Appendix G Drainage Impact Assessment

Issue No. : 1
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DRAINAGE IMPACT ASSESSMENT

FOR

APPLICATION FOR AMENDMENT OF PLAN UNDER SECTION 12A FOR THE TOWN PLANNING ORDINANCE (CAP. 131) FOR MIXED USE DEVELOPMENT AT LOTS 796 AND 1008RP IN D.D. 77 AND ADJOINING GOVERNMENT LAND IN PING CHE, TA KWU LING, NEW TERRITORIES

Prepared by

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COMMERCIAL-IN-CONFIDENCE

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1. INTRODUCTION

1.1. Background

1.1.1. Allied Environmental Consultants Limited ("AEC") has been appointed to conduct a Drainage Impact Assessment ("DIA") to support of a Section 12A application for the mixed use development at Lot 796 & 1008 RP at D.D. 77 and adjoining government land in Ping Che, Ta Kwu Ling, New territories (hereinafter referred to as "Application Site").

1.1.2. According to the approved Ping Che and Ta Kwu Ling Outline Zoning Plan (OZP No.: S/NE-TKL/14) gazette on 12/03/2010, the Application Site is currently zoned as "Open Storage" ("OS") Zone, the southern part of the Application Site is zoned as "Agriculture" ("AGR") and a minor portion of the Application Site is shown as "Road".

1.2. Objectives

1.2.1. The objectives of this DIA are to review the proposed drainage facilities in the vicinity of the Proposed Development at the Application Site, evaluate potential impacts based on the catchment, recommend appropriate options for stormwater discharge, if necessary.

1.3. Report Structure

1.3.1. The remaining chapters of this report are shown below:

Chapter 2 – Site Context
Chapter 3 – Relevant Guidelines & Standards
Chapter 4 – Drainage Impact Assessment
Chapter 5 – Conclusion

2. SITE CONTEXT

2.1. Site Location and Its Environs

2.1.1. The proposed development is located at Ping Che Road from the north to northeast, the unnamed village road to the east, village, agricultural land and open storage area to the south and west.

2.1.2. ***Figure 2.1*** shows the Site location and its environs.

2.2. Proposed Development Scheme

2.2.1. The proposed site area of the application site is 17,822m^2, with a plot ratio of 5.9 for domestic use and 1.1 for non-domestic use. The total GFA for domestic use is 105,145 m^2, and the 19,603 m^2 for non-domestic use. The proposed development will consist of 5 blocks of residential tower ranging from 47 to 48-storey (excluding basement) in height, provided 2,205 residential unit, and 1 block of commercial tower with 35-storey (excluding basement) in height. The non-domestic use consisted of retail, office, hotel or service apartment, clubhouse, day care centre for the elderly and child care centre, and a proposed on-site Sewerage Treatment Plant (STP) within the Application Site.

2.2.2. The Master Layout Plan (MLP) and Sectional Drawing of the proposed development are shown in ***Appendix A.*** Based on the tentative implementation programme, the planned population intake would be in year 2032.

2.3. Existing Drainage Condition

2.3.1. Drainage information was obtained from the GeoInfo Map services of the Lands Department in Aug 2023 to gather the background information on drainage infrastructure in the vicinity of the Application Site. Concerned drainage network was identified for estimation of the potential impact to the downstream drainage associated with the proposed development. Stormwater runoff from Proposed Development is collected at the terminal manhole and discharged to existing public stormwater network along the Ping Che Road at the northeast side of the site, flowing to northwest direction and into the Ping Yuen River.

3. RELEVANT GUIDELINES & STANDARDS

3.1. Legislation, Standards and Guidelines

3.1.1. Water quality in Hong Kong is legislated by the provisions of the Water Pollution Control Ordinance (Cap 358), 1980 (WPCO). Territorial Water has been subdivided into ten Water Control Zones (WCZ) and four supplementary water control zones. A Technical Memorandum on Standards for Effluents discharged into Drainage and Sewerage Systems, Inland and Coastal Water (TMES) has been issued, which requires licensing of all discharges into all public sewers and drains. The water quality standards will have to be met during the operation stage.

3.1.2. Besides as stipulated in the Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations 41(1), 40(2), 41(1), 90 and recap in ProPECC PN 5/93, domestic sewage should be discharged to a foul water sewer and surface water should be discharged via rainwater pipes to stormwater drains during operation phase.

3.2. Assessment Methodology

3.2.1. ***Figure 3.1*** illustrates an overview of corresponding catchment areas and existing drainage network for this study. As shown in the ***Figure 3.1***, the surface runoff within the Application Site and the treated effluent from on-site STP will be collected and discharge through the terminal manhole (P1: STMH-01) at the Application Site and connected to the existing 450mm sewer public storm water manhole (S1: SMH1003243).

3.2.2. The drainage calculations are in accordance with the Stormwater Drainage Manual (Fifth Edition, January 2018 and Corrigendum No. 1/2022) published by Drainage Services Department (DSD). Rational Method shall be applied to estimate the peak surface runoff values. The idea behind the Rational Method is that for a spatially and temporally uniform intensity *i*, which continues indefinitely, the runoff at the outlet of a catchment will increase until the time concentration t_c, when the whole catchment is contributing flow to the outlet. The peak runoff is calculated as follows.

$$Q_P = 0.278\ C\ i\ A \quad \ldots\ldots (1)$$

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

3.2.3. Runoff coefficient C depends on the permeability, slope and pond character of the surface; rainfall intensity i, is the average rainfall intensity selected on the basis of the design rainfall duration and return period.

4. DRAINAGE IMPACT ASSESSMENT

4.1. Site Condition

4.1.1. The existing Application Site is used as storage area and workshop, it is partially covered with vegetation (~35% vegetation; ~65% paved). Existing public stormwater drains can be found at the northeast of Application Site along the Ping Che Road. The surface runoff from Application Site will be collected by the public stormwater manhole and finally discharge to Ping Yuen River.

