Proposed Public Housing / Starter Homes Development and Private Residential Development with Government, Institution or Community Facilities at Various Lots in D.D. 122 and Adjoining Government Land, Yuen Long, New Territories (Land Sharing Pilot Scheme (Application No.: LSPS/005))

Drainage Impact Assessment

August 2025

Delivering a better world

Prepared by:

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Table of Contents

Tables

Figures

Annexes

1. Introduction

1.1 Background

1.1.1 AECOM Asia Company Limited (AECOM) has been commissioned by the Applicant to carry out a Drainage Impact Assessment (DIA) for the proposed Land Sharing Pilot Scheme (LSPS) Application in Wing Ning Tsuen, Yuen Long.

1.1.2 The purpose of this application is underpinned by the acute shortage of both public and private housing supply in Hong Kong. In the next decade, the Government estimates that there will be a major deficit of public and private housing production. Several policy initiatives have emerged to tackle the housing supply problem, the most notable of which is LSPS.

1.1.3 The Site is located in Wing Ning Tsuen, to the west of MTR Long Ping Station, to the east of Long Tin Road and to the northwest of Long Ping Road (**Figure 1** for the location of the Site).

1.1.4 The Application Site falls within the area under the Approved Ping Shan Outline Zoning Plan No. S/YL-PS/20 and is zoned partly “Green Belt” (GB) and partly “Comprehensive Development Area” (CDA).

1.1.5 The Applicant proposes a Public Housing / Starter Homes development and private residential development (around 7:3 in terms of flat supply), with supporting G/IC and infrastructure and community facilities under LSPS.

1.1.6 The Application Site refers to all land area covered by this LSPS application. The Development Sites comprise the proposed development of public and private residential flats with supporting G/IC and commercial facilities. The Application Site also includes an upgraded public access road. Please refer to **Table 1** for the proposed development scheme.

The Application Site	
Application Site Area incl. - Development Sites - Public Access Road	 45,465 m^2 (about) 17,132 m^2 (about)
Total GFA - Domestic - Non-domestic	 288,643 m^2 (about) 11,060 m^2 (about)
Total No. of Flats	5,773
Design Population	16,164
Development Site A1 (Private Residential Portion)	
Site Area	13,760 m^2 (about)
Domestic Plot Ratio	6.0 (about)
Total GFA - Domestic GFA - Non-domestic GFA	 82,560 m^2 (about) 7,000 m^2 (about)
No. of Flats (Private)	1,651 (about)
Maximum Number of Storeys	39
Maximum Building Height	not more than 175mPD

Development Site A2, B, C1 & C2 and D (Public Housing / Starter Homes Portion)	
Site Area	31,705 m^2 (about)
Domestic Plot Ratio	6.5 (about)
Total GFA - Domestic GFA - Non-domestic GFA	 206,083 m^2 (about) 4,060 m^2 (about)
No. of Flats (Public)	4,122 (about)
Maximum Number of Storeys	45
Maximum Building Height	not more than 160mPD

Table 1 – Proposed Development Scheme

1.2 Objective of this Submission

1.2.1 This report outlines the assessment results of the potential drainage impact caused by the Proposed Development at the Application Site. The main objectives of this assessment include the followings:

(i) Review the existing stormwater drainage condition;

(ii) Outline the methodology adopted in this assessment;

(iii) Outline changes to the drainage characteristics and potential drainage impacts which may arise from the Proposed Development;

(iv) Propose drainage mitigation measures where appropriate to mitigate the potential drainage impact.

1.3 Nomenclature

1.3.1 The following abbreviations and shortened expressions in **Table 2** are adopted in this report.

AECOM	AECOM Asia Company Limited
DSD	Drainage Services Department
GFA	Gross Floor Area
mPD	Metres above Principal Datum
PlanD	Planning Department
SDM	Stormwater Drainage Manual, Fifth Edition, January 2018

Table 2 – Nomenclature

2. Development Proposal

2.1 The Proposed Development

2.1.1 The Application Site consists of (i) Development Sites with total area of about 45,465 m^2; and (ii) proposed public access road of about 17,132m^2. Welfare facilities including a 30-place Small Group Home for Mildly Mentally Handicapped Children (SGHMMHC) and a Neighbourhood Elderly Centre (NEC) are proposed. The general layout of the Proposed Development is shown in **Figure 2**. The development schedule is referred to the Planning Statement.

2.1.2 The anticipated completion year of the Proposed Development is 2032/2033. The proposed flat nos. and development programme of the public housing portion are for technical assessment purpose only, and are subject to detailed design of the project proponent.

2.1.3 The proposed development schedule is summarized in **Table 3** below.

Development Site / Public Access Road	Site Area (m^2)
Private	
Site A1	13,760
Public	
Site A2	4,947
Site B	9,812
Site C1 & C2	12,500
Site C1	4,208
Site C2	8,292
Site D	4,446
Sub-Total (Private + Public (PH/SH))	**45,465**
Public Road	17,132

Table 3 – Development Schedule

3. Assessment Methodology

3.1 Drainage Impact Assessment Methodology

3.1.1 This assessment is carried out to assess the possible drainage impact arising from the Application Site on the drainage system. The Assessment is carried out in accordance with the requirements stated in "Advice Note No.1 – Application of the Drainage Impact Assessment Process to Private Sector Projects" issued by Drainage Services Department (DSD). Design parameters adopted are referenced to DSD's 5th Edition of Stormwater Drainage Manual (SDM) 2018, the Corrigendum No.1/2022 and Corrigendum No.1/2024 promulgated by Drainage Services Department (DSD). The adopted parameters are summarized in **Table 4**.

Design Standard	1 in 50-year storm event
Rainfall Zone	Hong Kong Observatory (HKO) Headquarters
Design Storm Parameters(2)	a = 505.5; b = 3.29; c = 0.355
Rainfall Intensity	$i = \frac{a}{(t_d + b)^c}$
Peak Runoff Estimation	Rational Method
Runoff Coefficient	0.95 for paved area; 0.35 for unpaved area
Pipe Sediment	10% reduction in pipe area
Pipe Roughness	ks=0.15mm for precast concrete pipe with 'O' ring joints under normal condition ks=0.6mm for precast concrete pipe with 'O' ring joints under poor condition n=0.018 for concrete lined channel
Rainfall Increase due to Climate Change (1)	16.0%
Design Allowance (1)	12.1%

Table 4 – Adopted Parameters in Drainage Impact Assessment

Note:

(1) In accordance with Corrigendum No. 1/2022 of Stormwater Drainage Manual, the proposed development adopted climate change effect up to End-21st century.

(2) In accordance with Corrigendum No.1/2024 of Stormwater Drainage Manual, the design storm parameters adopted storm constants for 1 in 50 years of HKO Headquarters.

4. Review on Existing Drainage System

4.1 Existing Drainage System

4.1.1 The Application Site consists of 6 Development Portions. The proposed Site A1, A2, and B are currently occupied by tree nurseries and covered with vegetation, while the remaining sites are largely occupied as a temporary storage or carpark area.

4.1.2 An existing stream “Kai Shan South Channel” located at the east of proposed Site C2. The surface runoff of Site C1, C2 and D are currently discharged to the stream connected to 3x1050mm pipe further downstream. It will eventually be discharged to a 12m wide Yuen Long West Nullah.

