# Annex G

Drainage Impact Assessment

ARUP

# S.12A Application for Amendment to the Approved Kam Tin South Outline Zoning Plan No. S/YL-KTS/15, to rezone the Application Site from "Comprehensive Development Area" to "Residential (Group A)" at Lot 2160 RP (Part) in D.D. 106, and Adjoining Government Land, Kam Sheung Road, Kam Tin, Yuen Long

## Drainage Impact Assessment

Issue 2 | September 2026

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number

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# 1. Introduction

## 1.1 Project Background

1.1.1 This Drainage Impact Assessment (DIA) was prepared in support of the Planning Application under Section 12A of the Town Planning Ordinance (Cap. 131) for the Amendment of Plan for Proposed Residential Development at Lot 2160 RP (Part) in D.D. 106, and Adjoining Government Land, Kam Sheung Road, Kam Tin, Yuen Long, New Territories (the Kam Sheung Road Site / the Application Site).

1.1.2 The Applicant proposes amendment to the Approved Kam Tin South Outline Zoning Plan (OZP) No. S/YL-KTS/15, i.e. to rezone the Application Site from "Comprehensive Development Area" ("CDA") zone to "Residential (Group A)" ("R(A)"), with a maximum PR of 3, a maximum BH of 69mPD (including roof-top structures) to facilitate the proposed residential development at the Application Site.

1.1.3 The Application Site, with an area of about 7,166m$^2$, is located to the northwest of Tung Wui Road and to the west of the Kam Wui Road. Currently, the Application Site is occupied by a temporary transitional housing development, referred to as "The NAScenT".

1.1.4 Considering the irregular configuration of the Application Site boundary, it is proposed to rationalise the boundary of the rezoning area for the purpose of conducting sensitivity test in technical assessments. This approach aims to assess the technical impacts associated with the potential rezoning area, while ensuring design and development flexibility for future considerations.

## 1.2 Proposed Development

1.2.1 The Application Site is located in Kam Tin, bounded by Tung Wui Road to the southeast and Kam Tin River to the north. The Kam Sheung Road Site is proposed with residential development and clubhouse. The total site area is approximately 7,166 m$^2$ and the design parameters are summarised in **Table 1.1** below.

**Table 1.1 Key Development Parameters of Application Site**

| Development Parameters | Indicative Scheme |
|---|---|
| Site Location | Lot 2160 RP (Part) in D.D. 106, and Adjoining Government Land, Kam Sheung Road, Kam Tin, Yuen Long |
| Application Site Area | About 7,166 m$^2$ |
| Total Plot Ratio (PR)<br>• Domestic PR | 3.0<br>• 3.0 |
| Total Gross Floor Area (GFA)<br>• Domestic GFA<br>• Non-Domestic GFA<br>– Sewage Treatment Plant (1) | About 21,498 m$^2$<br>• About 21,498 m$^2$<br>• About 400 m$^2$ |
| Residential Clubhouse | About 750 m$^2$ |
| No. of Residential Towers | 2 |

| | | |
|---|---|---|
| No. of Residential Units | 416 | |
| Anticipated Population | Domestic: | 1,207 |
| | Clubhouse (2): | 25 |

Remarks:
(1) The GFA for proposed sewage treatment plant is exempted from GFA calculation.
(2) Community, Social & Personal Services = 3.3 employee per 100m$^2$ of GFA based on PlanD's Commercial and Industrial Floor Space Utilization Survey "CIFSUS" Table 8.

1.2.2 Concerning the irregular configuration of the Application Site boundary, a more rationalised boundary is assumed for possible rezoning by incorporating an adjoining area (i.e. outside the Application Site). The additional area is assessed to ensure that there would still be no adverse technical impact (cumulative) to the infrastructural capacity of the area when the rationalised boundary will be adopted for rezoning. The sensitivity test assumes that the additional area would be developed as a similar residential use with a total plot ratio of not more than 3 as the proposed development. Under this assumption for a sensitivity test scenario, please refer to the layout plan for additional area under the rationalised boundary in **Appendix B1**, and the key development parameters of this sensitivity test area in **Appendix B2** for reference.

## 1.3 Purpose of the Report

1.3.1 This **Drainage Impact Assessment ("DIA")**, appended to the Supporting Planning Statement, is prepared in support of the Application for the proposed residential development.

1.3.2 The DIA Report includes relevant information to assess current flooding conditions, and flood risks after the proposed works including:

- Outline the current flooding susceptibility and proposed drainage;
- Outline the changes to the drainage characteristics and potential drainage impacts with might arise from the proposed project;
- Details of any proposed drainage impact mitigation measure and any further drainage impact implications; and
- Details of any proposed monitoring requirements.

1.3.3 The DIA Report outlines the existing drainage network in the vicinity of the Site; studies the proposed development; defines the potential impacts that may arise; and proposed mitigation measures where necessary.

1.3.4 The Report is structured as follows:

- **Section 1** introduces the project background, objectives and scope of the Project;
- **Section 2** presents the methodology and design criteria;
- **Section 3** describes the existing drainage system and its performance;
- **Section 4** describes the proposed drainage system and its performance;
- **Section 5** presents the potential drainage impacts and drainage mitigation measures; and
- **Section 6** summarises the conclusion.

# 2. Assessment Methodology

## 2.1 Overview

2.1.1 This chapter describes the methodology assessing the drainage network performance under both existing and proposed conditions.

## 2.2 Design Standards and Guidelines

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

- DSD's Advice Note No. 1 – Application of the Drainage Impact Assessment Process to Private Sector Projects;
- Stormwater Drainage Manual (SDM) Fifth Edition, January 2018;
- Stormwater Drainage Manual – Corrigendum No. 1/2022;
- Stormwater Drainage Manual – Corrigendum No. 1/2024;
- Stormwater Drainage Manual – Corrigendum No. 2/2024 (SDM 2024);
- CEDD GEO – Technical Guidance Note No. 39 (TGN 39) "*Guidelines for Estimation of surface Runoff from Natural Terrain Catchments for Drainage Design Purposes*";
- Drainage Record Plans obtained from the GeoInfo[1] Map services of the Lands Department.

## 2.3 Design Criteria

2.3.1 The SDM 2024 recommends a range of different flood protection standards for various land uses, as shown in **Table 2.1** below.

**Table 2.1 Design Flood Protection Standards**

| Land Use and Drainage Type | Return Period |
|---|---|
| Intensively used Agricultural Land | 2-5 years |
| Village Drainage including Internal Drainage System under a Polder Scheme | 10 years[1] |
| Main Rural Catchment Drainage Channels | 50 years[2] |
| Urban Drainage Trunk Systems | 200 years |
| Urban Drainage Branch Systems | 50 years |
| Notes:<br>1. The impact of a 50 year event should be assessed in each village to check whether a higher standard than 10 years can be justified.<br>2. Embanked channels must be capable of passing a 200 year flood within banks | |

[1] https://www.map.gov.hk/gm/

2.3.2 For low lying area or those in congested urban locations, the recommended standards may not be suitable or achievable. In such cases, consistent with SDM 2024, a pragmatic approach should be considered.

2.3.3 Where catchments are tidally influenced, the SDM 2024 recommends that for a T-year flood, peak flood levels are taken as the higher of the flood levels resulting from the following two cases:

Case A : a T-year sea level in conjunction with a X-year rainfall; and

Case B : a X-year sea level in conjunction with a T-year rainfall.

In the above rule,

X = 10 when T = 50, 100 or 200; and

X = 2 when T = 2, 5 or 10.

## 2.4 Method of Analysis

Drainage Network Performance

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

Catchment Runoff

2.4.2 The catchment runoff has been assessed through the adoption of the Rational Method as specified in section 7.5.2 of SDM.

2.4.3 The inlet time, or time of concentration of a natural catchment has been assessed with Brandsby William's Equation as per SDM section 7.5.2. The inlet time for urbanised catchments has been set to 5 minutes.

## 2.5 Design Parameters

Design Roughness

2.5.1 The adopted roughness coefficients are consistent with SDM Table 13 and Table 14; and are summarised in **Table 2.2**.

