. 0



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S12A Rezoning Application for Proposed Columbarium at Various Lots on D.D.41, Sha Tau Kok, New Territories

Drainage Proposal

Figure 3.2

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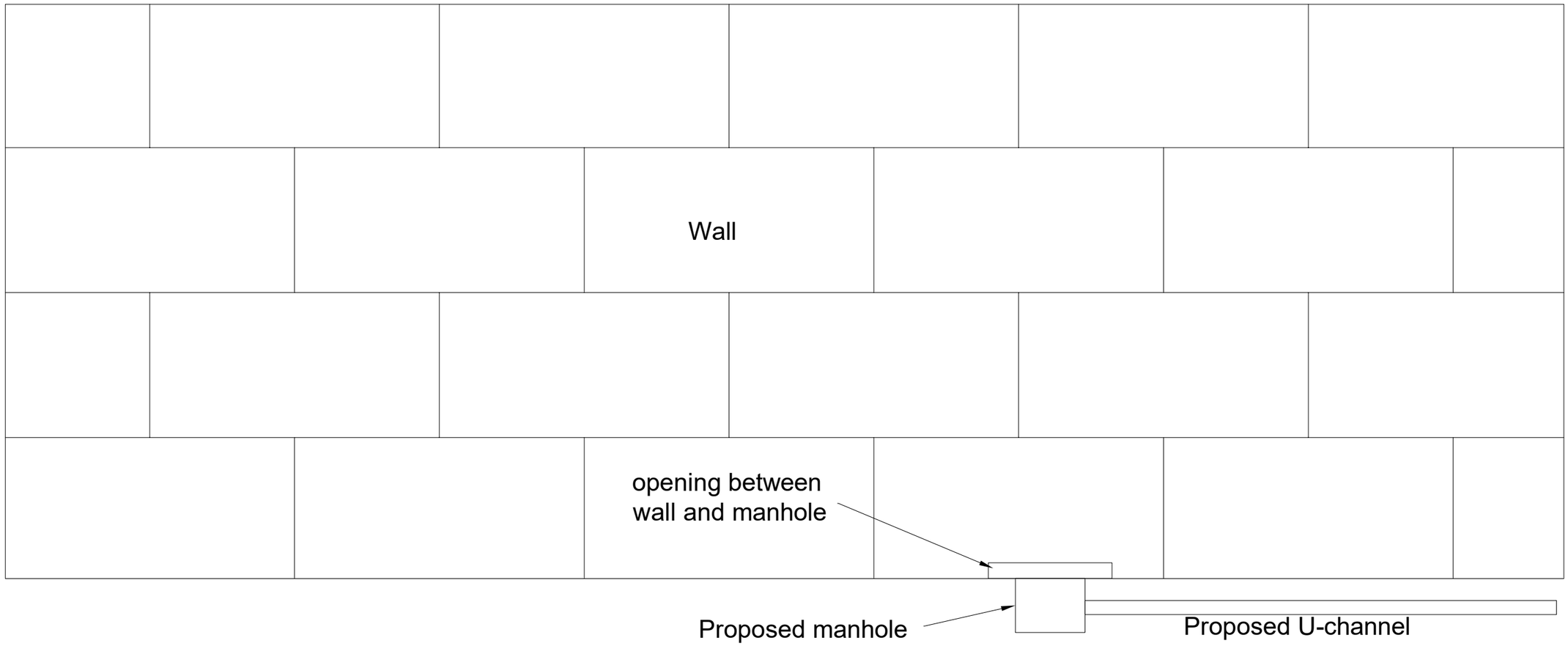
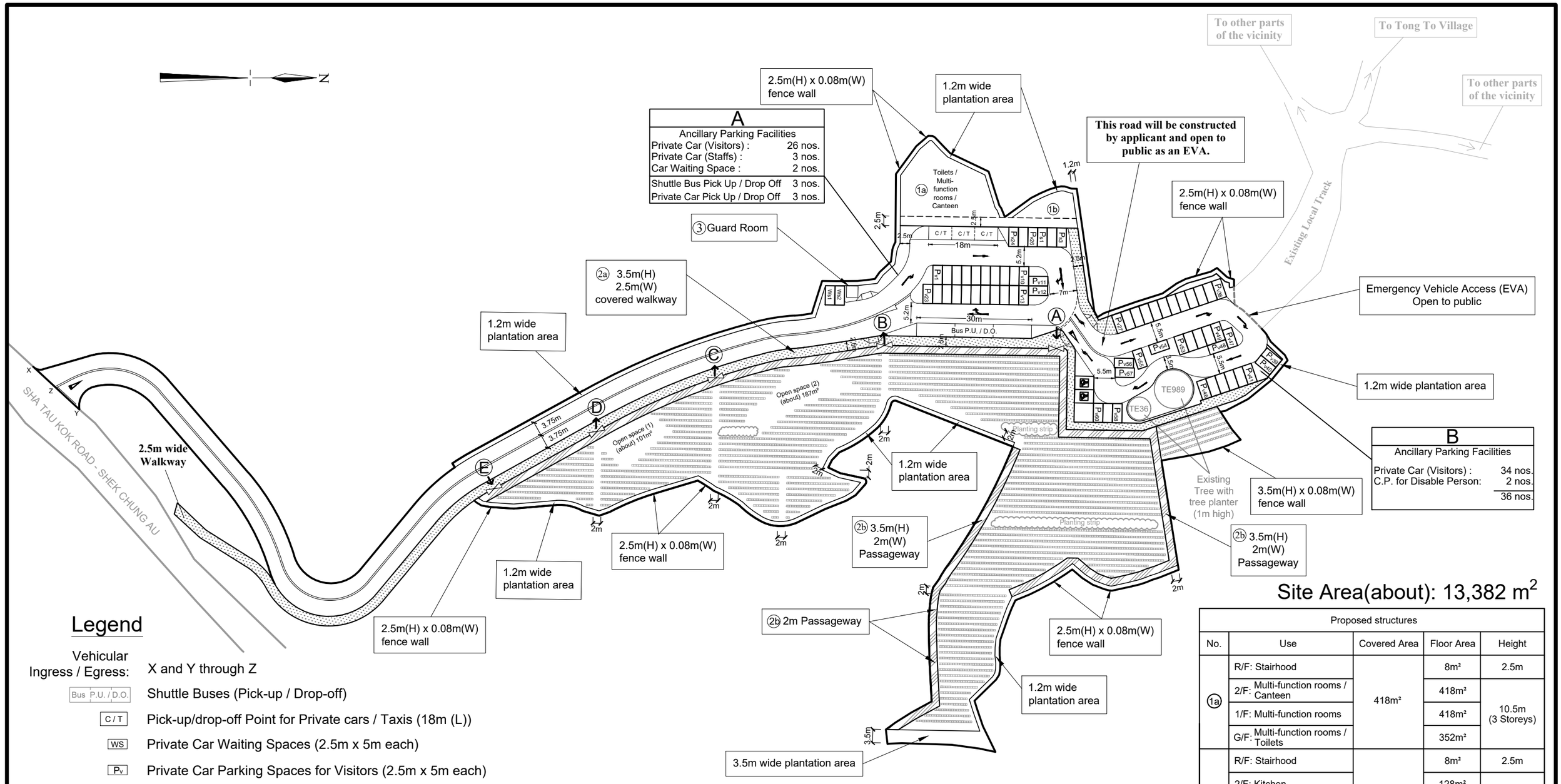

Wall
opening between
wall and manhole
Proposed manhole
Proposed U-channel

Appendix A

Proposed Layout Plan



Site Area(about): 13,382 m²

Legend

Vehicular Ingress / Egress:	X and Y through Z
Bus P.U. / D.O.	Shuttle Buses (Pick-up / Drop-off)
C / T	Pick-up/drop-off Point for Private cars / Taxis (18m (L))
WS	Private Car Waiting Spaces (2.5m x 5m each)
P_V	Private Car Parking Spaces for Visitors (2.5m x 5m each)
P_S	Private Car Parking Spaces for Staffs (2.5m x 5m each)
♿	Private Car Parking Spaces for Visitors (Disabled Persons) (3.5m x 5m each)
	Pedestrian access
	Canopy over walk-way
	Canopy over passageway
	Planting Strip

Ancillary Parking Facilities

	Private Car Parking Spaces for Visitors	Private Car Parking Spaces for Visitors (Disabled Persons)	Total Private Car Parking Space for Visitors	Private Car Parking Spaces for staffs	Private Car Waiting Spaces	Pick-up/drop-off Point for Private cars / Taxis	Lay-by for Shuttle Buses
Car park A	26	-		3	2	3	3
Car park B	34	2		-	-	-	-
Total	60	2	62	3	2	3	3

