Appendix D

Drainage Impact Assessment

CONFIDENTIAL

Civil Engineering and Development Department

Application for Permission under Section 16 of the Town Planning Ordinance (Cap. 131) for Proposed Temporary Centralised Quarters for Imported Labour in Construction Sector for a Period of 3 Years in "Industrial" Zone and Area Shown as 'Road' of Planning Area 36 of Hung Shui Kiu/ Ha Tsuen New Development Area

Drainage Impact Assessment

| August 2026

Job number 278463

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ARUP

Contents

Appendices

1 Introduction

1.1 General

1.1.1 Ove Arup and Partners Hong Kong Limited (Arup) was commissioned by the Civil Engineering and Development Department (CEDD) to submit a Section 16 Planning Application for Proposed Temporary Centralised Quarter for Imported Labour in Construction Sector within "Industrial" ("I") Zone and area shown as 'Road' of Planning Area 36 of the draft Hung Shui Kiu and Ha Tsuen Outline Zoning Plan ("the HSK/HT OZP") No. S/HSK/3 for a Period of 3 Years ("the proposed development").

1.1.2 The proposed development will have a total PR of about 0.456 with domestic GFA of about 13,414m^2 and non-domestic GFA of about 1,065m^2 respectively. The 8 nos. of two-storey residential blocks will provide about 450 residential module of Modular Integrated Construction (MiC) to provide accommodation for about 1,800 numbers of imported labour. The Proposed Development is targeted to commence operation in Q3 2027.

1.2 Site Location

1.2.1 The Application Site, with an area of about 31,787 m^2, is situated at the western part of HSK/HT NDA adjacent to the planned high-density development under the Second Phase Development of Hung Shui Kiu / Ha Tsuen New Development Area (HSK/HT NDA), of which the construction works have commenced since 2024. The Application Site itself is part of the Advance Works phase 3 of HSK/NT NDA for implementation of site clearance/ site formation and associated infrastructure works.

1.3 Scope of Updated Technical Assessments

1.3.1 The scope of updated technical assessment for drainage comprises the following:

- Undertake a review of the proposed drainage network and identify if there would be any deficiency / inadequate capacity based on the new development parameters;
- Propose the preliminary modification measures for the purpose of the DIA; and
- Submit the DIA to support the S16 Application.

1.3.2 This section outlines the assessment of the drainage impact potentially induced by the proposed development and includes:

- Estimation of drainage catchment arising from the proposed development;

- Assessment of potential impact on the existing and planned drainage system imposed by the proposed development; and
- Proposed preliminary drainage modification works, if considered necessary.

2 Planning Data and Drainage Design Parameters

2.1 Proposed Development

2.1.1

The development information is summarized in **Table 2.1**. The Indicative Scheme of the proposed development is shown in **Appendix A**.

Table 2.1 Proposed Development Parameters

Site Area (about)	31,787 m^2
Total Plot Ratio (about)	0.456
• **Domestic PR**	0.422
• **Non-domestic PR**	0.034
Total GFA (about)	14,479 m^2
• **Domestic GFA**	13,414 m^2
• **Non-domestic GFA**	1,065 m^2
Building Height	Residential Blocks: 2 storeys Ancillary Blocks: 1 to 2 storey(s)
Number of Blocks	8 Residential Blocks 6 Ancillary Blocks (including 3 Management Offices)
Population	About 1,800
Employment	About 100

2.2 Drainage Parameters and Assumptions

2.2.1

The DIA has been prepared in accordance with the following design manuals and information:

- ETWB TCW No. 2/2006 "Drainage Impact Assessment Process for Public Sector Projects";
- Stormwater Drainage Manual (SDM) Fifth Edition, January 2018;
- Stormwater Drainage Manual – Corrigendum No. 1/2022;
- Stormwater Drainage Manual – Corrigendum No. 1/2024;
- Stormwater Drainage Manual – Corrigendum No. 2/2024;
- DSD Technical Circulars and Practice Notes;
- Hong Kong Planning Standards and Guidelines, May 2016;

- CEDD GEO – Technical Guidance Note No. 39 (TGN 39) "Guidelines for Estimation of surface Runoff from Natural Terrain Catchments for Drainage Design Purposes";
- EN 12056-3:2000 "Gravity drainage systems inside buildings - Roof drainage, layout and calculation";
- Drainage Record Plans obtained from the GeoInfo Map services of the Lands Department; and
- Construction Drainage Impact Assessment (CDIA) Report (Report No. 4110616/BIN/CDIA/C58/Issue 1) submitted under construction stage of Second Phase Development of HSK/HT NDA.