**Table 2.2 Adopted Roughness Coefficients**

| **Drainage Network Element** | **Colebrook Roughness [mm]** |
|---|---|
| Existing Drainage Pipes | 0.6 |
| Proposed Drainage Pipes | 0.6 |
| **Drainage Network Element** | **Manning's Roughness [-]** |
| Natural Stream, winding with pools and ineffective slopes (fair) | 0.050 |

Design Siltation Allowance

2.5.2 To cater for capacity reduction due to materials deposited within stormwater network, siltation allowance has been adopted in accordance with SDM Section 9.3 and summarised below:

(a) 5% reduction in flow area if the gradient is greater than 1 in 25.

(b) 10% reduction in flow area in other cases.

Design Runoff Coefficients

2.5.3 The adopted runoff coefficients are summarised in **Table 2.3** and are consistent with SDM section 7.5 and GEO TGN 39.

**Table 2.3 Adopted Runoff Coefficients**

| Surface | Runoff Coefficients |
|---|---|
| Paved Area | 0.9 |
| Unpaved Area | 0.3 |

Design Rainfall

2.5.4 The synthetic rainfall designed in SDM section 4.3 has been adopted in this assessment. A uniformly distributed rainfall with an intensity determined by the Intensity-Duration-Frequency (IDF) relationship has been used.

2.5.5 The assessed catchments fall within SDM defined rainfall zone "HKO Headquarters"; the adopted rainfall parameters are obtained from SDM Table 3a and summarised in **Table 2.4**.

**Table 2.4 Adopted Rainfall IDF Parameters**

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

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

Design Sea Level

2.5.7 The synthetic design sea levels defined in SDM section 5.3 has been adopted in this assessment. The Site is located in Kam Tin, the nearest design sea level gauging station of "*Tsim Bei Tsui*" has been adopted.

Design Climate Change Scenario

2.5.8 With a conservative approach the Climate Change conditions defined in SDM section 6.8 for End of 21$^{st}$ Century have been adopted.

2.5.9 The adopted rainfall increase and design allowance as stipulated in SDM are summarised in **Table 2.5**.

**Table 2.5 Adopted Rainfall Increase**

| Scenario | Rainfall Increase | Design Allowance | Adopted Total Increase |
|---|---|---|---|
| End 21st Century | 16.0% | 12.1% | 28.1% |

2.5.10 The adopted sea levels together with their increase and design allowance stipulated in SDM are summarised in **Table 2.6**.

**Table 2.6 Adopted Sea Levels**

| Return Period | Tai Po Kau [mPD] | Scenario | Mean Sea Level Rise [m] | Stom Surge [m] | Design Allowance [m] | Adopted Total Sea Levels [mPD] |
|---|---|---|---|---|---|---|
| 10 | 3.52 | End 21st Century | 0.47 | 0.15 | 0.23 | 4.37 |
| 50 | 4.09 | | | 0.20 | 0.25 | 5.01 |

# 3. Existing Conditions

## 3.1 Overview

3.1.1 This chapter describes the existing drainage network and the existing catchments. The design runoff flows are defined and the performance of the existing drainage network in such conditions is assessed.

## 3.2 Existing Drainage Network

3.2.1 The Application Site is located at the Kam Tin South, which is at the north of the crossing of Kam Po Road and Tung Wui Road.

3.2.2 The main drainage network in the vicinity of the Application Site consists of a 35m width trapezoidal channel at the north and a 31m width trapezoidal channel at the south of the Application Site. A schematic plan of the existing drainage network is shown in **Figure 3.1**.

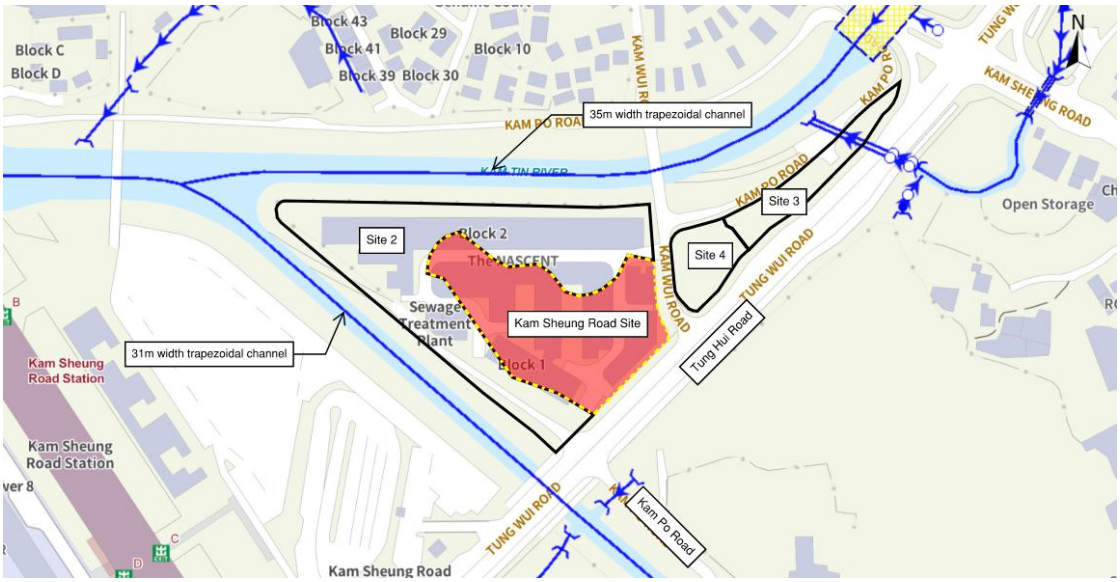



**Figure 3.1 Existing Drainage Network Schematic**

3.2.3 The runoff from the Application Site and its respective sensitivity test area is collected by unmapped minor drainage infrastructures and discharges to the existing channels nearby.

Existing Flooding Records

3.2.4 Available flooding records have been reviewed; the Application Site are not classified as Flooding Blackspots according to DSD website[2].

Ecological Sensitive Streams

3.2.5 The presence of Ecologically Important Streams/Rivers (EIS) as per ETWB TCW No. 5/2005 and associated website[3] has been scrutinised. There are no EIS that will be affected by proposed works.

## 3.3 Existing Catchments and Runoffs

3.3.1 The Application Site is currently zoned as "*Comprehensive Development Area*" ("CDA") under OZP No. S/YL-KTS/15. The Site is currently occupied by a transitional housing development named "The NAScenT". This land use has been considered as fully paved. The existing land uses near the Application Site are shown in **Figure 3.2**.

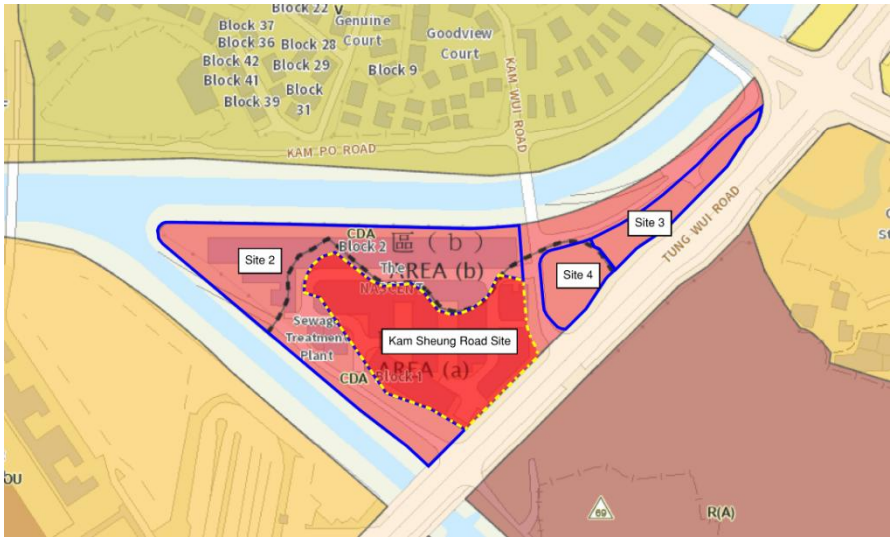



**Figure 3.2 Existing Land Use near Kam Sheung Road Site**

3.3.2 The Application Site is currently used as a transitional housing as mentioned in above and is considered as fully paved. The paved area would not be increased under the proposed development and thus no drainage impact is anticipated.

