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From:
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To: tpbpd/PLAND <tpbpd@pland.gov.hk>
Cc:
Subject: Planning Application No. A/YL-PH/1013
Attachment: 2529CL03.pdf

Dear Sir/ Madam,

Attached is our letter to your office.

Should you have any further queries, feel free to contact the undersigned on

Best Regards,
Wesley Tang

Lanbase Surveyors Ltd

L A N B A S E
Surveyors Limited

宏 基 測 量 師 行

Our Ref.: YL/TPN/2529C/L03

23 May 2024

Secretary
Town Planning Board
15/F, North Point Government Offices
333 Java Road, North Point
Hong Kong

By Email and by Post

Dear Sir/Madam,

Planning Application (No. A/YL-PH/1013) for
Temporary Wholesale Trade (Food) for a Period of Five Years
Lot Nos. 872, 873, 875, 876, 877, 878, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891 s.A, 892 s.A, 893 s.A, 3049 and 3050 in DD 111 and Adjoining Government Land
Pat Heung, Yuen Long, New Territories

We write to supplement our captioned planning application with the following information for your further consideration.

(i) A fire service installation proposal in respect of the planning application is at **Appendix 1**. The proposal is the same with that the version approved in the last planning application (No. A/YL-PH/804).

(ii) A drainage proposal in respect of the planning application is at **Appendix 2**. The proposal is the same with that the version approved in the last planning application (No. A/YL-PH/804).

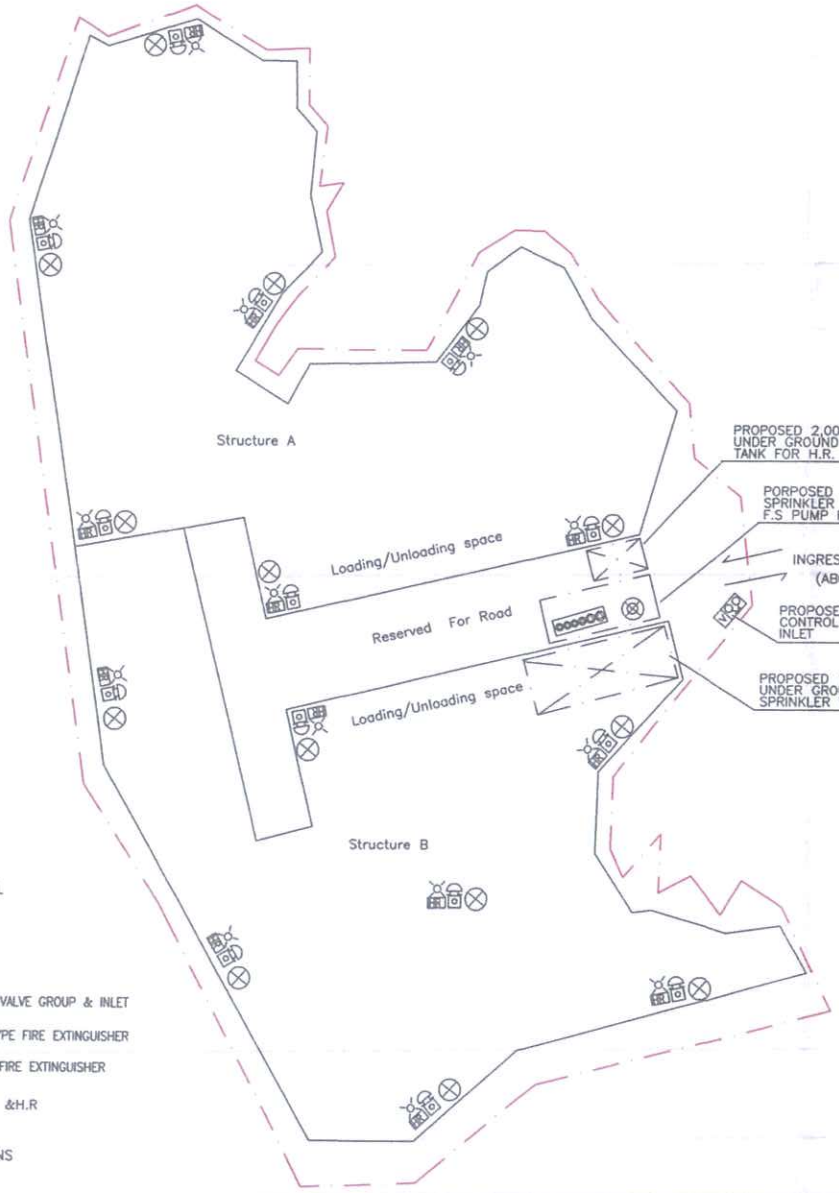
Should you have any queries, please contact our Mr. Wesley Tang at . Thank you.

Yours faithfully,
For and on behalf of
LANBASE SURVEYORS LIMITED

Rock K.M. Tsang
Director
RK/WT
Encl.

Appendix 1

Fire Service Installation Proposal



LEGEND

- FLASHING LIGHT
- FIRE ALARM BELL
- MFA CALL POINT
- HR — HOSE REEL SET (30M LENGTH)
- SPRINKLER CONTROL VALVE GROUP & INLET
- 4KG DRY POWDER TYPE FIRE EXTINGUISHER
- 5KG CO2 GAS TYPE FIRE EXTINGUISHER
- SPRINKLER PUMP &H.R PUMP SET
- NEW INSTALLATIONS
- BOUNDARY LINE

NATURE OCCUPANCY:

Structure A: Single storey structure for wholesale trade (food)

(GFA:7888 sq.m,Height:18m)

The aggregate area of openable window about 500 s.q.m exceeding 6.25% of the floor area of the Structure A.(7888sq.m x 6.25% =493sq.m)

Structure B: Single storey structure for wholesale trade (food)

(GFA:8028 sq.m,Height:18m)

The aggregate area of openable window about 520 s.q.m exceeding 6.25% of the floor area of the Structure B.(8028sq.m x 6.25% =501.75sq.m)

Fire Notes:

1. Sufficient emergency lighting shall be provided throughout the entire building in accordance with BS5266:Part 1 and BS EN 1838.
2. Sufficient directional and exit sign shall be provided in accordance with BS 5266: Part 1 and FSD Circulasr letter 5/2008.
3. Sufficient portable hand-operated approved appliance shall be provided as required by occupancy and as marked on plans.
4. An Automatic Sprinkler System Supplied by existing 135 m3 Sprinkler Water Tank and Hazard Class OH 3 shall be provided to the building/structure A & B in accordance with BS EN 12845:2015 and FSD Circular Letter No.5/2020. The Sprinkler Water Tank,Sprinkler Pump Room,Sprinkler Inlet and Sprinkler Control Valve Group shall be clearly marked on plans.
5. The storage configuration is ST1:free standing or block stacking with reference to the section 6.3.2 of B.S 12845.and storage pattern is the maximum storage heights shall not exceed 4 m & the maximum storage areas shall be 50m2 for any single block.with no less than 2.4m clearance around the block as Ordinary Hazard Group 3 in accordance with LPC BS EN 12845.(Storage Category : Category I)
6. A hose reel system should be supplied by a 2.0m3 F.S Water tank. There shall be sufficient hose reel to ensure that every part of each buillding can be reached by a length of not more than 30m of hose reel tubing.The F.S water tank, F.S pump room and hose reel shall be clearly marked on plans.
7. Fire alarm system shall be provided throughout the entire building in accordance with BS 5839:PART 1:2002+A2;2008 and FSD Circular Letter 1/2009. One actuation point and one audio warning device to be located at each hose reel point.The actuation point should include facilities for fire pump start and audio/visual warning device initiation.
8. One no.5.0 kg CO2 F.E. shall be provided at spinkler pump room & F.S pump room.
9. Sprinkler Tank water supply pipe should be connected to Town Main.
10. A Secondary electrical supply tee-off before main switch will be provided to maintain operation of fire service system in the event of normal power fuilure.
11. No Smoke extraction system will be provided for the structure A & B as the aggregate area of openable windows of structure A&B exceeding 6.25% of the floor area of the structure A&B. (Detail see Drawing No. 2021-FS/24-02)

INTERCEPT FIRE & SECURITY TECHNICIANS LIMITED
Registered Address :
Shop 25, G/F, Man Fung Building, YLTL 329, Fung Kwan Street, Yuen Long, N.T.
Tel : 9263 7766 Fax : 2428 5932
Business Address :
8 / F, Block L, Phase 2, Wah Fung Industrial Centre, 33 - 39 Kwai Fung Street, Kwai Chung, N.T., H.K.
Tel : 2425 5404 Fax : 2428 5932

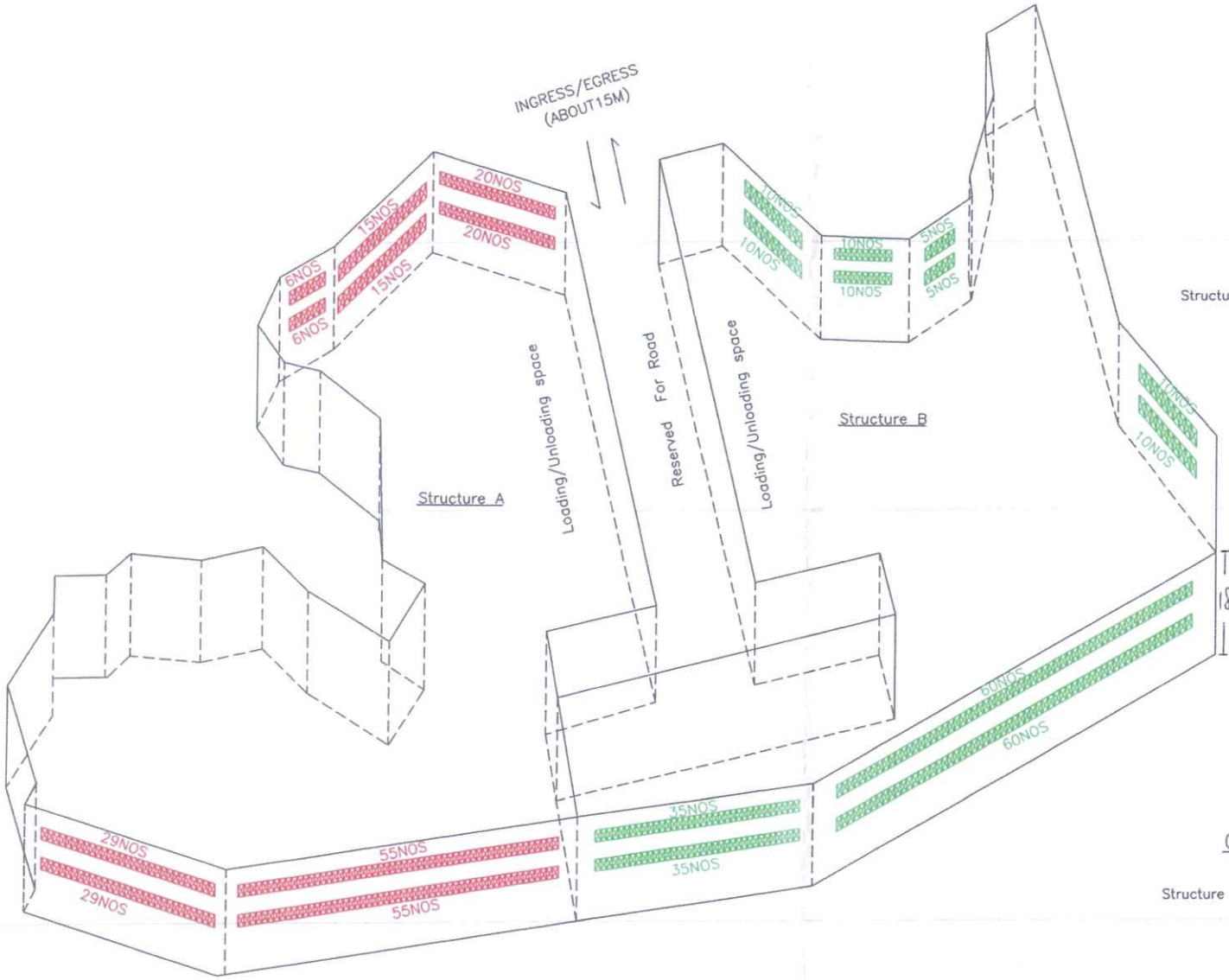
Project :

PROPOSED TEMPORARY WHOLESALE TRADE(FOOD) FOR A PERIOD OF 5 YEARS AT LOTS 872,873,875,876,877,878,880,881,882,883,884,885,886, 887,888,889,890,891(PART),892(PART),893(PART),3049 AND 3050 IN D.D. 111 AND ADJOINING GOVERNMENT LAND ,PAT HEUNG ,YUEN LONG.

TITLE :

PROPOSED FIRE SERVICE INSTALLATION LAYOUT PLAN.

Drawn By:	W.C WONG
Date:	31-12-2021
Scale:	1:1000 @ A3
Ref No:	TPB/A/YL-PH/804
Drawing No:	2021-FS/24-01



OPENABLE WINDOWS OF STRUCTURE A & B LAYOUT PLAN

LEGEND

OPENABLE WINDOW (Area:1m x 2m=2sq.m)

CALCULATE:

Structure A: The aggregate area of openable window is:

2sq.m x 250nos =500sq.m

6.25% of the floor area is:

7888sq.m x 6.25% =493sq.m

500sq.m > 493sq.m

LEGEND

OPENABLE WINDOW (Area:1m x 2m=2sq.m)

CALCULATE:

Structure B: The aggregate area of openable window is:

2sq.m x 260nos =520sq.m

6.25% of the floor area is:

8028sq.m x 6.25% =501.75sq.m

520sq.m > 501.75sq.m

INTERCEPT FIRE & SECURITY TECHNICIANS LIMITED

Registered Address :

Shop 25, G/F, Man Fung Building, YLTL 329, Fung Kwan Street, Yuen Long, N.T.
Tel : 9263 7766 Fax : 2428 5932

Business Address :

8 / F, Block L, Phase 2, Wah Fung Industrial Centre, 33 – 39 Kwai Fung Street, Kwai Chung, N.T., H.K.
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Project :

PROPOSED TEMPORARY WHOLESALE TRADE(FOOD) FOR A PERIOD OF 5 YEARS AT LOTS 872,873,875,876,877,878,880,881,882,883,884,885,886, 887,888,889,890,891(PART),892(PART),893(PART),3049 AND 3050 IN D.D. 111 AND ADJOINING GOVERNMENT LAND ,PAT HEUNG ,YUEN LONG.

TITLE :

PROPOSED FIRE SERVICE INSTALLATION LAYOUT PLAN.

Drawn By:	W.C WONG
Date:	31-12-2021
Scale:	A3 (NO SCALE)
Ref No:	TPB/A/YL-PH/804
Drawing No:	2021-FS/24-02

Appendix 2

Drainage Proposal

SMEC

Member of the Surbana Jurong Group

local people
global experience

D01 – Drainage Proposal

Proposed Temporary Wholesales Trade (Food) in D.D. 111 and Adjoining Government Land, Pat Heung, Yuen Long

Reference No. PLG10195
Prepared for Ha Che Development Limited
7 October 2021

SMEC INTERNAL REF. 7076764

Document Control

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REVISION NO.	DATE	PREPARED BY	REVIEWED BY	APPROVED FOR ISSUE BY
0	17 June 2020	Arthur CHIU	Antony WONG	Jacky YAU
1	7 May 2021	Arthur CHIU	Antony WONG	Jacky YAU
2	7 October 2021	Kitty LEE	Antony WONG	Jacky YAU

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SMEC Company Details

Approved by:	Alexi BHANJA		
Address:			
Signature:			
Tel:		Fax:	
Email:		Website:	

Important Notice

This report is confidential and is provided solely for the purposes of supporting Proposed Temporary Wholesales Trade (Food) in D.D. 111 and Adjoining Government Land, Pat Heung, Yuen Long. This report is provided pursuant to a Consultancy Agreement between SMEC Asia Limited ("SMEC") and Ha Che Development Limited, under which SMEC undertook to perform specific and limited tasks for Ha Che Development Limited. This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications and limitations in it and does not apply by implication to other matters. SMEC makes no representation that the scope, assumptions, qualifications and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes.

This report must be read as a whole. Any subsequent report must be read in conjunction with this report.