2.3 Design Return Period

2.3.1 According to Table 10 of SDM, the existing watercourses near San Sang San Tsuen and nearby drainage system is considered as village drainage in view of the land use characteristics. With reference to Note 1 of Table 10 of SDM, 50-year event (i.e. a higher standard than 10-year event) will be adopted for the hydraulic assessment. The hydraulic performance of the drainage system was checked against the design flood protection levels as shown in **Table 2.2**.

Table 2.2 Design Return Periods for Flood Protection

Drainage System Category	Return Period (Years)
Main Rural Catchment Drainage Channels	50
Urban Drainage Branch Systems	50

2.4 Method of Analysis and Design Parameters

2.4.1 The rational method or classical theory of unit hydrograph with constant proportional losses (runoff coefficient) were used to calculate the catchment run-offs.

Design Rainfall Intensity

2.4.2 The design rainfall intensity has been obtained through the Intensity-Duration-Frequency (IDF) Relationship, as per SDM section 4.3. The IDF data can be expressed by the following algebraic equation:

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

Where:

i = extreme mean intensity in mm/hr
t_d = duration in minutes ($t_d \leq 240$), and
a, b, c = storm constants per DSD SDM

Design Runoff Flows

2.4.3 The catchment runoff has been assessed through the adoption of the Rational Method as specified in section 7.5.2 of SDM. The peak runoff is given by the following expression:

$$Q_P = 0.278\ C\ i\ A$$

Where:

Q_P	= peak runoff in m^3/s
C	= runoff coefficient (dimensionless)
i	= rainfall intensity in mm/hr
A	= catchment area in km^2

2.4.4 The unit hydrograph used to simulate the rainfall events was derived synthetically using the symmetrically distributed rainfall based on RO (1991) as recommended in Section 4.3.5 of the DSD SDM. The formulation is shown below:

$$F(t) = \begin{cases} \dfrac{a[b + 2(1-c)t]}{(2t+b)^{c+1}} & , \quad 0 \le t \le \dfrac{t_d}{2} \\ F(-t) & , \quad -\dfrac{t_d}{2} \le t \le 0 \end{cases}$$

where: F(t) = rate of rainfall or instantaneous intensity in mm/hr at time t (in minutes)
t_d = rainstorm duration (in minutes) (td≤240)
a,b,c = storm constants are given in Table 3a of DSD SDM, which are the same as those given of the algebraic equation of the IDF relationship

2.4.5 The inlet time, or time of concentration of a natural catchment has been assessed with Brandsby William's Equation as per SDM section 7.5.2.

2.4.6 The inlet times, or time of concentration of the catchments considered in this DIA Report were estimated using the Brandsby William's Equation as presented below:

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

where: t_0 = time of concentration of the catchment (min)
L = distance (on plan) measured on the line of natural flow between the summit and the point under consideration (m)
A = Catchment area (m^2)
H = Average slope (m per 100m), measured along the line of natural flow, from the summit of the catchment to the point under consideration

Design Climate Change Scenario

2.4.7 The proposed imported labour will be operated for a period of 3 years. As such, climate change effect is not considered in the hydraulic analysis. **Table 2.3** summarises the design assumptions related to climate change effect.

Table 2.3 Adopted Rainfall Increase

Scenario	Rainfall Increase	Design Allowance	Adopted Total Increase
No climate change effect	0%	0%	0%

Drainage Network Performance

2.4.8 The performance the stormwater drainage network has been assessed as per SDM 2024 Section 8.3 and Table 12. Underground stormwater network has been assessed through Colebrook-White formula, river and channels have been assessed through Manning's formula.