[2] Flooding blackspot DSD website, inspected on 16/04/2024
https://www.dsd.gov.hk/EN/Flood_Prevention/Our_Flooding_Situation/Flooding_Blackspots/index.html

[3] Ecologically Important Streams AFCD website, inspected on 16/04/2024
https://www.afcd.gov.hk/english/conservation/con_wet/streams_rivers_hk/Con_NSR/Ecologically_Important_Streams.html

# 4. Proposed Conditions

## 4.1 Overview

4.1.1 This chapter describes the proposed development and the assesses the changes in land use and runoff characteristics as well flood storage. The proposed network is then described, and its performance assessed.

## 4.2 Proposed Works

4.2.1 The Application Site is proposed to be rezoned from "CDA" zone to "R(A)" zone for Residential Development. The preliminary layout is show in **Appendix A.**

## 4.3 Changes in Land Use and Runoff

4.3.1 The existing condition of the Application Site and its sensitivity test area were developed into a transitional housing which is fully paved. Therefore, no change in runoff flow and no drainage impact is anticipated from the proposed development.

## 4.4 Changes in Flood Storage

4.4.1 There is no flood storage within the Application Site, and no flood volume is accumulated during severe storm events. The proposed development will be fully drained by the proposed drainage network and does not include flood storage infrastructure. No change in flood storage has been identified.

## 4.5 Proposed Drainage Network

4.5.1 A new internal drainage network will collect runoff flows from the Application Site and convey it to the new terminal manhole (TM-B). The collected runoff will then be discharged to the existing channel section SCP1007862. A new 750mm diameter stormwater pipe is proposed to convey runoff collected at the new terminal manhole (TM-B) to the existing channel section SCP1007862. In addition, peripheral drains are proposed along the site boundary to intercept runoff from the external catchment and convey it to the drainage system. The proposed drainage network layout plan is provided in **Appendix C**.

4.5.2 To maximise the number of flats without flooding the proposed development in the Application Site, it is proposed that the minimum structural floor levels are set at +8.0mPD for the site.

## 4.6 Maintenance Responsibility

4.6.1 The management and maintenance responsibilities for the proposed drainage network inside the Application Site will be maintained by the developer or the management of the development after completion. The proposed drainage system outside the Application Sites will be handed over to DSD upon completion of the construction works.

# 5. Potential Drainage Impacts and Mitigation Measures

## 5.1 Overview

5.1.1 The identified drainage impacts and the associated mitigation measures are discussed in this chapter.

## 5.2 Performance of Proposed Drainage Network

5.2.1 The proposed formation level will be above design sea levels; the proposed network performance will therefore be dominated by extreme rainfalls and network capacity.

5.2.2 The proposed drain has sufficient capacity to convey the design flows as summarised in **Table 5.1** and further detailed in **Appendix D**.

**Table 5.1 Proposed Network Performance**

| Design return period | Network element | Capacity [$m^3/s$] | Design flow [$m^3/s$] | Utilisation % |
|---|---|---|---|---|
| 50 years - End 21st Century | Proposed 750mm pipe from TM-B for Kam Sheung Road Site | 1.88 | 1.43 | 76.1% |

## 5.3 Potential Drainage Impacts

5.3.1 The proposed drainage network of the Application Site will discharge to the 35m width channel SCP1007862. As the there are no change in paved area, no additional flows are generated from the development and will not affect the channel performance.

## 5.4 Drainage Mitigation Measures

5.4.1 The existing drainage network has sufficient capacity to convey the design flows; mitigation measures have not been identified necessary.

## 5.5 Sensitivity Test on Runoff from Additional Area under the Rationalised Boundary

5.5.1 A sensitivity test has been conducted for the additional areas outside the Application Site within a rationalised boundary of a potential rezoning area, based on the approach and assumptions outlined in **Sections 1.1.4** and **1.2.2**. Assuming that the additional area would be developed for a similar residential use with a total PR of not more than 3, consistent with the proposed development, an estimation of runoff discharging to the proposed drainage network for demonstration purpose is provided in **Appendix E**.

# 6. Conclusion

6.1.1 The Application Site is proposed with residential developments at Lot 2160 RP (Part) in D.D. 106 and adjoining government land in Kam Tin, Kam Sheung Road, Yuen Long. The Application Site is currently occupied by a transitional housing development named "the NAScenT".

6.1.2 This DIA has assessed the impacts of the proposed development in the Application Site and their sensitivity test areas in accordance with DSD's Advice Note No. 1 "*Application of the Drainage Impact Assessment Process to Private Sector Projects*" and DSD SDM.

6.1.3 According to the assessment of this report, the existing drainage network in the Application Site has sufficient capacity to convey the existing runoff flows.

6.1.4 The proposed development in the Application Site will be served by a dedicated 750mm diameter stormwater pipe. In addition, peripheral drains will be provided along the site boundary to collect site runoff and intercept overland flow from adjacent land before conveying the collected flow to the proposed drainage system.

6.1.5 The proposed drainage network has sufficient capacity to cater for the design runoff flows from the proposed development in Application Site, and its sensitivity test areas.

6.1.6 The existing drainage network has sufficient capacity to convey the design flows; mitigation measures have not been identified necessary.

6.1.7 The drainage impact assessment demonstrated that the proposed development of the Indicative Scheme with the implementation of the proposed drainage network will not cause any adverse drainage impact to existing public drainage infrastructure in the vicinity of the Application Site.

# Appendix A

## Master Layout Plan of Indicative Scheme in Application Site

WIP Apr 2003

WIP Apr 2003

Genuine Court

Goodview Court

Open Storage

KAM TIN RIVER

TUNG WUI ROAD

Outfall

SEWAGE TREATMENT PLANT

APPLICATION SITE

EVA

BLOCK 2
17 Storeys

BLOCK 1
17 Storeys

SWIMMING POOL

KAM SHEUNG ROAD STATION PACKAGE 2 SITE

PUBLIC HOUSING SITE
- KAM SHEUNG ROAD SITE 4a
( under construction)

NOTES:

DO NOT SCALE DRAWINGS.

LAYOUT LEGEND:

APPLICATION SITE

| NO | DATE | DESCRIPTION |
|---|---|---|
| | | |

ARCHITECT

STUDIO | RCA

[redacted]

STUDIO | RAYMOND CHAU | ARCHITECTURE | LIMITED

PROJECT NAME

PROPOSED RESIDENTIAL DEVELOPMENT AT LOT 2160 R.P. ( PART) IN D.D. 106 AND ADJOINING GOVERNMENT LAND, KAM SHEUNG ROAD, KAM TIN, YUEN LONG, NEW TERRITORIES