4.2 The Portion of Kai Shan Channel

4.2.1 About 340m^2 of 8,292 m^2 of Site C2 site area is the existing “Kai Shan Channel” which is located at the east of proposed Site C2 is proposed to remain in-situ. It followed the existing drainage flow direction and discharge to 3x1050mm pipe further downstream. Same drainage condition is anticipated before and after Site C2 development. Therefore, no adverse drainage impact arises for this portion of Kai Shan Channel in Site C2 and is excluded in the drainage impact assessment.

4.3 Impact on Existing Drainage System

4.3.1 Rational Method is adopted for estimation of the runoff from the pre-development and post development scenarios. No less than 10% greenery area will be provided for the individual proposed development sites according to the minimum site coverage of greenery of Buildings Department. Further to **Section 4.2**, about 7,952m^2 is considered for Site C2 hydraulic calculation.

4.3.2 The total surface runoff before the Proposed Development is 4.49m^3/s and post-development runoff is 5.81m^3/s. About 1.32m^3/s increase in surface runoff is expected after the proposed development due to the change of land use. The summary of the surface runoff calculation is shown in **Table 5** below. Details of runoff estimation for both pre-development and post-development refer to **Annex 1**.

		Unpaved area (m^2)[2]	Paved area (m^2)[2]	Time of Concentration (min)	Rainfall intensity (mm/hr)[1]	Total surface runoff (m^3/s)[3]
Pre-Development	A1[4]	42,037	0	9.71	261.32	1.07
	A2[5]	7,698	0	7.76	276.70	0.21
	B	2,944	6,868	4.00	320.25	0.67
	C1[8]	842	3,366	3.00	338.18	0.33
	C2[8]	2,386	5,566	4.03	320.25	0.55
	D	445	4,001	3.00	338.18	0.37
	Road[6]	1,713	15,419	5.00	306.16	1.30
					Total:	4.50

		Unpaved area (m^2)	Paved area (m^2)	Time of Concentration (min)	Rainfall intensity (mm/hr)(1)	Total surface runoff (m^3/s)(3)
Post-Development	A1(4)	29,653	12,384	6.01	294.63	1.81
	A2	495	4,452	2.92	339.47	0.42
	A2 external catchment	2,751	0	5.82	295.91	0.08
	B	981	8,831	4.00	320.25	0.78
	C1(8)	421	3,787	3.00	338.18	0.35
	C2(8)	795	7,157	4.47	313.85	0.62
	D	445	4,001	3.00	338.18	0.37
	Road	0	17,132	5.00	306.16	1.39
					Total:	5.82

Table 5 – Summary of Surface Runoff

Notes:

1) Please refer to Annex 1 for estimation of rainfall intensity and time of concentration.
2) Assume the percentage of paved area and unpaved area for pre-development is as a conservative estimate:
   - Site A1 & A2 (now as tree nurseries): 100% unpaved
   - Site B (tree nurseries with temporary structures): 30% unpaved and 70% paved
   - Site C1 (largely paved with temporary structure): 20% unpaved and 80% paved
   - Site C2 (largely paved with temporary structure): 30% unpaved and 70% paved
   - Site D (now as temporary carpark): 10% unpaved and 90% paved
   - Road Surface: 100% paved
3) In accordance with Corrigendum No. 1/2022 of Stormwater Drainage Manual, the Proposed Development adopted climate change effect up to End-21st century.
4) Include catchment A1 and external catchment (Ex-A1) in both pre and post development. (Figure 5 refers)
5) Include catchment A2 and external catchment (Ex-A2) in pre development.
6) Existing substandard road considered surface area 10% unpaved and 90% paved for runoff estimation.
7) The proposed development considered surface area 10% unpaved and 90% paved for runoff estimation.
8) The area difference of Site C1 and C2 (total: 12,160m^2) is due to the exclusion of Kai Shan Channel catchments (340m^2) in the drainage assessment.

5. Proposed Drainage System

5.1.1 Perimeter Drains are proposed to collect surface runoff generated from each development site. Runoff collected by perimeter drains will be discharged via a proposed terminal manhole in each development site. The cover level(s) of terminal manhole(s) should be higher than that of the downstream public manhole(s).

5.1.2 The surface runoff from Site A1, A2 and B and about half of the public road is estimated to be 3.79m^3/s under 1 in 50 year design storm event. The runoff is proposed to be discharged to the 1 cell box culvert located to the west of the site. New pipes ranged from 750mm dia. to 1500mm dia. pipe are proposed to convey the surface runoff to existing 5.8m(W) x 4.2m(H) box culvert. It is proposed to divert the existing 450mm dia. pipe between SCH1006661 and SMH1012247 and reconnected to proposed manhole SMH-1.11 to resolve pipe clash. The new pipe reconnection to the proposed stormwater manhole SMH-1.11 should be completed prior to the demolition of the existing pipe. The downstream 1500mm dia. pipe after proposed manhole SMH-1.11 will convey the surface runoff from Proposed Development and existing drainage catchment discharging via. 450mm dia. pipe to the existing 5.8m(W) x 4.2m(H) box culvert. The hydraulic calculation refers to **Annex 2**. The proposed drainage connection is shown in **Figure 4**.

5.1.3 The stormwater runoff will be eventually discharged to the existing 5.8m(W) x 4.2m(H) box culvert. The 3.79m^3/s runoff is equivalent to 1.60% utilization of the existing box culvert. Therefore, the drainage impact from the Proposed Development is insignificant. The hydraulic checking of the existing box culvert refers to **Annex 2**.

5.1.4 Likewise, runoff from the Site C1, C2 and D and about half of the public road proposed to discharge to the open channel located towards east of the site and eventually discharged to the 12m wide Yuen Long West Nullah. New pipes with diameter ranging from 525mm to 1050mm are proposed to connect to existing downstream public drainage system. The additional runoff from the Site C1, C2 and D and about half of the public road is about 0.135m^3/s. The drainage impact is insignificant to the existing 12m wide Yuen Long West Nullah. The proposed drainage connection is shown in **Figure 4** and hydraulic calculation can be referred to in **Annex 2**.

5.1.5 The size and details of the internal drainage system, perimeter drain Site C1, C2 and D and open channel proposed for the development will be further reviewed in the detailed design stage. Submission will be made to Buildings Department or relevant authorities for approval by individual developments in due course.

6. Maintenance Responsibility

6.1.1 The LSPS Applicant will be responsible for construction of all necessary drainage system, including the proposed pipe connected to the development sites under the site formation works (but excluding the internal drainage pipes within Site A2, B, C1, C2 and D) as well as other internal drainage infrastructure within the private development portion.

6.1.2 Future property management will be responsible for the maintenance of all proposed stormwater drain and other drainage infrastructure within the private development portion.

6.1.3 The Government will be responsible for the maintenance of all public stormwater drain and public drainage infrastructure. The property management of the Public Housing / Starter Homes development will be responsible for the maintenance of the stormwater drain or other drainage infrastructure within the Public Housing / Starter Homes development portion.

6.1.4 The responsible Government authority for maintenance of the portion of Kai Shan Channel at Site C2 will be discussed at later stage.

7. Conclusion

7.1.1 The DIA has been carried out to assess the impact on the existing drainage system due to the Proposed Development.

7.1.2 The development (Sites A1, A2, B, C1, C2 and D) and A1 and A2 external catchments would generate a total 5.81m^3/s runoff upon completion of the Proposed Development.