Design Siltation Allowance

2.4.9 The following reduction of pipe flow areas was adopted to assess the pipe hydraulic performance of both existing public drainage system and the proposed drainage system for the Site:

- a 5% reduction in flow area if the channel or pipe gradient is greater than 1 in 25; and
- a 10% reduction in flow area for other parts of the drainage network.

Design Extreme Sea Level

2.4.10 The existing drainage systems are within fluvial-tidal zones. The design extreme sea levels at Tsim Bei Tsui recommended in Corrigendum No. 1/2022 to SDM is adopted in the hydraulic analysis of this Project as shown in **Table 2.4**.

Table 2.3 Design Extreme Sea Levels

Return Period T (Year)	Design Extreme Sea Level (mPD)
50	4.09
10	3.52

Design Rainfall

2.4.11 The assessed catchments fall within SDM defined rainfall zone "HKO Headquarters". The adopted rainfall parameters are obtained from SDM 2024 Table 3a and summarised in **Table 2.5**.

Table 2.5 Adopted Rainfall IDF Parameters

Parameter	Return Period: 50 years
a	505.5
b	3.29
c	0.355

2.4.12 The assessed catchment areas are less than 25km^2, hence no aerial reduction factor has been applied.

Design Runoff Coefficients

2.4.13 The adopted runoff coefficients are summarised in **Table 2.6** and are consistent with SDM section 7.5.

Table 2.6 Adopted Runoff Coefficients

Surface	Runoff Coefficients
Paved Areas and Roofs	0.95
Green/Unpaved Areas	0.35

Design Inlet Time

2.4.14 The times of concentration (tc) for the different types of catchments are summarized in **Table 2.7**.

Table 2.7 Times of concentration for Different Types of Catchments

Type of Catchment	Time of Concentration
Natural Steep Slope	Based on Brandsby William's equation with a maximum of 5 minutes
Paved surface	Based on Brandsby William's equation with a maximum of 5 minutes

Design Roughness

2.4.15 The adopted roughness coefficients are consistent with SDM Table 13 and Table 14; and are summarised in **Table 2.8**.

Table 2.8 Adopted Roughness Coefficients

Drainage Network Element	Colebrook Roughness (mm)
Concrete Drainage Pipes	0.6
Drainage Network Element	**Manning's Roughness**
Concrete Channels	0.016

3 Assessment of Drainage Impact

3.1 Existing and Planned Drainage Infrastructure

3.1.1 Under the existing condition, runoff from the Yuen Tau Shan hillside catchments, including the proposed development site, is conveyed eastward through an existing channel crossing beneath Kong Sham Western Highway. The runoff then flows through the existing channel network to the nullah along Sha Chau Lei Road and ultimately discharges into the sea via the Tin Sam Channel.

3.1.2 Under the proposed development scenario, runoff from both the upstream hillside catchment and the development site will be collected and conveyed through a network of new surface channels and drainage pipes within the site. The collected runoff will subsequently be discharged via two proposed 1050 mm diameter pipes to the existing 2.25 m × 1.25 m and 1.2 m × 1.2 m rectangular channels, respectively, before ultimately discharging into the Tin Sam Channel.

3.1.3 The proposed drainage layout plan is presented in **Appendix B**.

3.2 Drainage Impact under Proposed Condition

3.2.1 The proposed development will involve the conversion of the existing unpaved area into paved surfaces and building footprints. As a result, the impermeable area within the site will increase, leading to an increase in surface runoff generated from the development site during rainfall events. Notwithstanding the increase in impermeable area, the proposed drainage system has been designed to collect and convey the additional runoff generated by the proposed development.

3.2.2 Meanwhile, the drainage impact to existing external drainage system is verified using the updated InfoWorks ICM model with reference to Stage 2 of the Construction Drainage Impact Assessment (CDIA) Report (Report No. 4110616/BIN/CDIA/C58/Issue 1) submitted under construction stage of Second Phase Development of HSK/HT NDA. A comparison of the flood levels under the baseline scenario and the proposed drainage scenario has been undertaken and is presented in **Appendix C**. Under the proposed development scenario, the existing downstream channels retain adequate freeboard and have sufficient hydraulic capacity to convey the additional runoff generated by the proposed development.