4.1.2. The Application Site contains an approximate area of 17,822 m^2. The horizontal greenery area will be maintained at 20% for the Application Site.

4.2. Peak Flow Estimation

4.2.1. The peak flow from the Proposed development and existing scenario is calculated from equation (1) as mentioned in ***Section 3.2.2***. Detailed calculation is tabulated in ***Appendix B*** and summarized in ***Table 7-4*** below. The catchment of existing subject Site is shown in ***Figure 3.1.***

Table 4-1 Estimated Peak Flow for the Application Site

Catchment	Area (m^2)	Runoff under 1 in 50 years scenario (m^3/s)	Receiving Terminal Stormwater Manhole	Receiving Public Stormwater Manhole
Proposed Development				
Application Site	17,822	0.536	STMH-01	SMH1003243
STP	-	0.024	STMH-01	SMH1003243
Total:		**0.559**		
Existing Scenario				
Application Site	17,822	0.755	N/A	SMH1003243
Total:		**0.755**		

4.3. Potential Impact on Public Stormwater System due to Surface Runoff

4.3.1. The Application site is currently slightly hilly land and partially covered by greenery, while the proposed development is basically built on the paved surface. There is expected to be a decrease in overall greenery area within the Application Site.

4.3.2. Despite the reduction in greenery from ~35% to ~20%, according to the DIA hydraulic

calculations presented in Table 4-1 and ***Appendix B***, it is anticipated that surface runoff will decrease, going from 0.755m³/s to 0.560m³/s.

4.3.3. However, noted there is a New Territories North (NTN) New Town and Man Kam To Development plan nearby the Application Site, but no programme and details can be obtained during the course of study. Therefore, the upgrading works of drainage system is expected and the hydraulic calculation is provided in ***Appendix C***.

4.3.4. The Colebrook-White and Manning frictional resistance equations with reference to the Stormwater Drainage Manual (Fifth Edition) are used to calculate the hydraulic capacities of the stormwater drainage pipes.

4.3.5. As defined in Section 6.6.2 in Stormwater Drainage Manual, 50 years of the return periods for an Urban Drainage Branch System is adopted for the assessment. According to the calculation as tabulated in ***Appendix B***, the total flows from the Application Site under 1 in 50 years storm event are found to be 0.560 m^3/s after the Proposed Development, as summarized in ***Table 4-1***.

4.3.6. Surface runoff from Ping Che Road along the east to northeast side of Application Site is expected to be collected by SMH1003243 and SMH1003247, discharged into the SMH1003252 and finally to Ping Yuen River. Runoff from this catchment is also included in the calculation to assess the adequacy of the proposed stormwater pipe, the calculation is shown in ***Appendix C*** and summarized in ***Table 4-2***

Table 4-2 Estimation of Peak Flow and Drainage Capacity Check

Manhole		Catchment	Total Flow from Catchment	Percentage of Capacity
From	To			
STMH-01	SMH1003243	Application Site + STP	0.560	79%
SMH1003243	SMH1003246	Application Site + STP + Ping Che Rd (I) & (II)	0.704	72%
SMH1003246	SMH1003247	Application Site + STP + Ping Che Rd (I) & (II)	0.704	79%
SMH1003247	SMH1003249	Application Site + STP + Ping Che Rd (I) & (II) & (III)	0.781	88%
SMH1003249	SMH1003248	Application Site + STP + Ping Che Rd (I) & (II) & (III)	0.781	90%
SMH1003248	SMH1003250	Application Site + STP + Ping Che Rd (I) & (II) & (III)	0.781	90%
SMH1003250	SMH1003252	Application Site + STP + Ping Che Rd (I) & (II) & (III)	0.781	71%

4.3.7. With the upgrading of stormwater pipe, no adverse stormwater drainage impact due to the Proposed Development would be imposed to the existing drainage system.

4.3.8. For collecting surface runoff within the Proposed Development, the design of site drainage and disposal of various site effluents generated within the Application Site should follow the relevant guidelines and practices as given in ProPECC PN5/93. Proper drainage facilities will also be provided to discharge the surface runoff to the public drain. Therefore, no significant impact to the existing drainage system is expected.

4.3.9. No fertilisers or pesticides will be routinely used for vegetation management in landscape area in accordance with the General Specification for Building (2012 edition) by Architectural Services Department (ASD). During heavy rainfall, trace of pollutants may be wash-off and is often bound or adsorbed onto particles (i.e. loose soil or litter). The stormwater drainage system on site will be equipped with silt trap to remove the particles and associated pollutants. The stormwater discharge will satisfy the effluent standards and requirements stipulated in the WPCO-TM, notably, with respect to prohibited substances as stated in clauses 8.4 and 9.1, as the case may be.

4.3.10. Layout of major drainage channels within the Proposed Development will be submitted to the relevant authorities. All drainage facilities shall be designed and constructed to conform to the requirements laid down in:

- The Stormwater Drainage Manual, DSD
- The General Specification for Civil Engineering Works, Hong Kong Government
- The DSD Standard Drawings