The report supersedes all previous draft or interim reports, whether written or presented orally, before the date of this report. This report has not and will not be updated for events or transactions occurring after the date of the report or any other matters that might have a material effect on its contents or which come to light after the date of the report. SMEC is not obliged to inform you of any such event, transaction or matter nor to update the report for anything that occurs, or of which SMEC becomes aware, after the date of this report.

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1 PROJECT BACKGROUND

1.1 Introduction

1.1.1 A temporary wholesale trade (food) development (the Proposed Use) has been proposed for a period of five years at Lots 872, 873, 875, 876, 877, 878, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891 (Part), 892 (Part), 893 (Part), 3049 and 3050 in DD 111 and adjoining government land, Pat Heung, Yuen Long ("the Site"). The Site is zoned "Open Storage" (OS) on the Approved Pat Heung Outline Zoning Plan (OZP) No. S/YL-PH/11. A planning application (no. A/YL-PH/804) for the Proposed Use was submitted under Section 16 of the Town Planning Ordinance (TPO) and was approved with conditions by the Town Planning Board (TPB) on 12 April 2019. Two of the approval conditions related to drainage issues are as follows:

(c) *The submission of drainage proposal within 6 months from the date of planning approval to the satisfaction of the Director of Drainage Services or of the Town Planning Board by 12.10.2019; and*

(d) *In relation to (c) above, the implementation of drainage proposal within 9 months from the date of planning approval to the satisfaction of the Director of Drainage Services or of the Town Planning Board by 12.10.2019.*

1.1.2 Subsequently, an application for Class B Amendment – Extension of Time Limit (no. A/YL-PH/804-2) under Section 16A of the TPO and was approved with conditions by the TPB in which the approval conditions related to drainage issues are summarised as follows:

- *The submission of drainage proposal to the satisfaction of the Director of Drainage Services or of the TPB as required under planning condition (c) by 12.4.2020.*
- *The implementation of drainage proposal to the satisfaction of the Director of Drainage Services or of the TPB as required under planning condition (d) by 12.4.2020.*

1.1.3 SMEC Asia Limited (SMEC) has been commissioned to prepare this Drainage Proposal to discharge the abovementioned approval condition (c).

1.2 Site Description

1.2.1 The Site location and its environs are shown on ***Figure 1.1*** which the uses surrounding the Site include:

- To the North and East: Various open storage / storage yards, workshops, container trailers / tracker park.
- To the South: Village houses in Fu Shing Garden and Ha Che.
- To the West: Vacant land covered with vegetation under "Green Belt" zone.

1.2.2 The Site area is approximately 21,006m^2 and its layout plans can be referred to the Planning Statement.

1.3 Objectives of this Report

1.3.1 The objectives of this Drainage Proposal are to:

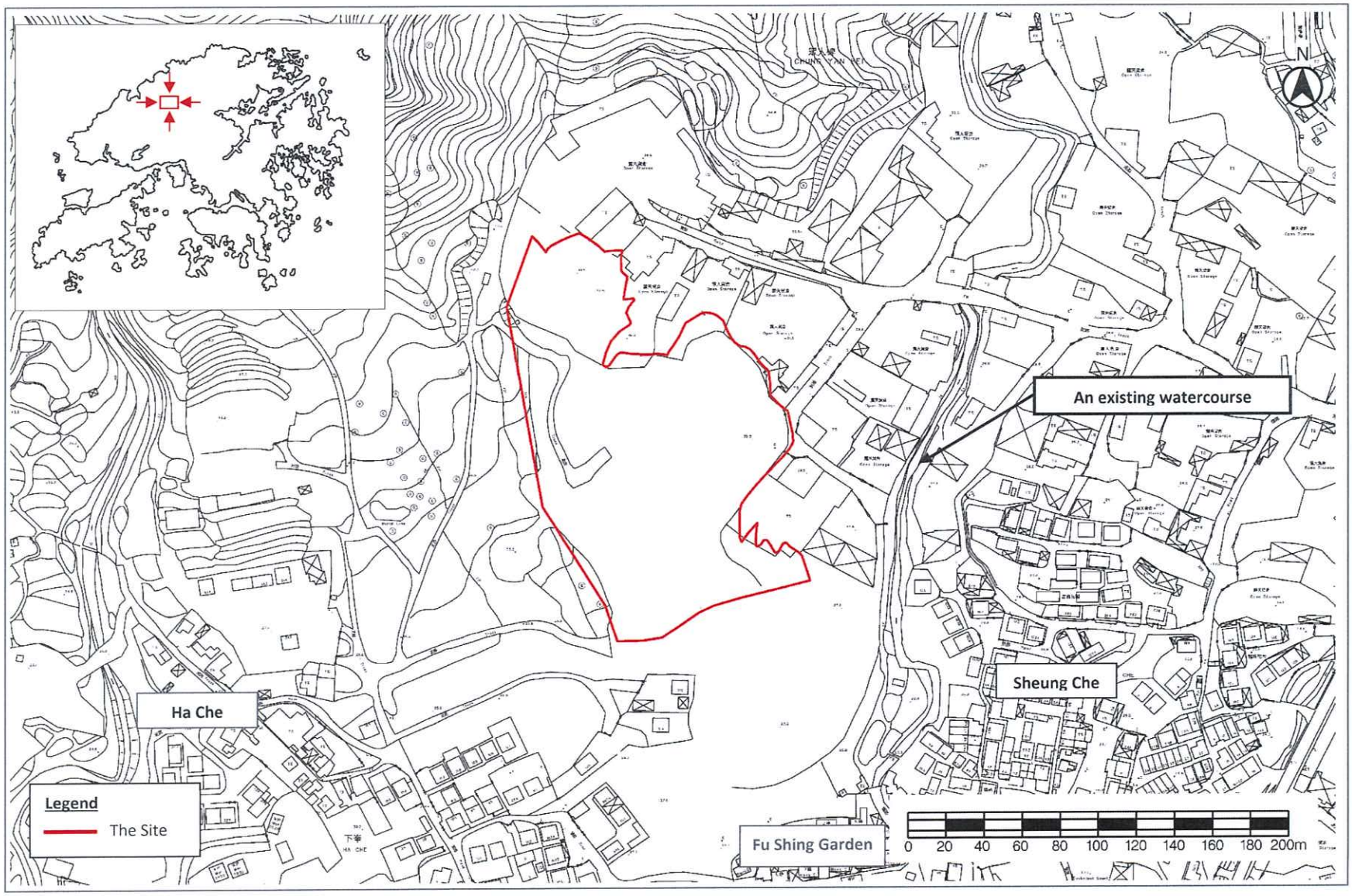
- Assess the potential drainage impacts arising from the Site.
- Recommend the necessary mitigation measures to alleviate any impacts.

1.4 Reference Materials

1.4.1 In evaluating the drainage impact arising from the Proposed Use, the following materials have been referred to:

- Drainage Services Department (DSD) publication Stormwater Drainage Manual (with Eurocodes incorporated) – Planning, Design and Management (2018 Edition).
- DSD Advice Note No. 1 – Application of the Drainage Impact Assessment Process to Private Sector Projects.
- DSD publication Technical Note to prepare a "Drainage Submission".
- GeoInfo Map reviewed on 21 May 2020.

Figure 1.1: Site Location and its Environs



2 DESCRIPTION OF EXISTING ENVIRONMENT AND DRAINAGE CONDITIONS

2.1 Site Location and Topography

2.1.1 As illustrated on ***Figure 1.1***, the Site is situated on a vacant land to the north of Ha Che in Pat Heung, Yuen Long and surrounded by various open storage / storage yards, workshops, container trailers / tracker park, village houses and vacant land.

2.2 Existing Baseline Conditions

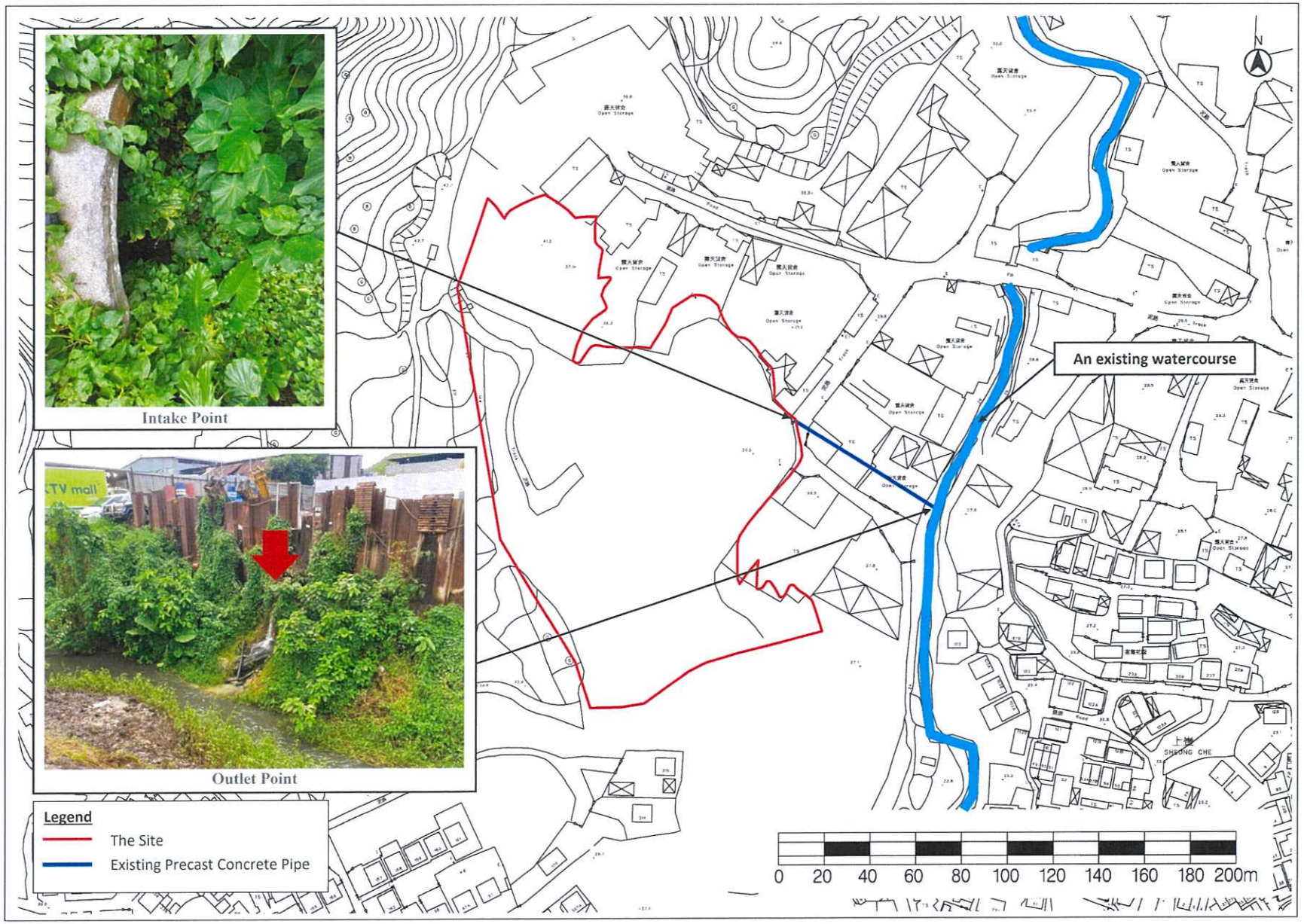
2.2.1 Majority of the Site area is currently unpaved and covered with vegetation.

2.2.2 With reference to GeoInfo Map and review on drainage layout records in DSD drawing office in May 2020, there is no municipal drainage system in the vicinity of the Site.

2.2.3 Based on the site observation and CCTV pipe inspection, there is an existing precast concrete pipe connecting the eastern boundary of the Site to an existing watercourse to the east of the Site as shown on ***Figure 2.1***. The dimension of the precast concrete pipe is Ø1,800mm in diameter starting from the Site and then change to Ø600mm in diameter near the outlet at the watercourse. Hence, it is proposed to divert the site runoff to the existing watercourse to the east of the Site following the current drainage arrangement. However, siltation and collapse of existing pipe was observed in some sections of the pipe. Therefore, the Applicant commits to repair and upgrade the existing pipe, if necessary.

2.2.4 The CCTV pipe inspection report is provided in ***Appendix A***. The photos of the pipe intake point and outlet point are shown on ***Figure 2.1.***

Figure 2.1: Existing Precast Concrete Pipe of the Site



3 DRAINAGE ANALYSIS

3.1 Assumptions and Methodology

3.1.1 Peak instantaneous runoff before and after the Proposed Use 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*.

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

$$Q_p = 0.278\, C\, i\, A \qquad \text{--- Equation 1}$$

where Q_p = peak runoff in m^3/s
C = runoff coefficient
i = rainfall intensity in mm/hr
A = catchment area in km^2

3.1.3 Rainfall intensity is calculated using the following expression:

$$i = \frac{a}{(t_d + b)^c} \qquad \text{--- Equation 2}$$

where i = rainfall intensity in mm/hr
t_d = duration in minutes ($t_d \leq 240$)
a, b, c = storm constants given in Table 3 of SDM

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

$$t_c = t_0 + t_f \qquad \text{--- Equation 3}$$

where t_c = time of concentration
t_0 = inlet time (time taken for flow from the remotest point to reach the most upstream point of the urban drainage system)
t_f = flow time

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

$$t_d = t_c = t_0$$

$$t_0 = \frac{0.14465\, L}{H^{0.2} A^{0.1}} \qquad \text{--- Equation 4}$$

where 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)

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

$$V = -\sqrt{32gRs} \times \log\left(\frac{k_s}{14.8R} + \frac{1.25\upsilon}{R\sqrt{32gRs}}\right)$$ --- ***Equation 5***

where
- V = mean velocity (m/s)
- g = gravitational acceleration (m/s^2)
- R = hydraulic radius (m)
- k_s = hydraulic pipeline roughness (m)
- υ = kinematic viscosity of fluid (m^2/s)
- s = hydraulic gradient (energy loss per unit length due to friction)

3.1.7 On the other hand, the capacity of open channel has been calculated using the Manning's Equation:

$$V = \frac{R^{1/6}}{n} \times \sqrt{Rs}$$ --- ***Equation 6***

where
- V = mean velocity (m/s)
- R = hydraulic radius (m)
- n = Manning coefficient (s/m$^{1/3}$)
- s = hydraulic gradient (energy loss per unit length due to friction)

3.2 Assessment Assumptions

Identification of Catchments

3.2.1 Catchment Areas A to K were identified in accordance with the topographical data on the basemap obtained from the Survey and Mapping Office (SMO) in May 2020. The identified catchment areas is shown on ***Figure 3.1***. Based on the design of the rooftop and internal drainage system of the Site, Catchment A (i.e. the Site) was further divided into 12 sub-catchments, namely Catchment Areas A1 to A12. The sub-catchment areas A1 to A12 are shown on ***Figure 3.2***. The layouts of the Proposed Development are provided in ***Appendix B***. The photos showing the condition of the Site and the surrounding catchment areas are provided in ***Appendix C***.

3.2.2 The runoff from Catchments B, C, D, E and F will pass through the Site (i.e. Catchment A). Details are descripted in below paragraph. The cross sections of the Site and the surrounding area after the Proposed Development are provided in ***Appendix D***.

3.2.3 Based on the CCTV report, there are two connection point between the manhole within the Site and the outlet of the existing precast concrete pipe. As advised by the Applicant, the intake points of these connection points are within Catchment I. Hence, the Catchment I is also considered as the cumulative catchment of the Site.

Project Site (Internal Catchment)

3.2.4 The Site is located at Catchment A comprising 12 sub-catchments, namely Catchments A1 to A12.

3.2.5 Based on the Site visit on 28 May 2020 and 18 September 2020, majority of the Site is currently vacant and covered with vegetation while the northern part of the Site is occupied by parking of vehicles and trailers without valid planning permission. As such, for conservative approach, it is assumed that the Site is currently 100% grassland.

3.2.6 For the Proposed Development, two single storey structure with a total floor area of about 15,916m^2 (about 76% of the site area) for a wholesale trade use and eight loading / unloading spaces for container vehicles will be provided within in the Site. Hence, it is assumed that the Site will be 100% paved as a conservative approach.

3.2.7 The Site is relatively flat. With reference to the SDM, the runoff coefficients of grassland and paved surface are 0.25 and 0.95, respectively. As a result, the respective average runoff coefficient of 0.25

and 0.95 were adopted for the Site before and after the proposed development, respectively, as summarised in ***Table 3.1***.