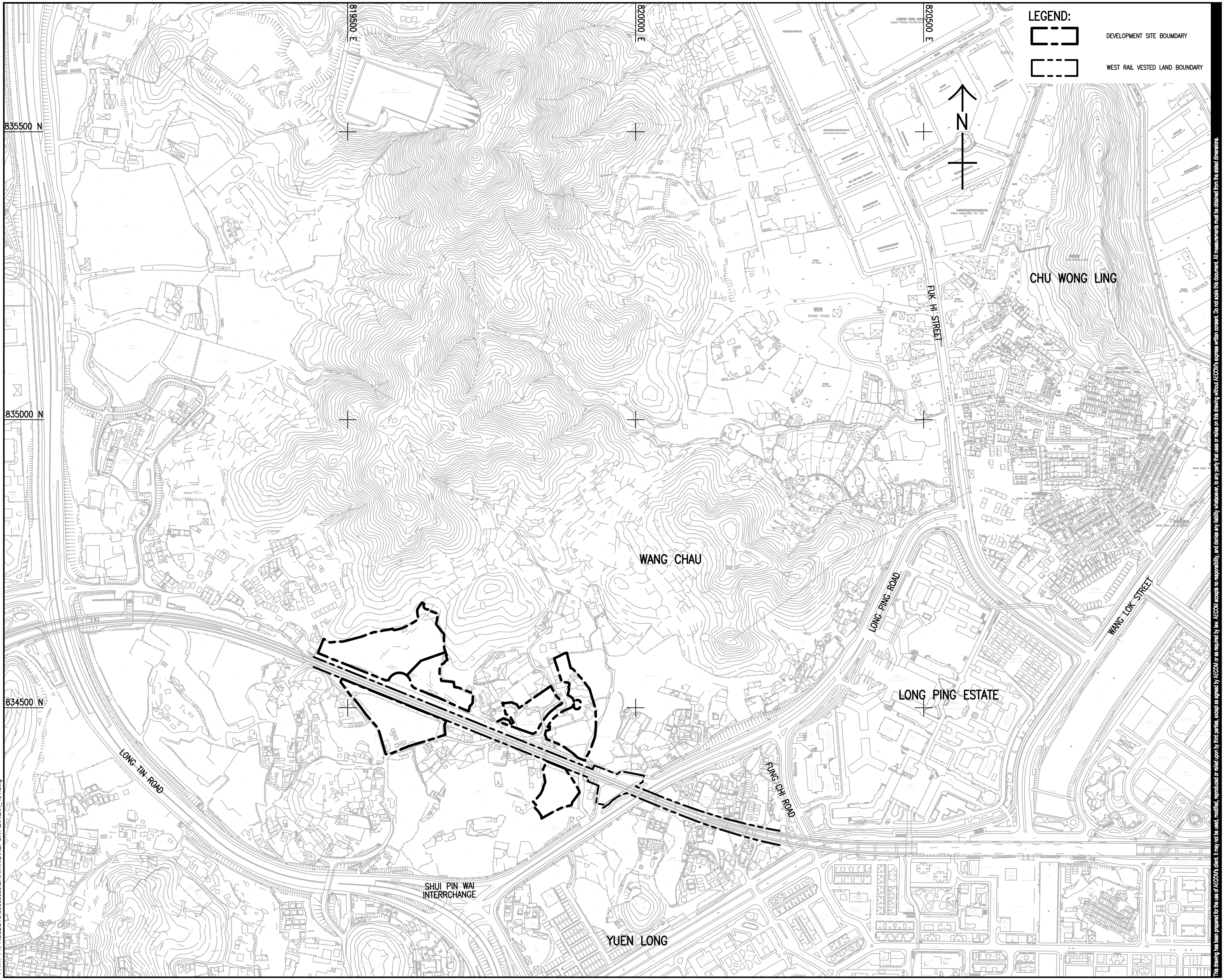
7.1.3 New pipes ranged from 750mm dia. to 1500mm dia. pipe are proposed from Site A1, A2 and B towards the western part of the site, discharged to the existing 5.8m(W)x4.2m(H) box culvert.

7.1.4 New drainage pipes with diameter ranging from 525mm to 1050mm are proposed from Site C1, C2 and D towards the southeast of the site connected to the existing downstream public drainage system. The runoff will be eventually discharged to the existing 12m wide Yuen Long West Nullah.

7.1.5 Based on the hydraulic assessment, there is no adverse drainage impact to the surrounding drainage system arising from the Proposed Development.

End of Report

Figures



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SCALE 比例 — A1 1 : 3000

DIMENSION UNIT 尺寸單位 — METRES

KEY PLAN 索引圖

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CONTRACT NO. 合約編號

SHEET TITLE 圖紙名稱

LOCATION PLAN

SHEET NUMBER 圖紙編號

60666680/DIA/FIGURE 1

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Checked:

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Project Management Initials:

819500 E

819700 E

819900 E

834700 N

834500 N

834300 N

LEGEND:

DEVELOPMENT SITE BOUMDARY

WEST RAIL VESTED LAND BOUNDARY

N

WANG CHAU

Podium Flat Roof
with Public Transport
Facilities Underneath

+30.0mPD

+23.0 mPD

SITE A1

175

T1
+157mPD

T2
+157mPD

+16.0mPD

T6 +175mPD

+175mPD T5

+38.0mPD

T3
+175mPD

+14.0mPD

T4
+175mPD

+15.4mPD

3m FOOTPATH

3m FOOTPATH

SITE A2

160

T1
+160mPD

+14.0mPD

+25.35mPD

SITE B

160

T1
+160.0mPD

+29.8mPD

CYCLE PARKING AREA

3m FOOTPATH

T2
+145mPD

3m FOOTPATH

4m CYCLE TRACK

Ingress & Egress of
Public Transport Facilities
(Bus Terminus, GMB
Terminus, Taxi Stand)

