Appendix I

Drainage Impact Assessment

S16 PLANNING APPLICATION FOR THE PROPOSED FILLING AND EXCAVATION OF LAND FOR THE PERMITTED "AGRICULTURAL USE" IN "CONSERVATION AREA" AT VARIOUS LOTS IN D.D.238, CLEAR WATER BAY, SAI KUNG, NEW TERRITORIES

DRAINAGE IMPACT ASSESSMENT

13 June 2024

Ref No: RT24120-DIA-01_r1

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Project:	S16 PLANNING APPLICATION FOR THE PROPOSED FILLING AND EXCAVATION OF LAND FOR THE PERMITTED "AGRICULTURAL USE" IN "CONSERVATION AREA" AT VARIOUS LOTS IN D.D.238, CLEAR WATER BAY, SAI KUNG, NEW TERRITORIES DRAINAGE IMPACT ASSESSMENT
Report No.:	RT24120-DIA-01_r1

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- We disclaim any responsibility to the client and others in respect of any matters outside the project scope.
- This report is confidential to the client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies upon the report at their own risk.

TABLE OF CONTENTS

1 INTRODUCTION

1.1 PROJECT BACKGROUND

BeeXergy Consulting Limited was commissioned by the KTA Planning Limited on behalf of Ringlet Global Limited (the Applicant) to prepare a drainage impact assessment (DIA) to support the S16 Planning Application for the Proposed Filling and Excavation of Land for the Permitted "Agricultural Use" in "Conservation Area" at Various Lots in D.D.238, Clear Water Bay, Sai Kung, New Territories (the Application).

Drawings and technical information on the existing agricultural land were provided by the Applicant and the Project Planning Consultant, KTA Planner Limited.

1.2 PROJECT LOCATION

The Project Site is located at Various Lots in D.D.238, Clear Water Bay, Sai Kung, New Territories, surrounded by Hang Hau Wing Lung Road. **Figure 1** shows the Project Site location and its surrounding area.

Figure 1 Location of the Project Site (Source: GeoInfo Map)

1.3 DESCRIPTION OF THE PROJECT SITE

The Project Site area is approximately 6,175 m^2. Minor filling for a bamboo shelter and excavation of site for two ponds is found. The master layout plan is provided in **Appendix A**.

2 DRAINAGE IMPACT ASSESSMENT

2.1 SCOPE OF WORKS

The objective of this Drainage Impact Assessment (DIA) is to assess whether the Project Site may cause adverse impacts on drainage and flooding or not with the minor filling and excavation of land. These impacts will be identified and mitigation measures will be proposed (when appropriate) in order to demonstrate that the Project Site with the minor filling and excavation of land will not cause an unacceptable increase in the risk of flooding in areas upstream of, adjacent to or downstream of the agricultural land.

2.2 SITE LOCATION AND TOPOGRAPHY

The Project Site is sloping downwards from west to east with topographic level from approximately +46.0 mPD to +32.0 mPD according to the topography map from Lands Department (LandsD). The Project site is currently a farmland.

2.3 EXISTING DRAINAGE FACILITIES

The existing drainage record from the GeoInfo Map of the LandsD and DSD are obtained for this DIA. According to the record, there are no existing manholes or public drainage pipes around the Project Site. Currently, the runoff from the Project Site is soaked away into the soil or flow through the natural valley according to topography of the surrounding area. The existing drainage record can be found in **Appendix B**.

2.4 DRAINAGE ANALYSIS

2.4.1 ASSUMPTIONS AND METHODOLOGY

Peak instantaneous runoff without and with the minor filling and land excavation was calculated based on the Rational Method. The recommended physical parameters, including runoff coefficient (C) and storm constants for different return periods, are as per the *Stormwater Drainage Manual* issued by DSD.