5. CONCLUSION

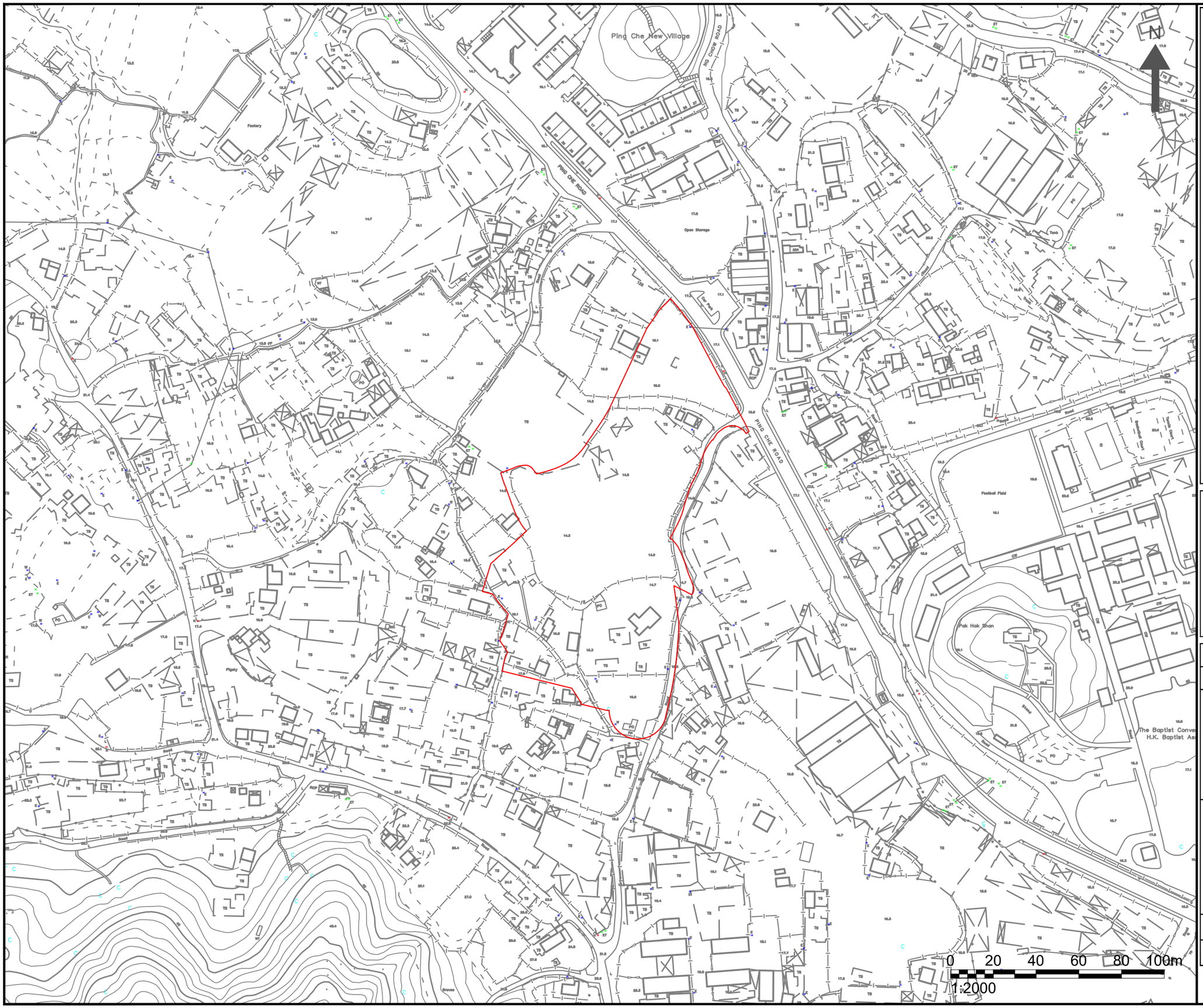
5.1.1. A Drainage Impact Assessment (DIA) has been conducted to evaluate the possible impacts on the public drainage network due to the proposed development. The stormwater runoff from Application Site and the treated effluent generated from STP will be collected at proposed terminal manhole (STMH-01) and discharged into the public stormwater manhole (SMH1003243).

5.1.2. There is a New Territories North (NTN) New Town and Man Kam To Development plan nearby the Application Site, the drainage system is expected to be upgraded, the assumption is made during the course of study. The assessment results demonstrated that all the pipe segments are sufficient to cater the surface runoff from proposed development.

5.1.3. Based on the above, it is concluded that the sewerage impact arising from the proposed development should be acceptable.

Figure 2.1

Application Site Location and Its Environs



NOTES :

APPLICATION SITE

Consultant

Allied Environmental Consultants Limited

Project No. :	2127
Drawing By :	CS

Project :

APPLICATION FOR AMENDMENT OF PLAN UNDER SECTION 12A FOR THE TOWN PLANNING ORDINANCE (CAP. 131) FOR MIXED USE DEVELOPMENT AT LOTS 796 AND 1008RP IN D.D. 77 AND ADJOINING GOVERNMENT LAND IN PING CHE, TA KWU LING, NEW TERRITORIES

Drawing Title :