Table 3.1: Surface Characteristics and Runoff Coefficients of the Site

Scenario Of Project	Area (m^2)	Surface Characteristics	Runoff Coefficient
Before Development	21,006	100% grassland	0.25
After Development		100% paved	0.95

3.2.8 There is no internal drainage system within the Site. A proper internal drainage system should be provided for collecting or diverting the runoff. The design of the internal drainage system will be discussed in the subsequent paragraphs below. The collected runoff will be then discharged to the existing watercourse to the east of the Site through the existing precast concrete pipe at the eastern boundary of the Site.

Cumulative Runoff (Surrounding Catchments)

3.2.9 The surrounding Catchment Areas B to K have been identified based on the topographical data as shown on ***Figure 3.1***.

3.2.10 Catchment B, C and D are relatively steep slopes, which are covered with vegetation, to the northwest of the Site. Based on the topographical data, the runoff from Catchment B, C and D will flow from northwest to southeast and pass through the northern part of the Site before discharging to the existing watercourse to the east of the Site.

3.2.11 Catchment E and F are relatively flat vacant land fully covered with vegetation to the west of the Site. Based on the topographical data, the runoff from Catchment E and F will flow from west to east and pass through southern part of the Site before discharge to the existing watercourse to the east of the Site.

3.2.12 Catchments G to J are paved areas occupied by open storages, temporary structures or access road. The runoff from these catchments will flow towards east, northeast or southeast and would be discharged to the existing watercourse to the east of the Site directly or indirectly though their internal drainage system. The runoff from these catchments will not pass though the Site. However, there are two intake points of the connection pipe to the existing precast concrete pipe within Catchment I. Therefore, Catchment I is also considered as the cumulative catchment of the Site.

3.2.13 Catchment K is a vacant land mainly covered with vegetation to the south of the Site. The runoff from Catchment K will flow from west to east and would be discharged to the existing watercourse to the east of Catchment K without passing through the Site.

3.2.14 Therefore, Catchment B, C, D, E and F are identified as the upper catchments to the Site. Catchment I is identified as the downstream catchment. With reference to the SDM, Catchment B, C and D are relatively steep covered with vegetation and the runoff coefficient is therefore assumed to be steep grassland of 0.35. On the other hand, Catchment E and F are relatively flat vacant land covered with vegetation and the runoff coefficient is therefore assumed to be flat grassland of 0.25. Catchment I is relatively flat fully paved area and the runoff coefficient is therefore assumed to be flat grassland of 0.95. The aforementioned runoff coefficients are summarised in ***Table 3.2***.

Table 3.2: Surface Characteristics and Runoff Coefficients of Surrounding Catchments

Catchment	Area (m^2)	Surface Characteristics	Runoff Coefficient
Catchment B	9,855	100% steep grassland	0.35
Catchment C	1,451	100% steep grassland	0.35
Catchment D	31,423	100% steep grassland	0.35
Catchment E	7,354	100% flat grassland	0.25
Catchment F	3,528	100% flat grassland	0.25
Catchment I	5,257	100% paved	0.95

3.3 Estimated Existing and Future Runoff

Peak Runoff from the Site

3.3.1 Based on the assumptions as described in ***paragraphs 3.2.1*** to ***3.2.7***, the runoff from the Site before and after development has been estimated based on the return periods of 2, 10 and 50 years.

3.3.2 As shown in ***Table 3.3***, the estimated peak runoff generated from the Site before development is 0.369 m^3/s under 50 years return period, while it is 1.275 m^3/s after the development with 100% paving condition. There will be 246% increment in the estimated peak runoff after the proposed development under all assessed return periods. Detailed calculations are provided in ***Appendix E***.

Table 3.3: Estimated Peak Runoff of the Site

Return Period	Estimated Peak Runoff (m^3/s)		% Change
	Before Development	After Development	
2 Years	0.273	0.925	239%
10 Years	0.335	1.148	243%
50 Years	0.369	1.275	246%

Peak Runoff from Surrounding Catchments

3.3.3 In addition to the runoff generated from the Site, runoff from surrounding Catchments should also be considered, as mentioned in ***paragraphs 3.2.9 to 3.2.14***. The runoff from the surrounding catchments is summarised in ***Table 3.4***.

Table 3.4: Estimated Peak Runoff from Surrounding Catchments

Return Period	Estimated Peak Runoff After Development (m^3/s)						
	Catchment B	Catchment C	Catchment D	Catchment E	Catchment F	Catchment I	Total
2 Years	0.167	0.027	0.393	0.077	0.039	0.220	0.923
10 Years	0.206	0.033	0.501	0.096	0.048	0.274	1.158
50 Years	0.228	0.037	0.570	0.108	0.054	0.305	1.302

Cumulative Peak Runoff

3.3.4 The estimated cumulative runoff from surrounding Catchments is approximately 2.577m^3/s under worst case scenario, i.e. 50 years return period, as shown in ***Table 3.5.*** Detailed calculations are provided in ***Appendix E***.

Table 3.5: Estimated Cumulative Runoff of the Site and Surrounding Catchments

Return Period	Estimated Peak Runoff after Development (m^3/s)		
	Site	Surrounding Catchments	Cumulative
2 Years	0.925	0.923	1.848
10 Years	1.148	1.158	2.306
50 Years	1.275	1.302	2.577

3.4 Proposed Drainage Layout

Internal Drainage System

3.4.1 As shown in ***Figure 3.1***, runoff from Catchment B to F will pass through the Site before discharging into the existing watercourse to the east of the Site as follows:

- Runoff from Catchment B will flow towards the southeast direction and pass though Catchment A5.
- Runoff from Catchment C will flow towards the east direction and pass though Catchment A4.
- Runoff from Catchment D will flow towards the southeast direction and pass though Catchment A3.
- Runoff from Catchment E will flow towards the east direction and pass though Catchment A2.
- Runoff from Catchment F will flow towards the east direction and pass though Catchment A1

3.4.2 A series of U-channel, as shown ***Figure 3.3*** and ***Figure 3.4***, should be constructed along the periphery of the Site to collect the runoff arising from Site and the cumulative catchments. The collected runoff by the U-channel will be further collected by series of internal underground circular drainage pipe. All the runoff would be flow to the sand trap before discharging out of the Site. The details of the U-channel and underground circular drainage pipe are summarised in ***Table 3.6*** and ***Table 3.7***, respectively.

Table 3.6: Summary of Proposed U-channels

U-Channel ID	Description	Size, mm	Gradient
UC01	Collecting runoff from Catchments A1 + F	Ø450	1:150
UC02	Collecting runoff from Catchments A2 + E	Ø450	1:150
UC03	Collecting runoff from Catchments A3 + D	Ø750	1:150
UC04	Collecting runoff from Catchments A4 + C	Ø450	1:150
UC05	Collecting runoff from Catchments A5 + B	Ø500	1:150
UC06-1	Collecting runoff from Catchment A6	Ø500	1:150
UC06-2	Collecting runoff from Catchment A6	Ø600	1:200
UC07-1	Collecting runoff from Catchment A7	Ø500	1:150
UC07-2	Collecting runoff from Catchment A7	Ø600	1:200
UC08-1	Collecting runoff from Catchment A8	Ø300	1:150
UC08-2	Collecting runoff from Catchment A8	Ø450	1:150
UC09-1	Collecting runoff from Catchment A9	Ø300	1:150
UC09-2	Collecting runoff from Catchment A9	Ø450	1:150
UC10-1	Collecting runoff from Catchment A10	Ø450	1:150
UC10-2	Collecting runoff from Catchment A10	Ø450	1:200
UC11	Collecting runoff from Catchment A11	Ø300	1:150

Table 3.7: Summary of Proposed Circular Drainage Pipe

Pipe ID	Description	Size, mm	Gradient
DP01	Collecting runoff from UC01 and UC06	Ø600	1:200
DP02	Collecting runoff from UC02 and UC03	Ø900	1:200
DP 03	Collecting runoff from UC04 and UC05	Ø600	1:200
DP04	Collecting runoff from UC08 and UC09	Ø600	1:200
DP05	Collecting runoff from UC03 and UC04	Ø750	1:200
DP06	Collecting runoff from DP02 and DP05	Ø1,000	1:200
DP07-1	Collecting runoff from DP01 and DP06	Ø1,200	1:200
DP07-2	Collecting runoff from DP01 and DP06	Ø1,200	1:20
DP08	Collecting runoff from UC07 and UC12	Ø600	1:200
DP09	Collecting runoff from UC10 and UC11	Ø450	1:200
DP10	Discharge the collected runoff from final sand trap to manhole	Ø1,000	1:200

3.4.3 Assessment on the flow capacity of the internal U-channel and circular drainage pipe have been conducted as shown in ***Table 3.8***. The typical details of U-channel is shown in ***Appendix F***, and detailed assessment is provided in ***Appendix G***.

Table 3.8: Summary of Flow Capacity of Proposed U-channel and Circular Drainage Pipe

U-Channel / Pipe ID	Size, mm	Gradient	Runoff, m^3/s	Capacity, m^3/s	% Of Capacity Used	Sufficient Capacity?
UC01	Ø450	1:150	0.075	0.268	28.0%	Yes
UC02	Ø450	1:150	0.186	0.268	69.5%	Yes
UC03	Ø750	1:150	0.743	1.045	71.1%	Yes
UC04	Ø450	1:150	0.112	0.268	41.8%	Yes
UC05	Ø500	1:150	0.267	0.354	75.3%	Yes
UC06-1	Ø500	1:150	0.294	0.354	82.9%	Yes
UC06-2	Ø600	1:200	0.294	0.499	58.9%	Yes
UC07-1	Ø500	1:150	0.285	0.354	80.4%	Yes
UC07-2	Ø600	1:200	0.285	0.499	57.1%	Yes
UC08-1	Ø300	1:150	0.075	0.091	82.6%	Yes
UC08-2	Ø450	1:150	0.075	0.268	28.0%	Yes
UC09-1	Ø300	1:150	0.063	0.091	69.4%	Yes
UC09-2	Ø450	1:150	0.063	0.268	23.5%	Yes
UC10-1	Ø450	1:150	0.103	0.268	38.5%	Yes
UC10-2	Ø450	1:200	0.103	0.232	44.4%	Yes
UC11	Ø300	1:150	0.061	0.091	67.2%	Yes
DP01	Ø600	1:200	0.369	0.438	84.3%	Yes
DP02	Ø900	1:200	0.929	1.266	73.4%	Yes
DP03	Ø600	1:200	0.379	0.438	86.5%	Yes
DP04	Ø600	1:200	0.138	0.438	31.5%	Yes
DP05	Ø750	1:200	0.517	0.786	65.8%	Yes
DP06	Ø1,000	1:200	1.446	1.667	86.7%	Yes
DP07-1	Ø1,200	1:200	1.815	2.689	67.5%	Yes
DP07-2	Ø1,200	1:20	1.815	8.533	21.3%	Yes
DP08	Ø600	1:200	0.293	0.438	66.9%	Yes
DP09	Ø450	1:200	0.111	0.209	53.2%	Yes
DP10	Ø1000	1:200	1.196	1.667	71.7%	Yes

Drainage Point

3.4.4 The collected runoff from the proposed internal U-channel and circular pipe would be diverted to the east of the Site and discharged to the existing watercourse through an existing precast concrete pipe, as shown on ***Figure 3.3*** and ***Figure 3.4***.

3.4.5 Flow capacities of existing precast concrete pipe has been assessed. The assessment results of the maximum estimated discharge based on the return period of 50 years are summarised in ***Table 3.9***, and the detailed assessment is provided in ***Appendix G***.

Table 3.9: Drainage Capacity of Existing Precast Concrete Pipe before Upgrading Works

Description	Size, mm	Related Catchment	Runoff, m^3/s	Capacity, m^3/s	% Of Capacity Used	Sufficient Capacity?
Existing Precast Concrete Pipe – Section near the Inlet	Ø1,800	Catchments A1, A2, B and C	2.577	21.996	11.7	Yes
Existing Precast Concrete Pipe – Section near the Outlet	Ø600	Catchments A1, A2, B and C	2.577	1.392	185.1	No

3.4.6 As shown in ***Table 3.9***, the section of existing precast concrete pipe near the outlet at the watercourse would exceed 100% drainage capacity. Mitigation measures shall be considered to alleviate impact on the on the existing precast concrete pipe resulting from the Proposed Development.

Proposed Mitigation Measures – Upgrading Drainage Works

3.4.7 In order to mitigate the adverse drainage impact, the precast concrete pipe with exceedance shall be upgraded as practicable, subject to the liaison with the relevant Authorities in the future. Two options of upgrading drainage works are proposed and described in subsequent sections.

Option 1 – Upgrading the precast concrete pipe to a diameter of 1,800mm

3.4.8 The concerned section of precast concrete pipe would be upgraded from a diameter of 600mm to a diameter of 1,800mm with a gradient of between 1:260 and 1:500. The proposed upgrade works are shown in ***Table 3.10*** and detailed in ***Appendix G***.

Table 3.10: Drainage Capacity of Existing Precast Concrete Pipe after Upgrading Works (Option 1)

Description	Size, mm	Related Catchment	Runoff, m^3/s	Capacity, m^3/s	% Of Capacity Used	Sufficient Capacity?
Existing Precast Concrete Pipe – Section near the Site	Ø1,800	Catchments A1, A2, B and C	2.577	21.996	11.7	Yes
Existing Precast Concrete Pipe – Section near the Outlet	Ø1,800 in gradient of 1:260; or	Catchments A1, A2, B and C	2.577	6.800	37.9	Yes
	Ø1,800 in gradient of 1:500			4.985	52.6	

3.4.9 As shown in ***Table 3.10***, the utilisations of the precast concrete pipe range between 11.7% and 37.9% or between 11.7% and 52.6% of the available sewerage capacity after the drainage system upgrading works depending on the gradient to be determined due to the site constraint in the future. Therefore, there should be no adverse impact on the precast concrete pipe due to the Proposed Development with the proposed upgrading works.

Option 2 – Upgrading the precast concrete pipe to a diameter of 1,200mm

3.4.10 The concerned section of precast concrete pipe would be upgraded from a diameter of 600mm to a diameter of 1,200mm with a gradient of 1:160. The proposed upgrade works are shown in ***Table 3.11*** and detailed in ***Appendix G***.

Table 3.11: Drainage Capacity of Existing Precast Concrete Pipe after Upgrading Works (Option 2)

Description	Size, mm	Related Catchment	Runoff, m^3/s	Capacity, m^3/s	% Of Capacity Used	Sufficient Capacity?
Existing Precast Concrete Pipe – Section near the Site	Ø1,800	Catchments A1, A2, B and C	2.577	21.996	11.7	Yes
Existing Precast Concrete Pipe – Section near the Outlet	Ø1,200 in gradient of 1:160; or	Catchments A1, A2, B and C	2.577	3.008	85.7	Yes

3.4.11 As shown in ***Table 3.11***, the utilisations of the precast concrete pipe range between 11.7% and 85.7% of the available sewerage capacity after the drainage system upgrading. Therefore, there should be no adverse impact on the precast concrete pipe due to the Proposed Development with the proposed upgrading works.

Preferred Option

3.4.12 The maximum utilisation of the precast concrete pipe under Option 1 and Option 2 will be about 52.6% and 85.7%, respectively. Compared with Option 2 in which there is only 14.3% spare capacity, Option 1 is more preferable option due to there is at least 47.6% spare capacity of the precast concrete pipe after upgrading works.

3.4.13 Nevertheless, the actual option to be adopted will be determined in the future due to the site constraints. The final design and construction of the upgraded precast concrete pipe will be provided to the satisfaction of the relevant government departments.

Existing Watercourse

3.4.14 Assessment on the flow capacity of the existing watercourse has been conducted as shown in ***Table 3.12***. Based on the Site visit on 28 May 2020 and 18 September 2020, the section of the downstream watercourse at Sheung Che is narrower and shallower than the watercourse upstream and at the discharge point of the existing precast concrete pipe. Hence, the drainage capacity of the existing watercourse in the vicinity of the Site is limited by the capacity of this section of downstream watercourse at Sheung Che. As a conservative approach, the capacity of the existing watercourse is assumed to be the same as the capacity of the downstream watercourse at Sheung Che for assessment purpose. The photos of the upstream watercourse of the Site, watercourse at the discharge point of existing precast concrete pipe and downstream watercourse at Sheung Che Tsuen are shown on ***Figure 3.5***.