T2
+160.0mPD

+14.0mPD

+29.8mPD

T3
+61.0mPD

+13.5 mPD

T2
+61.0mPD

+12.5 mPD

SITE C1

+25.3mPD

160

+10.5 mPD

SITE C2

160

T1
+160mPD

+25.3mPD

T1
+160mPD

SETBACK LINE FOR PODIUM / TOWER STRUCTURE:
1m

KAI SHAN CHANNEL

+10.5 mPD

4m CYCLE TRACK

3m FOOTPATH

3m FOOTPATH

4m CYCLE TRACK

+9.7 mPD

MTR
Tuen Ma Line Viaduct

160 +8.0 mPD

SITE D

T1
+160mPD

+22.2mPD

3m FOOTPATH

4m CYCLE TRACK

3m FOOTPATH

PAI LAU
PAK KUNG
SHRINE

Long Ping Road

3m FOOTPATH

4m CYCLE TRACK

3m FOOTPATH

LONG PING ROAD

YUEN LONG

YUNG YUEN ROAD

WIP May 2021

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A1 1 : 1000

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SHEET NUMBER

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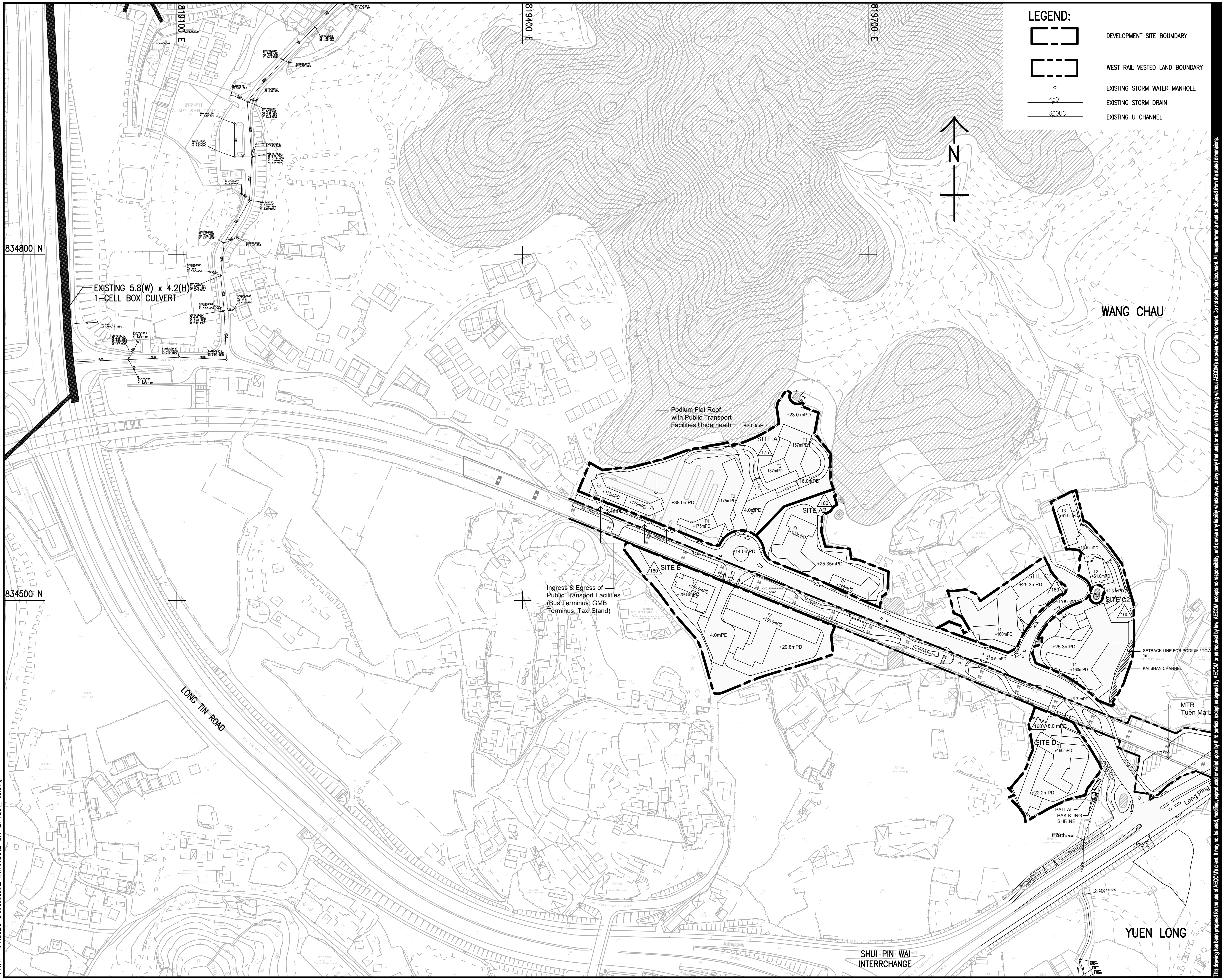

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DIMENSION UNIT: METRES

KEY PLAN

PROJECT NO.: 60666680

CONTRACT NO.

SHEET TITLE: EXISTING DRAINAGE LAYOUT PLAN

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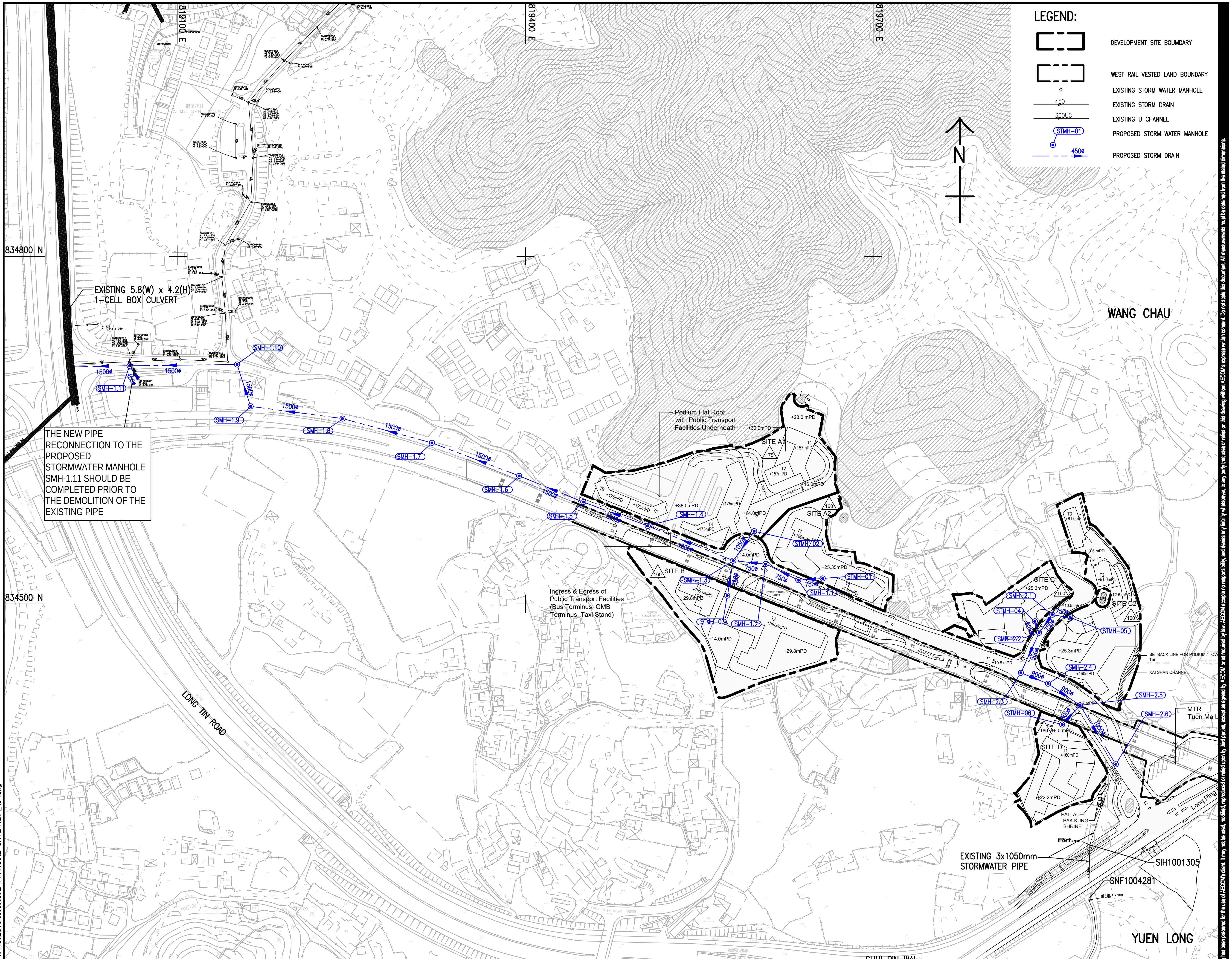

NOTE: THE COVER LEVEL(S) OF TERMINAL MANHOLE(S) SHOULD BE HIGHER THAN THAT OF THE DOWNSTREAM PUBLIC MANHOLE(S).