3.2.3 Based on the hydraulic assessment, no adverse drainage impact on the downstream drainage network is anticipated.

4 Summary

4.1.1 This DIA has been undertaken to assess the potential drainage impacts associated with the proposed Temporary Centralised Quarter for Imported Labour within Planning Area 36 of the HSK/HT NDA. The assessment reviewed the proposed drainage arrangement, evaluated the hydraulic performance of the drainage system, and assessed its potential impact on the existing downstream drainage network.

4.1.2 Under the existing condition, runoff from the Yuen Tau Shan hillside catchments, including the proposed development site, is conveyed eastward through the existing drainage system and ultimately discharged to the sea via the Tin Sam Channel. Under the proposed development scenario, runoff from both the upstream hillside catchment and the development site will be collected and conveyed through new surface channels and drainage pipes within the site before discharging into the existing downstream drainage network.

4.1.3 The proposed development will result in an increase in impermeable surfaces within the site and consequently generate additional surface runoff. The proposed internal drainage system has been designed to accommodate the additional runoff generated by the development.

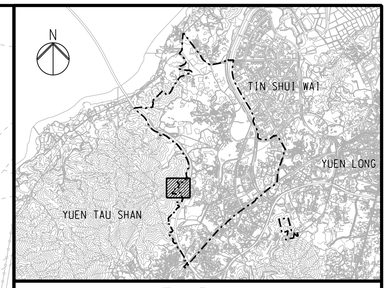
4.1.4 Hydraulic assessments were carried out with reference to the CDIA using the updated InfoWorks ICM model. The assessment results indicate that the existing downstream channels maintain adequate freeboard and possess sufficient hydraulic capacity to accommodate the additional runoff generated by the proposed development.

4.1.5 In conclusion, the proposed drainage system is considered adequate to serve the proposed development, and no adverse drainage impact on the existing downstream drainage network is anticipated as a result of the proposed development.

Appendix A

Indicative Scheme for the Proposed Development

816200 E
816400 E
833200 N
833000 N



KEY PLAN

LEGEND

APPLICATION SITE

Rev	Description	By	Date
A	FIRST ISSUE	KF	07/26

Consultant

ARUP

Project Title

Agreement No. CE 1/2020 (CE)
Hung Shui Kiu / Ha Tsuen
New Development Area Package A
Works for Second Phase Development
– Design and Construction