3.4.15 The maximum occupied capacity of watercourse by the cumulative runoff from the upstream and downstream catchment before the development are estimated by site observations on the high water level marks of the watercourse. Based on the site visit on 28 May 2020 and 18 September 2020, the maximum occupied capacity of the watercourse by the cumulative runoff from the upstream and downstream catchment before the development is about 20% of the watercourse. As a conservative approach, the maximum occupied capacity of watercourse by the cumulative runoff from the upstream and downstream catchment before the development is assumed as 25% for assessment purpose. The photos of the watercourse at assessment point are shown in ***Figure 3.5*** for reference.

3.4.16 As shown in ***Table 3.3***, the estimated peak runoff generated from the Site before development is 0.369 m^3/s under 50 years return period, while it is 1.275 m^3/s after the development with 100% paving condition. Therefore, additional runoff of 0.906 m^3/s will be generated from the Proposed Development, which contribute to 2.6% of capacity of the existing watercourse as shown in the calculation in ***Appendix G***. Together with 25% occupied capacity of watercourse by the cumulative

runoff from the upstream and downstream catchment, the occupied capacity of watercourse after the Proposed Development will be 27.6%. As there is sufficient spare capacity of the watercourse after development, no adverse drainage impact arising from the Proposed Development is anticipated.

Table 3.12: Drainage Capacity of Existing Watercourse

Description	Size	Related Catchment	Runoff, m^3/s	Capacity, m^3/s	% Of Capacity Used
Existing Watercourse at Downstream	3.56m (w) x 2.42m (h)	Additional Runoff from Site	0.906	34.393	2.6%
		All other cumulative catchment in upstream and downstream	--		25.0%
			Total % of Capacity Used		**27.6%**

3.5 Additional Mitigation Measure - Retention Tank

3.5.1 In addition to the upgrade of 1800mm dia. pipe proposed in Option 1 mentioned in ***para3.4.8*** and ***para3.4.9*** , a retention tank of about $1000m^3$ for 30-minutes retention time is proposed to be included within the site as an additional mitigation measure. The retention tank is proposed to store the additional runoff of $0.906m^3/s$ due to the proposed development. With the storage tank, additional runoff can be stored offline and to be discharged at a controlled manner during non-peak hours. The retention tank will be connected to a sandtrap which can help to filter out sand and silts before discharge. Device such as valve/ weir will be adopted as necessary to maintain the flow discharge rate no more than that of the discharge flow rate before development. Pumps will be added to empty the tank under regular maintenance. Calculations for sizing of the tank is presented in ***Appendix H*** Summary of the tank dimensions is presented in Table 3.13 below.

Table 3.13 Retention Tank Sizing

Description	Retention Time t (min)	Additional Runoff, m^3/s	Volume = Q x t	% time under peak flow	Tank capacity required m^3	Tank dimensions (LxWxH)	Tank capacity required m^3
Retention Tank	30	0.906	1630	60%	980	16x25x2.5	1000

3.6 Summary

3.6.1 Flow capacities of the internal drainage system (i.e. proposed U-channels and circular drainage pipe) and existing precast concrete pipe were calculated. Runoff from the corresponding catchment(s) (calculated based on a return period of 50 years) will account for 8.8% to 86.7% and 11.7% to 185.1% of their corresponding capacities, respectively. Therefore, upgrading the existing precast concrete pipe is required.

3.6.2 In order to mitigate the adverse drainage impact, the section of precast concrete pipe with surcharge shall be upgraded as practicable, subject to the liaison with the relevant authorities in the future. Two options of upgrading works are proposed and described as follow:

- Option 1 – Upgrading the section of precast concrete pipe with a diameter of 600mm into a diameter of 1,800mm with a gradient of at least 1:500 and no more than 1:260; or

- Option 2 – Upgrading the section of precast concrete pipe with a diameter of 600mm into a diameter of 1,200mm with a gradient of 1:160.

3.6.3 Under Option 1, the utilisations of the precast concrete pipe will range between 11.7% and 37.9% with a gradient of 1:260;or between 11.7% and 52.6% of the available drainage capacity with a gradient of 1:500.

3.6.4 Under Option 2 with a gradient of 1:160, the utilisations of the precast concrete pipe will range between 11.7% and 85.7%.

3.6.5 With the provision of the proposed drainage upgrading works, either Option 1 or Option 2, there should be no adverse impact on the precast concrete pipe due to the Proposed Development. Based on analysis, Option 1 is more preferable option due to there is at least 47.6% spare capacity of the precast concrete pipe after upgrading works

3.6.6 Nevertheless, the actual option to be adopted will be determined in the future due to the site constraints. The final design and construction of the upgraded precast concrete pipe will be provided to the satisfaction of the relevant government departments.

3.6.7 In addition to the upgrade of 1800mm dia. pipe proposed in Option 1, a retention tank of about 1,000m^3 for 30minutues retention time is proposed to be included within the site to store the additional runoff due to the proposed development. With the storage tank, excessive runoff can be stored offline and to be discharged at a controlled manner during non-peak hours.

3.6.8 Thus, the proposed drainage system and retention tank, the existing watercourse will have sufficient capacity to receive stormwater runoff from the Proposed Development and surrounding catchments with the proposed drainage system upgrading works. As a result, no adverse drainage impact is anticipated after the development of the Site

Figure 3.1: Identification of Catchments

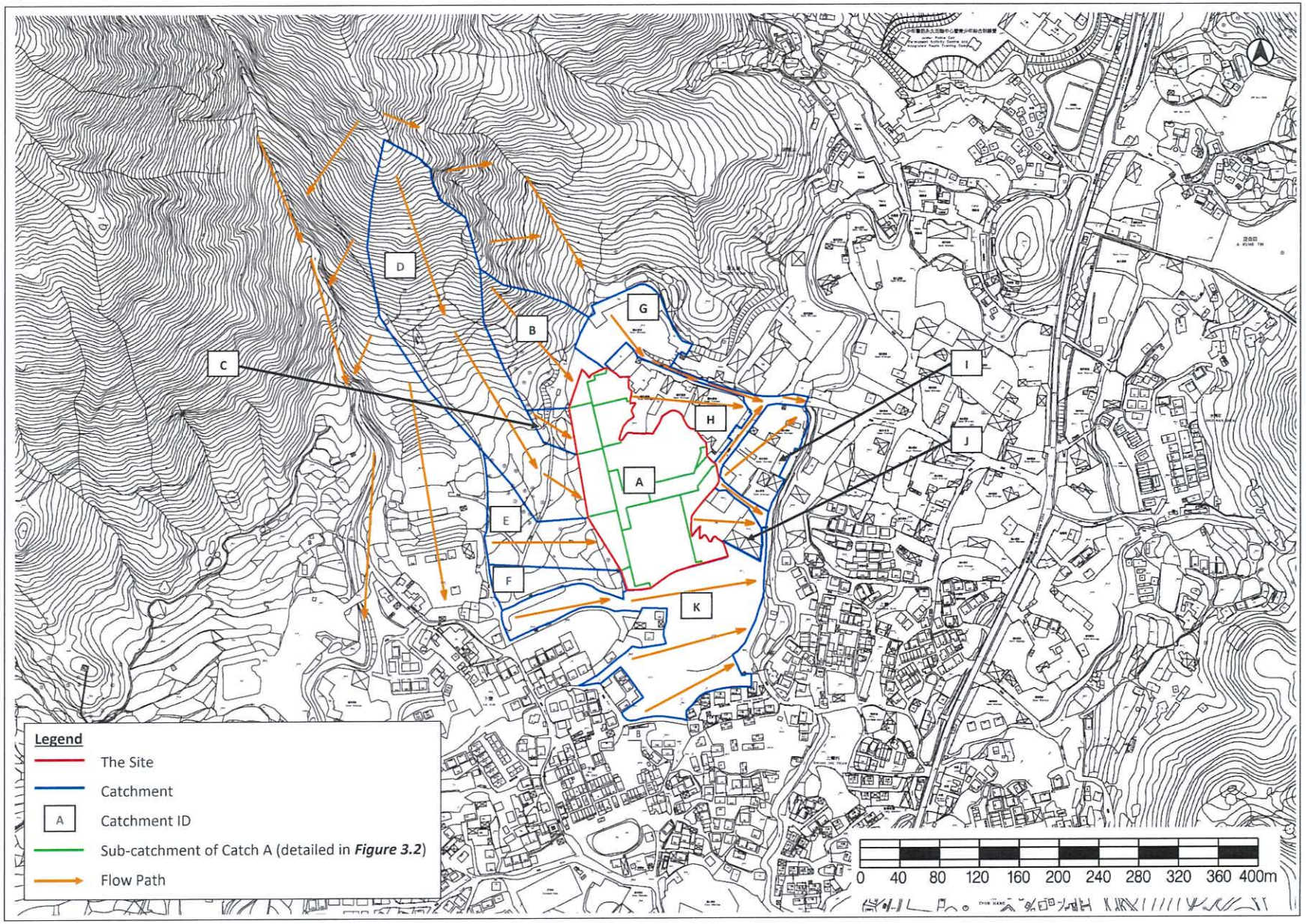


Figure 3.2: Sub-Catchment Areas A1 to A12

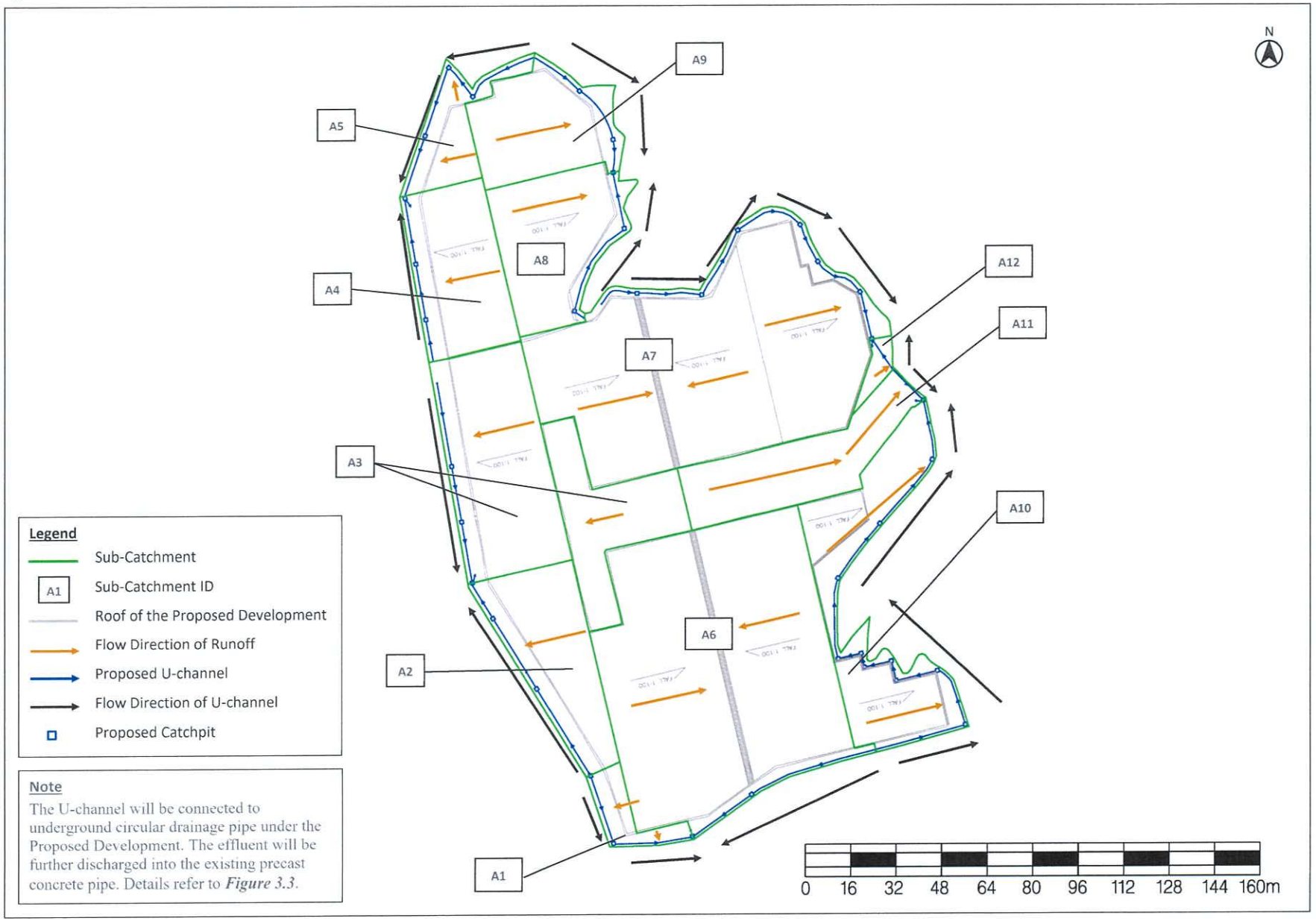


Figure 3.3: Proposed Drainage Diversion Layout (Sheet 1 of 2)

