

Hong Kong Housing Authority  
**Agreement No. CB20120293**  
**Planning and Engineering Study**  
**for the Public Housing Site and**  
**Yuen Long Industrial Estate**  
**Extension at Wang Chau**

Final Technical Report No.3D (TR-  
3D) Drainage Impact Assessment

REP-019-01

Final | April 2014

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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 226464

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# 1 INTRODUCTION

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## 1.1 Project Background

- 1.1.1.1 As stated in the Chief Executive's 2011-12 Policy Address, the Administration is committed to expanding the land resources and increasing housing land supply. To meet this policy objective, the Planning Department (PlanD) has carried out a comprehensive review of the areas zoned "Green Belt" (GB) on the Outline Zoning Plans (OZPs) focusing on sites which are no longer green or spoiled. A number of "GB" and "Open Storage" (OS) sites in Wang Chau, Yuen Long were identified as having potential for public housing (PH) development.
- 1.1.1.2 Subsequently, the Innovation and Technology Commission (ITC) and the Hong Kong Science and Technology Parks Corporation (HKSTP) advised of the need to expand the Yuen Long Industrial Estate (YLIE), in addition to the existing three Industrial Estates (IEs) at Tai Po, Tseung Kwan O and Yuen Long. It was requested to use a portion of the Wang Chau potential housing site for this purpose.
- 1.1.1.3 After due consideration, an agreement was reached between the Housing Department (HD) and ITC to share the site, tentatively with the northerly portion to be allocated for the YLIE extension (YLIEE), while the remaining south portion would be developed for public housing use. It was further agreed that no Potential Hazardous Installations (PHIs) would be located at the YLIEE so as to minimize the potential adverse impact on the neighbouring PH developments.
- 1.1.1.4 **Drawing No. 226464/OAP/C/011** shows the location of the Project site. The PH and YLIEE sites at Wang Chau are zoned GB and OS on the Ping Shan OZP No. S/YL-PS/14. It is currently occupied by open storage, vehicle parks, farmland, fallow land, grassland, rural residential dwellings and temporary structures.
- 1.1.1.5 Ove Arup & Partners Hong Kong Limited (Arup) was commissioned by Hong Kong Housing Authority (HKHA) under entrustments from the Government of the Hong Kong Special Administrative Region (HKSAR) & Hong Kong Science and Technology Parks Corporation (HKSTP) to conduct the Planning and Engineering Study for Public Housing Site and YLIEE at Wang Chau (the Study), which will examine the feasibility on developing public housing and YLIEE at Wang Chau by conducting planning, engineering and environmental assessments to formulate proposal for the PH site and YLIEE, and the implementation strategies and programme for the proposed development.

## 1.2 Objectives of the Report

- 1.2.1.1 Following on the endorsement of the Technical Report (TR) on Option Generation, Evaluation and Preliminary Assessments (TR-2)

in the Study Steering Group Meeting on 28 June 2013, a preferred development option has been formulated. According to the Clause 5.3(c) of the brief, technical assessments are required to demonstrate the feasibility of the preferred development option.

- 1.2.1.2 The Technical Report (TR-3) – Preferred Option and Technical Assessments under this P&E study is to undertake the technical assessments including traffic and transport assessments, drainage and sewerage impact assessment, water supply and utilities impact assessments, geotechnical assessments, foundation assessment, natural terrain hazard study, environmental impact assessment, financial assessment, air ventilation assessment and land requirement study to confirm the feasibility of the preferred development option and ascertain the implications that may arise.
- 1.2.1.3 The purpose of this report is to present the Drainage Impact Assessment (DIA) due to the proposed Public Housing Site development and Yuen Long Industrial Estate Extension at Wang Chau.
- 1.2.1.4 The report includes formulation of proposed storm drain systems and mitigation measures with an aim to minimize impacts to the existing drainage system, minimizing flood risk within and around the Project site, as well as maximizing the land usage within the Project site.
- 1.2.1.5 The report further substantiates the feasibility of the Project (further to TR-2 report) in terms of capability and serviceability of the systems and satisfies the requirement of maintenance authority – Drainage Services Department (DSD).
- 1.2.1.6 Specifically, the objectives of this report are set out as follows:
- to take cognisance of the existing, committed and planned developments which may have bearing on the development;
  - to assess the existing flooding susceptibility;
  - to assess the flooding susceptibility of the proposed development;
  - to assess the likely impacts of the proposed developments on the existing drainage system during construction and upon completion and the impacts on the proposed developments due to the existing problematic flooding problem, in particular at the southeast corner of Fuk Hi Street;
  - to carry out schematic design of the drainage system arising from the development including carrying out all necessary hydraulic analysis to substantiate the proposed scheme;
  - to formulate drainage connection points and details for the proposed developments to illustrate the hydraulic feasibility of the proposed connection points;
  - to formulate and recommend suitable mitigation measures including necessary improvement/upgrading/diversion works to existing and planned drainage systems for the proposed developments.

## 1.3 Structure of this Report

1.3.1.1 The structure of this Report is as follows:

- Section 1 Introduces the background of the study, as well as the purpose of this report.
- Section 2 Presents the key data of the proposed development on which the impact assessments is based.
- Section 3 Drainage Impact Assessment – to assess the impacts on existing and planned storm drain systems due to the development and formulate corresponding mitigation measures.

## 1.4 Nomenclature and Abbreviations

1.4.1.1 The following **Table 1.4.1** lists out the meaning of abbreviation for expressions adopted in this report:

**Table 1.4.1:** Abbreviations

Abbreviations	Term
DIA	Drainage Impact Assessment
DMP	Agreement No. CE 46/2007 (DS): Review of Drainage Master Plans in Yuen Long and North Districts – Feasibility Study
DN	Nominal Diameter
DSD	Drainage Services Department
EIA	Environmental Impact Assessment
EVA	Emergency Vehicle Access
GB	Green Belt
GFA	Gross Floor Area
G/IC	Government/ Institution/ Community
LOS	Local Open Space
OS	Open Storage
OZP	Outline Zoning Plan
PH	Public Housing Site (This Project)
PR	Plot Ratio
PTI	Public Transport Interchange
TR-2	Technical Report No. 2
TR-3	Technical Report No. 3
VE	Village Environs
YLIE	Yuen Long Industrial Estate (Existing)
YLIEE	Yuen Long Industrial Estate Extension (This Project)



## 2 PROJECT DESCRIPTION

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### 2.1 Site Location

2.1.1.1 The Project site is bounded by the existing YLIE, Fuk Hi Street and Fuk Hing Garden and Sai Tau Wai to the east, Long Ping Road and Long Ping Estate to the south, Kai Shan to the west, as well as Shing Uk Tsuen, Tai Tseng Wai and Ng Uk Tsuen to the north as indicated in **Drawing No. 226464/OAP/C/011**.