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SCALE 比例
A1 1 : 1500

DIMENSION UNIT 尺寸單位
METRES

KEY PLAN 索引圖

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60666680

CONTRACT NO. 合約編號

SHEET TITLE 圖紙名稱
PROPOSED DRAINAGE LAYOUT PLAN

SHEET NUMBER 圖紙編號
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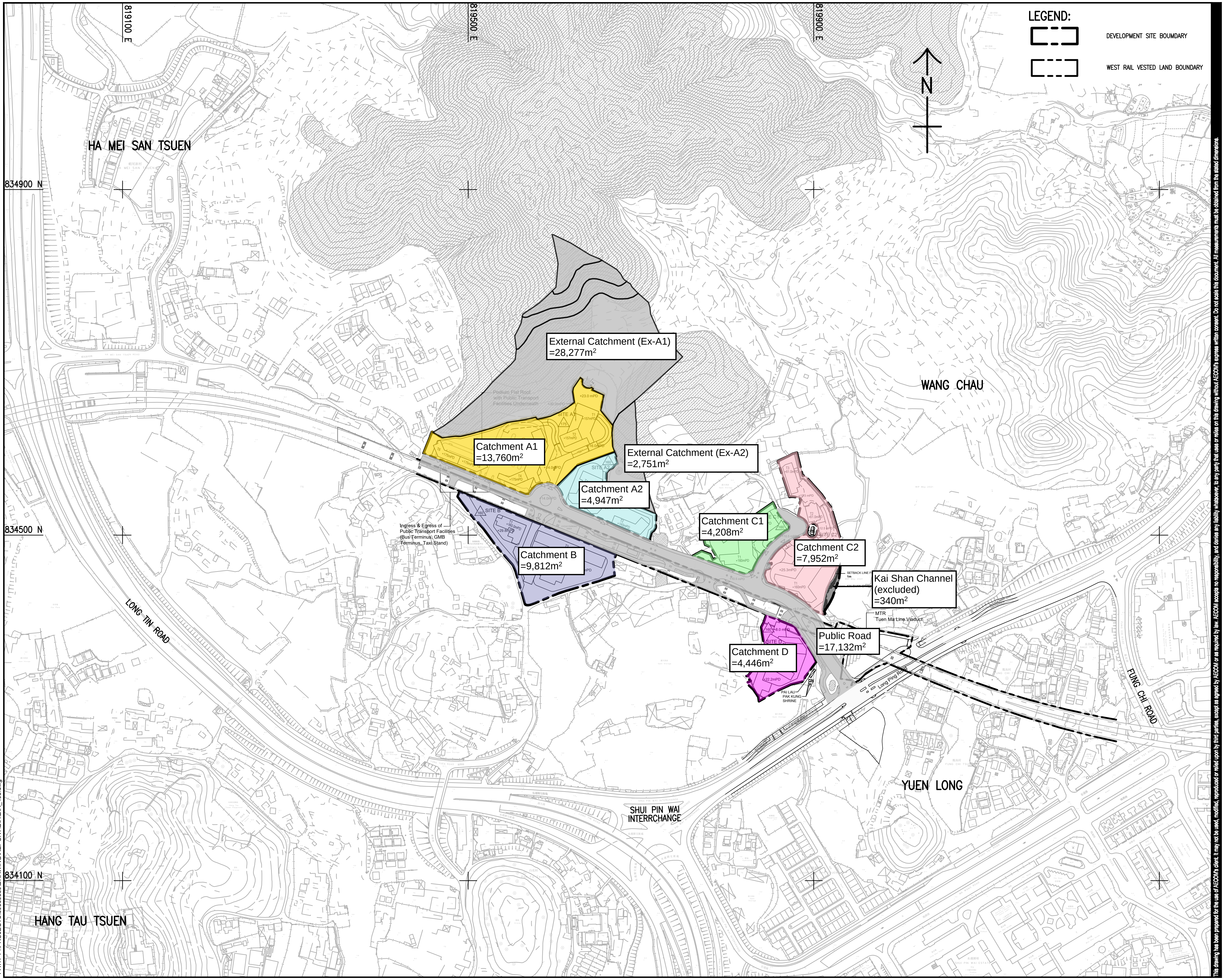

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CONTRACT NO. 合約編號

SHEET TITLE 圖紙名稱

PROPOSED DRAINAGE CATCHMENT PLAN

SHEET NUMBER 圖紙編號

6066680/DIA/FIGURE 5

Annex 1

Runoff Estimation

Time of concentration

Existing

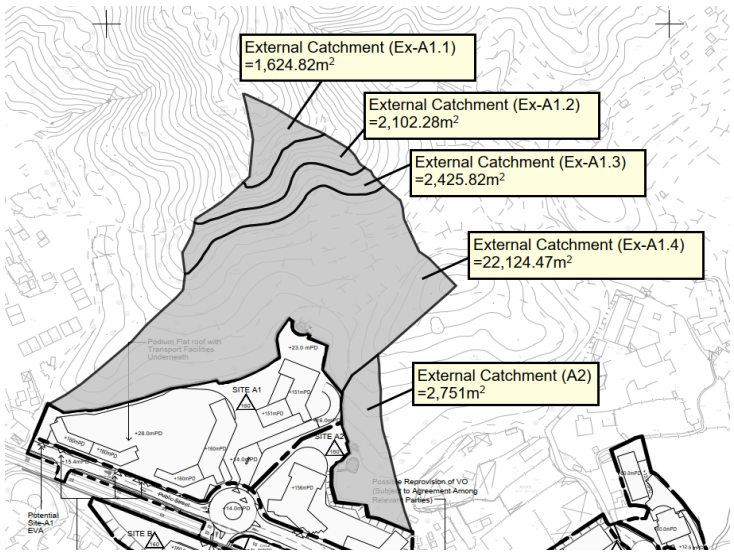
Time of Conecntration $t_c = t_o + t_f$

Inlet Time $t_o = \frac{0.14456L}{H^{0.2}A^{0.1}}$

Equal Area Slope Method for External Catchment Ex-A1.1~Ex-A1.4

	Contour Data				Equal Area Slope	
	CH	RL	Height	Area	LOB Height	LOB Area
	0	67.8	0	0	0.00	0.00
Ex-A1.1	50.5	55.1	12.7	1624.82	68.07	1718.84
Ex-A1.2	67.76	45	22.8	2102.28	91.34	1375.72
Ex-A1.3	86.77	39	28.8	2425.82	116.96	1979.92
Ex-A1.4	204.83	22.1	45.7	22124.47	276.11	23202.91

=> Slope: 1.35 m/m



	External Catchment Ex-A1		External Catchment Ex-A2	
Catchment Area (A)	28277.39	m^2	2751.42	m^2
Average Slope (H)	135	m/100m	31.76	m/100m
Distance (L)	204.83	m	131.62	m
Time of Concetration (t_o)	3.99	min	4.32	min

Flow Time $t_f = \sum_{j=1}^{n} \frac{L_j}{V_j}$

	Site A1		Site A2		Site C1		Site C2		Site D		Public Road	
Length of Drain	171.51	m	103.24	m	91.78	m	169.14	m	94.30	m	300.00	m
Flow Velocity of Drain	0.50	m/s	0.50	m/s	1.00	m/s	0.70	m/s	1.00	m/s	1.00	m/s
Flow Time (t_f)	343.02	sec	206.48	sec	91.78	sec	241.63	sec	94.30	sec	300.00	sec
Flow Time (t_f)	5.72	min	3.44	min	1.53	min	4.03	min	1.57	min	5.00	min
	9.71	min	7.76	min	3.00	min	4.03	min	3.00	min	5.00	min