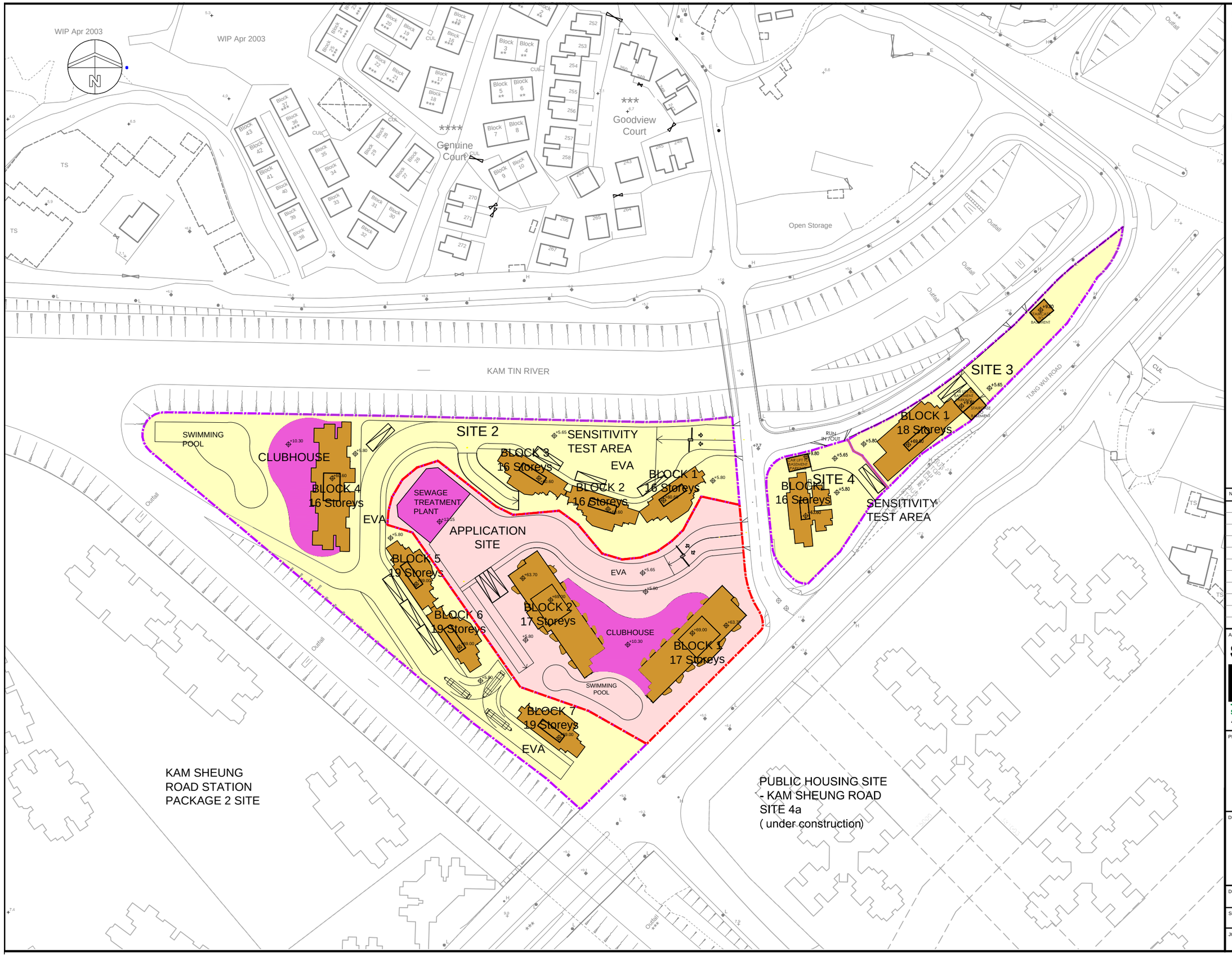
DRAWING TITLE

MASTER LAYOUT PLAN

| DRAWN BY | CHECKED BY |
|---|---|
| CC | RC |
| SCALE | DATE |
| 1:1250 | 2026.10.09 |
| JOB No. | DRAWING No. |
| 2526 | A-03 |

# Appendix B1

## Master Layout Plan for Additional Area under the Rationalised Boundary (for Sensitivity Test Purpose) (for Reference)




NOTES:

DO NOT SCALE DRAWINGS.

LAYOUT LEGEND:

- APPLICATION SITE
- PROPOSED RATIONALIZED BOUNDARY FOR REZONING AREA (FOR SENSITIVITY TEST PURPOSE ONLY)

| NO | DATE | DESCRIPTION |
|---|---|---|
| | | |

ARCHITECT

STUDIO | RCA

[redacted]

STUDIO | RAYMOND CHAU | ARCHITECTURE | LIMITED

PROJECT NAME

PROPOSED RESIDENTIAL DEVELOPMENT AT LOT 2160 R.P. ( PART) IN D.D. 106 AND ADJOINING GOVERNMENT LAND, KAM SHEUNG ROAD, KAM TIN, YUEN LONG, NEW TERRITORIES

DRAWING TITLE

MASTER LAYOUT PLAN

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| DRAWN BY: CC | CHECKED BY: RC |
| SCALE: 1:1250 | DATE: 2026.10.09 |
| JOB No.: 2526 | DRAWING No.: A-03A |

# Appendix B2

## Key Development Parameters of Sensitivity Test Area (for Reference)

## Key Development Parameters of Sensitivity Test Areas in Kam Sheung Road Site

### Sensitivity Test Area 2

| Development Parameters | Indicative Scheme |
|---|---|
| Application Site | About 11,610 $m^2$ |
| Total Plot Ratio (PR)<br>• Domestic PR | 3.0<br>• 3.0 |
| Total Gross Floor Area (GFA) (About)<br>• Domestic GFA | 34,829 $m^2$<br>• 34,829 $m^2$ |
| Building Height (Not more than) | 60.6 mPD – 69.0 mPD |
| No. of Residential Blocks | 7 |
| No. of Storeys | 16 – 19 |
| No. of Residential Units | 744 |
| Average Flat Size | About 46.81 $m^2$ |
| Anticipated Population [1] | About 2,158 |
| Residential Clubhouse | About 900 $m^2$ |

[1] A person per flat (PPF) ratio of 2.9 is adopted with reference to the average domestic household size of the Tertiary Planning Unit 531 as reported in the 2021 Population Census published by the Census and Statistics Department.

### Sensitivity Test Area 3

| Development Parameters | Indicative Scheme |
|---|---|
| Application Site | About 1,738 $m^2$ |
| Total Plot Ratio (PR)<br>• Domestic PR | 3.0<br>• 3.0 |
| Total Gross Floor Area (About)<br>• Domestic GFA | 5,217 $m^2$<br>• 5,217 $m^2$ |
| Building Height (Not more than) | 65.65 mPD |
| No. of Residential Blocks | 1 |
| No. of Storeys | 18 |
| No. of Residential Units | 102 |
| Average Flat Size | About 51.14 $m^2$ |
| Anticipated Population [1] | About 296 |
| Residential Clubhouse | - |

[2] A person per flat (PPF) ratio of 2.9 is adopted with reference to the average domestic household size of the Tertiary Planning Unit 531 as reported in the 2021 Population Census published by the Census and Statistics Department.