### 2.2 Existing Conditions

2.2.1.1 According to the approved Ping Shan OZP No. S/YL-PS/14, the PH and YLIEE sites are currently zoned as “Green Belt” (GB) and “Open Storage” (OS) (**Drawing No. 226464/OAP/C/021**). It is occupied by open storage, vehicle parks, farmland, fallow land, grassland, rural residential dwellings and temporary structures.

2.2.1.2 The surrounding areas of the Project site are characterized by a mixture of various land use zonings as well as different existing major land uses. These include high-rise residential development, villages and low-rise residential developments, natural landscapes, burial grounds and graves, industrial uses, major roads and railway tracks.

2.2.1.3 The Project site is irregular in shape. In terms of topography, it is generally flat on its northern and central portions and has a slightly hilly terrain on the south strip. The major land uses within the Project site include open storage/workshops, residential dwellings, agricultural and vegetated land, nullah with footpaths and watercourses.

### 2.3 The Preferred Option

2.3.1.1 During the process of option generation, a number of key elements which play determining roles in the formulation of initial development options have been identified. The key elements that have been paid with due respect include the burial ground at Kai Shan, Village Environs (VE) of Wing Ning Tsuen (D.D. 122), VE of Fung Chi Tsuen and Shui Tin Tsuen (D.D 120 & 122) and the Umah International Primary School. A preferred development option for PH site and YLIEE site has been formulated in the TR-2 Option Generation, Evaluation and Preliminary Assessments.

2.3.1.2 Since the approval of TR-2, discussions with various government departments have been carried out; and subsequently the Project site boundary, site layout and development parameters of the preferred option have been slightly refined and optimised to address different concerns of particular departments. This TR-3 is carried out based on the refined preferred option which is illustrated in **Drawing Nos. 226464/OAP/C/022 – 023**.

- 2.3.1.3 The revised Project site boundary, land use budget, site layout, urban design element and development scheme with parameters are briefly described in the following sections.

## 2.4 The Project Site Boundary

- 2.4.1.1 As recommended in TR-2, the Project site of the original preferred option is about 33.31 ha in size, with about 18.69 ha for the PH site and about 14.62 ha for the YLIEE site.
- 2.4.1.2 Taking into account the existing burial urns at Kai Shan, impacts to private land lots, woodland cutting, woodland compensation provision, existing boundaries of adjacent VE, interfacing with existing land use zonings and further optimisation of land use between PH and YLIEE sites, some minor refinements have been proposed.
- 2.4.1.3 The refined development site boundary is shown in **Drawing Nos. 226464/OAP/C/022 – 023**. With the refinement, the total area of the Project site is about 33.46 ha, with about 18.81 ha for PH site and about 14.65 ha for YLIEE site.

## 2.5 Land Use Budget

- 2.5.1.1 Subsequent to the refinement of the Project site boundary, with an aim to keep up with the development intensity and land use mix in the preferred option as generated under the guiding principles and relevant regulations, minor adjustments have also been made onto the land use budget.
- 2.5.1.2 **Table 2.5.1** below summarizes the land use budget for the refined site boundary.

**Table 2.5.1:** Proposed land use budget for the refined site boundary

Land Use	Land use budget
<b>PH Site</b>	
Residential	About 14.49 ha
School	About 1.94 ha (3 school sites)
G/IC (Integrated Social Welfare Building)	About 0.47 ha
Public Transport Interchange	About 0.41 ha
Roads, amenity greening and slope	About 1.49 ha
<b>Total site area</b>	<b>About 18.81 ha</b>
<b>YLIEE Site</b>	
Industrial	About 11.66 ha
Local Open Space (On-site preserved woodland area)	About 0.27 ha
Roads	About 1.81 ha
Slope	About 0.31 ha
Woodland compensation area & on-site ecological compensation area	About 0.41 ha
Parking Spaces	About 0.19 ha
<b>Total site area</b>	<b>About 14.65 ha</b>



## 2.6 Proposed Development of the PH Site

### 2.6.1 Guiding Planning Design Principles for the Public Housing Site

2.6.1.1 There are three major planning & urban design guiding principles followed in the design of the preferred option. These include:

- Establishing view corridors to Kai Shan - This is achieved by aligning the northern road toward the foothills of the mountain, by strategically placing the schools to provide visual and spatial relief around the taller residential structures, and by utilizing the 50-metre buffer area separating the public housing site from the proposed industrial estate extension site.
- Placing public functions closer to the existing road networks - Commercial activities and the public transport interchange (PTI) have been placed along Fuk Hi Street and Long Ping Road in order to serve the greater community.
- Creating a tapering building height profile. The buildings taper down from 41 to 31 storeys. The tapering occurs at 5-storey intervals, in order to minimize the effect of the flat-head development.

### 2.6.2 Land Use Proposals

2.6.2.1 With the proposed refinement of the PH site boundary, types of land use remain unchanged. These include residential with local open space and parking spaces, retail, schools, integrated social welfare building (ISWB), PTI, roads, amenity greening and slope.

2.6.2.2 The PH site can be roughly divided into three portions. The southwestern portion of the PH site consists of the area around residential blocks 1 to 10 (Phase 1), the middle portion consists of the area around residential blocks 11 to 17 (Phase 2), and the northern portion consists of the area around buildings 18 to 24 (Phase 3). The middle and northern portions are bisected by the proposed northern local access road.

2.6.2.3 **The Southwestern Portion:** The southwestern portion occupies an area of about 5.5ha. It consists of 10 residential buildings, two underground parking structures, a 2-storey commercial area, a social welfare building, i.e. ISWB, one school, and complementary recreational functions. All residential buildings in this portion will be of either 31 or 36 storeys. Single-aspect buildings have been utilized in all of the residential buildings, except Block 3, in order to minimize any potential conflicts from traffic noise issues. A two-storey retail facility has been placed strategically along Long Ping Road to allow street-front retail as well as serve the residents within the proposed new residential housing estate. A footbridge tentatively linking the pedestrian walkway system of Long Ping Estate would land at the same level as the podium level. The ISWB at the southwestern tip of

this portion will provide a minimum net operating floor area of approximately 6000 m<sup>2</sup> for various social welfare facilities. A site of a primary school is reserved and proposed with a maximum building height of 8 storeys. Areas for two children playgrounds, two badminton courts, and one basketball court have also been reserved to serve the future residents. An existing shrine exists adjacent to the ISWB. Minimal disturbance has been taken into consideration with site formation in order to preserve this shrine.