APPLICATION SITE LOCATION & ITS ENVIRONS

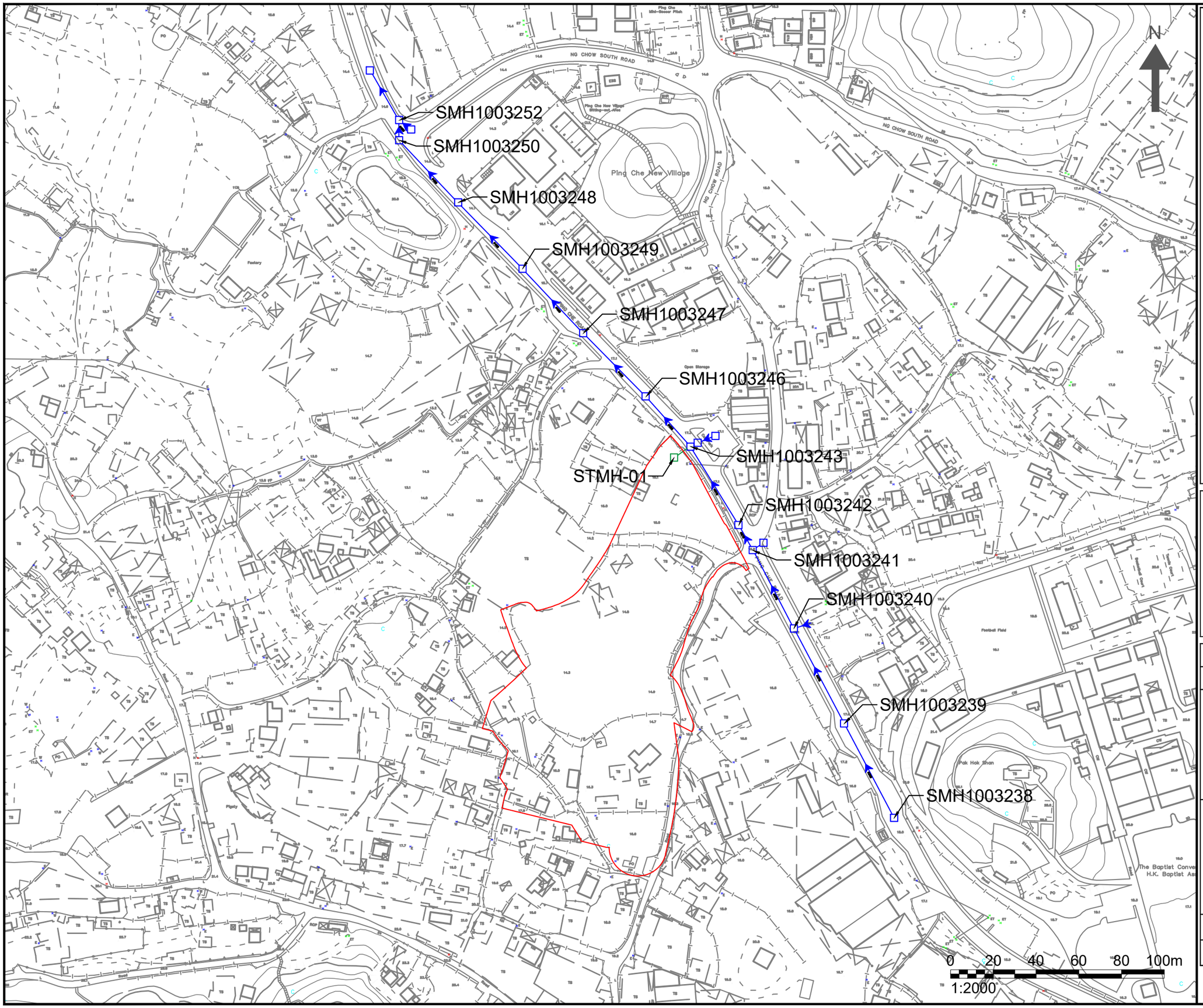
Drawing No :	Revision :
FIGURE 2.1	1
Scale :	Date :
AS SHOWN	OCT 2023

A3 420 x 297

C:\USERS\USER\SYNOLOGYDRIVE\2127 PING CHE DD77\05 REPORT\01 AEC REPORT\03 DIA\DRAFT 2\FIG & APP\[2127] DIA FIG 2.1_SITE LOCATION_DRAFT 2.DWG

Figure 3.1

Overview of Existing Drainage, Proposed Drainage & Catchment Area



NOTES :

APPLICATION SITE

EXISTING DRAINAGE & MANHOLE

PROPOSED DRAINAGE & MANHOLE

Consultant

Allied Environmental Consultants Limited

Project No. : 2127

Drawing By : CS

Project :

APPLICATION FOR AMENDMENT OF PLAN UNDER SECTION 12A FOR THE TOWN PLANNING ORDINANCE (CAP. 131) FOR MIXED USE DEVELOPMENT AT LOTS 796 AND 1008RP IN D.D. 77 AND ADJOINING GOVERNMENT LAND IN PING CHE, TA KWU LING, NEW TERRITORIES

Drawing Title :

OVERVIEW OF EXISTING DRAINAGE, PROPOSED DRAINAGE & CATCHMENT AREA

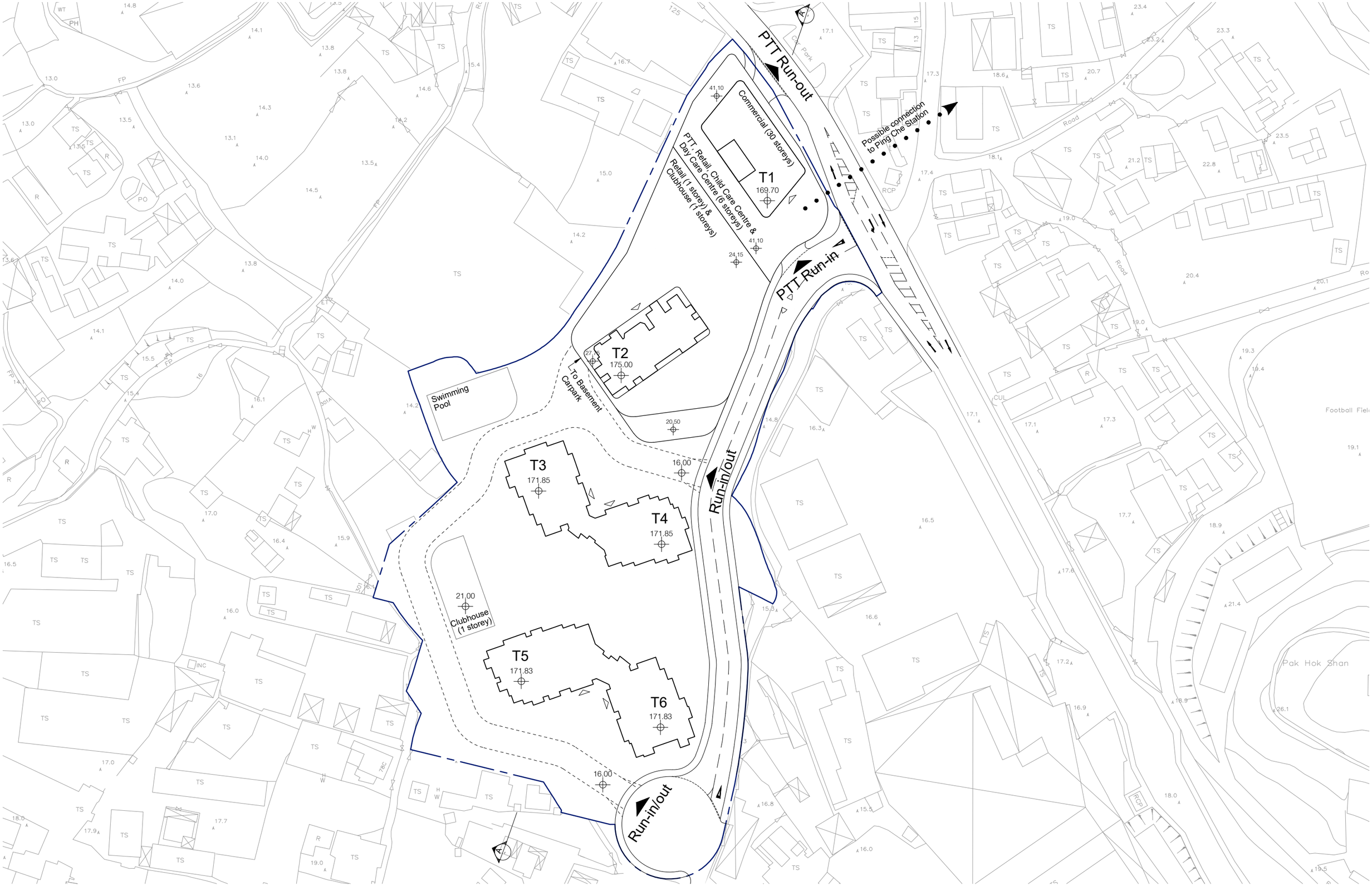
Drawing No :	Revision :
FIGURE 3.1	1
Scale :	Date :
AS SHOWN	OCT 2023