Niche count

	No. of niches
At-grade niche blocks	6,495 nos. x 1 = 6,495

Proposed structures

No.	Use	Covered Area	Floor Area	Height
1a	R/F: Stairhood	418m²	8m²	2.5m
	2/F: Multi-function rooms / Canteen		418m²	10.5m (3 Storeys)
	1/F: Multi-function rooms		418m²	
	G/F: Multi-function rooms / Toilets		352m²	
1b	R/F: Stairhood	128m²	8m²	2.5m
	2/F: Kitchen		128m²	10.5m (3 Storeys)
	1/F: Multi-function rooms		128m²	
	G/F: Office / Storeroom		78m²	
2a	Canopy over walk-way	832m²	832m²	3.5m (1 Storey)
2b	Canopy over passageway	748m²	748m²	3.5m (1 Storey)
3	1/F: Guard room	9m²	9m²	6m (2 Storeys)
	G/F: Guard room		9m²	
	Total	2,135m²	3,136m²	

1 : 1000 (A3)	Master Layout Plan	Goldrich Planners & Surveyors Ltd.
October 2025	Rezoning Application from “AGR” and “GB” to “OU (Columbarium)” on various Lots in D. D. 41 and Adjoining Government Land, Tong To, Sha Tau Kok, N.T.	Plan 4 (P 17106)

Appendix B

Detailed Drainage Analysis

Section 12A Rezoning Application for Proposed Columbarium on Various Lots in D.D.41 Sha Tau Kok, New Territories
Capacity Flow Estimation for Proposed Catchments and Drainage System with 50 Year Return Period

A. Calculation of Catchment Runoff Received by the Site

Catchment ID	Surface Type	Catchment Area (A), m^2	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_0), min	Time of Concentration (t_c), min	Duration (t_d), min	a (50 year return period)	b (50 year return period)	c (50 year return period)	Runoff intensity (i) mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
A	90% Concrete + 10% Grassland (heavysoil), flat	3,757	0.00376	5.95	100.9	4.49	4.49	4.49	474.6	2.9	0.37	226	0.88	0.0033	0.2077
B	90% Concrete + 10% Grassland (heavysoil), flat	4,229	0.00423	1.29	77.5	4.62	4.62	4.62	474.6	2.9	0.37	224	0.88	0.0037	0.2322
C	80% Concrete + 20% Grassland (heavysoil), steep	1,705	0.00171	4.60	58.7	2.97	2.97	2.97	474.6	2.9	0.37	246	0.83	0.0014	0.0968
D	100% Grassland (heavysoil), steep	1,272	0.00127	7.36	76.0	3.61	3.61	3.61	474.6	2.9	0.37	237	0.35	0.0004	0.0293
E	10% Concrete + 90% Grassland (heavysoil), steep	3,597	0.00360	8.30	92.8	3.88	3.88	3.88	474.6	2.9	0.37	233	0.41	0.0015	0.0957
F	100% Grassland (heavysoil), steep	1,573	0.00157	6.68	34.4	1.63	1.63	1.63	474.6	2.9	0.37	271	0.35	0.0006	0.0415
G	100% Grassland (heavysoil), steep	1,178	0.00118	5.18	38.6	1.98	1.98	1.98	474.6	2.9	0.37	264	0.35	0.0004	0.0302
H	90% Concrete + 10% Grassland (heavysoil), flat	2,762	0.00276	15.59	73.8	2.79	2.79	2.79	474.6	2.9	0.37	249	0.88	0.0024	0.1682
I	100% Grassland (heavysoil), steep	1,031	0.00103	21.74	46.0	1.80	1.80	1.80	474.6	2.9	0.37	267	0.35	0.0004	0.0268
J	100% Concrete	416	0.00042	6.79	39.8	2.15	2.15	2.15	474.6	2.9	0.37	260	0.95	0.0004	0.0286
K	100% Concrete	232	0.00023	13.16	7.6	0.38	0.38	0.38	474.6	2.9	0.37	305	0.95	0.0002	0.0187
L	100% Concrete	809	0.00081	2.61	68.9	4.21	4.21	4.21	474.6	2.9	0.37	229	0.95	0.0008	0.0490
M	100% Concrete	805	0.00081	1.30	54.0	3.80	3.80	3.80	474.6	2.9	0.37	234	0.95	0.0008	0.0498
														Total	**1.0746**

B. Calculation of Catchment Runoff Received by Existing Stream 1

Catchment ID	Surface Type	Catchment Area (A), m^2	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_0), min	Time of Concentration (t_c), min	Duration (t_d), min	a (50 year return period)	b (50 year return period)	c (50 year return period)	Runoff intensity (i) mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
AA	100% Grassland (heavysoil), steep	10,468	0.01047	53.54	151.30	3.91	3.91	3.91	474.6	2.9	0.37	233	0.35	0.0037	0.2372
AB	100% Grassland (heavysoil), steep	18,920	0.01892	70.41	196.00	4.52	4.52	4.52	474.6	2.9	0.37	226	0.35	0.0066	0.4153
AC	100% Grassland (heavysoil), steep	10,196	0.01020	88.19	129.50	3.04	3.04	3.04	474.6	2.9	0.37	245	0.35	0.0036	0.2431
AD	100% Grassland (heavysoil), steep	52,671	0.05267	62.61	405.71	8.65	8.65	8.65	474.6	2.9	0.37	191	0.35	0.0184	0.9813
AE	100% Grassland (heavysoil), steep	22,926	0.02293	67.68	257.11	5.87	5.87	5.87	474.6	2.9	0.37	212	0.35	0.0080	0.4731
AF	100% Grassland (heavysoil), steep	29,391	0.02939	49.39	380.65	9.02	9.02	9.02	474.6	2.9	0.37	189	0.35	0.0103	0.5412
AG	100% Grassland (heavysoil), steep	37,189	0.03719	38.34	354.70	8.64	8.64	8.64	474.6	2.9	0.37	192	0.35	0.0130	0.6931
AH	100% Grassland (heavysoil), steep	38,374	0.03837	51.54	419.06	9.59	9.59	9.59	474.6	2.9	0.37	186	0.35	0.0134	0.6945
AI	100% Grassland (heavysoil), steep	32,527	0.03253	36.21	469.53	11.72	11.72	11.72	474.6	2.9	0.37	175	0.35	0.0114	0.5552
AJ	100% Grassland (heavysoil), steep	43,371	0.04337	19.83	342.86	9.38	9.38	9.38	474.6	2.9	0.37	187	0.35	0.0152	0.7898
AK	100% Grassland (heavysoil), steep	12,505	0.01250	51.10	180.04	4.62	4.62	4.62	474.6	2.9	0.37	225	0.35	0.0044	0.2732
AL	100% Grassland (heavysoil), steep	38,295	0.03830	58.25	271.24	6.06	6.06	6.06	474.6	2.9	0.37	210	0.35	0.0134	0.7840
AM	100% Grassland (heavysoil), steep	66,715	0.06672	37.02	318.70	7.37	7.37	7.37	474.6	2.9	0.37	200	0.35	0.0234	1.2982
AN	100% Grassland (heavysoil), steep	62,139	0.06214	42.78	119.21	2.70	2.70	2.70	474.6	2.9	0.37	250	0.35	0.0217	1.5145
AO	100% Grassland (heavysoil), steep	27,601	0.02760	36.09	315.87	8.02	8.02	8.02	474.6	2.9	0.37	195	0.35	0.0097	0.5250
AP	100% Grassland (heavysoil), steep	18,727	0.01873	39.88	255.78	6.62	6.62	6.62	474.6	2.9	0.37	206	0.35	0.0066	0.3748
AQ	100% Grassland (heavysoil), steep	27,808	0.02781	39.27	273.22	6.82	6.82	6.82	474.6	2.9	0.37	204	0.35	0.0097	0.5524
AR	100% Grassland (heavysoil), steep	30,327	0.03033	18.92	295.94	8.47	8.47	8.47	474.6	2.9	0.37	193	0.35	0.0106	0.5683
AS	10% Concrete + 90% Grassland (heavysoil), flat	40,285	0.04028	1.49	168.25	7.79	7.79	7.79	474.6	2.9	0.37	197	0.32	0.0129	0.7062
AT	5% Concrete + 95% Grassland (heavysoil), flat	33,841	0.03384	8.19	244.27	8.18	8.18	8.18	474.6	2.9	0.37	194	0.29	0.0096	0.5214
AU	100% Grassland (heavysoil), flat	19,765	0.01976	3.59	244.98	10.20	10.20	10.20	474.6	2.9	0.37	183	0.25	0.0049	0.2510
AV	5% Concrete + 95% Grassland (heavysoil), flat	13,325	0.01333	7.26	132.24	4.98	4.98	4.98	474.6	2.9	0.37	221	0.29	0.0038	0.2330
AW	20% Concrete + 80% Grassland (heavysoil), flat	43,594	0.04359	3.44	270.60	10.51	10.51	10.51	474.6	2.9	0.37	181	0.39	0.0170	0.8563
														Total	**14.0824**