**2.6.2.4 The Middle Portion:** It has an area of about 5.8ha. It consists of 7 residential buildings, a commercial area, one underground parking area, and other complementary recreational functions as well as a new road. The residential buildings in this portion taper from tallest (41 storeys) to the west to lowest (31 storeys) to the east. A pedestrian corridor with retail facilities on both sides is proposed. This design will minimize the adverse interface conflict between pedestrians and vehicles. In terms of complementary recreational functions, areas for four children playgrounds, three badminton courts, and two basketball courts have been served. An existing well currently situated between the proposed Blocks 12 and 13 is proposed to be preserved and beautified to give the area more character.

**2.6.2.5 The Northern Portion:** This portion occupies an area of about 7.5ha. It consists of 7 residential buildings, a commercial area, a semi-covered PTI, a non-buildable area, one underground parking area, two schools and complementary recreational functions. The residential buildings taper from tallest to the west (41 storeys) to lowest to the east (31 storeys). This tapering is of similar nature as to the buildings tapering in the middle portion. The commercial area in this portion is placed in the vicinity of the PTI, and creates a gateway to the pedestrian street found in the middle portion with the intention that it would serve both the PH site as well as the YLIEE site. In order to minimize the adverse interface conflicts generated between the YLIEE and the PH sites, a 50-metre buffer has been created between these two distinct zones. The buffer area would comprise of open space, a football pitch, badminton courts, and two playgrounds. Due to the shape of the 50-metre buffer area, this area is also most suitable for an underground parking area. Two schools have been placed strategically at the end of the proposed road, in order to further expand the frame of vision toward Kai Shan, as well as to provide a visual buffer from the high-density developments of the middle and northern portions. Apart from the recreational functions found along the 50-metre buffer, areas for two additional children playgrounds and two basketball courts have been reserved.

## 2.6.3 Development Schemes with Parameters

**2.6.3.1** In the refined development scheme, the PH site has a site area of 18.81 ha. While the total site area is 18.81 ha, the total residential site area is of a total of 14.49ha which excludes 30-degree cut slope areas, local roads, and non residential structures, like the PTI, the ISWB, and

the three school sites, based on the abovementioned land use proposals. Taking the opportunities to further optimize housing supply in response to the territorial need for housing by visiting various factors with a plot ratio (PR) of 6.0 (i.e. 5.86 domestic and 0.14 non-domestic) and maximum building height of 41 storeys, a total of a domestic GFA of 848,750 m<sup>2</sup> and retail GFA of 19,760 m<sup>2</sup>. will be accommodated (**Table 2.6.1**). The proposed development option could then provide a total of 16,975 flats to cater for around 52,113 populations (**Table 2.6.2**). The breakdown of the GFA of each portion is as follows:

**Table 2.6.1:** Domestic and Retail GFA of the Three Portions

	Domestic GFA (m <sup>2</sup> )	Retail GFA (m <sup>2</sup> )
Southwestern Portion	213,750	6,784
Middle Portion	324,000	8,589
Northern Portion	311,000	4,383
<b>Total</b>	<b>848,750</b>	<b>19,756</b>

Remarks: It is assumed that the social welfare facilities, PTI, underground parking areas, schools and recreational functions are not accountable for GFA.

**Table 2.6.2:** The Estimation and Number of Flats of the Three Portions

	Area of Residential Site (ha)	Number of Flats <sup>^</sup>	Population <sup>*</sup>
Southwestern Portion	3.83	4,275	13,124
Middle Portion	5.00	6,480	19,894
Northern Portion	5.68	6,220	19,095
<b>Total</b>	<b>14.49#</b>	<b>16,975</b>	<b>52,113</b>

# An adjustment of 0.02ha has been applied and subtracted from the total site area to avoid overprovision of domestic GFA.

<sup>^</sup> It is also assumed that 50% of the flats will be for PRH and 50% will be for HOS.

<sup>\*</sup> It is assumed that the person per flat is 3.07.

### 2.6.3.2

A summary of the key planning parameters for the PH development is given in **Table 2.6.3** below.

**Table 2.6.3:** Summary of Key Planning Parameters for PH development

Development Parameters	Units
Residential Site Area	14.49 ha
Domestic Plot Ratio	5.86
Domestic GFA	848,750 m <sup>2</sup>
Estimates No. of Flats	16,975
Estimated Population	52,113
Non-domestic Plot Ratio	0.14
Non-domestic GFA	19,760 m <sup>2</sup>
Maximum Building Height (in storeys) (Ground floor included)	31 / 36 / 41
Maximum Building Height (in metres)	87.1m / 100.85m / 114.6m



Development Parameters	Units
Maximum Number of Residential Storeys	30 / 35 / 40
Assumed No. of Units Per Storey	11 - 29 units
No. of Towers	24

## 2.7 Proposed Development of the YLIEE Site

### 2.7.1 Guiding Planning & Design Principles for the YLIEE Site

2.7.1.1 There are four planning & design principles that should be considered:

- Optimising the development potential by partitioning the individual site with an optimal plot size between 0.65 and 0.75 ha as advised by HKSTPC.
- Minimising disturbance to existing woodland and providing an on-site woodland compensation area to minimise the need for off-site woodland compensation.
- Providing sufficient local open space for the enjoyment of local employees.
- Providing a pedestrian connection from the existing YLIE to the proposed YLIEE site.

### 2.7.2 Land Use Proposal

2.7.2.1 With the proposed refinement of the YLIEE site boundary, the major types of land use remain unchanged. These include industrial, local open space, car parking space, road and slope area. While chances have been taken to further bring forward capitalization on existing natural resources within the YLIEE site, it is proposed to allow more on-site woodland compensation and ecological conservation area.

2.7.2.2 The YLIEE site has an area of 14.65ha. It consists of 16 individual plots, connected by a local road that terminates at a roundabout. Adequate Local Open Space (LOS) and parking areas have also been provided within the site. The LOS is currently occupied by woodland which will be preserved on-site. One on-site ecological compensation area has been proposed to the west of development plot VIII, and a woodland compensation area to the west of development plot VII has also been proposed.

### 2.7.3 Development Schemes with Parameters

2.7.3.1 In the refined preferred option, the total area for YLIEE site is 14.65 ha with 11.66 ha reserved for industrial use. A PR ratio of 2.5 and a maximum building height of 8 storeys for the industrial lots are proposed to remain unchanged. Chances were also taken to optimize industrial GFA provision and as a result, a maximum GFA of 291,545

m<sup>2</sup> will be provided to accommodate about 3,887 workers. A summary of the key planning parameters for the YLIEE development is given in **Table 2.7.1** below.

**Table 2.7.1:** Summary of key planning parameters for YLIEE development

Development Parameters	Units
Industrial Site Area	11.66 ha
Plot Ratio	2.5
Maximum GFA	291,545 m <sup>2</sup>
Estimated No. of Worker*	About 3,887
Maximum Building Height (in storeys)	8 storeys
Maximum Building Height (in metres)	32m

\* It is assumed that a worker density is 75 workers/ m<sup>2</sup>.