Drawing title

HSK / HT NDA
SECOND PHASE DEVELOPMENT
IMPORTED LABOUR QUARTERS
GENERAL LAYOUT PLAN

Drawing no.	Rev.
278463/SK/C/479	A

Drawn	Date	Checked	Approved
RY	06/26	EH	KKC

Scale	Status
1:750 @ A1	PRELIMINARY

土木工程拓展署
Civil Engineering and Development Department

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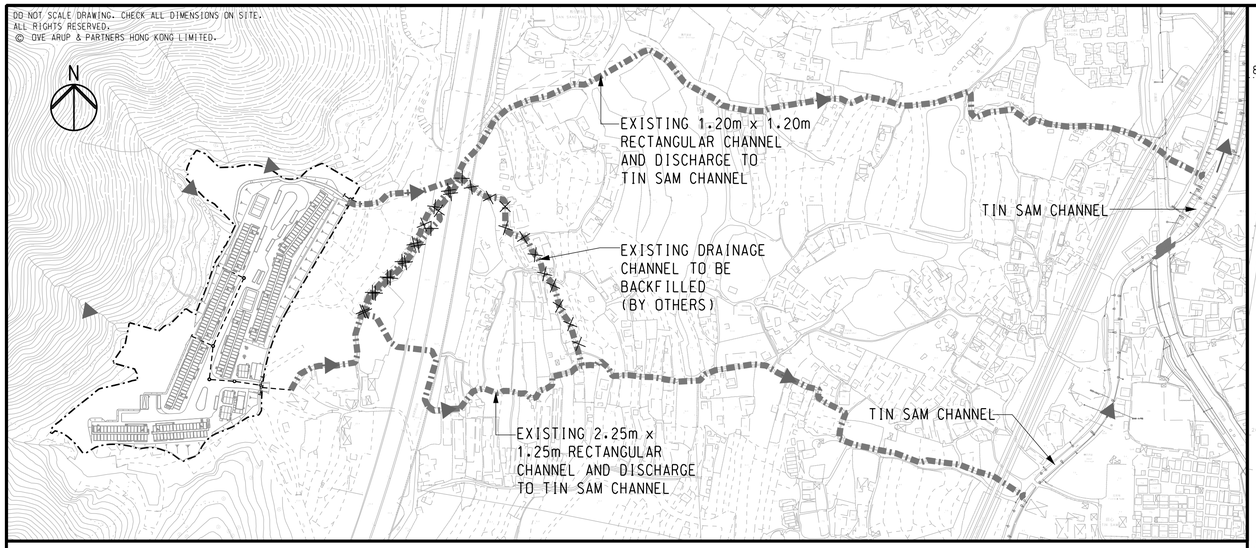
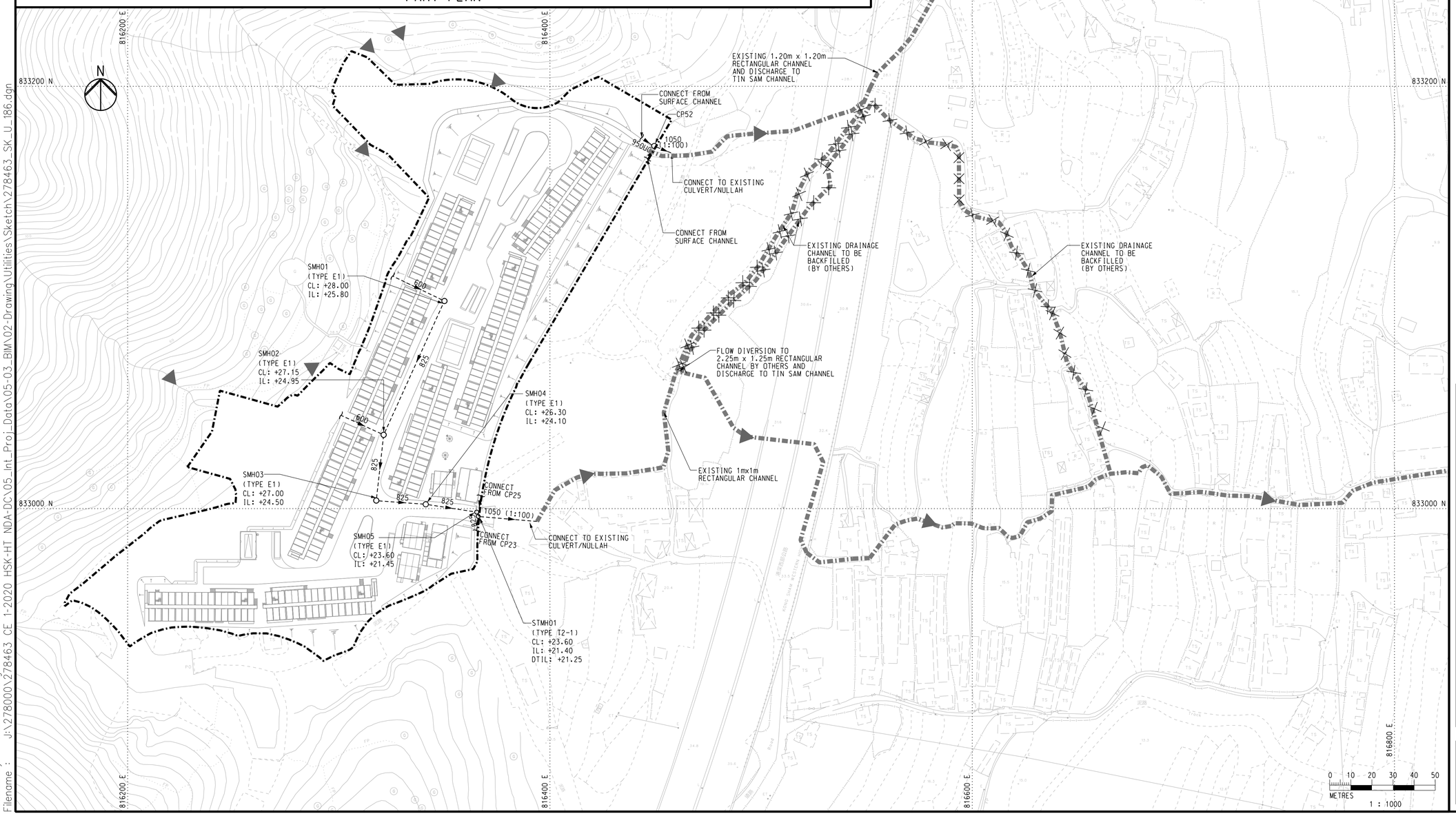
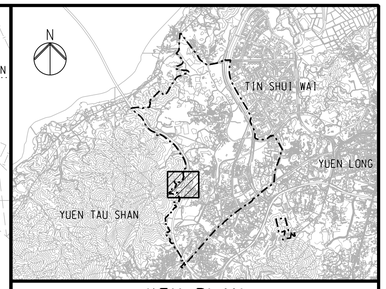
Appendix B

