

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.3E (TR-  
3E) Sewerage Impact Assessment

REP-016-01

Final | April 2014

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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 PHD.
- 1.1.1.4 **Drawing No. 226464/OAP/P/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 Sewerage Impact Assessment (SIA) 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 sewerage systems and improvement measures with an aim to minimize the impact on the downstream sewerage system, including pipeline system, pumping station and sewage treatment works.
- 1.2.1.5 The report further substantiates the feasibility of the Project (further to TR-2 report) in terms of adequacy of sewerage facilities and should be satisfactory to Drainage Services Department (DSD) and Environmental Protection Department (EPD).
- 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 sewage generated from the developments;
  - to assess the likely impacts of the proposed developments on the existing sewerage system including sewage treatment plant, public sewer system and disposal facilities and the requirements for capacity improvements and the extent of impact;
  - to carry out schematic design of the sewer arising from the development including carrying out all necessary hydraulic analysis to substantiate the proposed sewer scheme;
  - to formulate sewerage 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 sewerage systems for the proposed developments.

- 1.2.1.7 to enable an agreement in principle to be reached with WSD and utility service providers in respect of mitigation and protection schemes, diversion schemes, re-provisioning works and/or modifications of facilities for incorporation in design and during construction of the development.

## 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	Sewerage Impact Assessment – to assess the impacts on existing and planned sewerage 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
ADWF	Average Dry Weather Flow
DN	Nominal Diameter
DSD	Drainage Services Department
EIA	Environmental Impact Assessment
EPD	Environmental Protection Department
EPS	Effluent Polishing Scheme
EVA	Emergency Vehicle Access
GB	Green Belt
GFA	Gross Floor Area
G/IC	Government/ Institution/ Community
HKHA	Hong Kong Housing Authority
HKSTP	Hong Kong Science and Technology Parks Corporation
LOS	Local Open Space
OS	Open Storage
OZP	Outline Zoning Plan
PH	Public Housing Site (This Project)
PR	Plot Ratio
PTI	Public Transport Interchange
PVS	Planning Vision and Strategy Zones
SIA	Drainage Impact Assessment
SPS	Sewage Pumping Station
TPEDM	Territorial Population and Employment Data Matrices (2009)

<b>Abbreviations</b>	<b>Term</b>
TR-2	Technical Report No. 2
TR-3	Technical Report No. 3
UFF	Unit flow factor
VE	Village Environs
YLIE	Yuen Long Industrial Estate (Existing)
YLIEE	Yuen Long Industrial Estate Extension (This Project)
YLISTW	Yuen Long Sewage Treatment Works



## 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/P/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/P/021**). It is occupied by OS, 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 No. 226464/OAP/P/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 No. 226464/OAP/P/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:

1. 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 as a non-developable zone separating the public housing site from the proposed industrial estate extension site.
2. 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.
3. 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 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 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. An indicative pedestrian walkway from 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

Development Parameters	Units
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
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 Public Housing 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 and a large portion of the area still contributes to industrial uses. 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. In summary, other land uses include local open space, car parking space, road and slope 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 development scheme, 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 SEWERAGE IMPACT ASSESSMENT

### 3.1 Introduction

3.1.1.1 The proposed development scheme will generate a large amount of sewage flows. The expected impact on the existing sewerage systems and the requirement for any upgrading works to meet such demands are discussed in this section.

3.1.1.2 Since the commencement of this Study, coordination has been held with DSD / EPD to obtain relevant information and discuss sewerage impacts due to the proposed development. A list of obtained data is provided in **Table 3.1.1** below.

**Table 3.1.1:** Information Obtained from DSD / EPD

Item No.	Information	Source of Information	Date
1	Current and planned YLSTW treatment capacity	DSD/SP	18 Sep 2012
2	DSD drainage record plan	DSD/MN	18 Sep 2012
3	Reserve treatment flow at YLSTW and planned sewage flow from YLIE	HKSTP	16 Oct 2012
4	Agreement no. CE88/2002 (DS) - Feasibility Study for provision of sewerage to unsewered area / villages in northwest new territories, Final Report, September 2008	EPD	5 Oct 2012
5	Meeting with DSD and EPD – Discuss on swage discharge capacity of YLSTW <sup>[1]</sup>	N/A	6 Nov 2012
6	Existing sewage flow data of YLIE	HKSTP	16 Oct 2012

[1] – Meeting minutes are attached herein **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, CEDD and EPD and no specific comments pertaining to sewerage were received.