2.7.3.2 In terms of the distribution of industrial lots, a summary is given in **Table 2.7.2** below.

**Table 2.7.2:** Summary of industrial lot sizes

Industrial lot size	Number of lots
1.10 ha - 1.19 ha	1
1.00 ha - 1.09 ha	0
0.90 ha - 0.99 ha	0
0.80 ha - 0.89 ha	2
0.70 ha - 0.79 ha	4
0.60 ha - 0.69 ha	8
0.50 ha - 0.59 ha	1
Total number of lots	16

## 2.8 Tentative Implementation Programme

2.8.1.1 The PH site would be implemented in three phases and the YLIEE site would be developed in a single phase. The following summarises the tentative commissioning dates for both the PH and the YLIEE sites:

- Year 2022: Granting of YLIEE's land starting from 2022 which will take about 4 years to complete
- Year 2024: Population intake of PH Site Phase 1
- Year 2026: Population intake of PH Site Phases 2 & 3



## 3 DRAINAGE IMPACT ASSESSMENT

### 3.1 Introduction

3.1.1.1 DSD has commented in previous site potential study stage that the site's southeast corner at Fuk Hi Street is a problematic flooding location due to poor local drainage system to which particular attention to this area is paid during conduction of this DIA.

3.1.1.2 Since the commencement of this Study, coordination has been held with DSD to obtain relevant information and discussing on the stormwater drainage impacts as shown in **Table 3.1.1** below.

**Table 3.1.1:** Information Obtained from DSD

Item No.	Information	Source of Information	Date
1	Meeting with DSD – Discuss on condition of existing drainage system and arrangement of proposed drainage system	N/A	8 Feb 2012
2	DSD drainage record plan	DSD/MN	18 Sep 2012
3	Existing and Planned works near the Study Area	DSD/DP	12 Sep 2012
4	Agreement No. CE 46/2007 (DS): Review of Drainage Master Plans in Yuen Long and North Districts – Feasibility Study –Final Report	DSD/LD	26 Mar 2012

[1] – Meeting Minutes are provided in **Appendix B**

3.1.1.3 In addition, TR-2 report was issued on 5 June 2013 (letter ref. 226464/L0811/IL/vh) to seek consent from DSD and no specific comments were received.

### 3.2 Methodology

3.2.1.1 The following approach is adopted in carrying out the Drainage Impact Assessment:

- Identify the scope of development;
- Identify the existing and planned drainage systems within the Study area;
- Perform hydrology and hydraulic analysis to estimate the existing peak flow and corresponding performance of the existing drainage systems in terms of capacity and flood protection level;
- Examine the potential impacts arising from the development on the drainage conditions during construction and upon completion; and
- Formulate drainage proposals to serve the proposed development and to mitigate the potential impacts, including improvement or upgrading of existing drainage systems and/or implementation of flood control measures.

- 3.2.1.2 Generally, PH site and YLIEE is considered as a whole instead of individual sites when conducting this impact assessment. Development phasing is considered such that public drainage trunks are installed during earlier phases of construction.
- 3.2.1.3 To minimize the drainage impact on the existing drainage systems, delineation of catchment areas will maintain the same as existing condition as far as practicable such that effective catchment areas at the two major discharge points (Tai Tseng Wai Channel and Shan Pui River) would not be substantially increased, hence minimizing necessary upgrading works and flood protection measures.
- 3.2.1.4 Individual existing watercourses across the Project site will be diverted to the proposed peripheral drains at the slope crest along site boundary, combined and discharged to proposed drainage systems in order to maximize the land usage within the Project site.

### 3.3 Design Assumptions and Parameters

- 3.3.1.1 The estimation of drainage impacts from the proposed development is prepared with reference to the following information:
- Existing and planned developments within the catchment serving the proposed development, including areas upstream of the development such as Kai Shan hillside, and developments between the project site and the point of discharge to existing networks including local villages and roadways.
  - Development parameters based on the table shown in Section 2 above;
  - Hong Kong Drainage Services Department – Stormwater Drainage Manual (SDM) for Planning, Design and Management, December 2000; and
  - Agreement No. CE 46/2007 (DS) – Review of Drainage Master Plans (DMP) in Yuen Long and North Districts – Feasibility Study –Final Report.
- 3.3.1.2 Hydraulic models are established using *InfoWorks ICM* for hydraulic analysis of the drainage system.
- 3.3.1.3 Four hours (240 minutes) duration rainfall event, using the symmetrically distributed profile as recommended in the SDM is adopted. 300 minutes of storm simulation time is adopted in the hydraulic model.
- 3.3.1.4 The proposed drainage system within the project will be designed to 50-year capacity in accordance with DSD's criteria for urban drainage systems. The 50-year event is taken as the highest peak runoff / flood level due to the two combinations below.

**Table 3.3.1:** Criteria for Urban Drainage Systems

Case	Rainfall Event	Sea Level
Case I	50-year rain	10-year sea level
Case II	10-year rain	50-year sea level

3.3.1.5 The sea levels at catchment discharge points Tai Tseng Wai Channel and Shan Pui River are extracted from DMP as shown in **Table 3.3.2**. The sea levels at these two catchment discharge points are adopted as the boundary conditions for this DIA.

**Table 3.3.2:** Design Sea Level at Catchment Discharge Points

Catchment Discharge Point [2]	DSD Manhole No.	Sea Level [1]	
		10-year	50-year
Tai Tseng Wai Channel	SGJ1012323	4.34 mPD	4.51 mPD
Shan Pui River	SNF1004264	4.28 mPD	4.36 mPD

[1] – As taken from Agreement No. CE 46/2007 (DS) – Review of Drainage Master Plans (DMP) in Yuen Long and North Districts – Feasibility Study – Final Report, provided by DSD.

[2] – Catchment discharge points refer to Drawing No. 226464/OAP/C/012.

3.3.1.6 The following rainfall runoff parameters are adopted in this study:

- Runoff coefficients = 0.95 and Routing factor = 1.0 for paved and roof surfaces;
- Runoff coefficients = 0.35 and Routing factor = 4.0 for permeable surface.

3.3.1.7 Colebrook-White and Manning equations are applied for pipe and box culvert hydraulic analysis respectively. The design roughness coefficient for Colebrook-White equation (Ks) is 0.6mm while the roughness coefficient for Manning equation (n) is 0.016. These roughness values are adopted for existing drainage system. The same roughness values are also adopted for proposed drainage system in consideration of its reduced long term hydraulic performance due to degradation of material.