The Rational Method has been adopted for hydraulic analysis and the peak runoff is given by the following expression:

$$\boldsymbol{Q_p = 0.278\, C\, i\, A}$$

where:

Q_p = peak runoff in m^3/s

C = runoff coefficient

i = rainfall intensity in mm/hr

A = catchment area in km^2

Rainfall intensity is calculated using the following expression:

$$\boldsymbol{i = \frac{a}{(t_d + b)^c}}$$

where:

i = rainfall intensity in mm/hr

t_d = duration in minutes (td≤240)

a, b, c = storm constants given in Table 3 of SDM

For a single catchment, duration (t_d) can be assumed to be the time of concentration (t_c) which is calculated as follows:

$$\boldsymbol{t_c = t_0 + t_r}$$

where:

t_c = time of concentration

t_0 = inlet time (time taken for flow from the most remote point to reach the most upstream point of the urban drainage system)

Generally, t_0 is much smaller than t_f. As shown in Equation 2, t_d is the divisor. Therefore, larger t_d will result in smaller rain intensity (i) as well as a smaller Q_p. For the worst-case scenario, t_r is assumed to be negligible and so:

$$\boldsymbol{t_d = t_c = t_0}$$

$$\boldsymbol{t_0 = \frac{0.14465\, L}{H^{0.2}\, A^{0.1}}}$$

where:

A = catchment area (m^2)

H = average slope (m per 100m), measure along the line of natural flow, from the summit of the catchment to the point under consideration

L = distance (on plan) measured on the line of natural flow between the summit and the point under consideration (m)

The capacities of the drainage pipes have been calculated using the Colebrook-White Equation, assuming full bore flow with no surcharge, as follows, incorporate 10% sedimentation in the calculation of drainage flow capacity in accordance with the *Stormwater Drainage Manual:*

$$V = -\sqrt{32gRs} \times \log\left(\frac{k_s}{14.8R} + \frac{1.25v}{R\sqrt{32gRs}}\right)$$

where:

V = mean velocity (m/s)

g = gravitation acceleration (m/s^2)

R = hydraulic radius (m)

k_s = hydraulic pipeline roughness (m)

V = kinematic viscosity of fluid (m^2/s)

S = hydraulic gradient (energy loss per unit length due to friction)

2.5 ASSESSMENT ASSUMPTIONS

2.5.1 PROJECT SITE

For the Application, minor filling for a bamboo shelter and excavation of site for two ponds is found for the Project Site. The site characteristics of without and with the minor filling and land excavation are summarized in **Table 1**.

Table 1: Surface Characteristics and Runoff Coefficients of the Site

Scenario of Project	Area (m^2)	Surface Characteristics
Without the Minor Filling and Excavation of Site	6,175	95% unpaved + 5% paved[1]
With the Minor Filling and Excavation of Site	6,175	90% unpaved + 10% paved[1][2][3]

Remark:

[1] The percentage of paved area is assumed to be the amount of land covered by temporary structures, storage and platforms instead of paved with concrete.

[2] The excavation area is assumed as paved area in a conservative approach.

[3] The entire area of the free-standing bamboo shelter including the shaded area, plinths and barrels is assumed as paved area in a conservative approach.

2.5.2 CUMULATIVE RUNOFF (SURROUNDING CATCHMENTS)

According to the existing drainage record from the GeoInfo Map of the LandsD and DSD, there are no manholes and public drainage pipes around the Project site. All runoff from the Project site and the surrounding catchments shall be discharged by soak away method into the soil

or flow through the natural valley according to topography of the surrounding area.

The existing drainage network collects runoff from the Project Site and that from the surrounding catchments. Runoff from surrounding catchments (Catchment A) shall be taken into account in the estimation. The Project Site catchment that contributed to the cumulative runoff have been identified as Catchment S. According to the topography of the surrounding area, Catchment A is a valley located next to the Project Site. Runoff from Catchment A will soak away into the soil or flow down along the valley from west to east. Runoff from Catchment S will also soak away into the soil or flow down the valley and eventually flow into Catchment A due to topography of the surrounding area. Therefore, Catchment A is taken into account as a surrounding catchment for the flow estimation. The areas of Catchment S and Catchment A are shown in **Appendix C**.