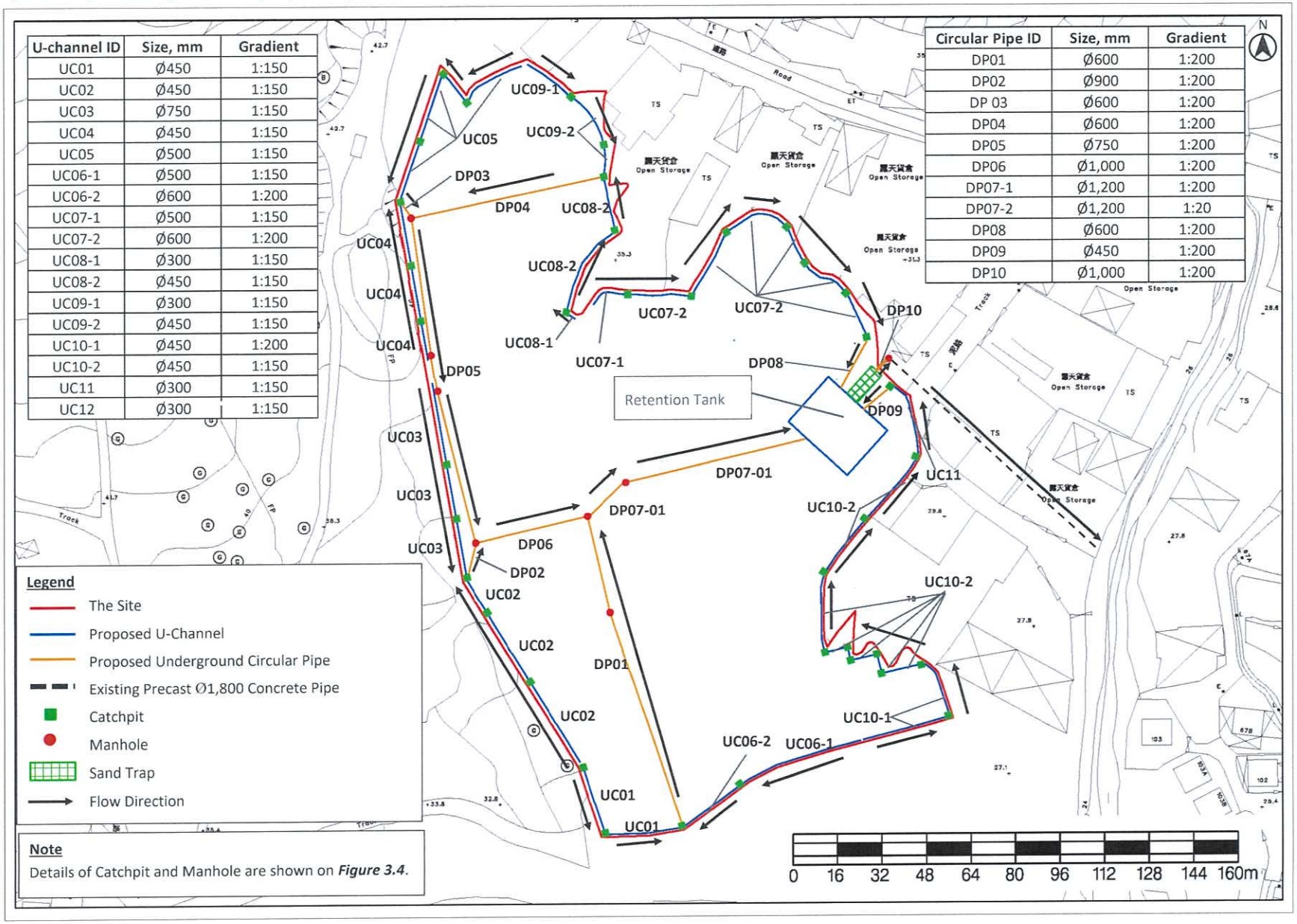
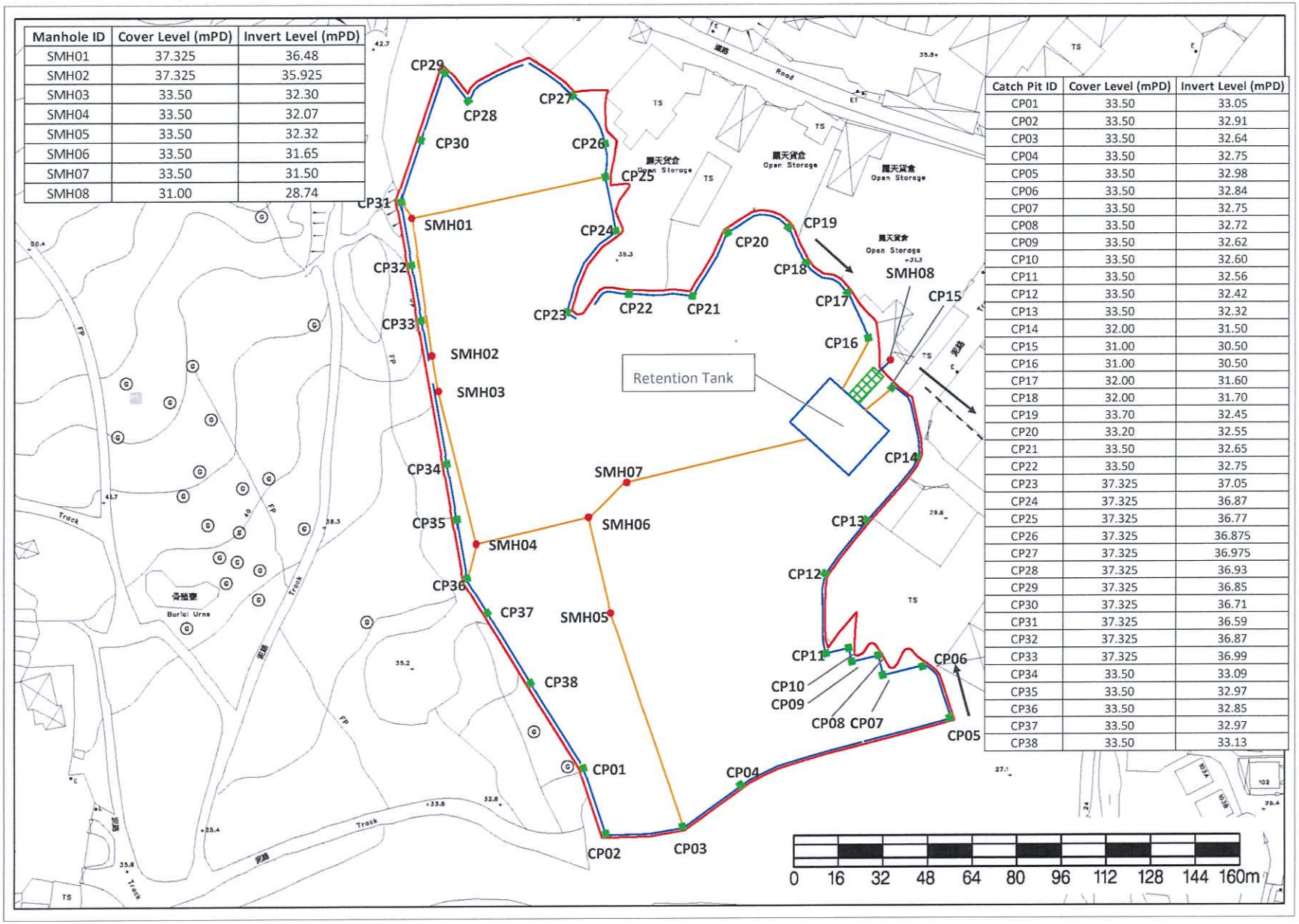


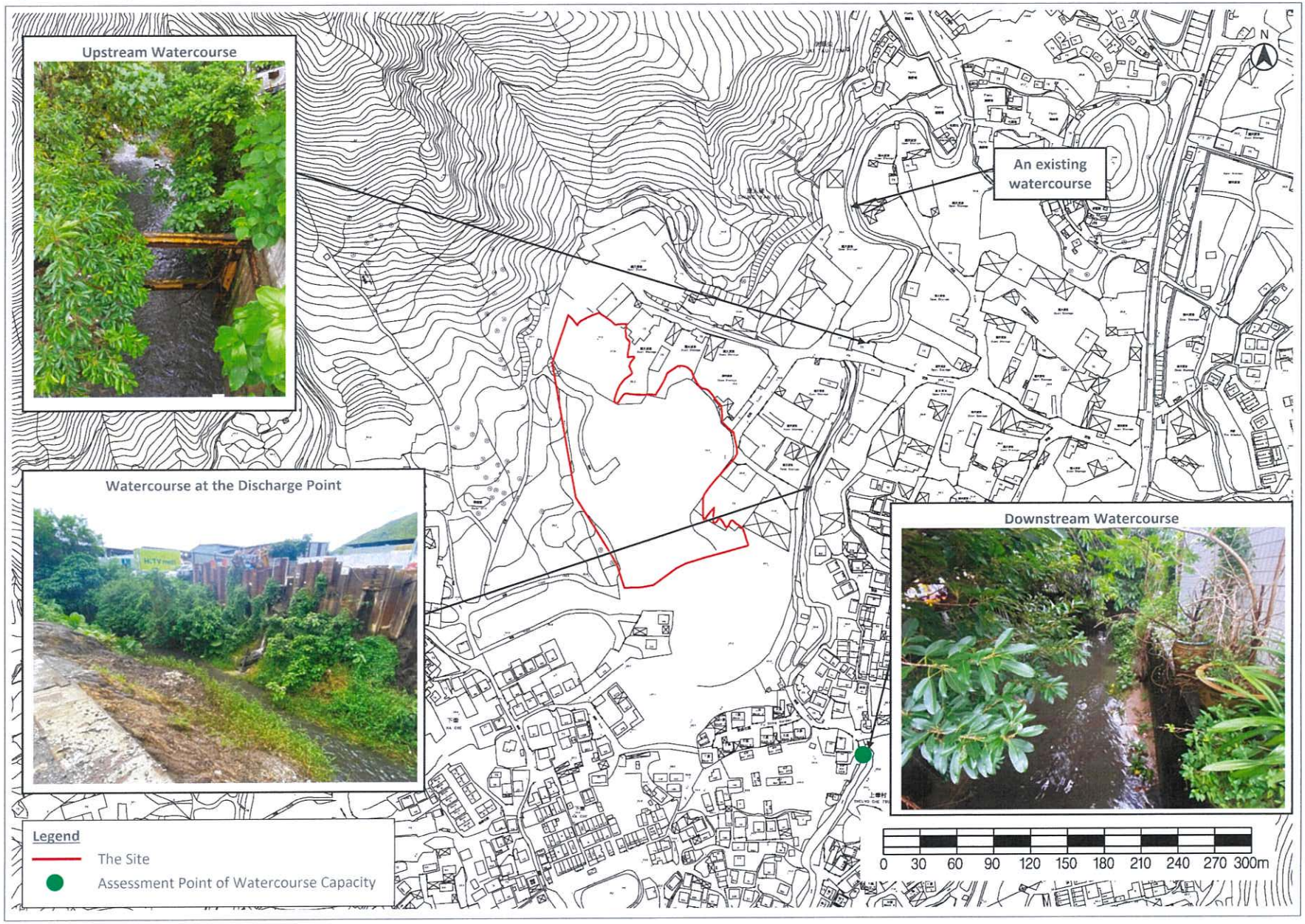
Figure 3.4: Proposed Drainage Diversion Layout (Sheet 2 of 2)



Manhole ID	Cover Level (mPD)	Invert Level (mPD)
SMH01	37.325	36.48
SMH02	37.325	35.925
SMH03	33.50	32.30
SMH04	33.50	32.07
SMH05	33.50	32.32
SMH06	33.50	31.65
SMH07	33.50	31.50
SMH08	31.00	28.74

Catch Pit ID	Cover Level (mPD)	Invert Level (mPD)
CP01	33.50	33.05
CP02	33.50	32.91
CP03	33.50	32.64
CP04	33.50	32.75
CP05	33.50	32.98
CP06	33.50	32.84
CP07	33.50	32.75
CP08	33.50	32.72
CP09	33.50	32.62
CP10	33.50	32.60
CP11	33.50	32.56
CP12	33.50	32.42
CP13	33.50	32.32
CP14	32.00	31.50
CP15	31.00	30.50
CP16	31.00	30.50
CP17	32.00	31.60
CP18	32.00	31.70
CP19	33.70	32.45
CP20	33.20	32.55
CP21	33.50	32.65
CP22	33.50	32.75
CP23	37.325	37.05
CP24	37.325	36.87
CP25	37.325	36.77
CP26	37.325	36.875
CP27	37.325	36.975
CP28	37.325	36.93
CP29	37.325	36.85
CP30	37.325	36.71
CP31	37.325	36.59
CP32	37.325	36.87
CP33	37.325	36.99
CP34	33.50	33.09
CP35	33.50	32.97
CP36	33.50	32.85
CP37	33.50	32.97
CP38	33.50	33.13

Figure 3.5: Photos of the Existing Watercourse



4 CONCLUSION

4.1.1 Potential drainage impacts that may arise from the Site after construction of the Proposed Development have been assessed.

4.1.2 The peak runoff before and after the development of the Site has been estimated using Rational Method and based on the catchment surface characteristics for the existing environment and the Proposed Development. The estimated peak runoff generated from the Site and the surrounding catchments are 2.577m3/s under 50 years return period.

4.1.3 Flow capacities of the internal drainage system (i.e. proposed U-channels and circular drainage pipe) and existing precast concrete pipe were calculated. Runoff from corresponding catchment(s) (calculated based on a return period of 50 years) will account for 8.8% to 86.7% and 11.7% to 185.1% of their corresponding capacities, respectively. Therefore, upgrading the existing precast concrete pipe is required.

4.1.4 In order to mitigate the adverse drainage impact, the section of precast concrete pipe with surchage shall be upgraded as practicable, subject to the liaison with the relevant Authorities in the future. Two options of upgrading works are proposed and described as follow:

- Option 1 – Upgrading the section of precast concrete pipe with a diameter of 600mm into a diameter of 1,800mm with a gradient of at least 1:500 and no more than 1:260; ; or
- Option 2 – Upgrading the section of precast concrete pipe with a diameter of 600mm into a diameter of 1,200mm with a gradient of 1:160.

4.1.5 Under Option 1, the utilisations of the precast concrete pipe will range between 11.7% and 37.9% with a gradient of 1:260;or between 11.7% and 52.6% of the available drainage capacity with a gradient of 1:500.

4.1.6 Under Option 2 with a gradient of 1:160, the utilisations of the precast concrete pipe will range between 11.7% and 85.7%.

4.1.7 With the provision of the proposed drainage upgrading works, either Option 1 or Option 2, there should be no adverse impact on the precast concrete pipe due to the Proposed Development. Based on analysis, Option 1 is more preferable option due to there is at least 47.6% spare capacity of the precast concrete pipe after upgrading works

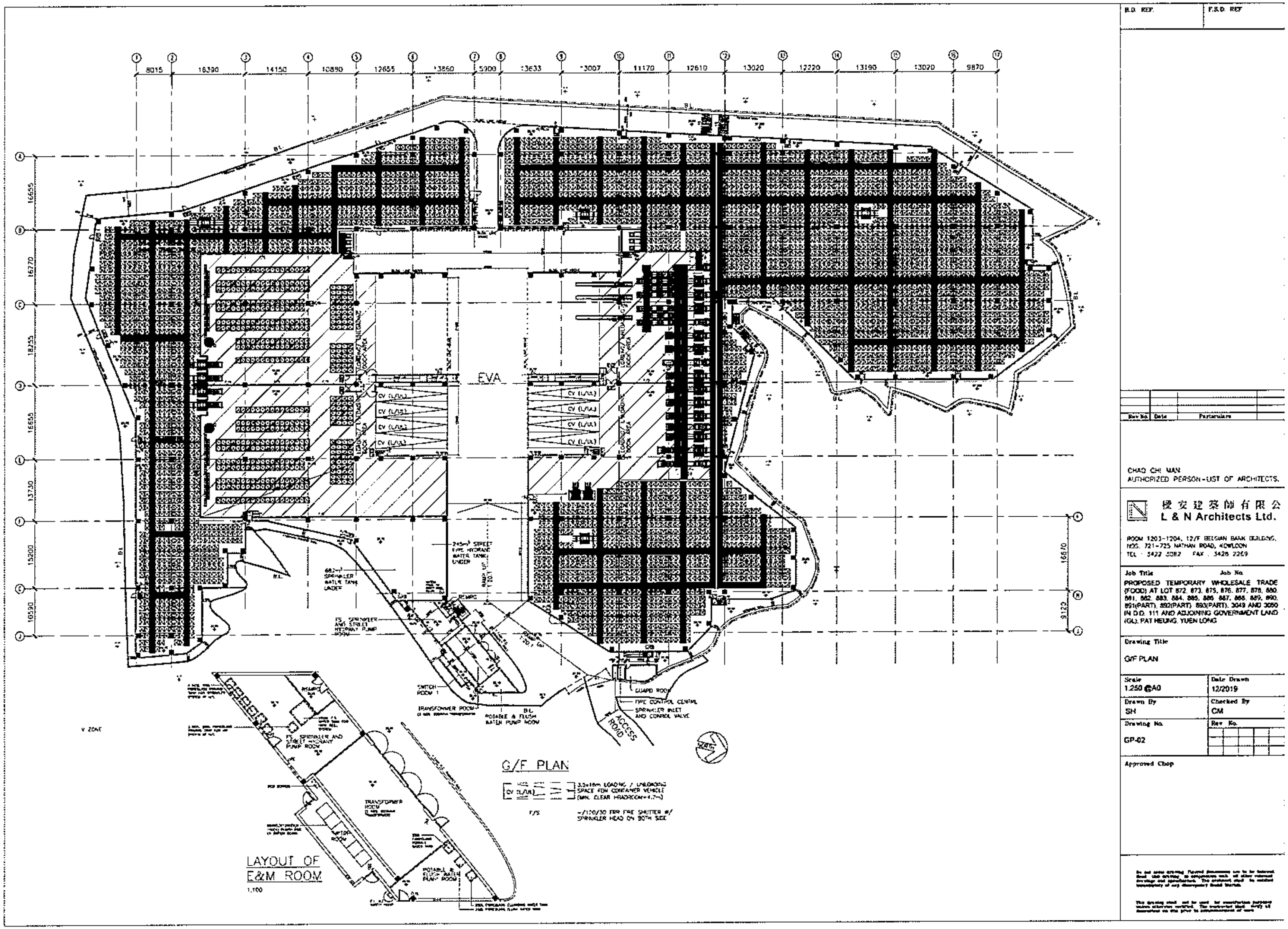
4.1.8 The actual option to be adopted will be determined in the future due to the site constraints. The final design and construction of the upgraded precast concrete pipe will be provided to the satisfaction of the relevant government departments.

4.1.9 In addition to the upgrade of 1800mm dia. pipe proposed in Option 1, a retention tank of about 1,000m3 for 30minutues retention time is proposed to be included within the site to store the additional runoff due to the proposed development. With the storage tank, excessive runoff can be stored offline and to be discharged at a controlled manner during non-peak hours.