3.3.1.8 Criteria for assessing the hydraulic performance of the proposed drainage system is based on the freeboard requirement as stipulated in SDM. A 200mm allowance is considered adequate for open channels. Under this assessment, minimum 300mm freeboard is adopted to account for inaccuracies in flood level computations.

3.3.1.9 Due to the change in land use from rural to urban, the Project site flood protection level will be increased from 1 in 10-years to 1 in 50-years. The site platforms will be elevated to achieve a minimum 500mm freeboard above the anticipated high water level.



## 3.4 Existing Drainage System

### 3.4.1 Inventory of Existing Drainage Services

- 3.4.1.1 With reference to the DSD drainage record plan, an inventory of the existing drainage services in the vicinity of the Project site comprise:
- Tai Tseng Wai Trapezoidal Drainage Channel, approximately 6000mm wide at the west boundary of YLIE. The channel collects runoff from a portion of YLIE/YLIEE and substantial flows from the Kai Shan hillside west of the Project site, directing them north and then east between YLIE and the Tai Tseng Wai Village, ultimately discharging to the Shan Pui River;
  - Trapezoidal channel along the west edge of Fuk Hi Street south of the Ting Fook Village and connecting with an existing 3500(W) x 2000(H) box culvert at Long Ping Road;
  - 1200Ø storm drain running beneath Fuk Hi Street from the Ting Fook Villages and connecting to an existing 3500(W) x 2000 (H) box culvert at the intersection with Long Ping Road;
  - Storm drains ranging from 900Ø to 1800Ø running beneath Long Ping Road and connecting to an existing 3500(W) x 2000(H) box culvert at the intersection with Fuk Hi Street;
  - 3500(W) x 2000(H) box culvert running beneath Fuk Hi Street from Long Ping Road to Wang Lok Street, discharging to the Shan Pui River.
- 3.4.1.2 Two natural channels cross the north section of the YLIEE directing runoff from the Kai Shan hillside west of the project site toward the Tai Tseng Wai channel along its eastern border. The channels carry larger, more frequent and varied flows during the wet season and are reduced to smaller more constant flows resulting in a number of shallow pools in flatter reaches during the dry season. The channel is characterized by steep gradient with narrow bottom and steeply sloping sides in the upper reaches to the west of the project site, and shallow gradient with varied bottom width, shallow pools, and softly sloping sides within the site.
- 3.4.1.3 The latest ecological surveys have confirmed the presence of the Reeves Terrapin turtle, Small Snakehead fish, and Hong Kong Freshwater Crab was revealed within the watercourse within the project site. All species are confirmed to be of ecological significance.
- 3.4.1.4 A third natural channel occurs near the mid-section of the project site directing runoff from the Kai Shan hillside west of the project site and from within the central portion of the site toward an existing trapezoidal channel along the west edge of Fuk Hi Street. It is here that the DMP indicates frequent flooding problems due to inadequate capacity of the constructed channel.
- 3.4.1.5 A natural drainage channel (hereafter called Kai Shan South Channel) directs runoff from the southern Kai Shan hillside across the southern

portion of the project site and into a covered channel near the elevated MTR track nearby its crossing of Long Ping Road.

- 3.4.1.6 An overview of existing drainage systems can be seen in **Drawing No. 226464/OAP/C/011**.

### 3.4.2 Current Flooding Susceptibility

- 3.4.2.1 The Review of Drainage Master Plans in Yuen Long and North Districts – Feasibility Study Draft Final Report (DMP) provides comprehensive analysis of existing drainage features within the Yuen Long District including those adjacent to the Project site. The report notably analyses flood protection levels by various return periods on the existing network, including the 50-year return period as is the recommended standard for Urban Drainage Branch Networks given in the SDM (2000).
- 3.4.2.2 According to the DMP, two problematic localized flooding areas are observed in the Project vicinity comprising:
- Tai Tseng Wai stream along Fuk Shun Street due to two blocked cross-road pipes beneath Fuk Shun Street and various concrete pipes placed within the stream by neighbouring residents. The stream discharges to the Tai Tseng Wai channel north of YLIE.
  - An open storage yard at the Project site's southeast corner near Fuk Hi Street mainly due to surface runoff from Kai Shan hillside and the central project site and insufficient drainage capacity at the downstream network. The DMP reports that for some low spot areas at Ting Fook Village, flooding depth in excess of 600mm is anticipated for the 50-year return period.
- 3.4.2.3 In addition to the observed flooding areas, the DMP has identified areas susceptible to flooding from between 5-year and 200-year return periods in the Project vicinity comprising:
- 90% of pipelines at Yuen Long Industrial Estate will not have adequate capacity to cope with the 50-year flood event. DMP recommended mitigation measures include the construction of boundary walls surrounding industrial buildings and advising property owners to modify existing flood gates. It is unknown whether or to what extent these measures have been implemented.
  - Intermittent areas along Fuk Hi Street between YLIE and the intersection of Long Ping Road are susceptible to flooding in the 5-year and 10-year return periods. This is primarily due to site constraints in which pipelines are located in low lying areas where the ground level is almost the same or lower than the 50-year design water level in the primary channel [Shan Pui River].
  - The downstream portions of Shan Pui River are identified to have flood protection levels of less than 50-years for the main rural drainage channel. Notably this occurs at the catchment discharge point of the box culvert beneath Fuk Hi Street into the Shan Pui River. The DMP recommends modifying the existing flood walls along the concerned section of channels for preventing overbank



flow during extreme events and installing flap valves at the outlet of pipelines subject to tidal flow to prevent backflow conditions. At the time of preparing this report, these measures had not been implemented.

- 3.4.2.4 Upon meeting with DSD (see **Table 3.1.1** and **Appendix A**), it was advised that any additional flow arisen from this development should be diverted to Fuk Hi Street direction such that the existing flow condition at Tai Tseng Wai Channel could be maintained.
- 3.4.2.5 A local low point is observed at Long Ping Road near the Long Ping Estate Bus Terminus (DSD Manhole No. SMH 1026952). Special attention is paid in particular where proposed retails at PH Phase 1 will be located in close proximity to this low point.

### 3.4.3 Existing Catchment Characteristics

3.4.3.1 The Study Area is located within the Yuen Long Basin and Tin Shui Wai Basin. However, the Project site only falls within the Yuen Long Basin. The general layout of both basins is shown in **Drawing No. 226464/OAP/C/010**.

3.4.3.2 **Table 3.4.1** summarises the existing catchment areas for this drainage assessment, runoff coefficients and effective catchment areas. For the location of catchment discharge points, refer to **Drawing No. 226464/OAP/C/012**.