### 3.2 Methodology and Design Criteria

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

- Identify existing and planned sewerage works within the study area;
- Estimate the sewage generated from the development and take into account / estimate sewage discharge into the same sewerage systems under consideration from all existing sources, committed and planned developments to be implemented within the same time frame of the proposed developments ;
- Examine the impact arising from the estimated sewage from the development on existing sewerage and treatment works capacities; and



- Propose improvement, upgrading and diversion works.
- 3.2.1.2 When conducting this impact assessment, the proposed PH and YLIEE developments are generally treated as whole rather than as individual sites. Development phasing is considered such that public sewer mains will be installed during earlier phases of construction.
- 3.2.1.3 The proposed sewerage systems are designed with an aim to minimize the impacts on existing sewers and sewage treatment works.

### 3.3 Existing Sewerage System

#### 3.3.1 Existing Sewerage Treatment Works

- 3.3.1.1 The Project site is located within Yuen Long Sewerage Catchment. The existing sewage flow within Yuen Long Sewerage Catchment is treated at the existing Yuen Long Sewerage Treatment Works (YLSTW). A record of the existing sewerage system in the vicinity of the Project site is attached as **Drawing No. 226464/OAP/C/021**.
- 3.3.1.2 The existing Average Dry Weather Flow (ADWF) treatment capacity of YLSTW is 70,000m<sup>3</sup>/day. At the time of preparing this report, the proposed Effluent Polishing Scheme (EPS) at YLSTW is under planning with tentative commissioning date in September 2017. The scope of EPS is to upgrade the effluent standards while reducing the design capacity to 46,000m<sup>3</sup>/day (ADWF), which was designed to cope with the planned sewage flow in Year 2030. However, the proposed developments at PH and YLIEE were not originally considered in the EPS planned sewage flow.
- 3.3.1.3 Information obtained from HKSTP on the Water Supply and Sewerage Treatment Allocation for YLIE revealed that HKSTP is entitled to a reserve treatment flow of 36,000m<sup>3</sup>/day (ADWF) at YLSTW and is obliged to retain an internal allocation of 12,000m<sup>3</sup>/day to all grantees in the YLIE.
- 3.3.1.4 It was agreed between EPD, DSD, HD and HKSTP in a meeting on 6 Nov 2012 (Meeting minutes refer to **Appendix B**) that sewage flows from the proposed PH and YLIEE development shall be conveyed to YLSTW, and the proposed EPS upgrading works at YLSTW will be designed to cater for the additional sewage flow from the proposed developments given that YLIE's 36,000m<sup>3</sup>/day entitlement is not exceeded. The PH and YLIEE development is therefore granted up to 24,000m<sup>3</sup>/day of YLSTW treatment capacity.
- 3.3.1.5 The YLSTW falls within the Deep Bay Water Control Zone where the requirement of "No net increase in pollution load to Deep Bay" shall be met. Provided the PH and YLIEE development remains within its 24,000m<sup>3</sup>/day entitlement, the proposed EPS will cater to the increased effluent loading from the proposed development such that no additional pollution will be discharged to Deep Bay.

### 3.3.2 Existing and Planned Sewerage Systems

3.3.2.1 With reference to the DSD drainage record plan and the Feasibility Study for provision of sewerage to unsewered area/villages in northwest new territories under Agreement no. CE88/2002 (DS), **Table 3.3.1** represents an inventory of sewerage pipes between the project site and the YLSTW serving the Project site. The layout of these existing systems is shown in **Drawing No. 226464/OAP/C/021**.

**Table 3.3.1:** Inventory of Existing and Planned Sewerage Systems Serving the Project Site

Item No.	Location	Size	Existing and Planned Projects Being Served	PVS Zone No. [1]
1	Gravity pipelines running along Fuk Hi Street and connect to YLSTW	300Ø to 1800Ø	Existing YLIE and Wang Chau	232
2	Gravity pipelines along Long Ping Road and Fung Chi Road discharging to Long Ping Sewage Pumping Station (SPS)	225Ø to 750Ø	Yuen Long Town	177
3	Rising (force) main from Long Ping SPS to YLSTW	600Ø Rising Main	Long Ping SPS Sewage Catchment	177; 232
4	Gravity pipelines from Long Ping SPS to YLSTW	1350Ø to 1800Ø	Long Ping SPS Catchment Kau Hui SPS Catchment New Housing Site at YL South	177; 232 372 368; 181; 373

[1] – Taken from TPEDM 2009

3.3.2.2 According to the Feasibility Study for provision of sewerage to unsewered area/villages in northwest new territories under Agreement no. CE88/2002 (DS), the capacity of the Long Ping SPS is shown in **Table 3.3.2** below. According to the “Interim Version of the HK2030 Planning Data,” the population contributing of PVS zone 177 is expected to increase from 46,236 (year 2006) to 46,768 (year 2030). The existing design capacity of Long Ping SPS is 17,288m<sup>3</sup>/d.