With reference to the *Stormwater Drainage Manual*, the runoff coefficients of paved surface and soft landscape are 0.95 and 0.25 respectively. The paving conditions and runoff coefficients of related catchments are summarized in **Table 2**.

Table 2: Surface Characteristics and Runoff Coefficients of Surrounding Catchments

Catchment	Area (m^2)	Surface Characteristics	Runoff Coefficient for paved area	Runoff Coefficient for unpaved area
Project Site with the Minor Filling and Excavation of Site (Catchment S)	6,175	90% unpaved + 10% paved[1]	0.95	0.25
Catchment A	14,331	77% unpaved + 23% paved[1][2][3]	0.95	0.25

Remark:
[1] The percentage of paved area is assumed to be the amount of land covered by temporary structures, storage and platforms instead of paved with concrete.
[2] The excavation area is assumed as paved area in a conservative approach.
[3] The entire area of the free-standing bamboo shelter including the shaded area, plinths and barrels is assumed as paved area in a conservative approach.

2.6 ESTIMATED EXISTING AND FUTURE RUNOFF

Based on the assumptions described in **Section 2.4**, the runoff from the Project Site without and with the minor filling and land excavation was estimated based on a return period of 50 years.

The estimated peak runoff under a return period of 50 years generated from the Project Site Catchment S without and with the minor filling and land excavation are 0.126 m^3/s and 0.144 m^3/s respectively, as shown in **Table 3**. There is an increase of 13.9% in the estimated peak

runoff under the return periods of 50 years. Combining the peak runoff of the Project Site with the surrounding catchments, the estimated peak runoff generated are 0.533 m^3/s and 0.550 m^3/s respectively. There is a 3.3% increase in estimated peak runoff under the return periods of 50 years. **Table 4** shows the peak runoff of the Project Site and surrounding catchments. Detailed calculations are provided in **Appendix D**.

Table 3: Estimated Peak Runoff of the Project Site

Return Period	Estimated Peak Runoff		
	Without the Minor Filling and Excavation of Site	With the Minor Filling and Excavation of Site	% Change
50 Years	0.126	0.144	+ 13.9%

Table 4: Estimated Peak Runoff of the Project Site and Surrounding Catchments

Return Period	Estimated Peak Runoff		
	Without the Minor Filling and Excavation of Site	With the Minor Filling and Excavation of Site	% Change
50 Years	0.533	0.550	+ 3.3%

2.7 DRAINAGE LAYOUT AND RESULTS

Since there are no existing manholes and public drainage pipes around the Project Site, the surface runoff generated from stormwater within the Project Site will be soaked away or flow into surroundings due to topography of the surrounding area. Infiltration takes place and stormwater will be drained into the soil. Despite the fact that there will be a 13.9% increase in peak runoff with the minor filling and land excavation, the amount of increase is small and the soak away method and natural flow currently used in the Project Site and surroundings can cater such a small increase in peak runoff. Combining the peak runoff from the Project Site and the surrounding catchment, there is only a 3.3% increase. The soak away method and natural flow used can cater such a small increase in peak runoff. In case when excess runoff from stormwater is encountered, the runoff will flow into the sea in the northeast side of the Project Site and will not lead to adverse drainage impact to the surrounding areas. Therefore, no adverse drainage impact from the Project Site with the minor filling and land excavation is anticipated.