**Table 3.4.1:** Existing Catchment Areas

Catchment Discharge Point <sup>[1]</sup>	Node No. <sup>[2]</sup>	Existing Development			
		Catchment Area (m <sup>2</sup> )	Runoff Coefficient, C	Effective Catchment Area (m <sup>2</sup> )	Total Effective Catchment Area (m <sup>2</sup> )
Tai Tseng Wai Channel	SGJ 1012323	83,566	0.95 (Paved Area)	79,388	133,190
		165,657	0.35 (Grassland)	57,980	
Shan Pui River	SNF 1004264	351,052	0.95 (Paved Area)	315,947	401,604
		244,735	0.35 (Grassland)	85,657	
Kai Shan South Channel	SMH 90003	161,730	0.35 (Grassland)	56,606	56,606

[1] – Catchment discharge points refer to Drawing No. 226464/OAP/C/012

[2] – Node numbers refer to Drawing Nos. 226464/OAP/C/101 – 108

## 3.5 Proposed Drainage System

### 3.5.1 Proposed Catchment Characteristics

3.5.1.1 **Table 3.5.1** summarises the proposed catchment areas for this drainage assessment, runoff coefficients and effective catchment areas. For the location of catchment discharge points, refer to **Drawing No. 226464/OAP/C/012**.

**Table 3.5.1:** Proposed Catchment Areas

Catchment Discharge Point <sup>[1]</sup>	Node No. <sup>[2]</sup>	Proposed Development			
		Catchment Area (m <sup>2</sup> )	Runoff Coefficient, C	Effective Catchment Area (m <sup>2</sup> )	Total Effective Catchment Area (m <sup>2</sup> )
Tai Tseng Wai Channel	SGJ 1012323	113,803	0.95 (Paved Area: 75%) 0.35 (Landscape Area: 25%)	91,042	144,797
		153,584	0.35 (Grassland)	53,754	
Shan Pui River	SNF 1004264	425,591	0.95 (Paved Area: 75%) 0.35 (Landscape Area: 25%)	369,422	458,453
		254,374	0.35 (Grassland)	89,031	
Kai Shan South Channel	SMH 90003	149,881	0.35 (Grassland)	52,458	52,458

[1] – Catchment discharge points refer to Drawing No. 226464/OAP/C/012

[2] – Node numbers refer to Drawing Nos. 226464/OAP/C/101 – 108

3.5.1.2 Conceptual development plans indicate an overall proposed site permeability of approximately 25% which may be achieved by woodland compensation, planned open space, general landscaping, permeable pavements, and green roofs.

## 3.5.2 Proposed Drainage Scheme

3.5.2.1 The proposed onsite drainage system and upgrading of the offsite drainage system are shown in **Drawing Nos. 226464/OAP/C/101 – 108** and **Drawing No. 226464/OAP/C/701**. **Table 3.5.2** below summarizes the proposed major drainage system upgrades.

**Table 3.5.2:** Proposed Major Drainage System Upgrades

Catchment Discharge Point	System ID	Trunk Location	Type	Size (mm)	Main Channel Downstream
Tai Tseng Wai Channel	P1	YLIEE Main Roadway	Box Culvert	3000(W) x 2500(H)	Tai Tseng Wai Channel
Shan Pui River	P2	Long Ping Road	Pipeline	1500Ø	Existing 3500(W) x 2000(H) twin cells box culvert along Fuk Hi Street
		Long Ping Road	Box Culvert (Single cell and Twin cells)	3500(W) x 2000(H)	Existing 3500(W) x 2000(H) twin cells box culvert along Fuk Hi Street
	P3	Fuk Hi Street	Twin cells box culvert	3500(W) x 2000(H)	Shan Pui River
Kai Shan South Channel	P4	Kai Shan South (PH Site Phase 1)	Natural Stream	Variable	Kai Shan South Channel

[1] – Catchment discharge points and system ID refer to Drawing No. 226464/OAP/C/012

- 3.5.2.2 The existing watercourses from across the Project site and the Kai Shan Hillside will be diverted to the proposed internal drainage system. The proposed catchment areas are designed such that flows entering the Shan Pui River and the Kai Shan South Channel closely match the existing regime. At DSD request, proposed flows entering the Tai Tseng Wai channel are the same as in the existing condition. The delineation of catchment areas is attached in **Appendix A**.
- 3.5.2.3 The proposed drainage system is aligned under public carriageway / Emergency Vehicular Access (EVA) as far as practicable to facilitate future maintenance.
- 3.5.2.4 Where public drains deviate from the public roadways, drainage reserve areas will be provided to ensure there is free and unrestricted access at all times for maintenance. The drainage reserve layout is shown in **Drawing Nos. 226464/OAP/C/101–108**.
- 3.5.2.5 It is proposed that storm drainage mainlines be concrete and comply with DSD standard details. U-channels should be in-situ or precast concrete and comply with CEDD standard details. Adherence to CEDD and DSD standards shall be maintained during detailed design and construction.

## 3.6 Drainage Impact Assessment

### 3.6.1 Estimated Flows

- 3.6.1.1 Based on the hydraulic evaluation of the proposed drainage scheme using *InfoWorks ICM*, the estimation of runoff and flood level for existing and proposed scenarios are determined. The detailed calculations are attached herein **Appendix A**, in which essential findings are summarized below.
- 3.6.1.2 **Table 3.6.1** shows peak flow from Study Area to the discharge points before and after completion of the proposed development with corresponding discharge capacity shown.



**Table 3.6.1:** Estimated Peak Flows at Catchment Discharge Points

Catchment Discharge Point <sup>[1]</sup>	Node No. <sup>[1]</sup>	Existing Condition		Existing Connection		Capacity of Existing Conduit (m <sup>3</sup> /s)
		Rainfall Intensity <sup>[2]</sup> (mm/hr)	Peak Flow (m <sup>3</sup> /s)	Conduit Dimension (mm)	Slope (1 in)	
Tai Tseng Wai Channel	SGJ 1012323	243.3	9.0	6000 Wide Trapezoidal Channel	500	20.5
Shan Pui River	SNF 1004264	228.6	25.5	3000(W) x 2000(H) Twin Cells Box Culvert	600	26.4
Kai Shan South Channel	SMH 90003	169.6	2.7	n/a	n/a	n/a
Catchment Discharge Point <sup>[1]</sup>	Node No. <sup>[1]</sup>	Proposed Development		Proposed Connection		Capacity of Proposed Conduit (m <sup>3</sup> /s)
		Rainfall Intensity <sup>[2]</sup> (mm/hr)	Peak Flow (m <sup>3</sup> /s)	Conduit Dimension (mm)	Slope (1 in)	
Tai Tseng Wai Channel	SGJ 1012323	245.4	9.0	3000(W) x 2500(H) Box Culvert	1200	12.9
Shan Pui River	SNF 1004264	213.9	32.3	2 Nos. of 3000(W) x 2000(H) Twin Cells Box Culvert	600	46.8
Kai Shan South Channel	SMH 90003	180.5	2.63	Ø1350 Pipe	200	3.3

[1] – Catchment discharge points and node layout numbers refer to Drawing Nos. 226464/OAP/C/101–108

[2] – Based on 50-year rainfall event with rainfall duration equal to time of concentration of the corresponding catchment

3.6.1.3 By matching the existing flow rate discharged to the Tai Tseng Wai channel, the proposed development creates no adverse impact to the downstream channel or to the discrete flooding location of the Tai Tseng Wai stream along Fuk Shun Street.