B. Calculation of Catchment Runoff Received by Existing Stream 2 (con't)

Catchment ID	Surface Type	Catchment Area (A), m^2	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_0), min	Time of Concentration (t_c), min	Duration (t_d), min	a (50 year return period)	b (50 year return period)	c (50 year return period)	Runoff intensity (i) mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
BA	100% Grassland (heavysoil), steep	34,288	0.03429	65.73	304.27	6.71	6.71	6.71	474.6	2.9	0.37	205	0.35	0.0120	0.6840
BB	100% Grassland (heavysoil), steep	67,748	0.06775	54.12	617.15	13.21	13.21	13.21	474.6	2.9	0.37	169	0.35	0.0237	1.1156
BC	100% Grassland (heavysoil), steep	14,692	0.01469	40.00	200.00	5.30	5.30	5.30	474.6	2.9	0.37	217	0.35	0.0051	0.3108
BD	100% Grassland (heavysoil), steep	22,149	0.02215	49.01	375.45	9.17	9.17	9.17	474.6	2.9	0.37	188	0.35	0.0078	0.4060
BE	100% Grassland (heavysoil), steep	10,272	0.01027	24.75	222.26	6.72	6.72	6.72	474.6	2.9	0.37	205	0.35	0.0036	0.2048
BF	100% Grassland (heavysoil), steep	2,779	0.00278	49.97	296.20	8.87	8.87	8.87	474.6	2.9	0.37	190	0.35	0.0010	0.0514
BG	100% Grassland (heavysoil), steep	15,947	0.01595	25.95	169.55	4.86	4.86	4.86	474.6	2.9	0.37	222	0.35	0.0056	0.3444
BH	30% Grassland (heavysoil), flat + 70% Grassland (heavysoil), steep	15,375	0.01538	2.71	73.80	3.34	3.34	3.34	474.6	2.9	0.37	241	0.32	0.0049	0.3292
BI	70% Grassland (heavysoil), flat + 30% Grassland (heavysoil), steep	24,849	0.02485	13.81	550.37	17.12	17.12	17.12	474.6	2.9	0.37	156	0.28	0.0070	0.3020
BJ	70% Grassland (heavysoil), flat + 30% Grassland (heavysoil), steep	39,109	0.03911	13.62	147.62	4.40	4.40	4.40	474.6	2.9	0.37	227	0.28	0.0110	0.6911
BK	15% Concrete + 15% Grassland (heavysoil), flat + 70% Grassland (heavysoil), steep	12,273	0.01227	12.35	103.61	3.54	3.54	3.54	474.6	2.9	0.37	238	0.43	0.0052	0.3449
BL	100% Concrete	929	0.00093	7.30	58.88	2.89	2.89	2.89	474.6	2.9	0.37	247	0.95	0.0009	0.0607
														Total	**4.8449**

C. Capacity Flow Estimation and Adequacy Check for Proposed Drainage System

Point (channel no.)	Shape	Diameter, m	Depth, m	Slope	Length, m	Manning's roughness coefficient	Cross Section Area, m^2	Wetted perimeter, m	Hydraulic radius, m	Mean velocity, m/s	Capacity flow, m^3/s	Catchments Served	Runoff, m^3/s	% of capacity flow	Sufficient Capacity? (Y/N)
A1 - A2	U-Channel	0.500	0.500	0.005	17	0.016	0.223	1.285	0.17	1.38	0.307	D,E,G	0.155	51%	Y
A2 - A3	U-Channel	0.500	0.500	0.005	8	0.016	0.223	1.285	0.17	1.38	0.307	D,E,G	0.155	51%	Y
A3 - A4	U-Channel	0.500	0.500	0.005	33	0.016	0.223	1.285	0.17	1.38	0.307	D,E,G	0.155	51%	Y
A4 - A5	U-Channel	0.750	0.750	0.005	33	0.016	0.502	1.928	0.26	1.80	0.905	B,C,D,E,G	0.484	54%	Y
A5 - A6	U-Channel	0.750	0.750	0.010	19	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.484	38%	Y
A6 - A7	U-Channel	0.750	0.750	0.010	13	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.484	38%	Y
A7 - A8	U-Channel	0.750	0.750	0.010	15	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.484	38%	Y
A8 - A9	U-Channel	0.750	0.750	0.010	10	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.484	38%	Y
A9 - A10	U-Channel	0.750	0.750	0.010	20	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.484	38%	Y
A10 - A11	U-Channel	0.750	0.750	0.010	7	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.484	38%	Y
A11 - A12	U-Channel	0.750	0.750	0.050	14	0.016	0.502	1.928	0.26	5.70	2.862	B,C,D,E,G	0.484	17%	Y
A12 - A13	U-Channel	0.750	0.750	0.050	8	0.016	0.502	1.928	0.26	5.70	2.862	B,C,D,E,G	0.484	17%	Y
A13 - A14	U-Channel	0.750	0.750	0.050	98	0.016	0.502	1.928	0.26	5.70	2.862	A,B,C,D,E,G	0.692	24%	Y
A14 - A15	U-Channel	0.750	0.750	0.050	39	0.016	0.502	1.928	0.26	5.70	2.862	A,B,C,D,E,G	0.692	24%	Y
A15 - A16	U-Channel	0.750	0.750	0.010	13	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J	0.721	56%	Y
A16 - A17	U-Channel	0.750	0.750	0.010	63	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J,K	0.739	58%	Y
A17 - A18	U-Channel	0.750	0.750	0.010	11	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J,K, L	0.788	62%	Y
A18 - A19	U-Channel	0.750	0.750	0.010	16	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J,K, L	0.788	62%	Y
A19 - A20	U-Channel	0.750	0.750	0.010	6	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J,K, L	0.788	62%	Y
C1 - C2	U-Channel	0.750	0.750	0.005	33	0.016	0.502	1.928	0.26	1.80	0.905	B,C,D,E,G	0.484	54%	Y
C2 - C3	U-Channel	0.750	0.750	0.100	22	0.016	0.502	1.928	0.26	8.06	4.047	B,C,D,E,G	0.484	12%	Y
C3 - C4	U-Channel	0.750	0.750	0.200	10	0.016	0.502	1.928	0.26	11.40	5.724	A,B,C,D,E,G	0.692	12%	Y
C4 - C5	U-Channel	0.750	0.750	0.100	11	0.016	0.502	1.928	0.26	8.06	4.047	A,B,C,D,E,G	0.692	17%	Y
C5 - C6	U-Channel	0.750	0.750	0.050	24	0.016	0.502	1.928	0.26	5.70	2.862	A,B,C,D,E,G	0.692	24%	Y
C6 - C7	U-Channel	0.750	0.750	0.050	26	0.016	0.502	1.928	0.26	5.70	2.862	A,B,C,D,E,G	0.692	24%	Y
C7 - C8	U-Channel	0.750	0.750	0.010	31	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G	0.692	54%	Y
C8 - C9	U-Channel	0.750	0.750	0.010	40	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G	0.692	54%	Y
C9 - C10	U-Channel	0.750	0.750	0.010	22	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J	0.721	56%	Y
C10 - C11	U-Channel	0.750	0.750	0.010	10	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J, K	0.739	58%	Y
C11 - C12	U-Channel	0.750	0.750	0.010	24	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J, K, L	0.788	62%	Y
C12 - A20	U-Channel	0.750	0.750	0.010	41	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J, K, L	0.788	62%	Y
CA1	Circular Pipe	0.750	--	0.020	22	0.015	0.442	2.356	0.19	3.09	1.364	A,B,C,D,E,G,J, K, L, M	0.838	61%	Y
CA2	Circular Pipe	0.750	--	0.020	45	0.015	0.442	2.356	0.19	3.09	1.364	A,B,C,D,E,G,J, K, L, M	0.838	61%	Y
CA3	Circular Pipe	0.750	--	0.020	6	0.015	0.442	2.356	0.19	3.09	1.364	A,B,C,D,E,G,J, K, L, M	0.838	61%	Y

C. Capacity Flow Estimation and Adequacy Check for Proposed Drainage System (con't)

Point (channel no.)	Shape	Diameter, m	Depth, m	Slope	Length, m	Manning's roughness coefficient	Cross Section Area, m^2	Wetted perimeter, m	Hydraulic radius, m	Mean velocity, m/s	Capacity flow, m^3/s	Catchments Served	Runoff, m^3/s	% of capacity flow	Sufficient Capacity? (Y/N)
A1 - B1	U-Channel	0.375	0.375	0.005	21	0.016	0.126	0.964	0.13	1.14	0.143	F, G	0.072	50%	Y
B1 - B2	U-Channel	0.375	0.375	0.005	8	0.016	0.126	0.964	0.13	1.14	0.143	F, G	0.072	50%	Y
B2 -B3	U-Channel	0.375	0.375	0.005	19	0.016	0.126	0.964	0.13	1.14	0.143	F, G	0.072	50%	Y
B3 - B4	U-Channel	0.500	0.500	0.005	28	0.016	0.223	1.285	0.17	1.38	0.307	F, G,H	0.240	78%	Y
B4 - B5	U-Channel	0.500	0.500	0.100	15	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.267	19%	Y
B5 - B6	U-Channel	0.500	0.500	0.100	11	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.267	19%	Y
B6 - B7	U-Channel	0.500	0.500	0.100	17	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.267	19%	Y
B7 - B8	U-Channel	0.500	0.500	0.100	12	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.267	19%	Y
B8 - B9	U-Channel	0.500	0.500	0.100	17	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.267	19%	Y
B9 - B10	U-Channel	0.500	0.500	0.100	11	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.267	19%	Y
B10 - B11	U-Channel	0.500	0.500	0.100	22	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.267	19%	Y
D1 - D2	U-Channel	0.375	0.375	0.100	42	0.016	0.126	0.964	0.13	5.08	0.637	H	0.168	26%	Y
D2 - D3	U-Channel	0.375	0.375	0.100	28	0.016	0.126	0.964	0.13	5.08	0.637	H	0.168	26%	Y
D3 - B11	U-Channel	0.375	0.375	0.200	12	0.016	0.126	0.964	0.13	7.18	0.901	H	0.168	19%	Y
CB1	Circular Pipe	0.500	--	0.014	24	0.015	0.196	1.571	0.13	1.99	0.391	F - I	0.267	68%	Y