3 CONCLUSION

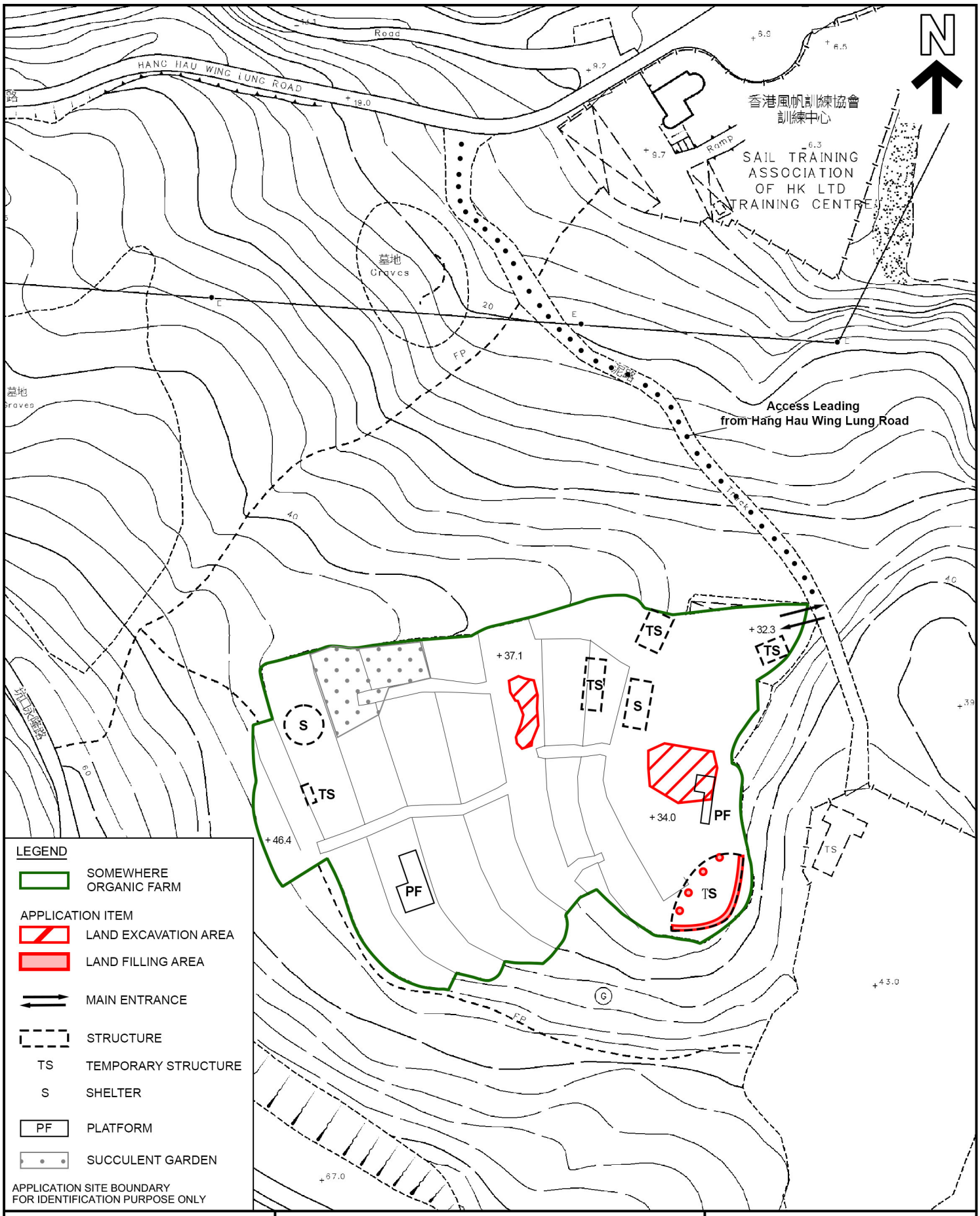
BeeXergy Consulting Limited was commissioned by the KTA Planning Limited on behalf of Ringlet Global Limited (the Applicant) to prepare a drainage impact assessment (DIA) to support the S16 Planning Application for the Proposed Filling and Excavation of Land for the Permitted "Agricultural Use" in "Conservation Area" at Various Lots in D.D.238, Clear Water Bay, Sai Kung, New Territories (the Application).

According to the existing drainage records from the GeoInfo Map of the LandsD and DSD, there are no existing manholes, public drainage pipes around the Project Site, runoff from the Project Site is currently soaked away or flew to the surrounding areas to deal with both surface runoff generated from stormwater. Infiltration takes place and stormwater will be drained into the soil.