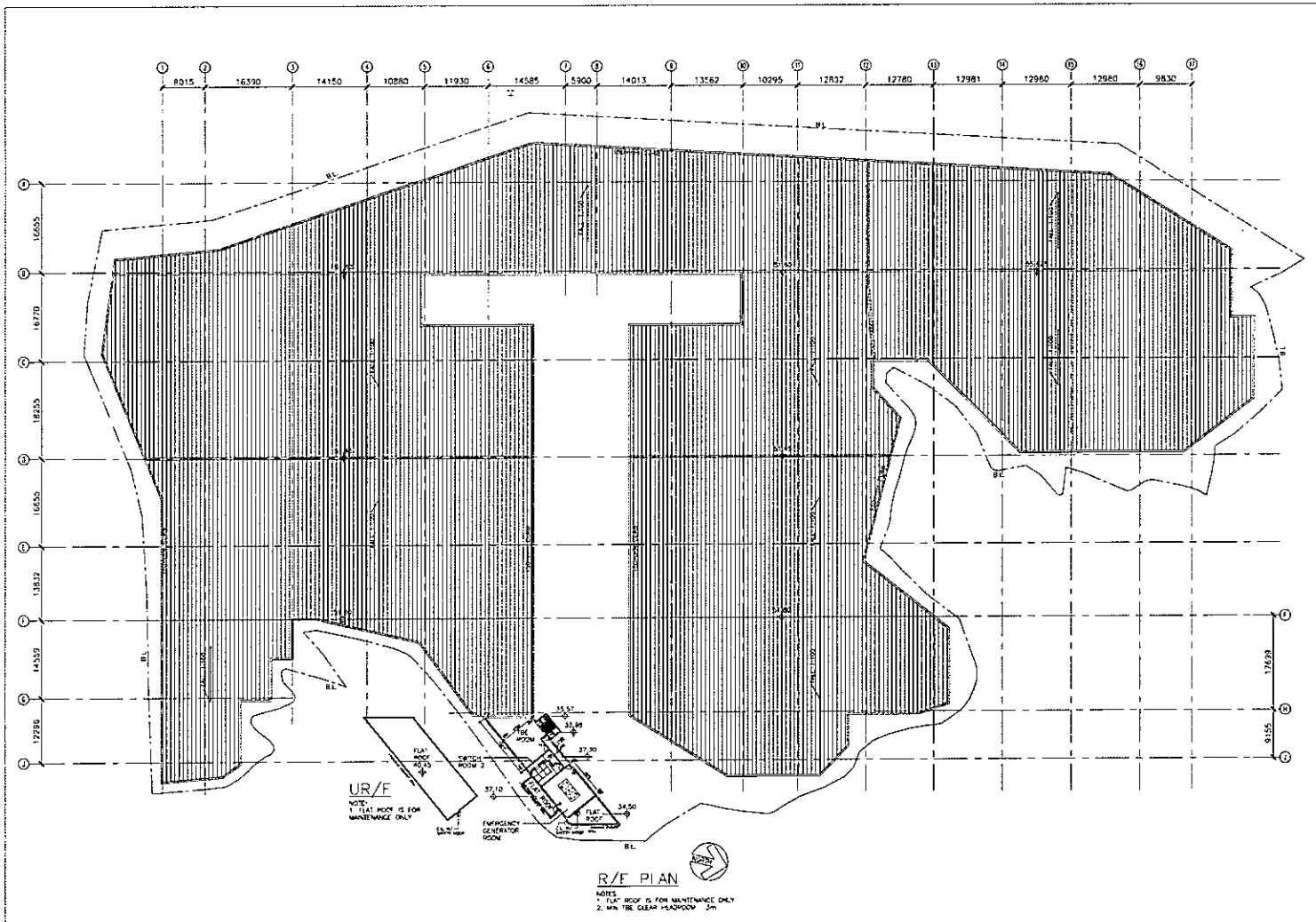
4.1.10 Thus, with the proposed drainage system and retention tank, the existing watercourse will have sufficient capacity to receive stormwater runoff from the Proposed Development and surrounding catchments with the proposed drainage system upgrading works. As a result, no adverse drainage impact is anticipated after the development of the Site.

Appendix A **CCTV PIPE INSPECTION REPORT**

Appendix B LAYOUT OF THE PROPOSED DEVELOPMENT



G/F PLAN
LAYOUT OF E&M ROOM
EVA
ACCESS ROAD
GUARD ROOM
TRANSFORMER ROOM
SWITCH ROOM 1
POTABLE & FLUSH WATER PUMP ROOM
3.5x16m LOADING / UNLOADING SPACE FOR CONTAINER VEHICLE (MIN. CLEAR HEADROOM=4.7m)
-/120/30 FRR FIRE SHUTTER W/ SPRINKLER HEAD ON BOTH SIDE
B.D. REF.
F.S.D. REF
Rev No. | Date | Particulars
CHAO CHI MAN
AUTHORIZED PERSON-LIST OF ARCHITECTS.
樑安建築師有限公司
L & N Architects Ltd.
ROOM 1203-1204, 12/F BELGIAN BANK BUILDING, NOS. 721-725 NATHAN ROAD, KOWLOON
TEL : 3422 3082 FAX : 3428 2269
Job Title
Job No.
PROPOSED TEMPORARY WHOLESALE TRADE (FOOD) AT LOT 872, 873, 875, 876, 877, 878, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891(PART), 892(PART), 893(PART), 3049 AND 3050 IN D.D. 111 AND ADJOINING GOVERNMENT LAND (GL), PAT HEUNG, YUEN LONG
Drawing Title
G/F PLAN
Scale
1:250 @A0
Date Drawn
12/2019
Drawn By
SH
Checked By
CM
Drawing No.
GP-02
Rev No.
Approved Chop



B.D. REF | F.S.D. REF

Rev No	Date	Particulars

CHAO CHI MAN
AUTHORIZED PERSON - LIST OF ARCHITECTS

梁安建築師有限公
L & N Architects Ltd.

ROOM 1203-1204, 12/F BELGIAN BANK BUILDING,
NOS. 721-725 NATHAN ROAD, KOWLOON
TEL 3422 3082 FAX 3428 2269

Job Title | Job No.

PROPOSED TEMPORARY WHOLESALE TRADE (FOOD) AT LOT 872, 873, 875, 876, 877, 878, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891(PART), 892(PART), 893(PART), 3049 AND 3050 IN D.D. 111 AND ADJOINING GOVERNMENT LAND (GL), PAT HEUNG, YUEN LONG

Drawing Title

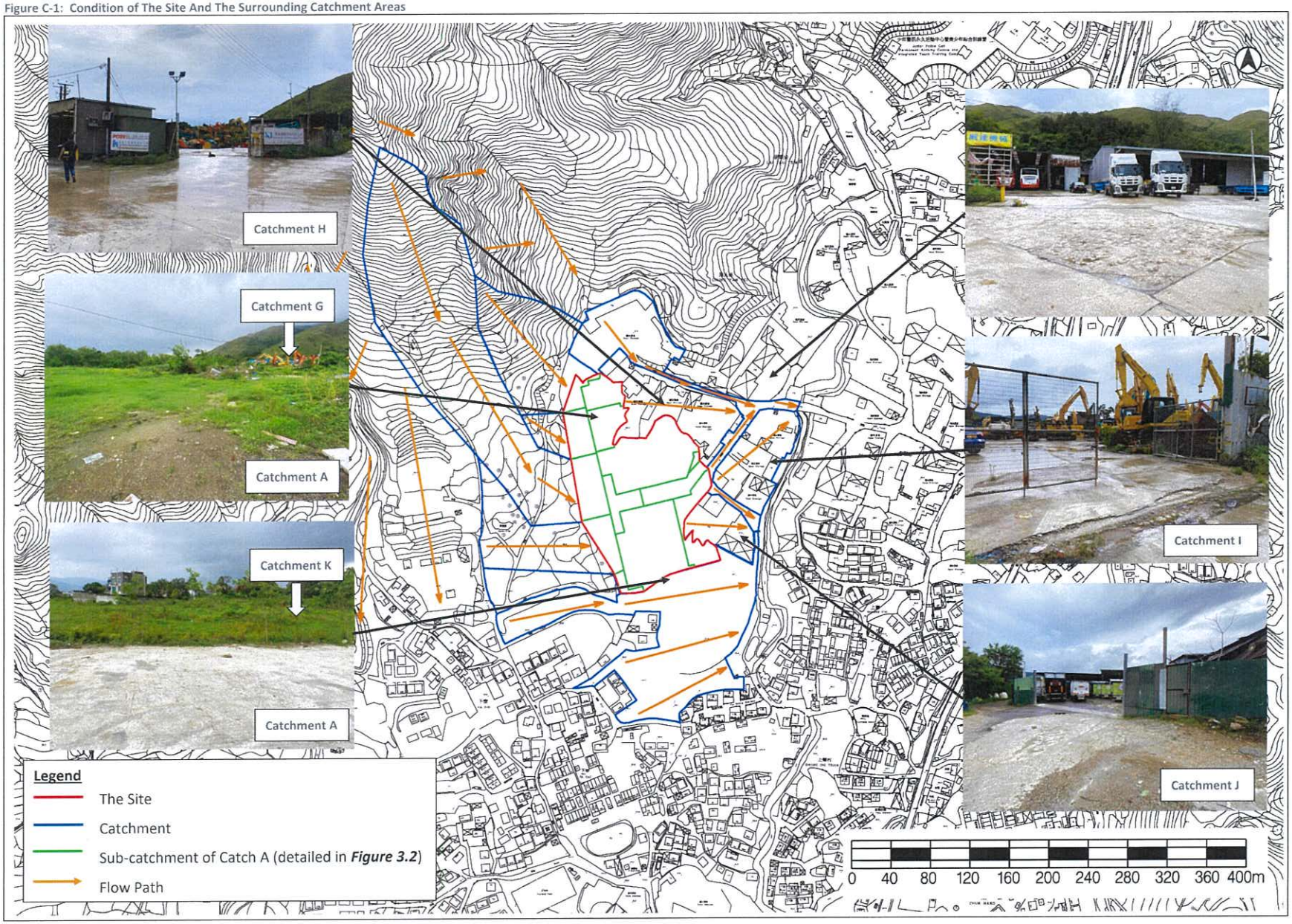
UPPER PART OF E&M ROOM AND R/F PLAN

Scale	Date Drawn
1:250 @A0	12/2019
Drawn By	Checked By
SH	CM
Drawing No.	Rev. No
GP-03	

Approved Chop

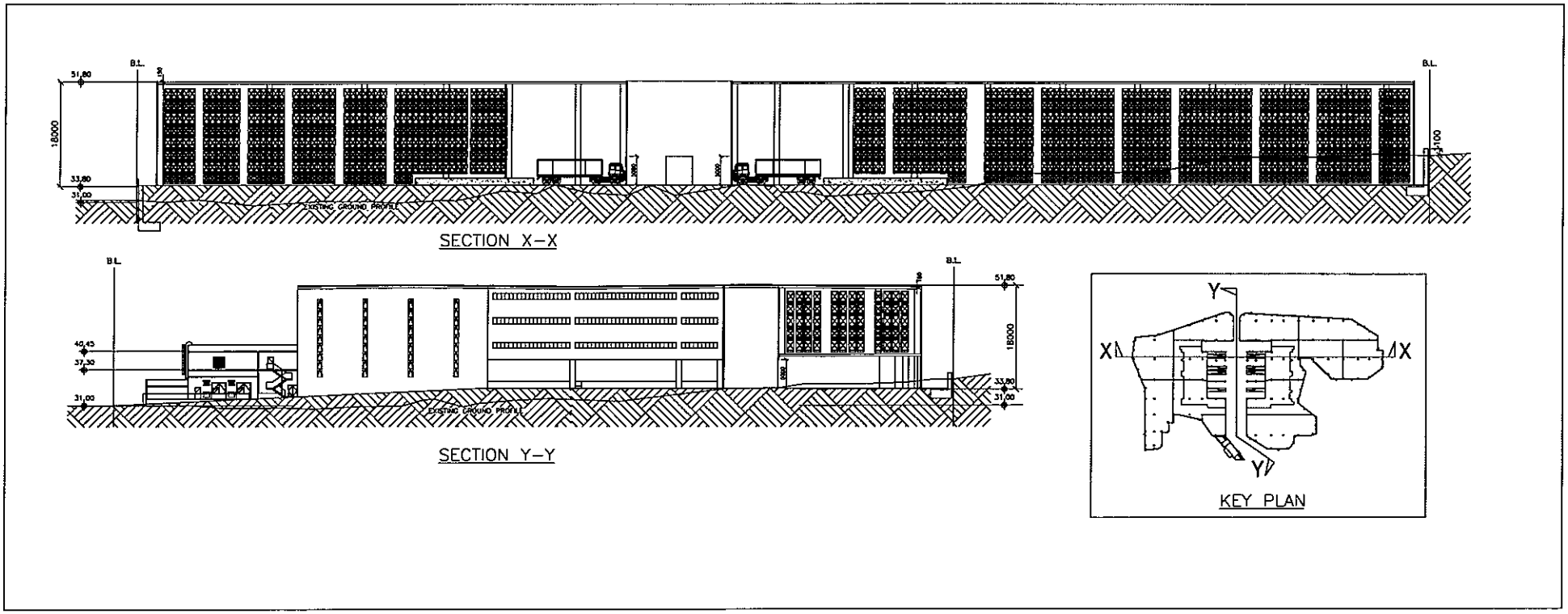
Appendix C CONDITION OF THE SITE AND THE SURROUNDING CATCHMENT AREAS

Figure C-1: Condition of The Site And The Surrounding Catchment Areas



Appendix D CROSS SECTION OF THE SITE AND THE SURROUNDING AREA AFTER THE PROPOSED DEVELOPMENT

Figure D-1: Cross Section



Appendix E **RUNOFF CALCULATION**

Calculation of Runoff for Return Period of 2 Years

Catchment ID	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), mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
						a	b	c				
Before the Proposed Development												
Site Area (Catchment A1)	0.0003	9.09	11.0	0.58	0.58	499.8	4.26	0.494	229.29	0.25	0.0001	0.004
Site Area (Catchment A2)	0.0012	6.39	61.0	2.99	2.99	499.8	4.26	0.494	187.82	0.25	0.0003	0.016
Site Area (Catchment A3)	0.0028	7.82	78.0	3.38	3.38	499.8	4.26	0.494	183.03	0.25	0.0007	0.036
Site Area (Catchment A4)	0.0012	7.45	51.0	2.43	2.43	499.8	4.26	0.494	195.44	0.25	0.0003	0.016
Site Area (Catchment A5)	0.0006	1.61	31.0	2.17	2.17	499.8	4.26	0.494	199.36	0.25	0.0001	0.008
Site Area (Catchment A6)	0.0048	4.17	84.0	3.91	3.91	499.8	4.26	0.494	177.08	0.25	0.0012	0.060
Site Area (Catchment A7)	0.0048	6.34	71.0	3.04	3.04	499.8	4.26	0.494	187.18	0.25	0.0012	0.062
Site Area (Catchment A8)	0.0013	9.61	43.7	1.96	1.96	499.8	4.26	0.494	202.55	0.25	0.0003	0.018
Site Area (Catchment A9)	0.0011	8.52	41.1	1.92	1.92	499.8	4.26	0.494	203.24	0.25	0.0003	0.016
Site Area (Catchment A10)	0.0017	4.26	72.8	3.75	3.75	499.8	4.26	0.494	178.76	0.25	0.0004	0.021
Site Area (Catchment A11)	0.0012	2.46	69.0	4.12	4.12	499.8	4.26	0.494	174.92	0.25	0.0003	0.014
Site Area (Catchment A12)	0.0001	3.13	16.0	1.16	1.16	499.8	4.26	0.494	216.88	0.25	0.0000	0.002
Catchment B	0.0099	39.87	153.0	4.22	4.22	499.8	4.26	0.494	173.83	0.35	0.0034	0.167
Catchment C	0.0015	13.69	65.0	2.69	2.69	499.8	4.26	0.494	191.80	0.35	0.0005	0.027
Catchment D	0.0314	28.82	432.0	11.33	11.33	499.8	4.26	0.494	128.70	0.35	0.0110	0.393
Catchment E	0.0074	7.91	182.0	7.15	7.15	499.8	4.26	0.494	150.16	0.25	0.0018	0.077
Catchment F	0.0035	3.63	124.0	6.12	6.12	499.8	4.26	0.494	157.29	0.25	0.0009	0.039
Catchment I	0.0053	1.82	110.0	5.99	5.99	499.8	4.26	0.494	158.28	0.95	0.0050	0.220
											Total (General Scenario)	**1.196**
After the Proposed Development												
Site Area (Catchment A1)	0.0003	0.01	7.8	1.61	1.61	499.8	4.26	0.494	208.45	0.95	0.0003	0.015
Site Area (Catchment A2)	0.0012	0.01	22.0	3.93	3.93	499.8	4.26	0.494	176.88	0.95	0.0012	0.057
Site Area (Catchment A3)	0.0028	0.01	27.9	4.58	4.58	499.8	4.26	0.494	170.28	0.95	0.0027	0.126
Site Area (Catchment A4)	0.0012	0.01	23.0	4.12	4.12	499.8	4.26	0.494	174.92	0.95	0.0011	0.055
Site Area (Catchment A5)	0.0006	0.01	11.8	2.28	2.28	499.8	4.26	0.494	197.65	0.95	0.0005	0.029
Site Area (Catchment A6)	0.0048	0.01	31.9	4.96	4.96	499.8	4.26	0.494	166.80	0.95	0.0046	0.214
Site Area (Catchment A7)	0.0048	0.01	34.5	5.37	5.37	499.8	4.26	0.494	163.25	0.95	0.0045	0.206
Site Area (Catchment A8)	0.0013	0.01	33.0	5.86	5.86	499.8	4.26	0.494	159.33	0.95	0.0012	0.054
Site Area (Catchment A9)	0.0011	0.01	37.5	6.76	6.76	499.8	4.26	0.494	152.76	0.95	0.0011	0.045
Site Area (Catchment A10)	0.0017	0.01	26.0	4.50	4.50	499.8	4.26	0.494	171.08	0.95	0.0016	0.075
Site Area (Catchment A11)	0.0012	0.05	69.6	9.05	9.05	499.8	4.26	0.494	139.14	0.95	0.0011	0.043
Site Area (Catchment A12)	0.0001	0.05	8.0	1.33	1.33	499.8	4.26	0.494	213.67	0.95	0.0001	0.006
Catchment B	0.0099	39.87	153.0	4.22	4.22	499.8	4.26	0.494	173.83	0.35	0.0034	0.167
Catchment C	0.0015	13.69	65.0	2.69	2.69	499.8	4.26	0.494	191.80	0.35	0.0005	0.027
Catchment D	0.0314	28.82	432.0	11.33	11.33	499.8	4.26	0.494	128.70	0.35	0.0110	0.393
Catchment E	0.0074	7.91	182.0	7.15	7.15	499.8	4.26	0.494	150.16	0.25	0.0018	0.077
Catchment F	0.0035	3.63	124.0	6.12	6.12	499.8	4.26	0.494	157.29	0.25	0.0009	0.039
Catchment I	0.0053	1.82	110.0	5.99	5.99	499.8	4.26	0.494	158.28	0.95	0.0050	0.220
											Total (General Scenario)	**1.848**