D. Capacity Flow Estimation and Adequacy Check for Existing Streams

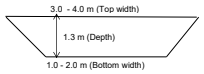
Stream	Top Width, m	Bottom Width, m	Depth, m	Slope	Manning's roughness coefficient	Cross Section Area, m^2	Wetted perimeter, m	Hydraulic radius, m	Mean velocity, m/s	Capacity flow, m^3/s	Catchments Served	Runoff, m^3/s	Contribution from Identified Catchments, %	Sufficient Capacity? (Y/N)
Stream 1	4.0	2	1.3	0.100	0.040	3.900	5.280	0.74	6.46	25.193	A to E, G, J to M and AA to AW	14.920	59%	Y
Stream 2	3.0	1	1.3	0.050	0.040	2.600	4.280	0.61	4.01	10.425	F to I and BA to BL	5.112	49%	Y

Note: Adequacy in capacities of the stream have been checked based on the most narrow section of the existing stream at the stormwater discharge point.

Note:
Runoff is calculated in accordance with DSD's "Stormwater Drainage Manual - Planning, Design and Management" (SDM), Fifth edition, Jan 2018.

Equations Used

$$t_0 = \frac{0.14465L}{H^{0.2}A^{0.1}} \qquad i = \frac{a}{(t_d + b)^c} \qquad t_c = t_0 + t_f \qquad Q_p = 0.278\,C\,i\,A$$



Schematic Section of the Streamcourse

Appendix C

Detailed Drainage Analysis with 11.1% Increased Rainfall with Climate Change Impact

Section 12A Rezoning Application for Proposed Columbarium on Various Lots in D.D.41 Sha Tau Kok, New Territories
Capacity Flow Estimation for Proposed Catchments and Drainage System with 50 Year Return Period (with 11.1% increase by Mid 21st Century)

A. Calculation of Catchment Runoff Received by the Site

Catchment ID	Surface Type	Catchment Area (A), m^2	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_0), min	Time of Concentration (t_c), min	Duration (t_d), min	a (50 year return period)	b (50 year return period)	c (50 year return period)	Runoff intensity (i), with 11.1% increase, mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
A	90% Concrete + 10% Grassland (heavysoil), flat	3,757	0.00376	5.95	100.9	4.49	4.49	4.49	474.6	2.9	0.37	251	0.88	0.0033	0.2308
B	90% Concrete + 10% Grassland (heavysoil), flat	4,229	0.00423	1.29	77.5	4.62	4.62	4.62	474.6	2.9	0.37	249	0.88	0.0037	0.2580
C	80% Concrete + 20% Grassland (heavysoil), steep	1,705	0.00171	4.60	58.7	2.97	2.97	2.97	474.6	2.9	0.37	273	0.83	0.0014	0.1076
D	100% Grassland (heavysoil), steep	1,272	0.00127	7.36	76.0	3.61	3.61	3.61	474.6	2.9	0.37	263	0.35	0.0004	0.0326
E	10% Concrete + 90% Grassland (heavysoil), steep	3,597	0.00360	8.30	92.8	3.88	3.88	3.88	474.6	2.9	0.37	259	0.41	0.0015	0.1063
F	100% Grassland (heavysoil), steep	1,573	0.00157	6.68	34.4	1.63	1.63	1.63	474.6	2.9	0.37	301	0.35	0.0006	0.0461
G	100% Grassland (heavysoil), steep	1,178	0.00118	5.18	38.6	1.98	1.98	1.98	474.6	2.9	0.37	293	0.35	0.0004	0.0336
H	90% Concrete + 10% Grassland (heavysoil), flat	2,762	0.00276	15.59	73.8	2.79	2.79	2.79	474.6	2.9	0.37	277	0.88	0.0024	0.1869
I	100% Grassland (heavysoil), steep	1,031	0.00103	21.74	46.0	1.80	1.80	1.80	474.6	2.9	0.37	297	0.35	0.0004	0.0298
J	100% Concrete	416	0.00042	6.79	39.8	2.15	2.15	2.15	474.6	2.9	0.37	289	0.95	0.0004	0.0317
K	100% Concrete	232	0.00023	13.16	7.6	0.38	0.38	0.38	474.6	2.9	0.37	339	0.95	0.0002	0.0208
L	100% Concrete	809	0.00081	2.61	68.9	4.21	4.21	4.21	474.6	2.9	0.37	255	0.95	0.0008	0.0544
M	100% Concrete	805	0.00081	1.30	54.0	3.80	3.80	3.80	474.6	2.9	0.37	260	0.95	0.0008	0.0554
														Total	**1.1939**

B. Calculation of Catchment Runoff Received by Existing Stream 1

Catchment ID	Surface Type	Catchment Area (A), m^2	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_0), min	Time of Concentration (t_c), min	Duration (t_d), min	a (50 year return period)	b (50 year return period)	c (50 year return period)	Runoff intensity (i), with 11.1% increase, mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
AA	100% Grassland (heavysoil), steep	10,468	0.01047	53.54	151.30	3.91	3.91	3.91	474.6	2.9	0.37	259	0.35	0.0037	0.2636
AB	100% Grassland (heavysoil), steep	18,920	0.01892	70.41	196.00	4.52	4.52	4.52	474.6	2.9	0.37	251	0.35	0.0066	0.4614
AC	100% Grassland (heavysoil), steep	10,196	0.01020	88.19	129.50	3.04	3.04	3.04	474.6	2.9	0.37	272	0.35	0.0036	0.2701
AD	100% Grassland (heavysoil), steep	52,671	0.05267	62.61	405.71	8.65	8.65	8.65	474.6	2.9	0.37	213	0.35	0.0184	1.0902
AE	100% Grassland (heavysoil), steep	22,926	0.02293	67.68	257.11	5.87	5.87	5.87	474.6	2.9	0.37	236	0.35	0.0080	0.5257
AF	100% Grassland (heavysoil), steep	29,391	0.02939	49.39	380.65	9.02	9.02	9.02	474.6	2.9	0.37	210	0.35	0.0103	0.6012
AG	100% Grassland (heavysoil), steep	37,189	0.03719	38.34	354.70	8.64	8.64	8.64	474.6	2.9	0.37	213	0.35	0.0130	0.7700
AH	100% Grassland (heavysoil), steep	38,374	0.03837	51.54	419.06	9.59	9.59	9.59	474.6	2.9	0.37	207	0.35	0.0134	0.7716
AI	100% Grassland (heavysoil), steep	32,527	0.03253	36.21	469.53	11.72	11.72	11.72	474.6	2.9	0.37	195	0.35	0.0114	0.6169
AJ	100% Grassland (heavysoil), steep	43,371	0.04337	19.83	342.86	9.38	9.38	9.38	474.6	2.9	0.37	208	0.35	0.0152	0.8775
AK	100% Grassland (heavysoil), steep	12,505	0.01250	51.10	180.04	4.62	4.62	4.62	474.6	2.9	0.37	249	0.35	0.0044	0.3036
AL	100% Grassland (heavysoil), steep	38,295	0.03830	58.25	271.24	6.06	6.06	6.06	474.6	2.9	0.37	234	0.35	0.0134	0.8710
AM	100% Grassland (heavysoil), steep	66,715	0.06672	37.02	318.70	7.37	7.37	7.37	474.6	2.9	0.37	222	0.35	0.0234	1.4423
AN	100% Grassland (heavysoil), steep	62,139	0.06214	42.78	119.21	2.70	2.70	2.70	474.6	2.9	0.37	278	0.35	0.0217	1.6827
AO	100% Grassland (heavysoil), steep	27,601	0.02760	36.09	315.87	8.02	8.02	8.02	474.6	2.9	0.37	217	0.35	0.0097	0.5833
AP	100% Grassland (heavysoil), steep	18,727	0.01873	39.88	255.78	6.62	6.62	6.62	474.6	2.9	0.37	229	0.35	0.0066	0.4164
AQ	100% Grassland (heavysoil), steep	27,808	0.02781	39.27	273.22	6.82	6.82	6.82	474.6	2.9	0.37	227	0.35	0.0097	0.6137
AR	100% Grassland (heavysoil), steep	30,327	0.03033	18.92	295.94	8.47	8.47	8.47	474.6	2.9	0.37	214	0.35	0.0106	0.6314
AS	10% Concrete + 90% Grassland (heavysoil), flat	40,285	0.04028	1.49	168.25	7.79	7.79	7.79	474.6	2.9	0.37	219	0.32	0.0129	0.7846
AT	5% Concrete + 95% Grassland (heavysoil), flat	33,841	0.03384	8.19	244.27	8.18	8.18	8.18	474.6	2.9	0.37	216	0.29	0.0096	0.5793
AU	100% Grassland (heavysoil), flat	19,765	0.01976	3.59	244.98	10.20	10.20	10.20	474.6	2.9	0.37	203	0.25	0.0049	0.2788
AV	5% Concrete + 95% Grassland (heavysoil), flat	13,325	0.01333	7.26	132.24	4.98	4.98	4.98	474.6	2.9	0.37	245	0.29	0.0038	0.2588
AW	20% Concrete + 80% Grassland (heavysoil), flat	43,594	0.04359	3.44	270.60	10.51	10.51	10.51	474.6	2.9	0.37	201	0.39	0.0170	0.9514
														Total	**15.6456**