The estimated peak runoff generated from the Project Site (Catchment S) without and with the minor filling and land excavation are 0.126 m^3/s and 0.144 m^3/s respectively. Combining the peak runoff of the Project Site with the surrounding catchments, the estimated peak runoff generated are 0.533 m^3/s and 0.550 m^3/s respectively. The percentage increases are 13.9% and 3.3% respectively. Since the amount of increase is small, the soak away method and natural flow currently used in the Project Site and surroundings can cater such a small increase in peak runoff. In case when excess runoff from stormwater is encountered, the runoff will flow into the sea in the northeast side of the Project Site and will not lead to adverse drainage impact to the surrounding areas. Therefore, no adverse drainage impact from the Project Site with the minor filling and land excavation is anticipated.

In conclusion, no adverse drainage impact generated from the Project Site with the minor filling and land excavation is anticipated.

APPENDIX A
MASTER LAYOUT PLAN OF THE PROJECT SITE



PLANNING LIMITED
規劃顧問有限公司

LAYOUT PLAN

PROPOSED EXCAVATION AND FILLING OF LAND
IN SUPPORT OF THE EXISTING AGRICULTURAL USE
VARIOUS LOTS IN D.D. 238, CLEAR WATER BAY,
SAI KUNG, NEW TERRITORIES