**Table 3.3.2:** Long Ping Sewage Pumping Stations Study Data

SPS	Design Capacity (m <sup>3</sup> /d)	Service Catchment (PVS Zone No.) [1]	Service Catchment Description	Discharge
Long Ping SPS	17,288	177	Long Ping	YLSTW

[1] – Taken from TPEDM 2009

3.3.2.3 According to DSD, there are currently no planned or upgrading sewerage projects in the vicinity of the project site.

## 3.4 Sewage Demand Estimation

### 3.4.1 Design Parameters and Assumptions

3.4.1.1 The sewage flow estimation, assessment and evaluation of impacts are based on the following established principals and guidelines of Hong Kong:

- EPD Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning No.: EPD/TP 1/05 (GESF)
- Hong Kong Planning Standards and Guidelines (HKPSG).
- Drainage Services Department Sewerage Manual, Third Edition, May 2013

3.4.1.2 The estimate of sewage demands for the proposed development is based on the development parameters shown in Section 2 above.

### 3.4.2 Interface Projects

3.4.2.1 In performing the impact assessment on existing sewerage and sewage treatment systems, the assessment takes into account the following:

- The proposed PH/YLIEE development;
- Existing developments within the sewerage supply zone of YLSTW with planned population growth through Year 2031; and
- Planning and Engineering Study for Housing Sites in Yuen Long South.

### 3.4.3 Unit Flow Factors

3.4.3.1 For new residences, a unit flow factor (UFF) of  $0.19\text{m}^3/\text{person}/\text{day}$  is used to estimate sewage flow according to Table T-1 of the GESF. An estimated population cap of 52,190 plus 10% increment is allowed for performing this assessment.

3.4.3.2 For schools, a UFF of  $0.04\text{m}^3/\text{person}/\text{day}$  is used to estimate sewage flow for students as taken from Table T-2 of the GESF. The recommended UFF have taken into account the trend of full time education which is appropriate for future planning purposes.

3.4.3.3 For social welfare facilities, a UFF of  $0.08\text{m}^3/\text{person}/\text{day}$  is used to estimate for sewage flow, assuming the same rate as Commercial Employees per Table T-2 of the GESF.

3.4.3.4 For commercial areas (retail/market), a UFF of  $0.28\text{m}^3/\text{person}/\text{day}$  comprising  $0.05\text{m}^3/\text{person}/\text{day}$  for flushing and  $0.23\text{m}^3/\text{person}/\text{day}$  for fresh water is used to estimate sewage flows from retail/markets and associated activities, as provided by Table T-2 of the GESF.

3.4.3.5 For industrial areas, a UFF of  $2.08\text{m}^3/\text{person}/\text{day}$ , including the sum of flows due to the employee ( $0.08\text{m}^3/\text{person}/\text{day}$ ) and industrial activities ( $2.0\text{m}^3/\text{person}/\text{day}$ ), is assumed to estimate the sewage flows as per Table T-3 of the GESF. The UFF is mainly used for planning catchment-wide facilities.

### 3.4.4 Peaking Factors

3.4.4.1 Peaking factors cater for seasonal/diurnal flow variations, and infiltration and inflow due to storm events. The peaking factors shall be in accordance with EPD's GESF and are shown in **Table 3.4.1**.

**Table 3.4.1:** Peaking Factors for Various Population Ranges

Population Range	Peaking Factor (Including Stormwater Allowance) for Facility with Existing Upstream Sewerage	Peaking Factor (Excluding Stormwater Allowance) for Facility with Existing Upstream Sewerage
<i>Sewers</i>		
< 1,000	8	6
1,000 – 5,000	6	5
5,000 – 10,000	5	4
10,000 – 50,000	4	3
> 50,000	Max (7.3/N <sup>0.15</sup> , 2.4) <sup>[1]</sup>	Max (6/N <sup>0.175</sup> , 1.6) <sup>[1]</sup>
<i>Sewage Treatment Works, Preliminary Treatment Works and Pumping Stations</i>		
< 10,000	4	3
10,000 – 25,000	3.5	2.5
25,000 – 50,000	3	2
> 50,000	Max (3.9/N <sup>0.065</sup> , 2.4) <sup>[1]</sup>	Max (2.6/N <sup>0.065</sup> , 1.6) <sup>[1]</sup>

[1] – N = Contributing population in thousands

3.4.4.2 Under normal condition, peaking factors (excluding stormwater allowance) are applicable to planning sewerage facilities receiving flow from new upstream sewerage systems which essentially have no misconnections and defects for infiltration. In this analysis, peaking factors (excluding stormwater allowance) is adopted since Yuen Long area is well developed and there are essentially no misconnections and defects for infiltration.

### 3.4.5 Estimated Sewage Flow from Proposed Development

3.4.5.1 With reference to EPD Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning No.: EPD/TP 1/05, sewage flow estimation for the proposed development is provided in **Table 3.4.2** below.