B. Calculation of Catchment Runoff Received by Existing Stream 2 (con't)

Catchment ID	Surface Type	Catchment Area (A), m^2	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_0), min	Time of Concentration (t_c), min	Duration (t_d), min	a (50 year return period)	b (50 year return period)	c (50 year return period)	Runoff intensity (i), with 11.1% Increase, mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
BA	100% Grassland (heavysoil), steep	34,288	0.03429	65.73	304.27	6.71	6.71	6.71	474.6	2.9	0.37	228	0.35	0.0120	0.7599
BB	100% Grassland (heavysoil), steep	67,748	0.06775	54.12	617.15	13.21	13.21	13.21	474.6	2.9	0.37	188	0.35	0.0237	1.2394
BC	100% Grassland (heavysoil), steep	14,692	0.01469	40.00	200.00	5.30	5.30	5.30	474.6	2.9	0.37	242	0.35	0.0051	0.3453
BD	100% Grassland (heavysoil), steep	22,149	0.02215	49.01	375.45	9.17	9.17	9.17	474.6	2.9	0.37	209	0.35	0.0078	0.4511
BE	100% Grassland (heavysoil), steep	10,272	0.01027	24.75	222.26	6.72	6.72	6.72	474.6	2.9	0.37	228	0.35	0.0036	0.2275
BF	100% Grassland (heavysoil), steep	2,779	0.00278	49.97	296.20	8.87	8.87	8.87	474.6	2.9	0.37	211	0.35	0.0010	0.0571
BG	100% Grassland (heavysoil), steep	15,947	0.01595	25.95	169.55	4.86	4.86	4.86	474.6	2.9	0.37	247	0.35	0.0056	0.3826
BH	30% Grassland (heavysoil), flat + 70% Grassland (heavysoil), steep	15,375	0.01538	2.71	73.80	3.34	3.34	3.34	474.6	2.9	0.37	267	0.32	0.0049	0.3657
BI	70% Grassland (heavysoil), flat + 30% Grassland (heavysoil), steep	24,849	0.02485	13.81	550.37	17.12	17.12	17.12	474.6	2.9	0.37	173	0.28	0.0070	0.3355
BJ	70% Grassland (heavysoil), flat + 30% Grassland (heavysoil), steep	39,109	0.03911	13.62	147.62	4.40	4.40	4.40	474.6	2.9	0.37	252	0.28	0.0110	0.7678
BK	15% Concrete + 15% Grassland (heavysoil), flat + 70% Grassland (heavysoil), steep	12,273	0.01227	12.35	103.61	3.54	3.54	3.54	474.6	2.9	0.37	264	0.43	0.0052	0.3832
BL	100% Concrete	929	0.00093	7.30	58.88	2.89	2.89	2.89	474.6	2.9	0.37	275	0.95	0.0009	0.0675
														Total	**5.3827**

C. Capacity Flow Estimation and Adequacy Check for Proposed Drainage System

Point (channel no.)	Shape	Diameter, m	Depth, m	Slope	Length, m	Manning's roughness coefficient	Cross Section Area, m^2	Wetted perimeter, m	Hydraulic radius, m	Mean velocity, m/s	Capacity flow, m^3/s	Catchments Served	Runoff, m^3/s	% of capacity flow	Sufficient Capacity? (Y/N)
A1 - A2	U-Channel	0.500	0.500	0.005	17	0.016	0.223	1.285	0.17	1.38	0.307	D,E,G	0.172	56%	Y
A2 - A3	U-Channel	0.500	0.500	0.005	8	0.016	0.223	1.285	0.17	1.38	0.307	D,E,G	0.172	56%	Y
A3 - A4	U-Channel	0.500	0.500	0.005	33	0.016	0.223	1.285	0.17	1.38	0.307	D,E,G	0.172	56%	Y
A4 - A5	U-Channel	0.750	0.750	0.005	33	0.016	0.502	1.928	0.26	1.80	0.905	B,C,D,E,G	0.538	59%	Y
A5 - A6	U-Channel	0.750	0.750	0.010	19	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.538	42%	Y
A6 - A7	U-Channel	0.750	0.750	0.010	13	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.538	42%	Y
A7 - A8	U-Channel	0.750	0.750	0.010	15	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.538	42%	Y
A8 - A9	U-Channel	0.750	0.750	0.010	10	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.538	42%	Y
A9 - A10	U-Channel	0.750	0.750	0.010	20	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.538	42%	Y
A10 - A11	U-Channel	0.750	0.750	0.010	7	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.538	42%	Y
A11 - A12	U-Channel	0.750	0.750	0.050	14	0.016	0.502	1.928	0.26	5.70	2.862	B,C,D,E,G	0.538	19%	Y
A12 - A13	U-Channel	0.750	0.750	0.050	8	0.016	0.502	1.928	0.26	5.70	2.862	B,C,D,E,G	0.538	19%	Y
A13 - A14	U-Channel	0.750	0.750	0.050	98	0.016	0.502	1.928	0.26	5.70	2.862	A,B,C,D,E,G	0.769	27%	Y
A14 - A15	U-Channel	0.750	0.750	0.050	39	0.016	0.502	1.928	0.26	5.70	2.862	A,B,C,D,E,G	0.769	27%	Y
A15 - A16	U-Channel	0.750	0.750	0.010	13	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J	0.801	63%	Y
A16 - A17	U-Channel	0.750	0.750	0.010	63	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J,K	0.821	64%	Y
A17 - A18	U-Channel	0.750	0.750	0.010	11	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J,K, L	0.876	68%	Y
A18 - A19	U-Channel	0.750	0.750	0.010	16	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J,K, L	0.876	68%	Y
A19 - A20	U-Channel	0.750	0.750	0.010	6	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J,K, L	0.876	68%	Y
C1 - C2	U-Channel	0.750	0.750	0.005	33	0.016	0.502	1.928	0.26	1.80	0.905	B,C,D,E,G	0.538	59%	Y
C2 - C3	U-Channel	0.750	0.750	0.100	22	0.016	0.502	1.928	0.26	8.06	4.047	B,C,D,E,G	0.538	13%	Y
C3 - C4	U-Channel	0.750	0.750	0.200	10	0.016	0.502	1.928	0.26	11.40	5.724	A,B,C,D,E,G	0.769	13%	Y
C4 - C5	U-Channel	0.750	0.750	0.100	11	0.016	0.502	1.928	0.26	8.06	4.047	A,B,C,D,E,G	0.769	19%	Y
C5 - C6	U-Channel	0.750	0.750	0.050	24	0.016	0.502	1.928	0.26	5.70	2.862	A,B,C,D,E,G	0.769	27%	Y
C6 - C7	U-Channel	0.750	0.750	0.050	26	0.016	0.502	1.928	0.26	5.70	2.862	A,B,C,D,E,G	0.769	27%	Y
C7 - C8	U-Channel	0.750	0.750	0.010	31	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G	0.769	60%	Y
C8 - C9	U-Channel	0.750	0.750	0.010	40	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G	0.769	60%	Y
C9 - C10	U-Channel	0.750	0.750	0.010	22	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J	0.801	63%	Y
C10 - C11	U-Channel	0.750	0.750	0.010	10	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J, K	0.821	64%	Y
C11 - C12	U-Channel	0.750	0.750	0.010	24	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J, K, L	0.876	68%	Y
C12 - A20	U-Channel	0.750	0.750	0.010	41	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J, K, L	0.876	68%	Y
CA1	Circular Pipe	0.750	--	0.020	22	0.015	0.442	2.356	0.19	3.09	1.364	A,B,C,D,E,G,J, K, L, M	0.931	68%	Y
CA2	Circular Pipe	0.750	--	0.020	45	0.015	0.442	2.356	0.19	3.09	1.364	A,B,C,D,E,G,J, K, L, M	0.931	68%	Y
CA3	Circular Pipe	0.750	--	0.020	6	0.015	0.442	2.356	0.19	3.09	1.364	A,B,C,D,E,G,J, K, L, M	0.931	68%	Y