Calculation of Runoff for Return Period of 10 Years

Catchment ID	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) mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
						a	b	c				
Before the Proposed Development												
Site Area (Catchment A1)	0.0003	9.09	11.0	0.58	0.58	471.9	3.02	0.397	283.72	0.25	0.0001	0.006
Site Area (Catchment A2)	0.0012	6.39	61.0	2.99	2.99	471.9	3.02	0.397	231.52	0.25	0.0003	0.020
Site Area (Catchment A3)	0.0028	7.82	78.0	3.38	3.38	471.9	3.02	0.397	225.83	0.25	0.0007	0.044
Site Area (Catchment A4)	0.0012	7.45	51.0	2.43	2.43	471.9	3.02	0.397	240.70	0.25	0.0003	0.020
Site Area (Catchment A5)	0.0006	1.61	31.0	2.17	2.17	471.9	3.02	0.397	245.48	0.25	0.0001	0.009
Site Area (Catchment A6)	0.0048	4.17	84.0	3.91	3.91	471.9	3.02	0.397	218.83	0.25	0.0012	0.074
Site Area (Catchment A7)	0.0048	6.34	71.0	3.04	3.04	471.9	3.02	0.397	230.75	0.25	0.0012	0.077
Site Area (Catchment A8)	0.0013	9.61	43.7	1.96	1.96	471.9	3.02	0.397	249.41	0.25	0.0003	0.022
Site Area (Catchment A9)	0.0011	8.52	41.1	1.92	1.92	471.9	3.02	0.397	250.26	0.25	0.0003	0.019
Site Area (Catchment A10)	0.0017	4.26	72.8	3.75	3.75	471.9	3.02	0.397	220.79	0.25	0.0004	0.025
Site Area (Catchment A11)	0.0012	2.46	69.0	4.12	4.12	471.9	3.02	0.397	216.29	0.25	0.0003	0.017
Site Area (Catchment A12)	0.0001	3.13	16.0	1.16	1.16	471.9	3.02	0.397	267.47	0.25	0.0000	0.002
Catchment B	0.0099	39.87	153.0	4.22	4.22	471.9	3.02	0.397	215.02	0.35	0.0034	0.206
Catchment C	0.0015	13.69	65.0	2.69	2.69	471.9	3.02	0.397	236.30	0.35	0.0005	0.033
Catchment D	0.0314	28.82	432.0	11.33	11.33	471.9	3.02	0.397	163.91	0.35	0.0110	0.501
Catchment E	0.0074	7.91	182.0	7.15	7.15	471.9	3.02	0.397	187.93	0.25	0.0018	0.096
Catchment F	0.0035	3.63	124.0	6.12	6.12	471.9	3.02	0.397	196.01	0.25	0.0009	0.048
Catchment I	0.0053	1.82	110.0	5.99	5.99	471.9	3.02	0.397	197.13	0.95	0.0050	0.274
											Total (General Scenario)	**1.493**
After the Proposed Development												
Site Area (Catchment A1)	0.0003	0.01	7.8	1.61	1.61	471.9	3.02	0.397	256.75	0.95	0.0003	0.019
Site Area (Catchment A2)	0.0012	0.01	22.0	3.93	3.93	471.9	3.02	0.397	218.59	0.95	0.0012	0.070
Site Area (Catchment A3)	0.0028	0.01	27.9	4.58	4.58	471.9	3.02	0.397	210.91	0.95	0.0027	0.156
Site Area (Catchment A4)	0.0012	0.01	23.0	4.12	4.12	471.9	3.02	0.397	216.30	0.95	0.0011	0.068
Site Area (Catchment A5)	0.0006	0.01	11.8	2.28	2.28	471.9	3.02	0.397	243.40	0.95	0.0005	0.036
Site Area (Catchment A6)	0.0048	0.01	31.9	4.96	4.96	471.9	3.02	0.397	206.89	0.95	0.0046	0.265
Site Area (Catchment A7)	0.0048	0.01	34.5	5.37	5.37	471.9	3.02	0.397	202.80	0.95	0.0045	0.256
Site Area (Catchment A8)	0.0013	0.01	33.0	5.86	5.86	471.9	3.02	0.397	198.33	0.95	0.0012	0.068
Site Area (Catchment A9)	0.0011	0.01	37.5	6.76	6.76	471.9	3.02	0.397	190.86	0.95	0.0011	0.056
Site Area (Catchment A10)	0.0017	0.01	26.0	4.50	4.50	471.9	3.02	0.397	211.83	0.95	0.0016	0.093
Site Area (Catchment A11)	0.0012	0.05	69.6	9.05	9.05	471.9	3.02	0.397	175.55	0.95	0.0011	0.054
Site Area (Catchment A12)	0.0001	0.05	8.0	1.33	1.33	471.9	3.02	0.397	263.36	0.95	0.0001	0.007
Catchment B	0.0099	39.87	153.0	4.22	4.22	471.9	3.02	0.397	215.02	0.35	0.0034	0.206
Catchment C	0.0015	13.69	65.0	2.69	2.69	471.9	3.02	0.397	236.30	0.35	0.0005	0.033
Catchment D	0.0314	28.82	432.0	11.33	11.33	471.9	3.02	0.397	163.91	0.35	0.0110	0.501
Catchment E	0.0074	7.91	182.0	7.15	7.15	471.9	3.02	0.397	187.93	0.25	0.0018	0.096
Catchment F	0.0035	3.63	124.0	6.12	6.12	471.9	3.02	0.397	196.01	0.25	0.0009	0.048
Catchment I	0.0053	1.82	110.0	5.99	5.99	471.9	3.02	0.397	197.13	0.95	0.0050	0.274
											Total (General Scenario)	**2.306**

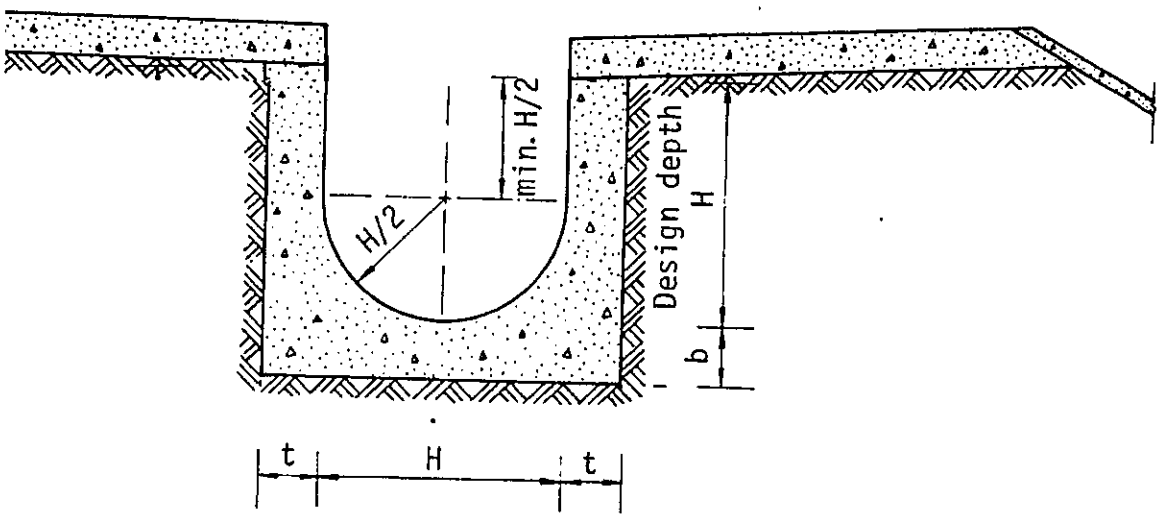
Calculation of Runoff for Return Period of 50 Years

Catchment ID	Catchment Area (A), km^2	Average slope (H), m/100m	Flow path length (L), m	Inlet time (t_0), min	Duration (t_d), min	Storm Constants			Runoff intensity (i) mm/hr	Runoff coefficient (C)	C x A	Peak runoff (Q_p), m^3/s
						a	b	c				
Before the Proposed Development												
Site Area (Catchment A1)	0.0003	9.09	11.0	0.58	0.58	451.3	2.46	0.337	310.19	0.25	0.0001	0.006
Site Area (Catchment A2)	0.0012	6.39	61.0	2.99	2.99	451.3	2.46	0.337	254.83	0.25	0.0003	0.022
Site Area (Catchment A3)	0.0028	7.82	78.0	3.38	3.38	451.3	2.46	0.337	248.98	0.25	0.0007	0.048
Site Area (Catchment A4)	0.0012	7.45	51.0	2.43	2.43	451.3	2.46	0.337	264.33	0.25	0.0003	0.022
Site Area (Catchment A5)	0.0006	1.61	31.0	2.17	2.17	451.3	2.46	0.337	269.31	0.25	0.0001	0.010
Site Area (Catchment A6)	0.0048	4.17	84.0	3.91	3.91	451.3	2.46	0.337	241.82	0.25	0.0012	0.081
Site Area (Catchment A7)	0.0048	6.34	71.0	3.04	3.04	451.3	2.46	0.337	254.04	0.25	0.0012	0.085
Site Area (Catchment A8)	0.0013	9.61	43.7	1.96	1.96	451.3	2.46	0.337	273.42	0.25	0.0003	0.025
Site Area (Catchment A9)	0.0011	8.52	41.1	1.92	1.92	451.3	2.46	0.337	274.31	0.25	0.0003	0.021
Site Area (Catchment A10)	0.0017	4.26	72.8	3.75	3.75	451.3	2.46	0.337	243.83	0.25	0.0004	0.028
Site Area (Catchment A11)	0.0012	2.46	69.0	4.12	4.12	451.3	2.46	0.337	239.24	0.25	0.0003	0.019
Site Area (Catchment A12)	0.0001	3.13	16.0	1.16	1.16	451.3	2.46	0.337	292.56	0.25	0.0000	0.002
Catchment B	0.0099	39.87	153.0	4.22	4.22	451.3	2.46	0.337	237.94	0.35	0.0034	0.228
Catchment C	0.0015	13.69	65.0	2.69	2.69	451.3	2.46	0.337	259.77	0.35	0.0005	0.037
Catchment D	0.0314	28.82	432.0	11.33	11.33	451.3	2.46	0.337	186.40	0.35	0.0110	0.570
Catchment E	0.0074	7.91	182.0	7.15	7.15	451.3	2.46	0.337	210.54	0.25	0.0018	0.108
Catchment F	0.0035	3.63	124.0	6.12	6.12	451.3	2.46	0.337	218.68	0.25	0.0009	0.054
Catchment I	0.0053	1.82	110.0	5.99	5.99	451.3	2.46	0.337	219.81	0.95	0.0050	0.305
											Total (General Scenario)	**1.671**
After the Proposed Development												
Site Area (Catchment A1)	0.0003	0.01	7.8	1.61	1.61	451.3	2.46	0.337	281.15	0.95	0.0003	0.021
Site Area (Catchment A2)	0.0012	0.01	22.0	3.93	3.93	451.3	2.46	0.337	241.58	0.95	0.0012	0.078
Site Area (Catchment A3)	0.0028	0.01	27.9	4.58	4.58	451.3	2.46	0.337	233.76	0.95	0.0027	0.173
Site Area (Catchment A4)	0.0012	0.01	23.0	4.12	4.12	451.3	2.46	0.337	239.24	0.95	0.0011	0.075
Site Area (Catchment A5)	0.0006	0.01	11.8	2.28	2.28	451.3	2.46	0.337	267.13	0.95	0.0005	0.039
Site Area (Catchment A6)	0.0048	0.01	31.9	4.96	4.96	451.3	2.46	0.337	229.68	0.95	0.0046	0.294
Site Area (Catchment A7)	0.0048	0.01	34.5	5.37	5.37	451.3	2.46	0.337	225.54	0.95	0.0045	0.285
Site Area (Catchment A8)	0.0013	0.01	33.0	5.86	5.86	451.3	2.46	0.337	221.02	0.95	0.0012	0.075
Site Area (Catchment A9)	0.0011	0.01	37.5	6.76	6.76	451.3	2.46	0.337	213.49	0.95	0.0011	0.063
Site Area (Catchment A10)	0.0017	0.01	26.0	4.50	4.50	451.3	2.46	0.337	234.69	0.95	0.0016	0.103
Site Area (Catchment A11)	0.0012	0.05	69.6	9.05	9.05	451.3	2.46	0.337	198.09	0.95	0.0011	0.061
Site Area (Catchment A12)	0.0001	0.05	8.0	1.33	1.33	451.3	2.46	0.337	288.17	0.95	0.0001	0.008
Catchment B	0.0099	39.87	153.0	4.22	4.22	451.3	2.46	0.337	237.94	0.35	0.0034	0.228
Catchment C	0.0015	13.69	65.0	2.69	2.69	451.3	2.46	0.337	259.77	0.35	0.0005	0.037
Catchment D	0.0314	28.82	432.0	11.33	11.33	451.3	2.46	0.337	186.40	0.35	0.0110	0.570
Catchment E	0.0074	7.91	182.0	7.15	7.15	451.3	2.46	0.337	210.54	0.25	0.0018	0.108
Catchment F	0.0035	3.63	124.0	6.12	6.12	451.3	2.46	0.337	218.68	0.25	0.0009	0.054
Catchment I	0.0053	1.82	110.0	5.99	5.99	451.3	2.46	0.337	219.81	0.95	0.0050	0.305
											Total (General Scenario)	**2.577**

Note:

1) Runoff is calculated in accordance with DSD's "*Stormwater Drainage Manual (with Eurocodes incorporated) - Planning, Design and Monogemen* t" (SDM), fifth edition, January 2018.