3.6.1.4 The peak flow discharge to Shan Pui River increased by approximately 6.8m<sup>3</sup>/s due to the increased effective catchment area.

3.6.1.5 The proposed development relies on the construction of flood protection measures proposed by the DMP in which existing flood walls at the project discharge point to Shan Pui River are elevated for preventing overbank flow during extreme events and flap valves are installed at the outlet of pipelines subject to tidal flow to prevent backflow conditions. These flood protection measures should be installed by 2022 prior to completion of the PH Phase 1 development.

3.6.1.6 Due to the decreased time of concentration for directly connecting flows from the south Kai Shan hillside and a decrease in effective

catchment area, the peak runoff to the Kai Shan South Channel is slightly reduced. Therefore no adverse impacts are expected.

- 3.6.1.7 The proposed drainage scheme takes particular care in alleviating the observed flooding condition at the southeast corner of the Project site through increased site permeability, flow diversion, and added capacity. Therefore flooding problems at the southeast corner of the Project site and at Fuk Hi Street will be reduced.

## 3.6.2 Estimated Water Levels

- 3.6.2.1 Based on the hydraulic evaluation using *InfoWorks ICM*, the estimated water levels at catchment discharge points under existing and proposed scenarios are determined.
- 3.6.2.2 At the Tai Tseng Wai Channel and Kai Shan South Channel discharge points, there is a reduction in water level due to the decrease in peak flow at these locations
- 3.6.2.3 Due to the increase in effective catchment area, the flow discharged to Shan Pui River will increase by approximately  $6.8\text{m}^3/\text{s}$  resulting in a water level rise of about 7mm at the river during the 50-year event (0.16% higher than the 50-year design water level). The impact is considered minor.
- 3.6.2.4 Besides the discharge points, attention is drawn to four locations with insufficient freeboard in the existing condition (not in compliance with DSD standard). These locations are identified in **Table 3.6.2** and refer to **Drawing Nos. 226464/OAP/C/101-108**. Insufficient freeboard is seen under existing condition due to the high design water level at Shan Pui River. For locations identified in Fuk Hi Street and Long Ping Road, flooding is still expected to occur during the 50-year event, however due to drainage upgrades the water level is reduced.
- 3.6.2.5 Under the proposed development, diversion of the Tai Tseng Wai channel increases the pipe length between the YLIE and the catchment discharge point, hence the accumulated headloss and slight rise in water level at the concerned node. The freeboard value is therefore reduced to slightly below 200mm, however the water level is still below ground.
- 3.6.2.6 Due to added capacity from the new box culvert in Fuk Hi Street, the 50-year peak water level within the street will be reduced from the anticipated existing flood level. Therefore flooding problems at Fuk Hi Street will be reduced. While the new culverts are expected to alleviate flooding during smaller rain events, some street flooding is still expected to occur in large events due to tidal surcharge from Shan Pui River being very near the existing ground level.
- 3.6.2.7 Due to added capacity from the new box culvert in Long Ping Road, the 50-year peak water level at the local low point will be reduced from the anticipated existing water level. This increased capacity allows retail development along the north side of Long Ping Road to



remain near roadway elevation and 300mm above the 50-year water level. While flooding problems are alleviated during smaller rain events, some street flooding is still expected during large events due to tidal surcharge.

**Table 3.6.2:** Locations of Estimated Insufficient Freeboard

Location	Node No. [1]	Ground Level (mPD)	Existing Condition		Proposed Development			Remarks
			Water Level [2] (mPD)	Freeboard [3] (m)	Node No.	Water Level [2] (mPD)	Freeboard [3] (m)	
YLIE Diverted Channel	SNF 1006140	4.90	4.63	0.27	SNF 1006140	4.73	0.17	Marginally Acceptable
Fuk Hi Street	SMH 1031687	4.20	5.28	-1.08	SMH 1031687	4.80	-0.60	Situation Improved
Long Ping Road	SMH 13005	4.43	4.96	-0.53	SMH 13005	4.64	-0.21	Situation Improved
	SMH 1026952	4.80	5.33	-1.18	SMH 1026952	4.75	0.05	Situation Improved

[1] – Node layout numbers refer to Drawing Nos. 226464/OAP/C/101–108

[2] – Maximum flood level under 50 year return period event

[3] – Negative freeboard indicates an occurrence of flooding

3.6.2.8 During heavy rainfall or should any proposed site drainage become blocked, the proposed site topography ensures overland flow of rainwater will be away from the Project site.

## 3.7 Permanent Mitigation Measures

### 3.7.1 Peripheral Hillside Drainage

3.7.1.1 Peripheral u-channel drains are proposed along the site boundary to intercept runoff from the Kai Shan hillside. Owing to the undulating topography along the site boundary, there are a number of local low points which inevitably serve as points of entry into the proposed development via down pipe and catchment pit. To maximize the flexibility of proposed development, runoff collected by the u-channels will be directly connected to the drainage system along public roads or routed along the Project boundary to the nearest public road.

### 3.7.2 Tai Tseng Wai Catchment (System P1)

3.7.2.1 The layout plan including proposed pipe sizes for the Tai Tseng Wai catchment and details of the ecological enhancement area refer to **Drawing No. 226464/OAP/C/101**. Typical sections are provided in **Drawing No. 226464/OAP/C/701**.

3.7.2.2 A section of the Tai Tseng Wai channel just west of YLIE will be removed, and flows diverted to a proposed 3000(W) x 2500(H) box culvert running along the onsite public road. The box culvert will

direct flow toward the northeast corner of the YLIEE and into the Tai Tseng Wai channel.

- 3.7.2.3 A 1200Ø drain pipe will connect a small amount of flow from the western edge of YLIE (DSD Manhole No. SNF 1006140) to the proposed box culvert along the onsite public road.
- 3.7.2.4 Peripheral u-channel drains are proposed for connection via underground drain pipes into the proposed box culvert at the onsite public road in three locations.
- 3.7.2.5 As recommended in the EIA, an ecological enhancement area (approximate dimension of 7 m by 50 m) is proposed at the northwest corner of the YLIEE to mitigate for the habitat loss in the watercourses during site formation. The ecological enhancement area will be fed by runoff from the Kai Shan hillside and this ecological enhancement area will be formed by concrete structure with appropriate design of riparian corridor with floodplain flora, riparian tree and shrub species. It will be sized to accommodate large seasonal flows with an overflow riser protecting the neighbouring property from flooding. The riser will discharge to 750Ø pipe running along the north Project boundary and into the box culvert leading to the Tai Tseng Wai channel.