A3 420 x 297

C:\USERS\USER\SYNOLOGYDRIVE\2127 PING CHE DD77\05 REPORT\01 AEC REPORT\03 DIA\DRAFT 2\FIG & APP\[2127] DIA FIG 3.1_DRAINAGE OVERVIEW_DRAFT 2.DWG

Appendix A

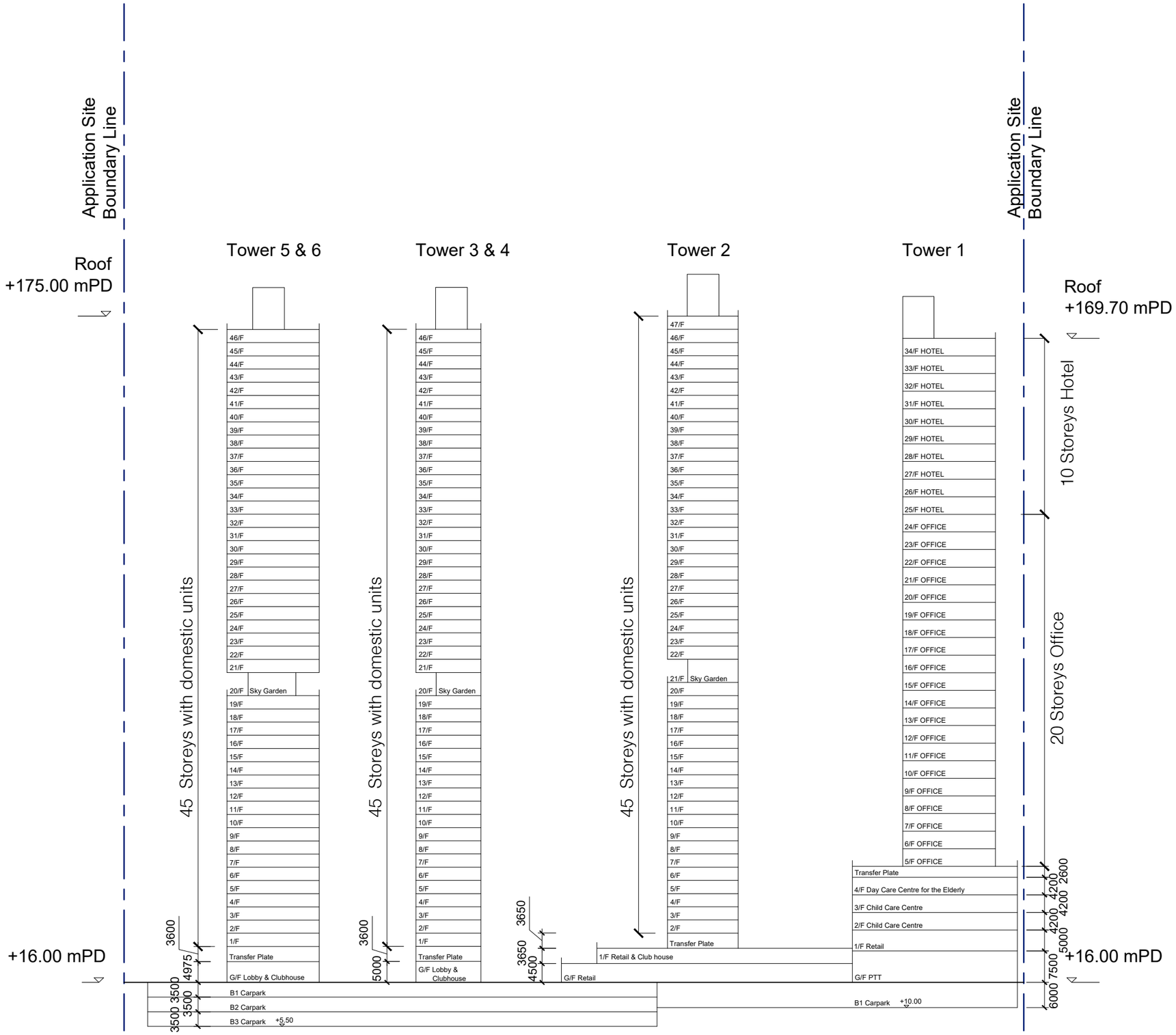
Master Layout Plan and Sectional Drawings



BLOCK PLAN SK-1
PROPOSED DEVELOPMENT AT PING CHE DD77, N.T.