Summary of time of concentration (min)

Site A1	Site A2	Site B	Site C1	Site C2	Site D	Road
9.71	7.76	4.00	3.00	4.03	3.00	5.00

(1) Time of concentration of 4 is adopted for Site B
(2) Minimum time of concentration 3 is adopted for Site C1 and Site D

Proposed

	Site A1				Site A2				Site A2 External Catchments			
	U Channel		Pipe		U Channel		Pipe		U Channel		Pipe	
Length of Drain	93.81	m	148.32	m	125.00	m	50.00	m	100.00	m	80.00	m
Flow Velocity of Drain	2.00	m/s	2.00	m/s	1.00	m/s	1.00	m/s	2.00	m/s	2.00	m/s
Flow Time (t_f)	46.91	sec	74.16	sec	125.00	sec	50.00	sec	50.00	sec	40.00	sec
Flow Time (t_f)	0.78	min	1.24	min	2.08	min	0.83	min	0.83	min	0.67	min
Total Time of Concentration =	6.01	min			Total Time of Concentration =	2.92	min		Total Time of Concentration =	5.82	min	

	Site C1				Site C2				Site D				Public Road	
	U Channel		Pipe		U Channel		Pipe		U Channel		Pipe		Pipe	
Length of Drain	73.93	m	82.94	m	148.21	m	119.99	m	59.21	m	84.01	m	300.00	m
Flow Velocity of Drain	1.00	m/s	1.00	m/s	1.00	m/s	1.00	m/s	1.00	m/s	1.00	m/s	1.00	m/s
Flow Time (t_f)	73.93	sec	82.94	sec	148.21	sec	119.99	sec	59.21	sec	84.01	sec	300.00	sec
Flow Time (t_f)	1.23	min	1.38	min	2.47	min	2.00	min	0.99	min	1.40	min	5.00	min
			2.61	min			4.47	min			2.39	min	5.00	min
			3	min							3	min		

Summary of time of concentration (min)

Site A1	Site A2	Site B	Site C1	Site C2	Site D	Road	Site A2 Ex. Catchments
6.01	2.92	4.00	3.00	4.47	3.00	5.00	5.82

(1) Time of concentration of 4 is adopted for Site B
(2) Minimum time of concentration 3 is adopted for Site C1 and Site D

Proposed Residential Development at
Wing Ning Tsuen
Runoff Calculations

Area	Existing Scenario		Proposed Scenario	
	Unpaved	Paved	Unpaved	Paved
Site A1 (m^2)	13760	0	1376	12384
	13760		13760	
External Catchment Ex-A1 (m^2)	28277	0	28277	0
	28277		28277	
Site A2 (m^2)	4947	0	495	4452
	4947		4947	
External Catchment Ex-A2 (m^2)	2751	0	2751	0
	2751		2751	
Site B (m^2)	2944	6868	981	8831
	9812		9812	
Site C1 (m^2)	842	3366	421	3787
	4208		4208	
Site C2 (m^2)	2386	5566	795	7157
	7952		7952	
Site D (m^2)	445	4001	445	4001
	4446		4446	
Public Road (m^2)	1713	15419	0	17132
	17132		17132	

(1) Area of the proposed development is 4.53 ha approx.
(2) The following paved/unpaved ratio is adopted for existing scenario according to satellite image.
- Site A1 & A2 (now as tree nurseries): 100% unpaved;
- Site B (tree nurseries with temporary structures): 30% unpaved and 70% paved;
- Site C1 (largely paved with temporary structures): 20% unpaved and 80% paved;
- Site C2 (largely paved with temporary structures): 30% unpaved and 70% paved;
- Site D (now as temporary carpark): 10% unpaved and 90% paved
- Road Surface: 10% unpaved and 90% paved

(3) The proposed development is adopting 10% unpaved and 90% paved ratio.

For **50-year** return period, t_d = varies min

a= 505.5
b= 3.29
c= 0.355

	Existing Scenario		Proposed Scenario	
Site A1 Rainfall Intensity (1 in 50 year)	261.32	mm/hr	294.63	mm/hr
Site A2 Rainfall Intensity (1 in 50 year)	276.70	mm/hr	339.47	mm/hr
Site A2 External Catchments Runoff (1 in 50 year)		mm/hr	295.91	mm/hr
Site B Rainfall Intensity (1 in 50 year)	320.25	mm/hr	320.25	mm/hr
Site C1 Rainfall Intensity (1 in 50 year)	338.18	mm/hr	338.18	mm/hr
Site C2 Rainfall Intensity (1 in 50 year)	320.25	mm/hr	313.85	mm/hr
Site D Rainfall Intensity (1 in 50 year)	338.18	mm/hr	338.18	mm/hr
Public Road Rainfall Intensity (1 in 50 year)	306.16	mm/hr	306.16	mm/hr

(1) With reference to Table 3a of SDM 2018 Corrigendum No.1/2024
(2) With climate change considered
(3) Site A1 and A2 rainfall intensity consider external catchments for Existing Scenario

	Existing Scenario		Proposed Scenario	
Site A1 Runoff (1 in 50 year)	1.07	m^3/s	1.81	m^3/s
Site A2 Runoff (1 in 50 year)	0.21	m^3/s	0.42	m^3/s
Site A2 External Catchments Runoff (1 in 50 year)		m^3/s	0.08	m^3/s
Site B Runoff (1 in 50 year)	0.67	m^3/s	0.78	m^3/s
Site C1 Runoff (1 in 50 year)	0.33	m^3/s	0.35	m^3/s
Site C2 Runoff (1 in 50 year)	0.55	m^3/s	0.62	m^3/s
Site D Runoff (1 in 50 year)	0.37	m^3/s	0.37	m^3/s
Public Road Runoff (1 in 50 year)	1.30	m^3/s	1.39	m^3/s

(1) Runoff (Q) = 0.278 x C x i x A
(2) Runoff coefficient for paved and unpaved ground is 0.95 and 0.35 respectively.
(3) Site A1 Runoff consider external catchments
(4) Site A2 and External Catchments for Site A2 Runoff are separated.

Summary of Results

	Existing Scenario (m^3/s)	Proposed Scenario (m^3/s)	Net increase / decrease (m^3/s)	Discharge Point
Site A1 Runoff (1 in 50 year)	1.07	1.81	0.74	West*
Site A2 Runoff (1 in 50 year)	0.21	0.42	0.29	
Site A2 External Catchments Runoff (1 in 50 year)		0.08		
Site B Runoff (1 in 50 year)	0.67	0.78	0.11	
Site C1 Runoff (1 in 50 year)	0.33	0.35	0.02	East
Site C2 Runoff (1 in 50 year)	0.55	0.62	0.07	
Site D Runoff (1 in 50 year)	0.37	0.37	0.00	
Public Road Runoff (1 in 50 year)	1.30	1.39	0.09	50% West 50% East
Total Runoff (1 in 50 year)	4.50	5.82	1.32	/

* No existing stormwater drainage system is identified before the development.
The post-development discharge follows the site topography.