**Kam Tin 2 Sites S12A Applications (Kam Sheung Road) – Development Parameters**

**Sensitivity Test Area 4**

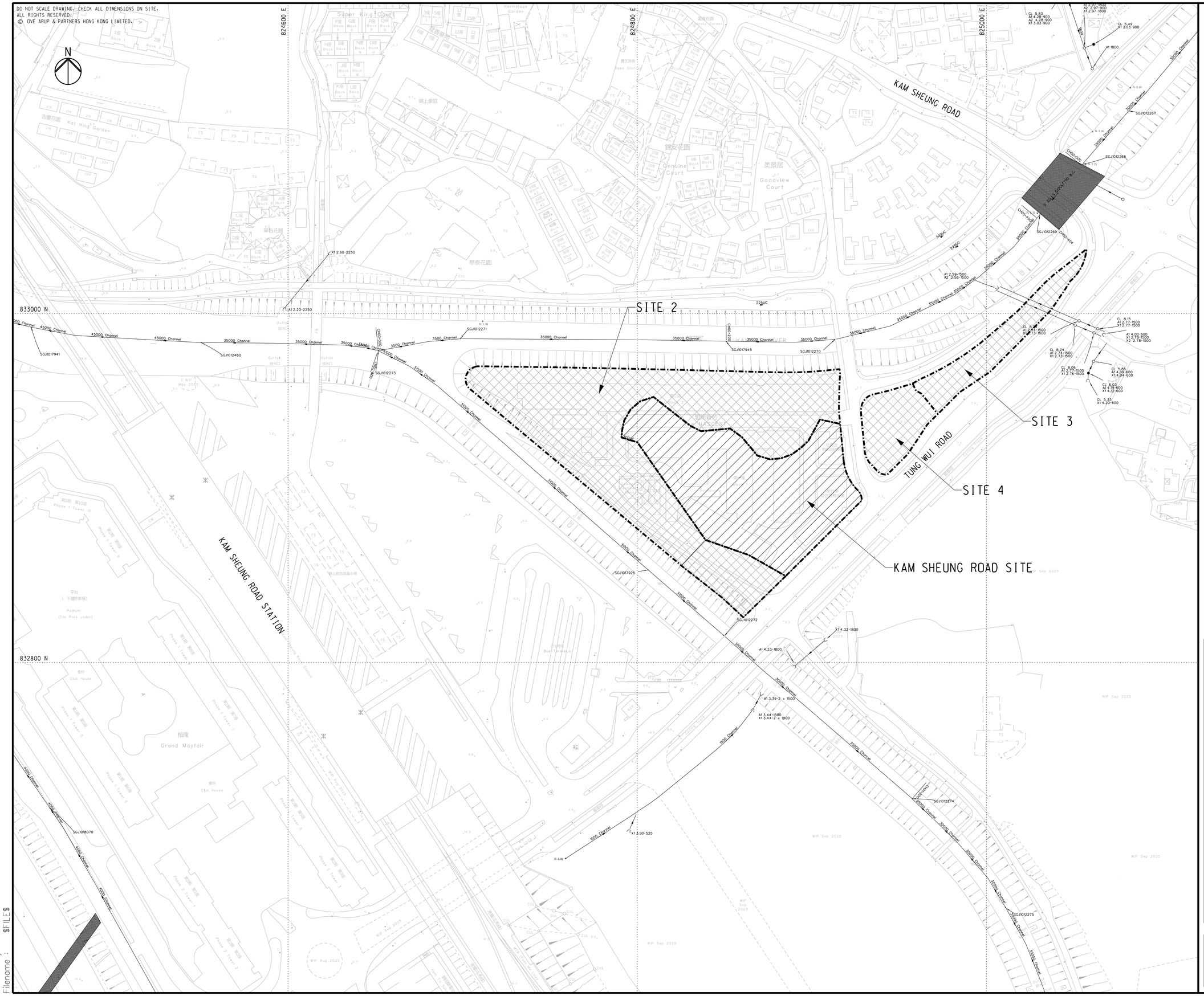
| Development Parameters | Indicative Scheme |
|---|---|
| Application Site | About 1,447 $m^2$ |
| Total Plot Ratio (PR)<br>• Domestic PR | 3.0<br>• 3.0 |
| Total Gross Floor Area (About)<br>• Domestic GFA | 4,341 $m^2$<br>• 4,341 $m^2$ |
| Building Height (Not more than) | 59.55 mPD |
| No. of Residential Blocks | 1 |
| No. of Storeys | 16 |
| No. of Residential Units | 60 |
| Average Flat Size | About 72.35 $m^2$ |
| Anticipated Population [1] | About 174 |
| Residential Clubhouse | - |

[3] A person per flat (PPF) ratio of 2.9 is adopted with reference to the average domestic household size of the Tertiary Planning Unit 531 as reported in the 2021 Population Census published by the Census and Statistics Department.

# Appendix C

## Drawings

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LEGEND

- PROPOSED DEVELOPMENT
- SENSITIVITY TEST AREA
- EXISTING DRAINAGE AND MANHOLE
- PROPOSED DRAINAGE NETWORK (INVERT LEVELS SUBJECT TO DETAILED DESIGN)

| Rev | Description | By | Date |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| A | FIRST ISSUE | JP | 11/25 |

Consultant

ARUP

Project Title

S.12A Application for Amendment to the Approved Kam Tin South Outline Zoning Plan No. S/YL-KTS/15, to rezone the Application Site from "Comprehensive Development Area" to "Residential (Group A)" at Lot 2160 RP (Part) in D.D. 106, and Adjoining Government Land, Kam Sheung Road, Kam Tin, Yuen Long

Drawing title

EXISTING DRAINAGE NETWORK (KAM SHEUNG ROAD SITE)

| Drawing no. | Rev. |
|---|---|
| 309160/C/DIA/003 | A |

| Drawn | Date | Checked | Approved |
|---|---|---|---|
| RY | 11/25 | JW | KK |

| Scale | Status |
|---|---|
| 1:1000 @ A1 | SUBMISSION |

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N

824600 E | 824800 E | 825000 E

833000 N | 832800 N

SENSITIVITY TEST AREA

KAM TIN RIVER

KAM SHEUNG ROAD

TUNG WUI ROAD

KAM SHEUNG ROAD STATION

CATCHMENT 1
CATCHMENT 2.1
CATCHMENT 2.2
CATCHMENT 2.3
CATCHMENT 2.4
CATCHMENT 2.5
CATCHMENT 2.6
CATCHMENT 2.7
CATCHMENT 2.8
CATCHMENT 2.9
CATCHMENT 2.10
CATCHMENT 3

PROPOSED TERMINAL MANHOLE TM-B TO 750mm DRAINS

KAM SHEUNG ROAD SITE

LEGEND

- PROPOSED DEVELOPMENT
- SENSITIVITY TEST AREA
- EXISTING DRAINAGE AND MANHOLE
- PROPOSED DRAINAGE NETWORK (INVERT LEVELS SUBJECT TO DETAILED DESIGN)

| Rev | Description | By | Date |
|---|---|---|---|
| A | FIRST ISSUE | JP | 11/25 |

Consultant: ARUP

Project Title: S.12A Application for Amendment to the Approved Kam Tin South Outline Zoning Plan No. S/YL-KTS/15, to rezone the Application Site from “Comprehensive Development Area” to “Residential (Group A)” at Lot 2160 RP (Part) in D.D. 106, and Adjoining Government Land, Kam Sheung Road, Kam Tin, Yuen Long

Drawing title: PROPOSED DRAINAGE NETWORK (KAM SHEUNG ROAD SITE)

| Drawing no. | Rev. |
|---|---|
| 309160/C/DIA/004 | A |

| Drawn | Date | Checked | Approved |
|---|---|---|---|
| RY | 11/25 | JW | KK |

Scale: 1:1000 @ A1 | Status: SUBMISSION

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Date : $DATE$

# Appendix D

## Runoff Assessment for the Proposed Development

**Table A - Hydraulic Checking of the existing drainage system after completion of the Proposed Development**

***A) Design Parameters :***

***Runoff***

Runoff Coeff., C = 0.90 (Paved)
= 0.30 (Unpaved)

Return Period = 50 years Main Rural Catchment Drainage Channels

Exi Inlet Time, $T_o$ = minutes 5.00 Urban Drainage
Time of Flow is conservatively assumed = 0 min

SCI Rainfall Intensity, I = a / ( Tc + b )^c 50-year (Gumbel solution)
where : a = 505.5 (Table 3a, Stormwater Drainage Manual Corridendum 1/24)
b = 3.29
c = 0.355

Peak Runoff ,$Q_p$ = 0.278 C I A

Rainfall Increase due to Climate Change = 28.1% (End 21st Century, Table 28 &31 Corrigendum 1/22)

***B) Existing Catchment Runoff:***

| Catchment | | Characteristics | | | Time | | | Catchment | | | | | | | | Rainfall | Runoff Flows | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Type | Total catchment area | | Catchment slope | Inlet, $t_o$ | Flow, $t_f$ | Concentration, $t_c$ | Paved Area | Unpaved Area | Catchment area (hard pavement) | Catchment area (grassland) | Paved effective Area | Unpaved effective Area | Effective area (Sum of C x A) | | Intensity | Peak Runoff | Towards |
| | Rural / Urban | [ha] | [$m^2$] | [m / 100m] | [min] | [min] | [min] | [ha] | [ha] | [%] | [%] | [ha] | [ha] | [ha] | [$km^2$] | [mm/h] | [$m^3/s$] | |
| 1 + 2 | Urban | 1.86 | 18600 | 24 | 5.0 | 0.0 | 5.0 | 1.86 | 0.00 | 100% | 0% | 1.67 | 0.00 | 1.674 | 0.01674 | 305.6 | 1.42 | SCP1007862 |