### 3.7.3 Shan Pui River Catchment (Systems P2 & P3)

- 3.7.3.1 The layout plan including proposed pipe sizes for the Shan Pui River catchment refers to **Drawing Nos. 226464/OAP/C/101–108**. Typical sections are provided in **Drawing No. 226464/OAP/C/701**.
- 3.7.3.2 Runoff from the southern YLIEE site will be collected by a 1650Ø storm drain proposed along the southern YLIEE public roadway. The pipe will continue along Fuk Hi Street and connect to an upgraded twin-cell box culvert in Fuk Hi Street.
- 3.7.3.3 An upgrade of the existing 1200Ø pipe to 3500(W) x 2000(H) twin-cell box culvert is proposed under the northbound lane of Fuk Hi Street between Fuk Hing Tsuen Village and Long Ping Road. This will increase capacity of the drainage network in Fuk Hi Street and alleviate some flooding problems. The culvert will connect into a new twin-cell box culvert in Fuk Hi Street.
- 3.7.3.4 Peripheral u-channel drains are proposed along the west boundary of the PH Phase 2 and 3 sites. At discrete low points, flows will be diverted onsite via down pipes and catch pits and routed internally via underground storm drains ranging from 600Ø to 1650Ø toward the public roadway.
- 3.7.3.5 A new 1200Ø pipe and 3000(W) x 2000(H) box culvert are proposed along the PH Phase 2 and 3 public roadway to carry flows from the peripheral drains and from within the PH Phase 2 and 3 sites to the upgraded twin-cell box culvert at Fuk Hi Street. Storm drains serving



PH Phases 2 and 3 outside of the public roadway will be maintained by Housing Authority.

- 3.7.3.6 A new 3500(W) x 2000(H) twin-cell box culvert is proposed under the southbound lane of Fuk Hi Street from Long Ping Road and discharging to the Shan Pui River. A new headwall will be required at the box culvert interface with the river channel, and a flap valve is recommended to prevent backflow conditions.
- 3.7.3.7 Peripheral u-channel drains along the west boundary of PH Phase 1 will divert flows to discrete low points and into the site via down pipes and catch pits. Underground storm drains ranging from 600Ø to 1350Ø are proposed under the EVA roadway to carry flows toward an upgraded twin-cell box culvert at Long Ping Road.
- 3.7.3.8 An existing 1650Ø storm drain along Long Ping Road is proposed to be upgraded to 3500(W) x 2000(H) twin-cell box culvert and connect to the existing box culvert just west of the intersection of Long Ping Road and Fuk Hi Street. No improvements to the existing box-culvert along Fuk Hi Street are proposed. Runoff is ultimately discharged to Shan Pui River.
- 3.7.3.9 An existing 1650Ø storm drain along Long Ping Road is proposed to be upgraded to 3500(W) x 2000(H) (single-cell) box culvert to serve flows from the southern end of PH Phase 1. The increased capacity reduces water level in the street to accommodate retail development along the north side of Long Ping Road. While flooding problems will be alleviated in smaller rain events, some flooding is anticipated during larger events.
- 3.7.3.10 Runoff from the southern end of PH Phase 1 site will be collected by proposed storm drains ranging from 1050Ø to 1350Ø at the onsite public roadway and connecting to the upgraded box culvert at Long Ping Road.

### 3.7.4 Kai Shan South Channel Catchment (System P4)

- 3.7.4.1 The layout plan including proposed pipe sizes for the Kai Shan South Channel catchment refers to **Drawing Nos. 226464/OAP/C/104**.
- 3.7.4.2 Offsite runoff from the southern hillside of Kai Shan will be collected by peripheral u-channel drains and diverted onsite via down pipe and catch pit. Flows will be diverted via discrete underground storm drain along the EVA roadway, the public roadway and along the site perimeter and discharged to the covered channel near the MTR elevated track. Penetration through the site perimeter wall will be required to connect the pipe to the existing channel.

## 3.8 Construction Stage Mitigation Measures

- 3.8.1.1 The proposed development includes large scale site formation works where large areas of exposed soil are expected. It is proposed to cover the exposed soil (especially for open stockpiles area) properly by



suitable material, e.g. geotextile / tarpaulin to minimize the amount of soil being washed into the downstream drainage system.

- 3.8.1.2 Except eliminate the source of contamination, for site runoff contaminated by suspended solids, dust and wastes should be properly treated before discharging to public drainage system. Any sedimentation deposited to the existing drainage system would cause pollution and affect the discharge capacity of the system.
- 3.8.1.3 It is preferable to provide sedimentation tank / sand traps to collect debris and silt and allow sedimentation before discharge. The desilting facilities should be inspected and cleaned out in a regular basis to maintain its functionality.
- 3.8.1.4 Temporary drainage system should be designed with sufficient capacity, constructed and maintained to prevent increasing flood risk within and upstream of the Project area.
- 3.8.1.5 Reference should be made to *EPD's Practice Note ProPECC PNI/94* for further guidelines on construction site drainage management.
- 3.8.1.6 With proper implementation of the above-mentioned mitigation measures, the impacts on the drainage conditions during construction stage would be minimal.

## 3.9 Conclusions and Further Study

- 3.9.1.1 In general, with incorporation of the proposed drainage system and upgrading of drains along Fuk Hi Street and Long Ping Road, anticipated flooding problems and/or insufficient freeboard is reduced.
- 3.9.1.2 An increase in flow to Shan Pui River by approximately 6.8m<sup>3</sup>/s is expected resulting in a water level rise of about 7mm at the river during the 50-year event (0.16% higher than the 50-year design water level). This impact is considered to be minor.
- 3.9.1.3 Liaison with DSD is needed to work out the details of maintenance access and drainage reserves to maximize the available land use.
- 3.9.1.4 Proposed works (including but not limited to upgrading works, diversion works and proposed additional drainage systems) should be well planned to match with the phasing of the proposed development.
- 3.9.1.5 Flood protection measures identified by DMP should be designed, programmed and implemented prior to completion of the Phase 1 development in 2022.

## 3.10 References

- a) Drainage Services Department Stormwater Drainage Manual, Fourth Edition, May 2013.
- b) Advice Note No. 1 – Application of the Drainage Impact Assessment Process to Private Sector Projects issued by Drainage Services

Department, September 2010.Hong Kong Planning Standards and  
Guidelines, August 2011.