Annex 2

Hydraulic Calculation

Annex 2 - Hydraulic Calculations (Discharge to West, connected to existing manhole SMH1012249)

Checking of Velocity, Capacity and Hydraulic Head

Assume the proposed box culvert is operated under uniform flow at all time Using Colebrook-White Equation given in Table 12 of DSD Stormwater Drainage Manual as recommended by Section 8.3.1 of DSD Stormwater Drainage Manual

Colebrook-White Equation

$$\bar{v} = -\sqrt{32\,gRS}\,\log\left(\frac{k_s}{14.8R} + \frac{1.255\,v}{R\sqrt{32\,gRS}}\right)$$

where	$\bar{v}$ =	mean velocity (m/s)			
	g =	acceleration due to gravity (m/s^2)	=	9.81	m^2/s
	R =	hydraulic radius (m)			
	S =	frictional gradient (dimensionless)			
	k_s =	surface roughness (m)	=	0.15 mm	(Precast concrete pipes with "o" ring joints - normal condition)
	v =	kinematic viscoity (m^2/s)	=	0.000001003	m^2/s

1 in 50-yr

Catchment	Area (m2)	Rainfall Intensity (mm/hr)	Runoff Coefficient	Runoff (m3/s)
Site A1 Runoff (1 in 50 year)*	42037	294.6	0.52	1.81
Site A2 Runoff (1 in 50 year)	4947	339.5	0.89	0.42
Site A2 External Catchments Runoff (1 in 50 year)	2751	295.9	0.35	0.08
Site B Runoff (1 in 50 year)	9812	320.3	0.89	0.78
Public Road Runoff (1 in 50 year)	17132	306.2	0.95	1.39

*External Catchment included for Site A1

Calculation Check for 1 in 50 years

Flow (m^3/s)	MH#		IL		Conduit Length (m)	Gradient X (1 in X)	Type	Dimension (mm)		Flowable Area (m^2)	K_s (mm)	Wetted Perimeter (m)	Hydraulic Radius (m)	Velocity (m/s)	Capacity (m^3/s)	Runoff (m3/s)	FOS	Utilitzation	Remark
	From	To	US	DS				Height	Width										
0.420	STMH-01	SMH-1.1	11.31	11.22	18.5	200	Pipe	750	750	0.40	0.15	2.4	0.169	2.12	0.844	0.420	2.01	50	Runoff from Site A2
0.674	SMH-1.1	SMH-1.2	11.22	11.09	25.5	200	Pipe	750	750	0.40	0.15	2.4	0.169	2.12	0.844	0.674	1.25	80	Runoff from Site A2+12.5% public road+Site A2 external catchment
0.674	SMH-1.2	SMH-1.3	11.09	10.92	34	200	Pipe	750	750	0.40	0.15	2.4	0.169	2.12	0.844	0.674	1.25	80	Runoff from Site A2+12.5% public road+Site A2 external catchment
0.780	STMH-03	SMH-1.3	11.48	11.32	31.5	200	Pipe	750	750	0.40	0.15	2.4	0.169	2.12	0.844	0.780	1.08	92	Runoff from Site B
1.810	STMH-02	SMH-1.3	11.68	11.52	31	200	Pipe	1050	1050	0.78	0.15	3.3	0.236	2.61	2.033	1.810	1.12	89	Runoff from Site A1
3.611	SMH-1.3	SMH-1.4	10.92	10.61	78.5	250	Pipe	1500	1500	1.59	0.15	4.7	0.338	2.89	4.602	3.611	1.27	78	Runoff from Site A1+A2+A2 external catchment+B+37.5% public road
3.785	SMH-1.4	SMH-1.5	10.01	9.77	60	250	Pipe	1500	1500	1.59	0.15	4.7	0.338	2.89	4.602	3.785	1.22	82	Runoff from Site A1+A2+A2 external catchment+B+50% public road
3.785	SMH-1.5	SMH-1.6	9.27	9.03	59	250	Pipe	1500	1500	1.59	0.15	4.7	0.338	2.89	4.602	3.785	1.22	82	Runoff from Site A1+A2+A2 external catchment+B+50% public road
3.785	SMH-1.6	SMH-1.7	7.53	7.21	81	250	Pipe	1500	1500	1.59	0.15	4.7	0.338	2.89	4.602	3.785	1.22	82	Runoff from Site A1+A2+A2 external catchment+B+50% public road
3.785	SMH-1.7	SMH-1.8	5.71	5.40	78	250	Pipe	1500	1500	1.59	0.15	4.7	0.338	2.89	4.602	3.785	1.22	82	Runoff from Site A1+A2+A2 external catchment+B+50% public road
3.785	SMH-1.8	SMH-1.9	3.40	3.11	73	250	Pipe	1500	1500	1.59	0.15	4.7	0.338	2.89	4.602	3.785	1.22	82	Runoff from Site A1+A2+A2 external catchment+B+50% public road
3.785	SMH-1.9	SMH-1.10	3.11	2.96	35.5	250	Pipe	1500	1500	1.59	0.15	4.7	0.338	2.89	4.602	3.785	1.22	82	Runoff from Site A1+A2+A2 external catchment+B+50% public road
3.785	SMH-1.10	SMH-1.11	2.96	2.58	95	250	Pipe	1500	1500	1.59	0.15	4.7	0.338	2.89	4.602	3.785	1.22	82	Runoff from Site A1+A2+A2 external catchment+B+50% public road
0.192	SCH1006661	SMH-1.11	3.50	3.43	15	200	Pipe	450	450	0.14	0.6	1.4	0.101	1.34	0.192	0.192	1.00	100	Full-bored capacity ultilization of drainage pipe is assumed
3.977	SMH-1.11	1 cell B.C.	2.58	2.26	48	150	Pipe	1500	1500	1.59	0.6	4.7	0.338	3.28	5.216	3.977	1.31	76	Runoff from Site A1+A2+A2 external catchment+B+50% Public Road+Upstream drainage catchment collected by 450mm dia. pipe

Note

(1) 10% siltation of reduction of flowable area is considered for hydraulic check.

(2) Runoff coeffient is based on 10% unpaved & 90% paved under post-development

(3) 10% greenery assumption in hydraulic assessment is not include vertical greening.

(4) Precast concrete pipes with "o" ring joints is adopted for pipe checking.

(5) Manhole no. SMH-1.6, SMH-1.7 and SMH 1.8 are recommended to be proposed backdrop manholes to cater for level drop greater than 600mm.