0 10 20 50m

SINGULAR STUDIO LTD
6 OCTOBER 2023



SCHEMATIC SECTION AA' SK-2
PROPOSED DEVELOPMENT AT PING CHE DD77, N.T.

0 10 20 50m

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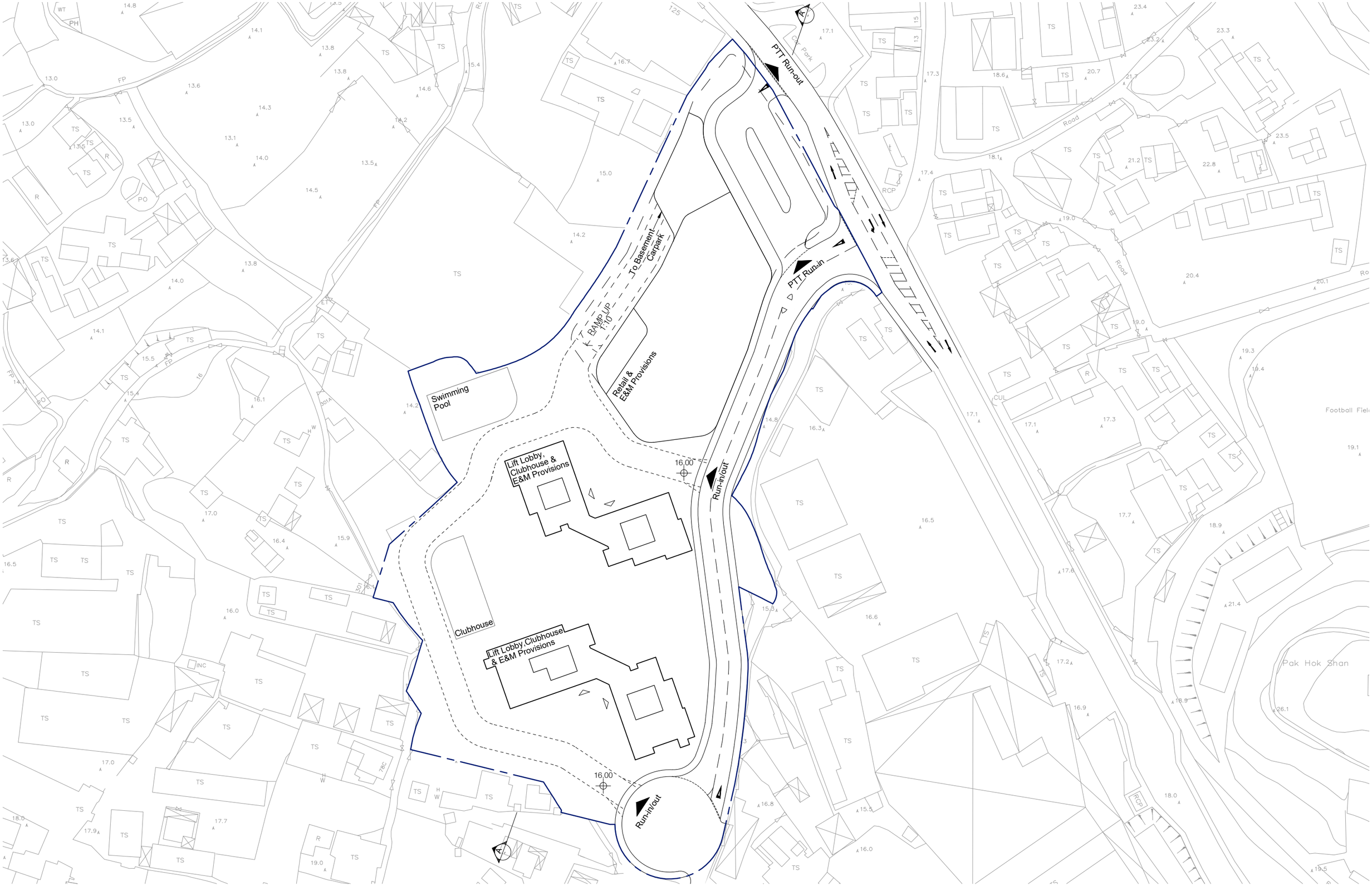
6 OCTOBER 2023



GROUND FLOOR PLAN SK-3
PROPOSED DEVELOPMENT AT PING CHE DD77, N.T.