Proposed Drainage Layout Plan



PART PLAN





KEY PLAN

LEGEND

- APPLICATION SITE
- PROPOSED DRAINAGE PIPE
- PROPOSED DRAINAGE MANHOLE
- EXISTING CHANNEL
- EXISTING CHANNEL TO BE BACKFILLED (BY OTHERS)

Rev	Description	By	Date
A	FIRST ISSUE	KF	07/26

Consultant

ARUP

Project Title

Agreement No. CE 1/2020 (CE)
Hung Shui Kiu / Ha Tsuen
New Development Area Package A
Works for Second Phase Development
– Design and Construction

Drawing title

HSK / HT NDA
SECOND PHASE DEVELOPMENT
IMPORTED LABOUR QUARTERS
DRAINAGE LAYOUT PLAN

Drawing no.	Rev.
278463/SK/U/DIA/001	A

Drawn	Date	Checked	Approved
RY	06/26	EH	KKC

Scale	Status
1:1000 @ A1	PRELIMINARY

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Civil Engineering and Development Department

Printed by : Michael-KH.Ng Date : 8/3/2026
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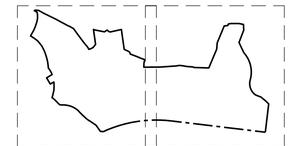
SCHEMATIC LAYOUT PLAN
FOR INFORMATION ONLY

EXTRACTED FROM DRAWING:



KEY PLAN

EXISTING POND WITHIN SITE BOUNDARIES

CP21 CP31 CP32 CP22 CP23 CP15 CP43 CP42 CP41 CP14 CP01 CP02 CP03 CP04 CP13 CP12 CP11 CP51 CP52

CONNECT TO SMH02
CONNECT TO SMH01
CONNECT TO STMH01
500 CUC TO STMH01 (1:100)
OUTLET (REFERS TO CIVIL DRAINAGE PLAN) +19.20
825 CUC (1:100) UNDER SEPARATE SUBMISSION +30.70
+26.10

MASS CONCRETE FILL

MASTER PERMANENT SITE DRAINAGE LAYOUT PLAN

LEGEND

- SITE BOUNDARY LINE
- CP1 — PROPOSED CATCHPIT
- 225 CUC (1:100) — PROPOSED U-CHANNEL WITH COVER; DIAMETER (mm) OF COVER U-CHANNEL; MINIMUM DEGREE OF FLOW
- 300 SC — PROPOSED STEPPED U-CHANNEL; DIAMETER (mm) OF STEPPED U-CHANNEL
- RAINWATER OUTLINE
- +23.73 — EXISTING GROUND LEVEL (mPD)