***C) Proposed Catchment Runoff:***

| Catchment | | Characteristics | | | Time | | | Catchment | | | | | | | | Rainfall | Runoff Flows | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Type | Total catchment area | | Catchment slope | Inlet, $t_o$ | Flow, $t_f$ | Concentration, $t_c$ | Paved Area | Unpaved Area | Catchment area (hard pavement) | Catchment area (grassland) | Paved effective Area | Unpaved effective Area | Effective area (Sum of C x A) | | Intensity | Peak Runoff | Towards |
| | Rural / Urban | [ha] | [$m^2$] | [m / 100m] | [min] | [min] | [min] | [ha] | [ha] | [%] | [%] | [ha] | [ha] | [ha] | [$km^2$] | [mm/h] | [$m^3/s$] | |
| 1 | Urban | 0.72 | 7166 | 24 | 5.0 | 0.0 | 5.0 | 0.72 | 0.00 | 100% | 0% | 0.64 | 0.00 | 0.64494 | 0.0064494 | 305.6 | 0.55 | SCP1007862 |
| 2.1 | Urban | 0.13 | 1293.14 | 24 | 5.0 | 0.0 | 5.0 | 0.13 | 0.00 | 100% | 0% | 0.12 | 0.00 | 0.1163826 | 0.0011638 | 305.6 | 0.10 | Channel 1.1 |
| 2.2 | Urban | 0.24 | 2414.062 | 24 | 5.0 | 0.0 | 5.0 | 0.24 | 0.00 | 100% | 0% | 0.22 | 0.00 | 0.2172656 | 0.0021727 | 305.6 | 0.18 | MH1.2 |
| 2.3 | Urban | 0.27 | 2679.7 | 24 | 5.0 | 0.0 | 5.0 | 0.27 | 0.00 | 100% | 0% | 0.24 | 0.00 | 0.241173 | 0.0024117 | 305.6 | 0.20 | MH1.4 |
| 2.4 | Urban | 0.14 | 1396.17 | 24 | 5.0 | 0.0 | 5.0 | 0.14 | 0.00 | 100% | 0% | 0.13 | 0.00 | 0.1256553 | 0.0012566 | 305.6 | 0.11 | MH1.6 |
| 2.5 | Urban | 0.07 | 715.4 | 24 | 5.0 | 0.0 | 5.0 | 0.07 | 0.00 | 100% | 0% | 0.06 | 0.00 | 0.064386 | 0.0006439 | 305.6 | 0.05 | MH1.8 |
| 2.6 | Urban | 0.06 | 561.45 | 24 | 5.0 | 0.0 | 5.0 | 0.06 | 0.00 | 100% | 0% | 0.05 | 0.00 | 0.0505305 | 0.0005053 | 305.6 | 0.04 | MH1.10 |
| 2.7 | Urban | 0.06 | 622.06 | 24 | 5.0 | 0.0 | 5.0 | 0.06 | 0.00 | 100% | 0% | 0.06 | 0.00 | 0.0559854 | 0.0005599 | 305.6 | 0.05 | MH1.11 |
| 2.8 | Urban | 0.07 | 691.4 | 24 | 5.0 | 0.0 | 5.0 | 0.07 | 0.00 | 100% | 0% | 0.06 | 0.00 | 0.062226 | 0.0006223 | 305.6 | 0.05 | MH1.13 |
| 2.9 | Urban | 0.09 | 883.6 | 24 | 5.0 | 0.0 | 5.0 | 0.09 | 0.00 | 100% | 0% | 0.08 | 0.00 | 0.079524 | 0.0007952 | 305.6 | 0.07 | MH1.85 |
| 2.10 | Urban | 0.03 | 252.36 | 24 | 5.0 | 0.0 | 5.0 | 0.03 | 0.00 | 100% | 0% | 0.02 | 0.00 | 0.0227124 | 0.0002271 | 305.6 | 0.02 | MH1.18 |

Note: Total catchment area under proposed conditions is conservatively assumed as existing catchement.

**ARUP**

Ove Arup & Partners Calculation Sheet

Job Title

S.12A Application for Amendment to the Approved Kam Tin South Outline Zoning Plan No. S/YL-KTS/15, to rezone the Application Site from “Comprehensive Development Area” to “Residential (Group A)” at Lot 2160 RP (Part) in D.D. 106, and Adjoining Government Land, Kam Sheung Road, Kam Tin, Yuen Long

**Table - Capacity Performance of Proposed Drainage**

Notes:

Calculated by Manning Equation $\bar{V} = \frac{R^{1/6}}{n}\sqrt{RS_f}$

$n$ is Manning coefficient, which n = 0.013 in accordance with TGN 43.

$V$ is the velocity, $R$ is the hydraulic radius of the channel and $S_f$ is the slope of the channel.

For channel > 600mm :

Calculated by Colebrook-White Equation $\bar{V} = -\sqrt{32gRS_f}\log\left[\frac{k_s}{14.8R} + \frac{1.255\nu}{R\sqrt{32gRS_f}}\right]$

$\nu$ is kinematic viscosity of fluid = 1.14 x 10-6 m2/s and $g$ is the gravity = 9.81m/s2

$V$ is the velocity, $D$ is the diameter of the sewer and S is the gradient of the sewer.