C. Capacity Flow Estimation and Adequacy Check for Proposed Drainage System (con't)

Point (channel no.)	Shape	Diameter, m	Depth, m	Slope	Length, m	Manning's roughness coefficient	Cross Section Area, m^2	Wetted perimeter, m	Hydraulic radius, m	Mean velocity, m/s	Capacity flow, m^3/s	Catchments Served	Runoff, m^3/s	% of capacity flow	Sufficient Capacity? (Y/N)
A1 - B1	U-Channel	0.375	0.375	0.005	21	0.016	0.126	0.964	0.13	1.14	0.143	F, G	0.080	56%	Y
B1 - B2	U-Channel	0.375	0.375	0.005	8	0.016	0.126	0.964	0.13	1.14	0.143	F, G	0.080	56%	Y
B2 -B3	U-Channel	0.375	0.375	0.005	19	0.016	0.126	0.964	0.13	1.14	0.143	F, G	0.080	56%	Y
B3 - B4	U-Channel	0.500	0.500	0.005	28	0.016	0.223	1.285	0.17	1.38	0.307	F, G,H	0.267	87%	Y
B4 - B5	U-Channel	0.500	0.500	0.100	15	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.296	22%	Y
B5 - B6	U-Channel	0.500	0.500	0.100	11	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.296	22%	Y
B6 - B7	U-Channel	0.500	0.500	0.100	17	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.296	22%	Y
B7 - B8	U-Channel	0.500	0.500	0.100	12	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.296	22%	Y
B8 - B9	U-Channel	0.500	0.500	0.100	17	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.296	22%	Y
B9 - B10	U-Channel	0.500	0.500	0.100	11	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.296	22%	Y
B10 - B11	U-Channel	0.500	0.500	0.100	22	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.296	22%	Y
D1 - D2	U-Channel	0.375	0.375	0.100	42	0.016	0.126	0.964	0.13	5.08	0.637	H	0.187	29%	Y
D2 - D3	U-Channel	0.375	0.375	0.100	28	0.016	0.126	0.964	0.13	5.08	0.637	H	0.187	29%	Y
D3 - B11	U-Channel	0.375	0.375	0.200	12	0.016	0.126	0.964	0.13	7.18	0.901	H	0.187	21%	Y
CB1	Circular Pipe	0.500	--	0.014	24	0.015	0.196	1.571	0.13	1.99	0.391	F - I	0.296	76%	Y

D. Capacity Flow Estimation and Adequacy Check for Existing Streams

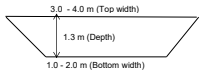
Stream	Top Width, m	Bottom Width, m	Depth, m	Slope	Manning's roughness coefficient	Cross Section Area, m^2	Wetted perimeter, m	Hydraulic radius, m	Mean velocity, m/s	Capacity flow, m^3/s	Catchments Served	Runoff, m^3/s	Contribution from Identified Catchments, %	Sufficient Capacity? (Y/N)
Stream 1	4.0	2	1.3	0.100	0.040	3.900	5.280	0.74	6.46	25.193	A to E, G, J to M and AA to AW	16.577	66%	Y
Stream 2	3.0	1	1.3	0.050	0.040	2.600	4.280	0.61	4.01	10.425	F to I and BA to BL	5.679	54%	Y

Note: Adequacy in capacities of the stream have been checked based on the most narrow section of the existing stream at the stormwater discharge point.

Note:
Runoff is calculated in accordance with DSD's "Stormwater Drainage Manual - Planning, Design and Management" (SDM), Fifth edition, Jan 2018.

Equations Used

$$t_0 = \frac{0.14465L}{H^{0.2}A^{0.1}} \qquad i = \frac{a}{(t_d + b)^c} \qquad t_c = t_0 + t_f \qquad Q_p = 0.278\,C\,i\,A$$



Schematic Section of the Streamcourse

Appendix D

Detailed Drainage Analysis with 16% Increased Rainfall with Climate Change Impact

Section 12A Rezoning Application for Proposed Columbarium on Various Lots in D.D.41 Sha Tau Kok, New Territories
Capacity Flow Estimation for Proposed Catchments and Drainage System with 50 Year Return Period (with 16.0% increase by Mid 21st Century)

A. Calculation of Catchment Runoff Received by the Site

Catchment ID	Surface Type	Catchment Area (A), m^2	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_0), min	Time of Concentration (t_c), min	Duration (t_d), min	a (50 year return period)	b (50 year return period)	c (50 year return period)	Runoff intensity (i), with 16.0% Increase, mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
A	90% Concrete + 10% Grassland (heavysoil), flat	3,757	0.00376	5.95	100.9	4.49	4.49	4.49	474.6	2.9	0.37	262	0.88	0.0033	0.2410
B	90% Concrete + 10% Grassland (heavysoil), flat	4,229	0.00423	1.29	77.5	4.62	4.62	4.62	474.6	2.9	0.37	260	0.88	0.0037	0.2694
C	80% Concrete + 20% Grassland (heavysoil), steep	1,705	0.00171	4.60	58.7	2.97	2.97	2.97	474.6	2.9	0.37	285	0.83	0.0014	0.1123
D	100% Grassland (heavysoil), steep	1,272	0.00127	7.36	76.0	3.61	3.61	3.61	474.6	2.9	0.37	275	0.35	0.0004	0.0340
E	10% Concrete + 90% Grassland (heavysoil), steep	3,597	0.00360	8.30	92.8	3.88	3.88	3.88	474.6	2.9	0.37	271	0.41	0.0015	0.1110
F	100% Grassland (heavysoil), steep	1,573	0.00157	6.68	34.4	1.63	1.63	1.63	474.6	2.9	0.37	314	0.35	0.0006	0.0481
G	100% Grassland (heavysoil), steep	1,178	0.00118	5.18	38.6	1.98	1.98	1.98	474.6	2.9	0.37	306	0.35	0.0004	0.0350
H	90% Concrete + 10% Grassland (heavysoil), flat	2,762	0.00276	15.59	73.8	2.79	2.79	2.79	474.6	2.9	0.37	289	0.88	0.0024	0.1952
I	100% Grassland (heavysoil), steep	1,031	0.00103	21.74	46.0	1.80	1.80	1.80	474.6	2.9	0.37	310	0.35	0.0004	0.0311
J	100% Concrete	416	0.00042	6.79	39.8	2.15	2.15	2.15	474.6	2.9	0.37	302	0.95	0.0004	0.0331
K	100% Concrete	232	0.00023	13.16	7.6	0.38	0.38	0.38	474.6	2.9	0.37	354	0.95	0.0002	0.0217
L	100% Concrete	809	0.00081	2.61	68.9	4.21	4.21	4.21	474.6	2.9	0.37	266	0.95	0.0008	0.0568
M	100% Concrete	805	0.00081	1.30	54.0	3.80	3.80	3.80	474.6	2.9	0.37	272	0.95	0.0008	0.0578
														Total	**1.2465**

B. Calculation of Catchment Runoff Received by Existing Stream 1

Catchment ID	Surface Type	Catchment Area (A), m^2	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_0), min	Time of Concentration (t_c), min	Duration (t_d), min	a (50 year return period)	b (50 year return period)	c (50 year return period)	Runoff intensity (i), with 16.0% Increase, mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
AA	100% Grassland (heavysoil), steep	10,468	0.01047	53.54	151.30	3.91	3.91	3.91	474.6	2.9	0.37	270	0.35	0.0037	0.2752
AB	100% Grassland (heavysoil), steep	18,920	0.01892	70.41	196.00	4.52	4.52	4.52	474.6	2.9	0.37	262	0.35	0.0066	0.4818
AC	100% Grassland (heavysoil), steep	10,196	0.01020	88.19	129.50	3.04	3.04	3.04	474.6	2.9	0.37	284	0.35	0.0036	0.2820
AD	100% Grassland (heavysoil), steep	52,671	0.05267	62.61	405.71	8.65	8.65	8.65	474.6	2.9	0.37	222	0.35	0.0184	1.1383
AE	100% Grassland (heavysoil), steep	22,926	0.02293	67.68	257.11	5.87	5.87	5.87	474.6	2.9	0.37	246	0.35	0.0080	0.5488
AF	100% Grassland (heavysoil), steep	29,391	0.02939	49.39	380.65	9.02	9.02	9.02	474.6	2.9	0.37	220	0.35	0.0103	0.6278
AG	100% Grassland (heavysoil), steep	37,189	0.03719	38.34	354.70	8.64	8.64	8.64	474.6	2.9	0.37	222	0.35	0.0130	0.8040
AH	100% Grassland (heavysoil), steep	38,374	0.03837	51.54	419.06	9.59	9.59	9.59	474.6	2.9	0.37	216	0.35	0.0134	0.8056
AI	100% Grassland (heavysoil), steep	32,527	0.03253	36.21	469.53	11.72	11.72	11.72	474.6	2.9	0.37	204	0.35	0.0114	0.6441
AJ	100% Grassland (heavysoil), steep	43,371	0.04337	19.83	342.86	9.38	9.38	9.38	474.6	2.9	0.37	217	0.35	0.0152	0.9162
AK	100% Grassland (heavysoil), steep	12,505	0.01250	51.10	180.04	4.62	4.62	4.62	474.6	2.9	0.37	260	0.35	0.0044	0.3169
AL	100% Grassland (heavysoil), steep	38,295	0.03830	58.25	271.24	6.06	6.06	6.06	474.6	2.9	0.37	244	0.35	0.0134	0.9095
AM	100% Grassland (heavysoil), steep	66,715	0.06672	37.02	318.70	7.37	7.37	7.37	474.6	2.9	0.37	232	0.35	0.0234	1.5059
AN	100% Grassland (heavysoil), steep	62,139	0.06214	42.78	119.21	2.70	2.70	2.70	474.6	2.9	0.37	291	0.35	0.0217	1.7569
AO	100% Grassland (heavysoil), steep	27,601	0.02760	36.09	315.87	8.02	8.02	8.02	474.6	2.9	0.37	227	0.35	0.0097	0.6090
AP	100% Grassland (heavysoil), steep	18,727	0.01873	39.88	255.78	6.62	6.62	6.62	474.6	2.9	0.37	239	0.35	0.0066	0.4348
AQ	100% Grassland (heavysoil), steep	27,808	0.02781	39.27	273.22	6.82	6.82	6.82	474.6	2.9	0.37	237	0.35	0.0097	0.6408
AR	100% Grassland (heavysoil), steep	30,327	0.03033	18.92	295.94	8.47	8.47	8.47	474.6	2.9	0.37	223	0.35	0.0106	0.6592
AS	10% Concrete + 90% Grassland (heavysoil), flat	40,285	0.04028	1.49	168.25	7.79	7.79	7.79	474.6	2.9	0.37	229	0.32	0.0129	0.8192
AT	5% Concrete + 95% Grassland (heavysoil), flat	33,841	0.03384	8.19	244.27	8.18	8.18	8.18	474.6	2.9	0.37	226	0.29	0.0096	0.6048
AU	100% Grassland (heavysoil), flat	19,765	0.01976	3.59	244.98	10.20	10.20	10.20	474.6	2.9	0.37	212	0.25	0.0049	0.2911
AV	5% Concrete + 95% Grassland (heavysoil), flat	13,325	0.01333	7.26	132.24	4.98	4.98	4.98	474.6	2.9	0.37	256	0.29	0.0038	0.2703
AW	20% Concrete + 80% Grassland (heavysoil), flat	43,594	0.04359	3.44	270.60	10.51	10.51	10.51	474.6	2.9	0.37	210	0.39	0.0170	0.9933
														Total	**16.3356**