CATCHPIT SCHEDULE

Catchpit	Covered Level (mPD)	Inverted Level (mPD)	Catchpit Type
CP01	+28.05	+26.85	CATCHPIT TYPE (B) - CP(B)
CP02	+28.05	+27.05	CATCHPIT TYPE (B) - CP(B)
CP03	+30.8	+29.8	CATCHPIT TYPE (B) - CP(B)
CP04	+29.5	+28.7	CATCHPIT TYPE (B) - CP(B)
CP11	+31	+30.2	CATCHPIT TYPE (B) - CP(B)
CP12	+29	+28.2	CATCHPIT TYPE (B) - CP(B)
CP13	+28.25	+27.45	CATCHPIT TYPE (B) - CP(B)
CP14	+27.4	+26.4	CATCHPIT TYPE (B) - CP(B)
CP15	+23.6	+22.1	CATCHPIT TYPE (B) - CP(B)

NOTE: CATCHPIT DETAILS REFER TO DRAWING NO. F/RW001/DD001.

Catchpit	Covered Level (mPD)	Inverted Level (mPD)	Catchpit Type
CP21	+28.35	+27.55	CATCHPIT TYPE (B) - CP(B)
CP22	+24.8	+24	CATCHPIT TYPE (B) - CP(B)
CP23	+23.6	+22.6	CATCHPIT TYPE (B) - CP(B)
CP31	+26.8	+26	CATCHPIT TYPE (B) - CP(B)
CP32	+27.15	+25	CATCHPIT TYPE (B) - CP(B)
CP41	+27.15	+26.35	CATCHPIT TYPE (B) - CP(B)
CP42	+27.65	+26.25	CATCHPIT TYPE (B) - CP(B)
CP43	+23.2	+22.4	CATCHPIT TYPE (B) - CP(B)
CP51	+19	+18	CATCHPIT TYPE (B) - CP(B)