Assumed data

Siltation

S< 1 in 25 10%

S> 1 in 25 5%

With Proposed Develpoment

| U/S | D/S | Channel Shape | Length | U/S GL | D/S GL | U/S IL | D/S IL | Bottom Size | Bottom Width | Area | Wetted Perimeter | Hydraulic Radius | Gradient | Slope | Manning coefficient /Roughness | Flow Velocity | Flow Capacity | Siltration | CAP w. S. | Upstream Flow | Additional Flow | Total Flow | Capacity Check |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (m) | (mPD) | (mPD) | (mPD) | (mPD) | (mm) | (m) | ($m^2$) | (m) | (m) | (S) | | | (m/s) | ($m^3$/s) | (%) | ($m^3$/s) | ($m^3$/s) | ($m^3$/s) | ($m^3$/s) | (%) |
| Channel 1.1 | MH1.1 | U | 24 | 5.8 | 5.8 | 5.35 | 5.3 | 450 | 0.45 | 0.18 | 1.16 | 0.16 | 480 | 0.0021 | 0.013 | 1.02 | 0.18 | 10% | 0.17 | 0.09 | 0.00 | 0.09 | 57.3% |
| MH1.1 | MH1.2 | U | 26 | 5.8 | 5.8 | 5.3 | 5.25 | 450 | 0.45 | 0.18 | 1.16 | 0.16 | 520 | 0.0019 | 0.013 | 0.98 | 0.18 | 10% | 0.16 | 0.09 | 0.00 | 0.09 | 59.6% |
| MH1.2 | MH1.3 | U | 70 | 5.8 | 5.8 | 5.25 | 5.12 | 600 | 0.6 | 0.32 | 1.54 | 0.21 | 538.462 | 0.0019 | 0.013 | 1.17 | 0.37 | 10% | 0.34 | 0.09 | 0.18 | 0.27 | 80.8% |
| MH1.3 | MH1.4 | U | 10 | 5.8 | 5.8 | 5.12 | 5.1 | 600 | 0.6 | 0.32 | 1.54 | 0.21 | 500 | 0.0020 | 0.013 | 1.21 | 0.39 | 10% | 0.35 | 0.27 | 0.00 | 0.27 | 77.9% |
| MH1.4 | MH1.5 | U | 10 | 5.8 | 5.8 | 5.1 | 5.05 | 600 | 0.6 | 0.32 | 1.54 | 0.21 | 200 | 0.0050 | 0.013 | 1.91 | 0.61 | 10% | 0.55 | 0.27 | 0.20 | 0.47 | 84.8% |
| MH1.5 | MH1.6 | U | 10 | 5.8 | 5.8 | 5.05 | 5 | 600 | 0.6 | 0.32 | 1.54 | 0.21 | 200 | 0.0050 | 0.013 | 1.91 | 0.61 | 10% | 0.55 | 0.47 | 0.00 | 0.47 | 84.8% |
| MH1.6 | MH1.7 | U | 7 | 5.8 | 5.8 | 5 | 4.95 | 600 | 0.6 | 0.32 | 1.54 | 0.21 | 140 | 0.0071 | 0.013 | 2.28 | 0.73 | 10% | 0.66 | 0.47 | 0.10 | 0.57 | 86.5% |
| MH1.7 | MH1.8 | U | 7 | 5.8 | 5.8 | 4.95 | 4.9 | 600 | 0.6 | 0.32 | 1.54 | 0.21 | 140 | 0.0071 | 0.013 | 2.28 | 0.73 | 10% | 0.66 | 0.57 | 0.00 | 0.57 | 86.5% |
| MH1.8 | MH1.9 | U | 23 | 5.8 | 5.8 | 4.9 | 4.7 | 600 | 0.6 | 0.32 | 1.54 | 0.21 | 115 | 0.0087 | 0.013 | 2.52 | 0.81 | 10% | 0.73 | 0.57 | 0.05 | 0.62 | 85.6% |
| MH1.9 | MH1.10 | U | 10 | 5.8 | 5.8 | 4.7 | 4.6 | 600 | 0.6 | 0.32 | 1.54 | 0.21 | 100 | 0.0100 | 0.013 | 2.70 | 0.87 | 10% | 0.78 | 0.62 | 0.00 | 0.62 | 79.8% |
| MH1.10 | MH1.11 | U | 16 | 5.8 | 5.8 | 4.6 | 4.55 | 750 | 0.75 | 0.50 | 1.93 | 0.26 | 320 | 0.0031 | 0.6 | 1.91 | 0.96 | 10% | 0.86 | 0.62 | 0.04 | 0.67 | 77.1% |
| MH1.11 | MH1.12 | U | 7 | 5.8 | 5.8 | 4.55 | 4.525 | 750 | 0.75 | 0.50 | 1.93 | 0.26 | 280 | 0.0036 | 0.6 | 2.04 | 1.03 | 10% | 0.92 | 0.67 | 0.05 | 0.71 | 77.0% |
| MH1.12 | MH1.13 | U | 15 | 5.8 | 5.8 | 4.525 | 4.475 | 750 | 0.75 | 0.50 | 1.93 | 0.26 | 300 | 0.0033 | 0.6 | 1.97 | 0.99 | 10% | 0.89 | 0.71 | 0.00 | 0.71 | 79.7% |
| MH1.13 | MH1.14 | U | 7 | 5.8 | 5.8 | 4.475 | 4.45 | 750 | 0.75 | 0.50 | 1.93 | 0.26 | 280 | 0.0036 | 0.6 | 2.04 | 1.03 | 10% | 0.92 | 0.71 | 0.05 | 0.76 | 82.5% |
| MH1.14 | MH1.15 | U | 7 | 5.8 | 5.8 | 4.45 | 4.425 | 750 | 0.75 | 0.50 | 1.93 | 0.26 | 280 | 0.0036 | 0.6 | 2.04 | 1.03 | 10% | 0.92 | 0.76 | 0.00 | 0.76 | 82.5% |
| MH1.15 | MH1.16 | U | 8 | 5.8 | 5.8 | 4.425 | 4.39 | 750 | 0.75 | 0.50 | 1.93 | 0.26 | 228.571 | 0.0044 | 0.6 | 2.26 | 1.14 | 10% | 1.02 | 0.76 | 0.06 | 0.83 | 80.9% |
| MH1.16 | MH1.17 | U | 13 | 5.8 | 5.8 | 4.39 | 4.33 | 750 | 0.75 | 0.50 | 1.93 | 0.26 | 216.667 | 0.0046 | 0.6 | 2.32 | 1.17 | 10% | 1.05 | 0.83 | 0.00 | 0.83 | 78.7% |
| MH1.17 | MH1.18 | U | 13 | 5.8 | 5.8 | 4.33 | 4.27 | 750 | 0.75 | 0.50 | 1.93 | 0.26 | 216.667 | 0.0046 | 0.6 | 2.32 | 1.17 | 10% | 1.05 | 0.83 | 0.00 | 0.83 | 78.7% |
| MH1.18 | TM - B | U | 10 | 5.8 | 5.8 | 4.27 | 4.22 | 750 | 0.75 | 0.50 | 1.93 | 0.26 | 200 | 0.0050 | 0.6 | 2.42 | 1.22 | 10% | 1.09 | 0.83 | 0.03 | 0.85 | 78.0% |

## Table - Capacity Performance of Proposed Drain

Notes:

Calculated by Colebrook-White Equation $\overline{V} = -\sqrt{32gRS_f}\,\log\left[\frac{k_s}{14.8R} + \frac{1.255\nu}{R\sqrt{32gRS_f}}\right]$

$\nu$ is kinematic viscosity of fluid = 1.14 x 10-6 m2/s and g is the gravity = 9.81m/s2

$V$ is the velocity, $D$ is the diameter of the sewer and S is the gradient of the sewer.

Assumed data

| | | Roughness |
|---|---|---|
| Pipe Materal | | ks (mm) |
| PC | | 0.6 |
| | | |

Siltation

| | |
|---|---|
| S< 1 in 25 | 10% |
| S> 1 in 25 | 5% |

## Proposed Network

| Manhole | | | | | | Existing Pipe Parameter | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UP_MAN No. | DN_MAN No. | Catchment inflow | Runoff flows ($m^3/s$) | Upstream flows ($m^3/s$) | Design Flow ($m^3/s$) | DIA (D) (mm) | DIA (D) (m) | No of Pipe | Area (m2) | Perimeter (m) | Hydr Radius (m) | LEN (m) | UP_GL (mPD) | DN_GL (mPD) | UP_INV (mPD) | DN_INV (mPD) | Gradient (S) | Pipe Materal | Roughness Used ks (mm) | Pipe Material ks (mm) | VEL (m/s) | CAP full bore ($m^3/s$) | Siltation (%) | CAP w. Silt. ($m^3/s$) | F/C (%) | Adequate Capacity? |
| MH2 | SCP1007862 | | 0.00 | 1.43 | 1.43 | 750 | 0.75 | 1 | 0.442 | 2.355 | 0.188 | 50.0 | 7.00 | 7.00 | 4.22 | 2.80 | 35 | PC | 0.60 | PC, ks=0.6 mm | 4.72 | 2.09 | 10% | 1.88 | 76.1% | YES |

Abbreviation:

| | |
|---|---|
| 1 | Upstream Manhole |
| DN_MAN | Downstream Manhole |
| DIA | Diameter |
| LEN | Length |
| UP_GL | Upstream Ground Level |
| DN_GL | Downstream Ground Level |
| UP_INV | Upstream Invert Level |
| DN_INV | Downstream Invert Level |
| VEL | Peak Pipe Velocity |
| CAP | Peak Pipe Capacity |
| F/C | Peak Flow/Capacity |
| PC | Precast Concrete Pipe |
| MC | Monolithic Concrete |
| GRP | Factory manufactured GRP |
| 0 | #N/A |

# Appendix E

## Cumulative Runoff Assessment from the Application Site and Sensitivity Test Area (for Reference)

**Table A - Hydraulic Checking of the existing drainage system after completion of the Proposed Development + Sensitivity Test Areas (For Reference)**

***A) Design Parameters :***

***Runoff***

Runoff Coeff., C = 0.90 (Paved)
= 0.30 (Unpaved)

Return Period = 50 years Main Rural Catchment Drainage Channels

EXI Inlet Time, $T_o$ = minutes 5.00 Urban Drainage
Time of Flow is conservatively assumed = 0 min

SCI Rainfall Intensity, $I = a / ( Tc + b )^c$ 50-year (Gumbel solution)
where : a = 505.5 (Table 3a, Stormwater Drainage Manual Corridendum 1/24)
b = 3.29
c = 0.355

Peak Runoff ,$Q_p$ = 0.278 C I A

Rainfall Increase due to Climate Change = 28.1% (End 21st Century, Table 28 &31 Corrigendum 1/22)

***B) Existing Catchment Runoff:***

| Catchment | | Characteristics | | | Time | | | Catchment | | | | | | | | Rainfall | Runoff Flows | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Type | Total catchment area | | Catchment slope | Inlet, $t_o$ | Flow, $t_f$ | Concentration, $t_c$ | Paved Area | Unpaved Area | Catchment area (hard pavement) | Catchment area (grassland) | Paved effective Area | Unpaved effective Area | Effective area (Sum of C x A) | | Intensity | Peak Runoff | Towards |
| | Rural / Urban | [ha] | [$m^2$] | [m / 100m] | [min] | [min] | [min] | [ha] | [ha] | [%] | [%] | [ha] | [ha] | [ha] | [$km^2$] | [mm/h] | [$m^3/s$] | |
| 1 + 2 | Urban | 1.86 | 18600 | 24 | 5.0 | 0.0 | 5.0 | 1.86 | 0.00 | 100% | 0% | 1.67 | 0.00 | 1.674 | 0.01674 | 305.6 | 1.42 | SCP1007862 |
| 3 | Urban | 0.32 | 3185 | 24 | 5.0 | 0.0 | 5.0 | 0.11 | 0.21 | 35% | 65% | 0.10 | 0.06 | 0.16299 | 0.0016299 | 305.6 | 0.14 | SCP1007862 |