SCALE 1 : 1 000

PLAN 2

EXTRACT PLAN BASED ON
SURVEY SHEETS No. 12-NW-17B

DATE: 7.6.2024

APPENDIX B
EXISTING DRAINAGE SYSTEM

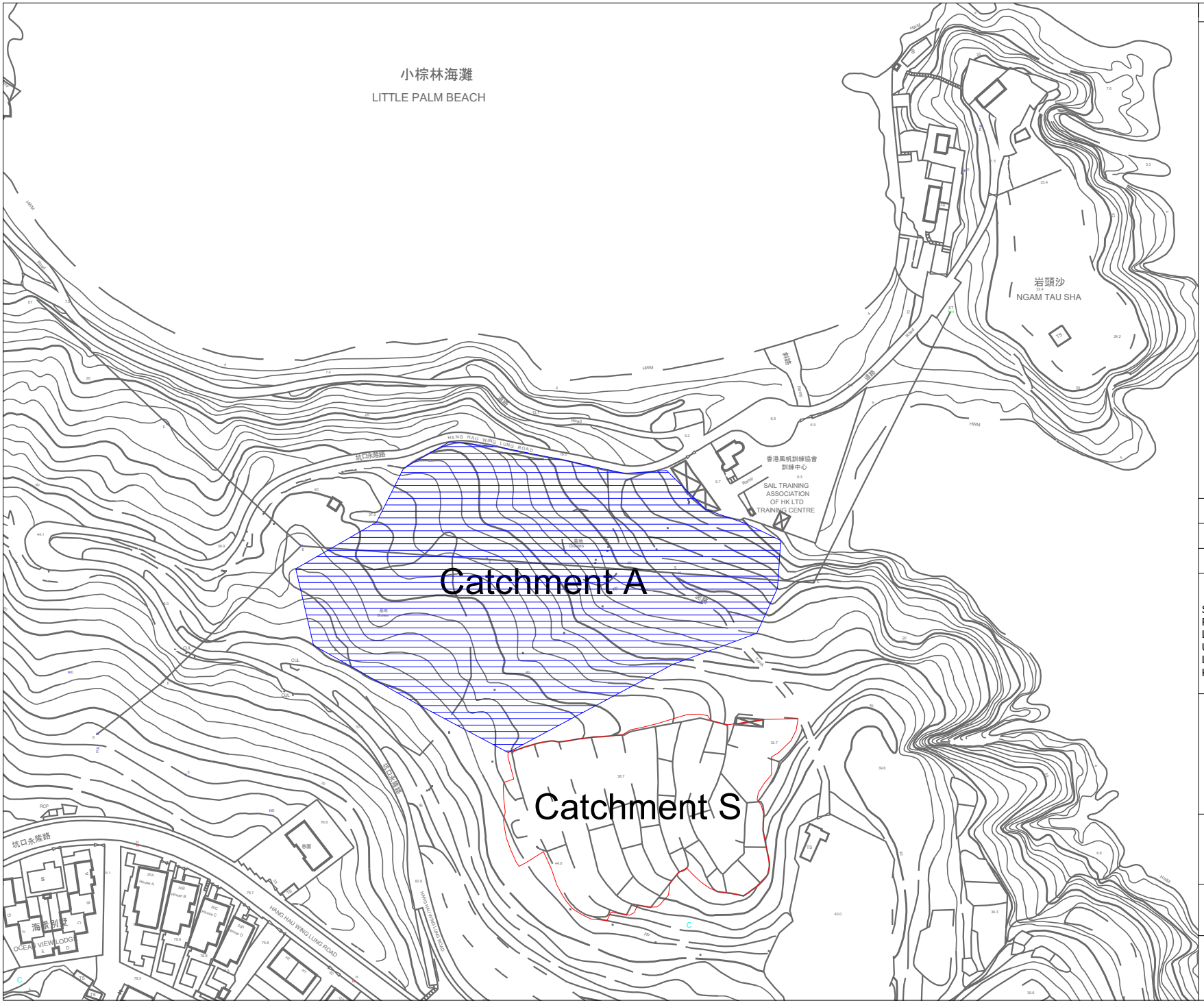
GEOINFO MAP
地理資訊地圖

Go to map: https://www.map.gov.hk/gm/geo:22.3165,114.2804?z=4514

Map Printed On 8th May 2023

Powered by GeoInfo Map: https://www.map.gov.hk

APPENDIX C
SURROUNDING CATCHMENTS PLAN



LEGEND:

PROJECT SITE

CATCHMENT TAKEN INTO ACCOUNT

	Prepared	Checked	Approved
Initial	HY	CC	YS
Date	12062024	12062024	12062024

Project Title

S16 PLANNING APPLICATION FOR THE PROPOSED FILLING AND EXCAVATION OF LAND FOR THE PERMITTED "AGRICULTURAL USE" IN "CONSERVATION AREA" AT VARIOUS LOTS IN D.D.238, CLEAR WATER BAY, SAI KUNG, NEW TERRITORIES

Drawing Title

SURROUNDING CATCHMENTS PLAN

Drawing No.	Rev.
DIA- 1001	0

Scale:

A4 - 1:2000

BXG

BeeXergy Consulting Limited

APPENDIX D
RUNOFF CALCULATION

Calculation of Runoff for Return Period of 50 Years

Catchment ID	Unpaved Catchment Area (km^2)	Paved Catchment Area (km^2)	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_o), min	Duration (t_d), min	Storm Constants			Runoff intensity (i) with climate change factor(*), mm/hr	Runoff coefficient for unpaved area (C_{up})	Runoff coefficient for paved area (C_p)	C x A	Peak runoff (Q_p) m^3/s
								a	b	c					
Without the Minor Filling and Excavation of Site															
Catchment S	0.005891	0.000284	0.0062	11.49	121.9	4.52	4.52	451.3	2.46	0.337	260.50	0.25	0.95	0.00174	0.126
Catchment A	0.011044	0.003287	0.0143	21.64	184.8	5.55	5.55	451.3	2.46	0.337	248.67	0.25	0.95	0.00588	0.407
														Total	**0.533**
With the Minor Filling and Excavation of Site															
Catchment S	0.005546	0.000629	0.0062	11.49	121.9	4.52	4.52	451.3	2.46	0.337	260.50	0.25	0.95	0.00198	0.144
Catchment A	0.011044	0.003287	0.0143	21.64	184.8	5.55	5.55	451.3	2.46	0.337	248.67	0.25	0.95	0.00588	0.407
														Total	**0.550**

Remark:

*Rainfall Increase due to climate Change = 111.1% (1.111)
Rainfall increase precentage due to climate change is referenced from Table 28 in DSD Corrigendum No. 1/2022 of the Stormwater Drainage Manual (SDM). 11.1% for Mid of 21st Century is adopted as worst case scenario.