Annex 2 - Hydraulic Calculations (Discharge to East, connected to existing Kai Shan South Channel)

Checking of Velocity, Capacity and Hydraulic Head

Assume the proposed box culvert is operated under uniform flow at all time Using Colebrook-White Equation given in Table 12 of DSD Stormwater Drainage Manual as recommended by Section 8.3.1 of DSD Stormwater Drainage Manual

Colebrook-White Equation

$$\bar{v} = -\sqrt{32\,gRS}\,\log\left(\frac{k_s}{14.8R} + \frac{1.255\,v}{R\sqrt{32\,gRS}}\right)$$

where	$\bar{v}$ =	mean velocity (m/s)			
	g =	acceleration due to gravity (m/s^2)	=	9.81 m^2/s	
	R =	hydraulic radius (m)			
	S =	frictional gradient (dimensionless)			
	k_s =	surface roughness (m)	=	0.15 mm	(Precast concrete pipes with "o" ring joints - normal condition)
	v =	kinematic viscoity (m^2/s)	=	0.000001003 m^2/s	

Catchment	Area (m^2)	Rainfall Intensity (mm/hr)	Runoff Coefficient	Runoff (m3/s)
Site C1 Runoff (1 in 50 year)	4208	338.2	0.83	0.35
Site C2 Runoff (1 in 50 year)	7952	313.8	0.83	0.62
Site D Runoff (1 in 50 year)	4446	338.2	0.83	0.37
Public Road Runoff (1 in 50 year)	17132	306.2	0.95	1.39

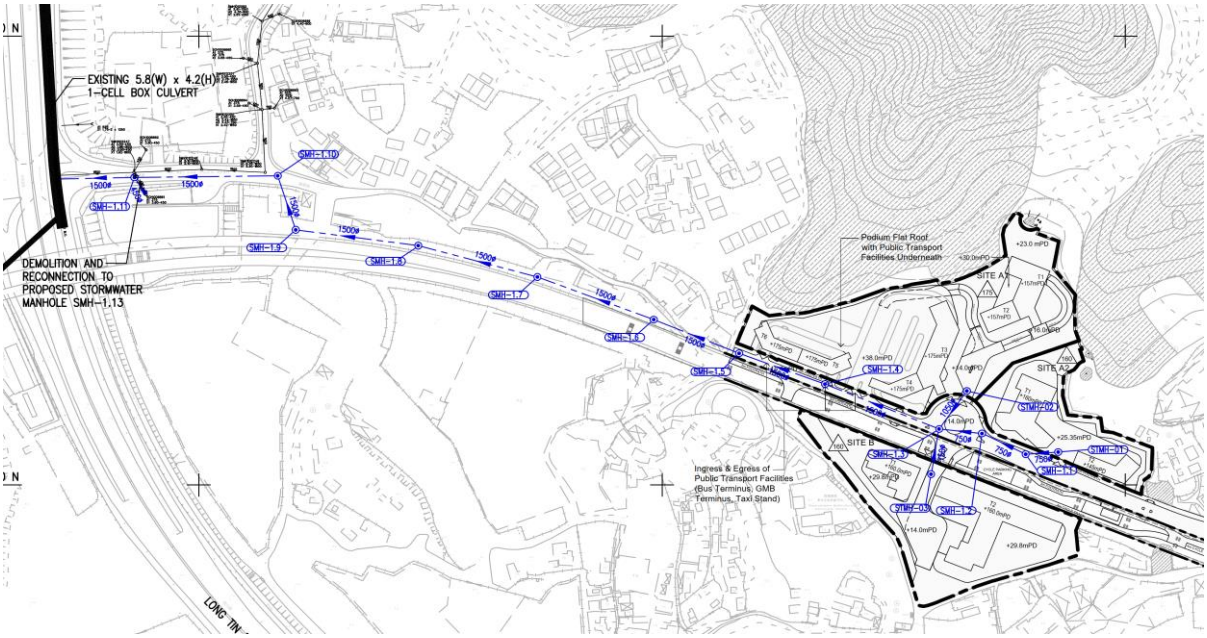
Calculation Check for 1 in 50 years

Flow (m^3/s)	MH#		IL		Conduit Length (m)	Gradient X (1 in X)	Type	Dimension (mm)		Flowable Area (m^2)	K_s (mm)	Wetted Perimeter (m)	Hydraulic Radius (m)	Velocity (m/s)	Capacity (m^3/s)	Runoff (m3/s)	FOS	Utilization	Remark
	From	To	US	DS				Height	Width										
0.620	STMH-05	SMH-2.1	6.79	6.72	13	200	Pipe	750	750	0.40	0.15	2.4	0.169	2.12	0.844	0.620	1.362	73	Runoff from Site C2
0.794	SMH-2.1	SMH-2.2	6.72	6.58	20.5	150	Pipe	750	750	0.40	0.15	2.4	0.169	2.46	0.977	0.794	1.231	81	Runoff from Site C2+12.5% of public road
0.350	STMH-04	SMH-2.2	7.18	7.08	10	100	Pipe	525	525	0.19	0.15	1.6	0.118	2.43	0.473	0.350	1.350	74	Runoff from Site C1
1.144	SMH-2.2	SMH-2.3	6.58	6.31	41	150	Pipe	900	900	0.57	0.15	2.8	0.203	2.75	1.574	1.144	1.376	73	Runoff from Site C1+C2+12.5% of public road
1.318	SMH-2.3	SMH-2.4	6.31	6.15	24	150	Pipe	900	900	0.57	0.15	2.8	0.203	2.75	1.574	1.318	1.195	84	Runoff from Site C1+C2+25% of public road
1.318	SMH-2.4	SMH-2.5	6.15	5.95	30	150	Pipe	900	900	0.57	0.15	2.8	0.203	2.75	1.574	1.318	1.195	84	Runoff from Site C1+C2+25% of public road
0.370	STMH-06	SMH-2.5	6.04	5.95	17.5	200	Pipe	600	600	0.25	0.15	1.9	0.135	1.85	0.471	0.370	1.272	79	Runoff from Site D
1.861	SMH-2.5	SMH-2.6	5.95	5.66	44	150	Pipe	1050	1050	0.78	0.15	3.3	0.236	3.02	2.353	1.861	1.264	79	Runoff from Site C1+C2+D+37.5% of public road
2.035	SMH-2.6	SIH1001305	5.66	5.24	84	200	Pipe	1050	1050	0.78	0.6	3.3	0.236	2.28	5.327	2.035	2.618	38	Runoff from Site C1+C2+D+50% public road
2.035	SIH1001305	SNF1004281	5.24	4.80	47.5	108	Pipe	1050	1050	0.78	0.6	3.3	0.236	3.11	7.262	2.035	3.569	28	Runoff from Site C1+C2+D+50% public road

Note

(1) 10% siltation of reduction of flowable area is considered for hydraulic check.
(2) Runoff coeffient is based on 10% unpaved & 90% paved under post-development
(3) 10% greenery assumption in hydraulic assessment is not include vertical greening.
(4) Precast concrete pipes with "o" ring joints is adopted for pipe checking
(5) Capacity of 3 nos. of existing 1050mm dia. storm drain have been taken into account for hydraulic checking. (Location of 3 nos. of existing 1050mm dia. storm drain refer to Figure 4)

Annex 2 - Existing Box Culvert Capacity Checking (From Site A1, A2 and B)



Parameter of Box Culvert

Height =	4.2 m			
Width =	5.8 m	Manning Coefficient,n=	0.018	(DSD SDM2013 table 13)
No. of Cells =	1			(Concrete lined Channel)

Hydraullic Capacity of Box Culvert By Manning Equations

$$\overline{V} = \frac{R^{1/6}}{n}\sqrt{RS_f}$$

Flow Area, A=	22.62 m^2		
Wetted Parameter, P =	13.6 m		
Hydraullic Radius , R =	A/P	=	1.663235 m
Hydraullic Gradient , S_f =	1 in 500	=	0.002

Flow Velocity, V=	3.49 m/s		
Discharge,Q =	78.89 m^3/s		
Drainage Capacity of Box Culvert		=	236.68 m^3/s

Total Runoff from Development = 3.79 m^3/s

Portion of Total Runoff to Drainage Capacity of Box Culvert = 1.60 %

(1) Area of the proposed development is 4.5 ha approx.
(2) Half of the road runoff is proposed to be discharged to the existing box culvert.
(3) The drainage impact from the proposed development to the existing box culvert is insignificant.