***C) Proposed Catchment Runoff:***

| Catchment | | Characteristics | | | Time | | | Catchment | | | | | | | | Rainfall | Runoff Flows | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Type | Total catchment area | | Catchment slope | Inlet, $t_o$ | Flow, $t_f$ | Concentration, $t_c$ | Paved Area | Unpaved Area | Catchment area (hard pavement) | Catchment area (grassland) | Paved effective Area | Unpaved effective Area | Effective area (Sum of C x A) | | Intensity | Peak Runoff | Towards |
| | Rural / Urban | [ha] | [$m^2$] | [m / 100m] | [min] | [min] | [min] | [ha] | [ha] | [%] | [%] | [ha] | [ha] | [ha] | [$km^2$] | [mm/h] | [$m^3/s$] | |
| 1 | Urban | 0.72 | 7166 | 24 | 5.0 | 0.0 | 5.0 | 0.72 | 0.00 | 100% | 0% | 0.64 | 0.00 | 0.64494 | 0.0064494 | 305.6 | 0.55 | SCP1007862 |
| 2.1 | Urban | 0.13 | 1293.14 | 24 | 5.0 | 0.0 | 5.0 | 0.13 | 0.00 | 100% | 0% | 0.12 | 0.00 | 0.1163826 | 0.0011638 | 305.6 | 0.10 | Channel 1.1 |
| 2.2 | Urban | 0.24 | 2414.062 | 24 | 5.0 | 0.0 | 5.0 | 0.24 | 0.00 | 100% | 0% | 0.22 | 0.00 | 0.2172656 | 0.0021727 | 305.6 | 0.18 | MH1.2 |
| 2.3 | Urban | 0.27 | 2679.7 | 24 | 5.0 | 0.0 | 5.0 | 0.27 | 0.00 | 100% | 0% | 0.24 | 0.00 | 0.241173 | 0.0024117 | 305.6 | 0.20 | MH1.4 |
| 2.4 | Urban | 0.14 | 1396.17 | 24 | 5.0 | 0.0 | 5.0 | 0.14 | 0.00 | 100% | 0% | 0.13 | 0.00 | 0.1256553 | 0.0012566 | 305.6 | 0.11 | MH1.6 |
| 2.5 | Urban | 0.07 | 715.4 | 24 | 5.0 | 0.0 | 5.0 | 0.07 | 0.00 | 100% | 0% | 0.06 | 0.00 | 0.064386 | 0.0006439 | 305.6 | 0.05 | MH1.8 |
| 2.6 | Urban | 0.06 | 561.45 | 24 | 5.0 | 0.0 | 5.0 | 0.06 | 0.00 | 100% | 0% | 0.05 | 0.00 | 0.0505305 | 0.0005053 | 305.6 | 0.04 | MH1.10 |
| 2.7 | Urban | 0.06 | 622.06 | 24 | 5.0 | 0.0 | 5.0 | 0.06 | 0.00 | 100% | 0% | 0.06 | 0.00 | 0.0559854 | 0.0005599 | 305.6 | 0.05 | MH1.11 |
| 2.8 | Urban | 0.07 | 691.4 | 24 | 5.0 | 0.0 | 5.0 | 0.07 | 0.00 | 100% | 0% | 0.06 | 0.00 | 0.062226 | 0.0006223 | 305.6 | 0.05 | MH1.13 |
| 2.9 | Urban | 0.09 | 883.6 | 24 | 5.0 | 0.0 | 5.0 | 0.09 | 0.00 | 100% | 0% | 0.08 | 0.00 | 0.079524 | 0.0007952 | 305.6 | 0.07 | MH1.85 |
| 2.10 | Urban | 0.03 | 252.36 | 24 | 5.0 | 0.0 | 5.0 | 0.03 | 0.00 | 100% | 0% | 0.02 | 0.00 | 0.0227124 | 0.0002271 | 305.6 | 0.02 | MH1.18 |

**(C) Total Runoff to Proposed network** 1.43

| Catchment | | Characteristics | | | Time | | | Catchment | | | | | | | | Rainfall | Runoff Flows | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | Type | Total catchment area | | Catchment slope | Inlet, $t_o$ | Flow, $t_f$ | Concentration, $t_c$ | Paved Area | Unpaved Area | Catchment area (hard pavement) | Catchment area (grassland) | Paved effective Area | Unpaved effective Area | Effective area (Sum of C x A) | | Intensity | Peak Runoff | Towards |
| | Rural / Urban | [ha] | [$m^2$] | [m / 100m] | [min] | [min] | [min] | [ha] | [ha] | [%] | [%] | [ha] | [ha] | [ha] | [$km^2$] | [mm/h] | [$m^3/s$] | |
| 3 | Urban | 0.32 | 3185 | 1 | 5.0 | 0.0 | 5.0 | 0.32 | 0.00 | 100% | 0% | 0.29 | 0.00 | 0.29 | 0.0028665 | 305.6 | 0.24 | TM-B |

Note: Total catchment area under proposed conditions is conservatively assumed as existing catchement.

**Table - Capacity Performance of Proposed Drain (including runoff from sensitivity test areas) (For Reference)**

Notes:

Calculated by Colebrook-White Equation $\overline{V} = -\sqrt{32gRS_f}\,\log\left[\frac{k_s}{14.8R} + \frac{1.255\nu}{R\sqrt{32gRS_f}}\right]$

$\nu$ is kinematic viscosity of fluid = 1.14 x 10-6 m2/s and g is the gravity = 9.81m/s2

$V$ is the velocity, $D$ is the diameter of the sewer and S is the gradient of the sewer.

Assumed data

| Pipe Materal | | Roughness ks (mm) |
|---|---|---|
| PC | | 0.6 |
| | | |

Siltation

| | |
|---|---|
| S< 1 in 25 | 10% |
| S> 1 in 25 | 5% |

## Proposed Network

| Manhole | | | | | | Existing Pipe Parameter | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UP_MAN No. | DN_MAN No. | Catchment inflow | Runoff flows ($m^3/s$) | Upstream flows ($m^3/s$) | Design Flow ($m^3/s$) | DIA (D) (mm) | DIA (D) (m) | No of Pipe | Area (m2) | Perimeter (m) | Hydr Radius (m) | LEN (m) | UP_GL (mPD) | DN_GL (mPD) | UP_INV (mPD) | DN_INV (mPD) | Gradient (S) | Pipe Materal | Roughness Used ks (mm) | Pipe Material ks (mm) | VEL (m/s) | CAP full bore ($m^3/s$) | Siltation (%) | CAP w. Silt. ($m^3/s$) | F/C (%) | Adequate Capacity? |
| MH2 | SCP1007862 | | 0.24 | 1.43 | 1.67 | 750 | 0.75 | 1 | 0.442 | 2.355 | 0.188 | 50.0 | 7.00 | 7.00 | 4.22 | 2.80 | 35 | PC | 0.60 | PC, ks=0.6 mm | 4.72 | 2.09 | 10% | 1.88 | 89.0% | YES |

Abbreviation:

| | |
|---|---|
| 1 | Upstream Manhole |
| DN_MAN | Downstream Manhole |
| DIA | Diameter |
| LEN | Length |
| UP_GL | Upstream Ground Level |
| DN_GL | Downstream Ground Level |
| UP_INV | Upstream Invert Level |
| DN_INV | Downstream Invert Level |
| VEL | Peak Pipe Velocity |
| CAP | Peak Pipe Capacity |
| F/C | Peak Flow/Capacity |
| PC | Precast Concrete Pipe |
| MC | Monolithic Concrete |
| GRP | Factory manufactured GRP |
| 0 | #N/A |