0 10 20 50m

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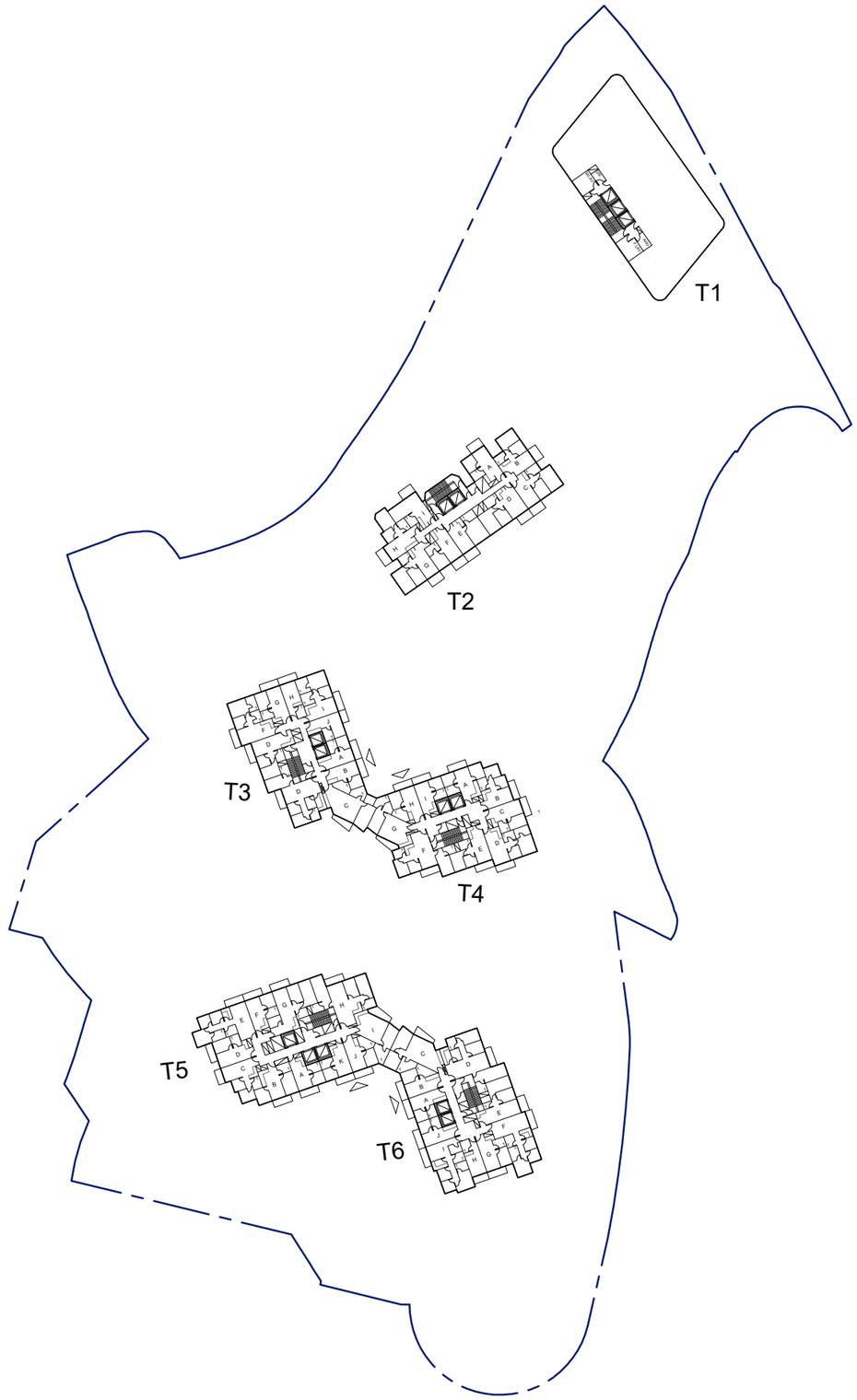
6 OCTOBER 2023



TYPICAL FLOOR PLAN SK-4
PROPOSED DEVELOPMENT AT PING CHE DD77, N.T.

0 10 20 50m

SINGULAR STUDIO LTD
3 OCTOBER 2023

Appendix B

Peak Runoff Estimation of Sub-catchments and Subject Site after the completion of Proposed Development

Appendix A Peak Runoff Estiamtion

Peak Runoff Estimation of Subcatchments and Subject Site **after** the completion of Proposed Development

Catchment	Total Area of the Catchment (m^2)	Land Use		Topography		Average Slope, H (m per 100m)	Flow Distance, L (m)	Inlet Time, t_o (min) [1]	Flow Time, t_f (min) [2]	Duration, t_c (min) [3]	50 - year return period				Runoff Coefficient, C [6]	Rainfall Increase due to Climate Change, % [7]	50 - year return period	
		Surface Characteristics	Area (m^2)	Inlet invert level (mPD)	Outlet invert level (mPD)						Storm Constant, a [4]	Storm Constant, b [4]	Storm Constant, c [4]	Extreme Mean Intensity, i (mm/hr) [5]			Peak Runoff, Qp (m3/s) [8]	Total Peak Runoff, Qp (m3/s) [8]
Application Site	17822	Concrete	14257	16.0	16.0	0.00	232	59.53	0	59.53	451.3	2.46	0.337	112.32	0.95	16.0	0.491	0.536
		Grass	3565												0.35		0.045	
STP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.024
Ping Che Rd (I)	1389.2	Concrete	1389.2	17.6	16.9	0.38	183	15.52	0	15.52	451.3	2.46	0.337	170.45	0.95	16.0	0.073	0.073
Ping Che Rd (II)	1337.2	Concrete	1337.2	17.3	17.1	0.15	135	13.94	0	13.94	451.3	2.46	0.337	175.83	0.95	16.0	0.072	0.072
Ping Che Rd (III)	1355.8	Concrete	1355.8	17.1	14.6	1.40	179	11.77	0	11.77	451.3	2.46	0.337	184.43	0.95	16.0	0.077	0.077
Existing Condition																		
Application Site	17822	Concrete	11503	16.1	14.3	0.77	232	13.29	0	13.29	451.3	2.46	0.337	178.22	0.95	16.0	0.628	0.755
		Grass	6319												0.35		0.127	

Note: 0.354539333

[1] Brandsby William's equation is referenced from Section 7.5.2 in DSD Stormwater Drainage Manual (Fifth Edition).

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

where t_o = time of concentration of a natural catchment (min.)

A = catchment area (m^2)

H = average slope (m per 100 m), measured 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)

Time of concentraction for subject site is assumed as 5 min.

[2] t_f is assumed to be 0 for conservative estimation.

[3] $t_c = t_o + t_f$

[4] Storm constants are referenced to Table 3a in DSD Stormwater Drainage Manual (Fifth Edition) based on corresponding return periods.