AMENDED DRAWING

0 5 10 15 20 25 m
1 : 500 SCALE BAR

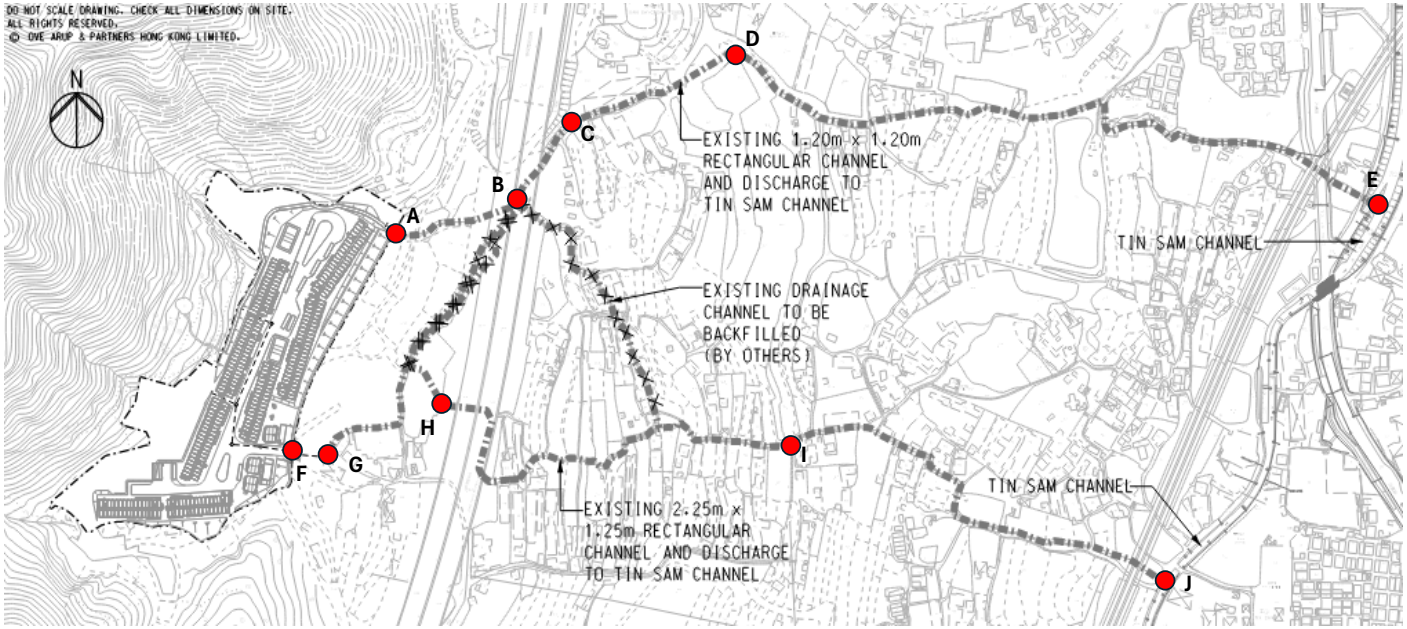
Drawing Title

SITE FORMATION WORKS –
MASTER PERMANENT SITE DRAINAGE LAYOUT PLAN

Status		
SUBMISSION		
Drawn: WT	Checked: KC	Approved: WC
Scale: 1:500 (A1)	CAD File No.: –	Date: JUNE 2026
First Issued	Drawing No.: F/SF001/FP201	Rev.: a

Appendix C

Results of Hydraulic Checking



Maximum Water Levels at Existing Drainage Channels

Existing Channel	Location ID	ICM ID	Description	Bank Level (mPD)	Scenario - Baseline						Scenario - Post Development					
					Water Level (mPD)			Freeboard (m)			Water Level (mPD)			Freeboard (m)		
					10A	50A	50B	10A	50A	50B	10A	50A	50B	10A	50A	50B
Existing 1.2m x 1.2m Rectangular Channel	A	816448833168	CP 52 (1050mm dia. discharge pipe from development site)	20.15	19.44	19.48	19.441	0.71	0.67	0.71	19.44	19.48	19.44	0.71	0.67	0.71
	B	OF 5A.2	Along the existing channel	17.30	16.17	16.31	16.172	1.13	0.99	1.13	15.87	15.93	15.87	1.43	1.37	1.43
	C	816600833254	Along the existing channel	16.50	15.05	15.19	15.048	1.45	1.31	1.45	14.86	14.99	14.86	1.64	1.52	1.64
	D	816706833313	Along the existing channel	14.60	12.96	13.10	12.963	1.64	1.51	1.64	12.84	12.95	12.84	1.76	1.65	1.76
	E	817246833173	Tin Sam Channel	6.65	4.84	5.20	5.05	1.81	1.46	1.60	4.91	5.25	5.10	1.74	1.40	1.55

Existing Channel	Location ID	ICM ID	Description	Bank Level (mPD)	Scenario - Baseline						Scenario - Post Development					
					Water Level (mPD)			Freeboard (m)			Water Level (mPD)			Freeboard (m)		
					10A	50A	50B	10A	50A	50B	10A	50A	50B	10A	50A	50B
Existing 2.25m x 1.25m Rectangular Channel	F	STMH06	STMH01 (1050mm dia. discharge pipe from development site)	23.60	22.42	22.60	22.418	1.18	1.00	1.18	22.41	22.59	22.41	1.19	1.01	1.19
	G	816510833135	Along the existing channel	21.20	20.64	20.82	20.653	0.56	0.38	0.55	20.74	20.89	20.74	0.46	0.31	0.46
	H	816462833046	Along the existing channel	21.05	17.45	17.50	17.453	3.59	3.55	3.59	18.52	18.62	18.52	2.53	2.43	2.53
	I	816701833008	Along the existing channel	11.33	10.72	10.88	10.721	0.61	0.45	0.61	10.88	11.01	10.88	0.46	0.32	0.46
	J	817079832893	Tin Sam Channel	7.68	6.10	6.48	6.108	1.58	1.21	1.58	6.31	6.70	6.31	1.38	0.99	1.38

Notes:
(1) Bank levels and water levels for the baseline scenario are extracted from the hydraulic model provided by DSD/LD in November 2025.
(2) Effects of climate change on rainfall intensity and sea level are not considered in the post-development scenarios.

Key:
Freeboard ≥ 300mm
0 ≤ Freeboard ≤ 299mm
Freeboard < 0 (i.e. overtopping)