Appendix F DRAWING OF TYPICAL DETAILS OF U-CHANNEL


min. H/2
H/2
Design depth
H
b
t
H
t

Appendix G **CALCULATION OF DRAINAGE CAPACITY**

Calculation of Drainage Capacity for Return Period of 50 Years

Drainage Capacity of Internal Drainage System (U-channel)

Description	Shape	Depth (m)	Diameter (m)	s	A_w	P_w	R	n	V	Q_c	Total Runoff (m3/s)	% of capacity	Remark
Proposed U-shape channel UC01 (For collecting runoff from Catchments A1 + F)	U-Shape	0.23	0.45	0.0067	0.18	1.16	0.16	0.016	1.48	0.268	0.075	28.0%	OK
Proposed U-shape channel UC02 (For collecting runoff from Catchments A2 + E)	U-Shape	0.23	0.45	0.0067	0.18	1.16	0.16	0.016	1.48	0.268	0.186	69.5%	OK
Proposed U-shape channel UC03 (For collecting runoff from Catchments A3 + D)	U-Shape	0.38	0.75	0.0067	0.50	1.93	0.26	0.016	2.08	1.045	0.743	71.1%	OK
Proposed U-shape channel UC04 (For collecting runoff from Catchments A4 + C)	U-Shape	0.23	0.45	0.0067	0.18	1.16	0.16	0.016	1.48	0.268	0.112	41.8%	OK
Proposed U-shape channel UC05 (For collecting runoff from Catchments A5 + B)	U-Shape	0.25	0.50	0.0067	0.22	1.29	0.17	0.016	1.59	0.354	0.267	75.3%	OK
Proposed U-shape channel UC06-1 (For collecting runoff from Catchment A6)	U-Shape	0.25	0.50	0.0067	0.22	1.29	0.17	0.016	1.59	0.354	0.294	82.9%	OK
Proposed U-shape channel UC06-2 (For collecting runoff from Catchment A6)	U-Shape	0.30	0.60	0.0050	0.32	1.54	0.21	0.016	1.55	0.499	0.294	58.9%	OK
Proposed U-shape channel UC07-1 (For collecting runoff from Catchment A7)	U-Shape	0.25	0.50	0.0067	0.22	1.29	0.17	0.016	1.59	0.354	0.285	80.4%	OK
Proposed U-shape channel UC07-2 (For collecting runoff from Catchment A7)	U-Shape	0.30	0.60	0.0050	0.32	1.54	0.21	0.016	1.55	0.499	0.285	57.1%	OK
Proposed U-shape channel UC08-1 (For collecting runoff from Catchment A8)	U-Shape	0.15	0.30	0.0067	0.08	0.77	0.10	0.016	1.13	0.091	0.075	82.6%	OK
Proposed U-shape channel UC08-2 (For collecting runoff from Catchment A8)	U-Shape	0.23	0.45	0.0067	0.18	1.16	0.16	0.016	1.48	0.268	0.075	28.0%	OK
Proposed U-shape channel UC09-1 (For collecting runoff from Catchment A9)	U-Shape	0.15	0.30	0.0067	0.08	0.77	0.10	0.016	1.13	0.091	0.063	69.4%	OK
Proposed U-shape channel UC09-2 (For collecting runoff from Catchment A9)	U-Shape	0.23	0.45	0.0067	0.18	1.16	0.16	0.016	1.48	0.268	0.063	23.5%	OK
Proposed U-shape channel UC10-1 (For collecting runoff from Catchment A10)	U-Shape	0.23	0.45	0.0067	0.18	1.16	0.16	0.016	1.48	0.268	0.103	38.5%	OK
Proposed U-shape channel UC10-2 (For collecting runoff from Catchment A10)	U-Shape	0.23	0.45	0.0050	0.18	1.16	0.16	0.016	1.28	0.232	0.103	44.4%	OK
Proposed U-shape channel UC11 (For collecting runoff from Catchment A11)	U-Shape	0.15	0.30	0.0067	0.08	0.77	0.10	0.016	1.13	0.091	0.061	67.2%	OK

Legend

D = diameter, m
A_w = Cross Section Area of Flow, m^2
P_w = Wetted Perimeter, m
R = Hydraulic Radius = A_w/P_w, m
s = Hydraulic Gradient
n = Manning's roughness coefficient
V = Mean Velocity, m/s
Q_c = Flow Capacity, m^3/s
Q_p = Estimated Peak Flow, m^3/s

Drainage Capacity of Internal Drainage System (Circular Pipe)

Description	Length	d	r	A_w	P_w	R	s	k_s	V	Q_c	Total Runoff	% of capacity	Remark
	m	m	m	m^2	m	m	-	mm	m/s	m^3/s	m^3/s	%	
Proposed Underground Circular Pipe DP01 (For collecting runoff from UC01+UC06)	-	0.60	0.30	0.28	1.89	0.15	0.005	0.60	1.72	0.438	0.369	84.3%	OK
Proposed Underground Circular Pipe DP02 (For collecting runoff from UC02+UC03)	-	0.90	0.45	0.64	2.83	0.22	0.005	0.60	2.21	1.266	0.929	73.4%	OK
Proposed Underground Circular Pipe DP03 (For collecting runoff from UC04+UC05)	-	0.60	0.30	0.28	1.89	0.15	0.005	0.60	1.72	0.438	0.379	86.5%	OK
Proposed Underground Circular Pipe DP04 (For collecting runoff from UC08+UC09)	-	0.60	0.30	0.28	1.89	0.15	0.005	0.60	1.72	0.438	0.138	31.5%	OK
Proposed Underground Circular Pipe DP05 (For collecting runoff from DP03+DP04)	-	0.75	0.38	0.44	2.36	0.19	0.005	0.60	1.98	0.786	0.517	65.8%	OK
Proposed Underground Circular Pipe DP06 (For collecting runoff from DP02+DP05)	-	1.00	0.50	0.79	3.14	0.25	0.005	0.60	2.36	1.667	1.446	86.7%	OK
Proposed Underground Circular Pipe DP07-1 (For collecting runoff from DP01+DP06)	-	1.20	0.60	1.13	3.77	0.30	0.005	0.60	2.64	2.689	1.815	67.5%	OK
Proposed Underground Circular Pipe DP07-2 (For collecting runoff from DP01+DP06)	-	1.20	0.60	1.13	3.77	0.30	0.050	0.60	8.38	8.533	1.815	21.3%	OK
Proposed Underground Circular Pipe DP08 (For collecting runoff from UC07+runoff from Catchment A12)	-	0.60	0.30	0.28	1.89	0.15	0.005	0.60	1.72	0.438	0.293	66.9%	OK
Proposed Underground Circular Pipe DP09 (For collecting runoff from UC10+UC11)	-	0.45	0.23	0.16	1.42	0.11	0.005	0.60	1.44	0.209	0.164	78.6%	OK
Proposed Underground Circular Pipe DP10 (For For discharging the collected runoff)	-	1.00	0.50	0.79	3.14	0.25	0.005	0.60	2.36	1.667	1.196	71.7%	OK

Legend

d = pipe diameter, m
r = pipe radius (m) = 0.5d
A_w = wetted area (m^2) = πr^2
P_w = wetted perimeter (m) = $2\pi r$
R = Hydraulic radius (m) = A_w/P_w
s = Slope of the total energy line
k_s = equivalent sand roughness, mm
V = Velocity of flow calculated based on Colebrook White Equation, m/s
Q_c = Flow Capacity (10% sedimentation incorporated), m^3/s
Q_p = Estimated total peak flow from the Site during peak season, m^3/s

Drainage Capacity of Existing Precast Concrete Pipe before Upgrading Works

From	To	Description	Length	d	r	A_w	P_w	R	s	k_s	V	Q_c	Total Runoff	% of capacity	Remark
			m	m	m	m^2	m	m	-	mm	m/s	m^3/s	m^3/s	%	
Sand Trap / Manhole	Existing Stream	Exising Precast Concentrate Pipe (Circular) - Section near the Intake within the Site	-	1.8	0.90	2.545	5.655	0.450	0.040	0.60	9.60	21.996	2.577	11.7%	OK
Sand Trap / Manhole	Existing Stream	Exising Precast Concentrate Pipe (Circular) - Section near the Outlet at the watercourse	-	0.6	0.30	0.283	1.885	0.150	0.050	0.60	5.46	1.392	2.577	185.1%	*NOTOK

Legend

d = pipe diameter, m
r = pipe radius (m) = 0.5d
A_w = wetted area (m^2) = πr^2
P_w = wetted perimeter (m) = $2\pi r$
R = Hydraulic radius (m) = A_w/P_w
s = Slope of the total energy line
k_s = equivalent sand roughness, mm
V = Velocity of flow calculated based on Colebrook White Equation, m/s
Q_c = Flow Capacity (10% sedimentation incorporated), m^3/s
Q_p = Estimated total peak flow from the Site during peak season, m^3/s

Remark

1. The gradinet of the exising precast concentrate pipe is based on the CCTV inspection report. The lowest gradients of each section are adotped for assessment as a conservative approach.

Drainage Capacity of Existing Precast Concrete Pipe after Upgrading Works (Option 1)

From	To	Description	Length	d	r	A_w	P_w	R	s	k_s	V	Q_c	Total Runoff	% of capacity	Remark
			m	m	m	m^2	m	m	-	mm	m/s	m^3/s	m^3/s	%	
Sand Trap / Manhole	Existing Stream	Exising Precast Concentrate Pipe (Circular) - Section near the Intake within the Site	-	1.8	0.90	2.545	5.655	0.450	0.040	0.60	9.60	21.996	2.577	11.7%	OK
Sand Trap / Manhole	Existing Stream	Exising Precast Concentrate Pipe (Circular) - Section near the Outlet at the watercourse	-	1.8	0.90	2.545	5.655	0.450	0.004	0.60	2.97	6.800	2.577	37.9%	OK
			-	1.8	0.90	2.545	5.655	0.450	0.002	0.60	2.14	4.895	2.577	52.6%	OK

Legend

d = pipe diameter, m
r = pipe radius (m) = 0.5d
A_w = wetted area (m^2) = πr^2
P_w = wetted perimeter (m) = $2\pi r$
R = Hydraulic radius (m) = A_w/P_w
s = Slope of the total energy line
k_s = equivalent sand roughness, mm
V = Velocity of flow calculated based on Colebrook White Equation, m/s
Q_c = Flow Capacity (10% sedimentation incorporated), m^3/s
Q_p = Estimated total peak flow from the Site during peak season, m^3/s

Drainage Capacity of Existing Precast Concrete Pipe after Upgrading Works (Option 2)

From	To	Description	Length	d	r	A_w	P_w	R	s	k_s	V	Q_c	Total Runoff	% of capacity	Remark
			m	m	m	m^2	m	m	-	mm	m/s	m^3/s	m^3/s	%	
Sand Trap / Manhole	Existing Stream	Exising Precast Concentrate Pipe (Circular) - Section near the Intake within the Site	-	1.8	0.90	2.545	5.655	0.450	0.040	0.60	9.60	21.996	2.577	11.7%	OK
Sand Trap / Manhole	Existing Stream	Exising Precast Concentrate Pipe (Circular) - Section near the Outlet at the watercourse	-	1.2	0.60	1.131	3.77	0.300	0.006	0.60	2.96	3.008	2.577	85.7%	OK

Legend

d = pipe diameter, m
r = pipe radius (m) = 0.5d
A_w = wetted area (m^2) = πr^2
P_w = wetted perimeter (m) = $2\pi r$
R = Hydraulic radius (m) = A_w/P_w
s = Slope of the total energy line
k_s = equivalent sand roughness, mm
V = Velocity of flow calculated based on Colebrook White Equation, m/s
Q_c = Flow Capacity (10% sedimentation incorporated), m^3/s
Q_p = Estimated total peak flow from the Site during peak season, m^3/s

Drainage Capacity of Watercourse at the Assessment Point

Description	Description	Shape	Width	Depth	Leg	Radius	Start Level	End Level	Slope (s)	Cross Section Area, m2	Wetted Perimeter	Hydaralius Radius, m	Manning Roughness Coefficient	Mean Velocity, m/s	Capacity Flow, m3/s	Total Runoff, m3/s	% of capacity	Remark
Catchment A	Capalcty of the Channel	Rectangular	3.56	2.42	--	--	--	--	0.01	8.61	8.40	1.03	0.018	3.99	34.393	0.906	2.6%	OK

Appendix H **SIZING OF RETENTION TANK**

Design Parameters			Remarks
Return Period	50	years	
Q=0.278CiA			
Catchment surface area (Site only)	21000	m^2	
Peak Surface Runoff from Site			
Before Development	0.369	m^3/s	
After Development	1.275	m^3/s	
Increment of runoff Q1	0.906	m^3/s	
Duration of storm event= time t	30	min	30min is assumed as the retention time
Volume = Q1x t			
Volume=	1630.8	m^3	
Required Volume	978.48	m^3	
L	16	m	Assume 60% of the time at peak flow
D	25	m	
W	2.5	m	
Design Volume	1000	m^3	

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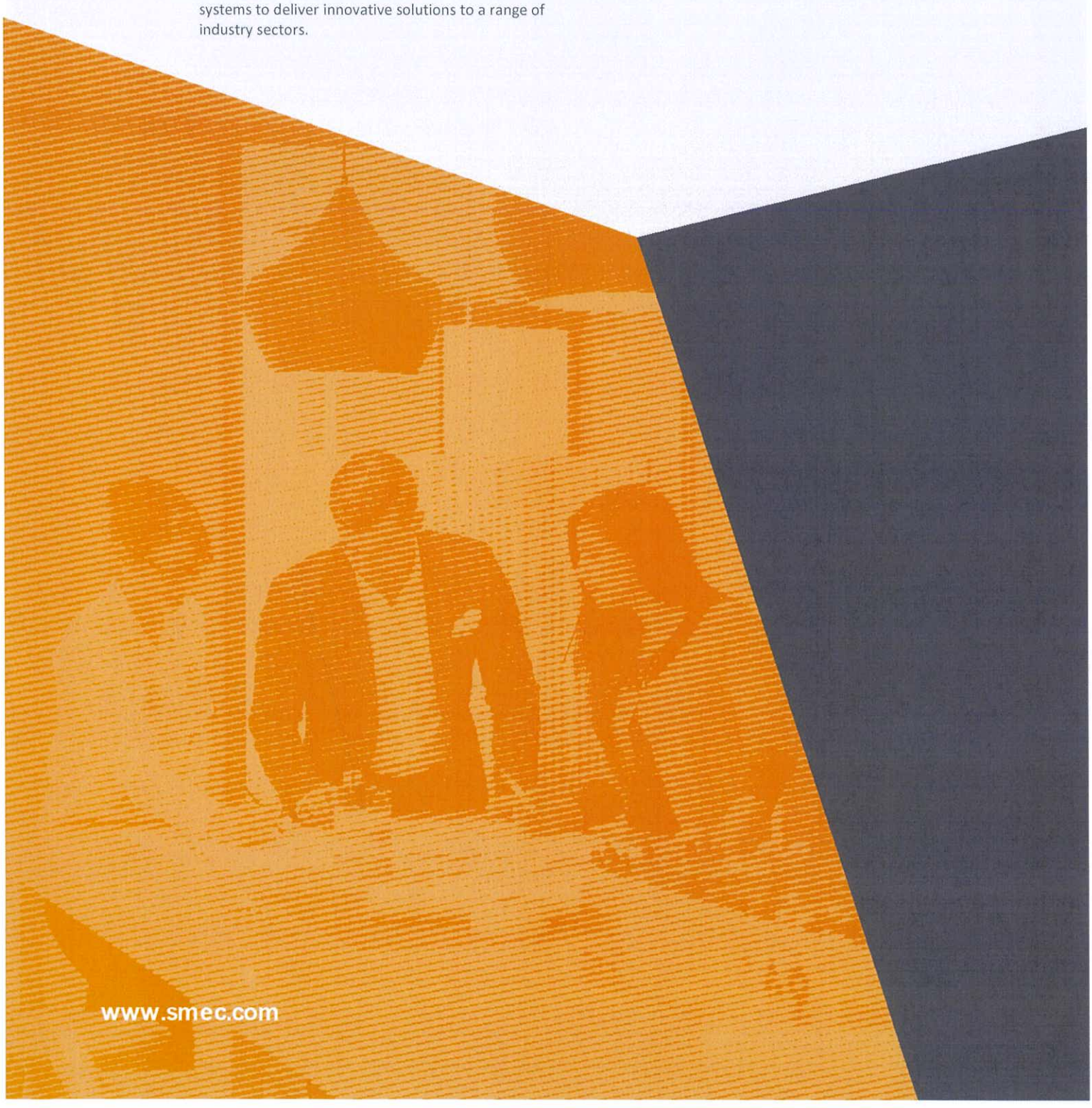

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