[5] Intensity-Duration-Frequency calculation is referenced from Section 4.3.3 in DSD Stormwater Drainage Manual (Fifth Edition).

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

where i = extreme mean intensity in mm/hr,

t_d = duration in minutes ($t_d \le 240$), and

a, b, c = storm constants given in Tables 3a, 3b, 3c and 3d.

[6] Runoff coefficient is referenced from Section 7.5.2 in DSD Stormwater Drainage Manual (Fifth Edition). For conservative estimation, coefficient of 0.35 is assumed for unpaved area while that of 0.95 for paved area.

[7] Rainfall increase precentage due to climate change is referenced from Table 28 in DSD Stormwater Drainage Manual (Fifth Edition) and Corrigendum No. 1/2022. 16.0% for End of 21st Century is adopted as worst case scenario.

[8] Rational method for peak runoff estimation is referenced from Section 4.3.3 in DSD Stormwater Drainage Manual (Fifth Edition).

$$Q_p = 0.278\,C\,i\,A$$

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

Appendix C

Estimation of Drainage Flow from Proposed Development and Detailed Hydraulic Calculation

Peak Runoff Estimation of Subcatchments and Subject Site **after** the completion of Proposed Development

ID	From	ID	To	Diameter, D (m) [1]	Cross-section Area, A (m^2) [2]	Wetted Perimeter, P (m) [2]	Hydraulic Radius, R (m) [3]	Length of Pipe, L (m) [1]	Inlet Invert Level (mPD) [1]	Outlet Invert Level (mPD) [1]	Slope, s [4]	Pipe Roughess, k (m) [5]	Velocity, V (m/s) [6]	Full Capacity, Q (m^3/s) [7]	Contributing Catchment Area [8]	Return Periods (Year) [9]	Additional Peak Flow, Q (m^3/s)	Total Flow from All Catch-ment Area (m^3/s)	Occupancy (%)
P1	STMH-01	D1	SMH1003243	0.500	0.177	1.571	0.113	6.4	15.00	14.75	0.039	0.0006	4.02	0.711	Application Site + STP	50	0.560	0.560	79%
D1	SMH1003243	D2	SMH1003246	0.700	0.346	2.199	0.158	35.3	14.75	14.30	0.013	0.0006	2.83	0.980	Application Site + STP + Ping Che Rd (I) & (II)	50	0.145	0.704	72%
D2	SMH1003246	D3	SMH1003247	0.700	0.346	2.199	0.158	47.9	14.30	13.80	0.010	0.0006	2.56	0.886	Application Site + STP + Ping Che Rd (I) & (II)	50	0.000	0.704	79%
D3	SMH1003247	D4	SMH1003249	0.700	0.346	2.199	0.158	47.7	13.80	13.30	0.010	0.0006	2.56	0.888	Application Site + STP + Ping Che Rd (I) & (II) & (III)	50	0.077	0.781	88%
D4	SMH1003249	D5	SMH1003248	0.700	0.346	2.199	0.158	49.5	13.30	12.80	0.010	0.0006	2.52	0.872	Application Site + STP + Ping Che Rd (I) & (II) & (III)	50	0.000	0.781	90%
D5	SMH1003248	D6	SMH1003250	0.750	0.398	2.356	0.169	45.7	12.10	11.78	0.007	0.0006	2.19	0.869	Application Site + STP + Ping Che Rd (I) & (II) & (III)	50	0.000	0.781	90%
D6	SMH1003250	D7	SMH1003252	0.750	0.398	2.356	0.169	9.0	11.60	11.50	0.011	0.0006	2.76	1.099	Application Site + STP + Ping Che Rd (I) & (II) & (III)	50	0.000	0.781	71%

[1] With reference to the Drainage Plan and Geoinfo Map.
[2] According to Section 9.3 in DSD Stormwater Drainage Manual (Fifth Edition), 5% / 10% reduction in flow area based on channel gradient is taken into account for the effects to flow capacity due to materials deposited on the bed.
[3] Hydraulic Radius = Cross-section Area / Wetted Perimeter
[4] Slope = (Inlet Invert Level - Outlet Invert Level) / Length of Pipe
[5] Surface roughness is assumed to be 6.0mm for slimed concrete pipe with poor condition as worst case scenario, with reference to Table 14 in DSD Stormwater Drainage Manual (Fifth Edition).

Treated el Surface roughness is assumed to be 6.0mm for slimed concrete pipe with poor condition as worst case scenario, with reference to Table 14 in DSD Stormwater Drainage Manual (Fifth Edition).

[6] Velocity is calculated based on Colebrook-White equations.

$$\overline{V} = -\sqrt{32gRS_f}\,\log\left[\frac{k_s}{14.8R} + \frac{1.255\nu}{R\sqrt{32gRS_f}}\right]$$ Section 7.5.2 in DSD Stormwater Drainage Manual (Fifth Edition).

$\overline{V}$ = cross-sectional mean velocity (m/s)
R = hydraulic radius (m)
S_f = friction gradient (dimensionless)
C = Chézy coefficient ($m^{½}/s$)
n = Manning coefficient ($s/m^{1/3}$)
f = Darcy-Weisbach friction factor (dimensionless)
k_s = surface roughness (m)
ν = kinematic viscosity (m^2/s)
g = acceleration due to gravity (m/s^2)
C_{HW} = Hazen-William coefficient (dimensionless)

With Reference to Table 14 in DSD Stromwater Drainage Manual (Fifth Edition),
Kinematic viscosity is 0.000001306 m/s.
Gravitational acceleration is $9.8m/s^2$.

[7] Capacity = Length of Pipe × Velocity
[8] Bold and underlined subcatchment ID stands for stormwater in those subcatchments flowing into the corresponding pipe.
[9] With reference to Table 3 of Section 6.6.2 in DSD Stormwater Drainage Manual (Fifth Edition), 50 years of return period has been adopted.