B. Calculation of Catchment Runoff Received by Existing Stream 2 (con't)

Catchment ID	Surface Type	Catchment Area (A), m^2	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_0), min	Time of Concentration (t_c), min	Duration (t_d), min	a (50 year return period)	b (50 year return period)	c (50 year return period)	Runoff intensity (i), with 16.0% Increase, mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
BA	100% Grassland (heavysoil), steep	34,288	0.03429	65.73	304.27	6.71	6.71	6.71	474.6	2.9	0.37	238	0.35	0.0120	0.7934
BB	100% Grassland (heavysoil), steep	67,748	0.06775	54.12	617.15	13.21	13.21	13.21	474.6	2.9	0.37	196	0.35	0.0237	1.2940
BC	100% Grassland (heavysoil), steep	14,692	0.01469	40.00	200.00	5.30	5.30	5.30	474.6	2.9	0.37	252	0.35	0.0051	0.3606
BD	100% Grassland (heavysoil), steep	22,149	0.02215	49.01	375.45	9.17	9.17	9.17	474.6	2.9	0.37	219	0.35	0.0078	0.4709
BE	100% Grassland (heavysoil), steep	10,272	0.01027	24.75	222.26	6.72	6.72	6.72	474.6	2.9	0.37	238	0.35	0.0036	0.2376
BF	100% Grassland (heavysoil), steep	2,779	0.00278	49.97	296.20	8.87	8.87	8.87	474.6	2.9	0.37	221	0.35	0.0010	0.0596
BG	100% Grassland (heavysoil), steep	15,947	0.01595	25.95	169.55	4.86	4.86	4.86	474.6	2.9	0.37	257	0.35	0.0056	0.3995
BH	30% Grassland (heavysoil), flat + 70% Grassland (heavysoil), steep	15,375	0.01538	2.71	73.80	3.34	3.34	3.34	474.6	2.9	0.37	279	0.32	0.0049	0.3819
BI	70% Grassland (heavysoil), flat + 30% Grassland (heavysoil), steep	24,849	0.02485	13.81	550.37	17.12	17.12	17.12	474.6	2.9	0.37	181	0.28	0.0070	0.3503
BJ	70% Grassland (heavysoil), flat + 30% Grassland (heavysoil), steep	39,109	0.03911	13.62	147.62	4.40	4.40	4.40	474.6	2.9	0.37	263	0.28	0.0110	0.8016
BK	15% Concrete + 15% Grassland (heavysoil), flat + 70% Grassland (heavysoil), steep	12,273	0.01227	12.35	103.61	3.54	3.54	3.54	474.6	2.9	0.37	276	0.43	0.0052	0.4001
BL	100% Concrete	929	0.00093	7.30	58.88	2.89	2.89	2.89	474.6	2.9	0.37	287	0.95	0.0009	0.0704
														Total	**5.6201**

C. Capacity Flow Estimation and Adequacy Check for Proposed Drainage System

Point (channel no.)	Shape	Diameter, m	Depth, m	Slope	Length, m	Manning's roughness coefficient	Cross Section Area, m^2	Wetted perimeter, m	Hydraulic radius, m	Mean velocity, m/s	Capacity flow, m^3/s	Catchments Served	Runoff, m^3/s	% of capacity flow	Sufficient Capacity? (Y/N)
A1 - A2	U-Channel	0.500	0.500	0.005	17	0.016	0.223	1.285	0.17	1.38	0.307	D,E,G	0.180	59%	Y
A2 - A3	U-Channel	0.500	0.500	0.005	8	0.016	0.223	1.285	0.17	1.38	0.307	D,E,G	0.180	59%	Y
A3 - A4	U-Channel	0.500	0.500	0.005	33	0.016	0.223	1.285	0.17	1.38	0.307	D,E,G	0.180	59%	Y
A4 - A5	U-Channel	0.750	0.750	0.005	33	0.016	0.502	1.928	0.26	1.80	0.905	B,C,D,E,G	0.562	62%	Y
A5 - A6	U-Channel	0.750	0.750	0.010	19	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.562	44%	Y
A6 - A7	U-Channel	0.750	0.750	0.010	13	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.562	44%	Y
A7 - A8	U-Channel	0.750	0.750	0.010	15	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.562	44%	Y
A8 - A9	U-Channel	0.750	0.750	0.010	10	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.562	44%	Y
A9 - A10	U-Channel	0.750	0.750	0.010	20	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.562	44%	Y
A10 - A11	U-Channel	0.750	0.750	0.010	7	0.016	0.502	1.928	0.26	2.55	1.280	B,C,D,E,G	0.562	44%	Y
A11 - A12	U-Channel	0.750	0.750	0.050	14	0.016	0.502	1.928	0.26	5.70	2.862	B,C,D,E,G	0.562	20%	Y
A12 - A13	U-Channel	0.750	0.750	0.050	8	0.016	0.502	1.928	0.26	5.70	2.862	B,C,D,E,G	0.562	20%	Y
A13 - A14	U-Channel	0.750	0.750	0.050	98	0.016	0.502	1.928	0.26	5.70	2.862	A,B,C,D,E,G	0.803	28%	Y
A14 - A15	U-Channel	0.750	0.750	0.050	39	0.016	0.502	1.928	0.26	5.70	2.862	A,B,C,D,E,G	0.803	28%	Y
A15 - A16	U-Channel	0.750	0.750	0.010	13	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J	0.836	65%	Y
A16 - A17	U-Channel	0.750	0.750	0.010	63	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J,K	0.858	67%	Y
A17 - A18	U-Channel	0.750	0.750	0.010	11	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J,K, L	0.914	71%	Y
A18 - A19	U-Channel	0.750	0.750	0.010	16	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J,K, L	0.914	71%	Y
A19 - A20	U-Channel	0.750	0.750	0.010	6	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J,K, L	0.914	71%	Y
C1 - C2	U-Channel	0.750	0.750	0.005	33	0.016	0.502	1.928	0.26	1.80	0.905	B,C,D,E,G	0.562	62%	Y
C2 - C3	U-Channel	0.750	0.750	0.100	22	0.016	0.502	1.928	0.26	8.06	4.047	B,C,D,E,G	0.562	14%	Y
C3 - C4	U-Channel	0.750	0.750	0.200	10	0.016	0.502	1.928	0.26	11.40	5.724	A,B,C,D,E,G	0.803	14%	Y
C4 - C5	U-Channel	0.750	0.750	0.100	11	0.016	0.502	1.928	0.26	8.06	4.047	A,B,C,D,E,G	0.803	20%	Y
C5 - C6	U-Channel	0.750	0.750	0.050	24	0.016	0.502	1.928	0.26	5.70	2.862	A,B,C,D,E,G	0.803	28%	Y
C6 - C7	U-Channel	0.750	0.750	0.050	26	0.016	0.502	1.928	0.26	5.70	2.862	A,B,C,D,E,G	0.803	28%	Y
C7 - C8	U-Channel	0.750	0.750	0.010	31	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G	0.803	63%	Y
C8 - C9	U-Channel	0.750	0.750	0.010	40	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G	0.803	63%	Y
C9 - C10	U-Channel	0.750	0.750	0.010	22	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J	0.836	65%	Y
C10 - C11	U-Channel	0.750	0.750	0.010	10	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J, K	0.858	67%	Y
C11 - C12	U-Channel	0.750	0.750	0.010	24	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J, K, L	0.914	71%	Y
C12 - A20	U-Channel	0.750	0.750	0.010	41	0.016	0.502	1.928	0.26	2.55	1.280	A,B,C,D,E,G,J, K, L	0.914	71%	Y
CA1	Circular Pipe	0.750	--	0.020	22	0.015	0.442	2.356	0.19	3.09	1.364	A,B,C,D,E,G,J, K, L, M	0.972	71%	Y
CA2	Circular Pipe	0.750	--	0.020	45	0.015	0.442	2.356	0.19	3.09	1.364	A,B,C,D,E,G,J, K, L, M	0.972	71%	Y
CA3	Circular Pipe	0.750	--	0.020	6	0.015	0.442	2.356	0.19	3.09	1.364	A,B,C,D,E,G,J, K, L, M	0.972	71%	Y

C. Capacity Flow Estimation and Adequacy Check for Proposed Drainage System (con't)

Point (channel no.)	Shape	Diameter, m	Depth, m	Slope	Length, m	Manning's roughness coefficient	Cross Section Area, m^2	Wetted perimeter, m	Hydraulic radius, m	Mean velocity, m/s	Capacity flow, m^3/s	Catchments Served	Runoff, m^3/s	% of capacity flow	Sufficient Capacity? (Y/N)
A1 - B1	U-Channel	0.375	0.375	0.005	21	0.016	0.126	0.964	0.13	1.14	0.143	F, G	0.083	58%	Y
B1 - B2	U-Channel	0.375	0.375	0.005	8	0.016	0.126	0.964	0.13	1.14	0.143	F, G	0.083	58%	Y
B2 -B3	U-Channel	0.375	0.375	0.005	19	0.016	0.126	0.964	0.13	1.14	0.143	F, G	0.083	58%	Y
B3 - B4	U-Channel	0.500	0.500	0.005	28	0.016	0.223	1.285	0.17	1.38	0.307	F, G,H	0.278	91%	Y
B4 - B5	U-Channel	0.500	0.500	0.100	15	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.309	23%	Y
B5 - B6	U-Channel	0.500	0.500	0.100	11	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.309	23%	Y
B6 - B7	U-Channel	0.500	0.500	0.100	17	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.309	23%	Y
B7 - B8	U-Channel	0.500	0.500	0.100	12	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.309	23%	Y
B8 - B9	U-Channel	0.500	0.500	0.100	17	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.309	23%	Y
B9 - B10	U-Channel	0.500	0.500	0.100	11	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.309	23%	Y
B10 - B11	U-Channel	0.500	0.500	0.100	22	0.016	0.223	1.285	0.17	6.15	1.373	F, G, H,I	0.309	23%	Y
D1 - D2	U-Channel	0.375	0.375	0.100	42	0.016	0.126	0.964	0.13	5.08	0.637	H	0.195	31%	Y
D2 - D3	U-Channel	0.375	0.375	0.100	28	0.016	0.126	0.964	0.13	5.08	0.637	H	0.195	31%	Y
D3 - B11	U-Channel	0.375	0.375	0.200	12	0.016	0.126	0.964	0.13	7.18	0.901	H	0.195	22%	Y
CB1	Circular Pipe	0.500	--	0.014	24	0.015	0.196	1.571	0.13	1.99	0.391	F - I	0.309	79%	Y

D. Capacity Flow Estimation and Adequacy Check for Existing Streams

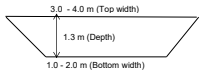
Stream	Top Width, m	Bottom Width, m	Depth, m	Slope	Manning's roughness coefficient	Cross Section Area, m^2	Wetted perimeter, m	Hydraulic radius, m	Mean velocity, m/s	Capacity flow, m^3/s	Catchments Served	Runoff, m^3/s	Contribution from Identified Catchments, %	Sufficient Capacity? (Y/N)
Stream 1	4.0	2	1.3	0.100	0.040	3.900	5.280	0.74	6.46	25.193	A to E, G, J to M and AA to AW	17.308	69%	Y
Stream 2	3.0	1	1.3	0.050	0.040	2.600	4.280	0.61	4.01	10.425	F to I and BA to BL	5.930	57%	Y

Note: Adequacy in capacities of the stream have been checked based on the most narrow section of the existing stream at the stormwater discharge point.

Note:
Runoff is calculated in accordance with DSD's "Stormwater Drainage Manual - Planning, Design and Management" (SDM), Fifth edition, Jan 2018.

Equations Used

$$t_0 = \frac{0.14465L}{H^{0.2}A^{0.1}} \qquad i = \frac{a}{(t_d + b)^c} \qquad t_c = t_0 + t_f \qquad Q_p = 0.278\,C\,i\,A$$



Schematic Section of the Streamcourse

Appendix E

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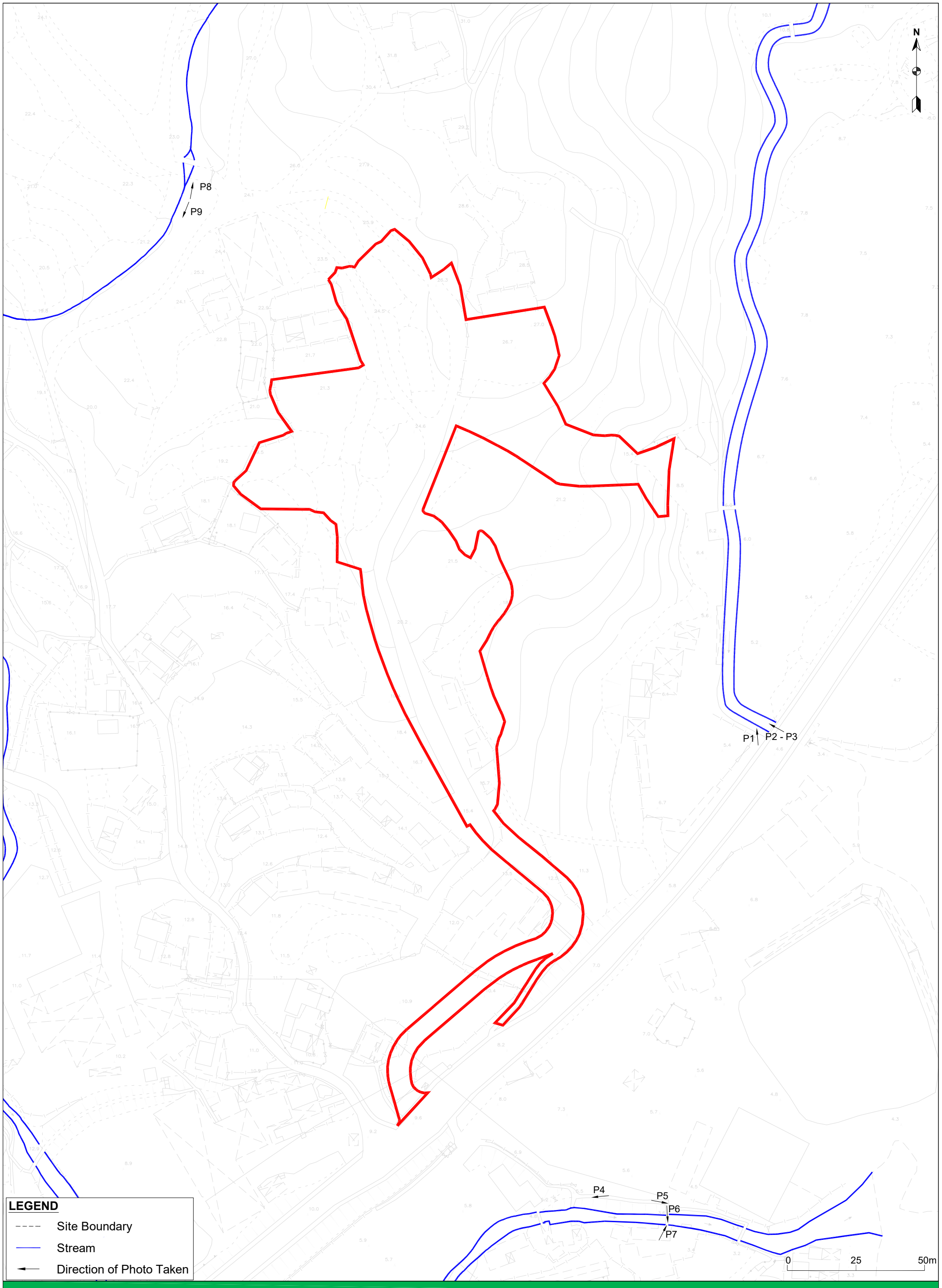

URBAN GREEN

S12A Rezoning Application for Proposed Columbarium on Various Lots in D.D.41, Sha Tau Kok, New Territories

Photo Index Plan

Appendix D

Rev. 0