**Table 3.4.2:** Estimated Sewage Generated by the Proposed Development

Accommodation Type	Development	Remarks
<b>Residential - PRH &amp; HOS</b>		
Population	57,409	For assessment purpose, 17,000 max. number of flats is assumed and 10% increment is applied  Table T-1, EPD's GESF
Unit Flow Factor (m <sup>3</sup> /person/day)	0.190	
ADWF (m <sup>3</sup> /day)	10,908	
<b>Education - Schools</b>		
No. of Schools	3	Table 4, Chapter 3, HKPSG
Students per School	765	
No. of Students	2,295	
Unit Flow Factor (m <sup>3</sup> /person/day)	0.040	Table T-2, EPD's GESF
ADWF (m <sup>3</sup> /day)	92	

Accommodation Type	Development	Remarks
<b>Social Welfare Facilities</b>		
Type of Facilities	Unknown	
NOFA (m <sup>2</sup> )	5,908	Being conservative, taking Q1 amongst various types of facilities in Table 3, Chapter 3, HKPSG
NOFA per Person (m <sup>2</sup> /employee)	5.70	
No. of Persons	1,036	Assuming the same as Commercial Employee, Table T-2, EPD's GESF
Unit Flow Factor (m <sup>3</sup> /person/day)	0.080	
ADWF (m <sup>3</sup> /day)	83	
<b>Retail/Market</b>		
IFA (m <sup>2</sup> )	13,173	
IFA per Employment (m <sup>2</sup> /employee)	26.15	Clause 2.1, Chapter 6, HKPSG
No. of Employee	504	
Unit Flow Factor (m <sup>3</sup> /employee/day)	0.280	Table T-2, EPD's GESF
ADWF (m <sup>3</sup> /day)	141	
<b>Industrial</b>		
GFA (m <sup>2</sup> )	291,545	
GFA per Employment (m <sup>2</sup> /employee)	75	Table 2, Chapter 5, HKPSG
No. of Employee	3,887	
Unit Flow Factor (m <sup>3</sup> /employee/day)	2.080	Table T-3, EPD's GESF
ADWF (m <sup>3</sup> /day)	8,086	
<b>Total ADWF (m<sup>3</sup>/day)</b>	19,309	
Contributing Population N (in thousands)	71.51	Clause 12.1, EPD's GESF
Peaking Factor	2.84	Table T-5, EPD's GESF
<b>Peak Flow (m<sup>3</sup>/day)</b>	54,877	For Sewerage Design

3.4.5.2 Sewage flow estimation for the existing development with projection to year 2031 is performed based on the Population and Employment Data of 2009 Base-Year Estimates by PVS Zones. This calculation includes additional flow contributing from the New Housing Site at Yuen Long South. Detailed calculations of the estimated sewage flow within the YLSTW service catchment refers to **Appendix A**.

### 3.4.6 Total Combined Sewage Flow

3.4.6.1 Sewage demands arising from the proposed development combined with existing demands, planned growth through 2031, and planned developments have been estimated and are summarized in the **Table 3.4.3** below.

**Table 3.4.3:** Combined Sewage Generated within YLSTW Service Area

Service Area	Zone No.	TPEDM Population Projection in Year 2031				ADWF			
		Residential	School	Employee	Total	Increment (L/s)	Total (L/s)	Total (m <sup>3</sup> /d)	
Existing Sewage Flow within YLSTP Service Catchment	232	2,880	-	52	2933	6.50	22.53	1,947	
		-	-	46	46	0.15			
		-	-	155	155	0.50			
		-	-	53	53	0.17			
		-	-	43	43	0.14			
		-	-	274	274	0.89			
		-	-	88	88	0.28			
		-	-	207	207	0.67			
		-	-	224	224	0.72			
		-	-	112	112	0.36			
		-	-	255	255	0.83			
		-	-	129	129	0.42			
		-	-	1341	1341	4.34			
		-	-	175	175	0.57			
		-	-	45	45	0.15			
		-	-	171	171	0.55			
		-	-	1551	1551	5.03			
		-	-	76	76	0.25			
		177	15,726	-	-	15,726	34.58	349.84	30,226
		232	8,270	1,800	1,151	11,221	22.75		
	372	2,294	-	2,726	5,019	13.88			
	372	3,158	-	-	3,158	5.48			
Sewage Flow from Other Planned Projects	New Housing Site at Yuen Long South (368+181+373)	72,000	-	20,000	92,000	273.15			
Estimated Sewage from Proposed Development	PH Site Phase 1	14,687	765	1260	16,712	34.47	223.48	19,309	
	YLIEE	-	-	3,887	3,887	95.56			
	PH Site Phases 2 and 3	42,722	1,530	280	44,532	93.58			
<b>Total</b>							<b>595.9</b>	<b>51,482</b>	

3.4.6.2 With incorporation of the sewage discharge from the Project Site under the planned scenario, and accounting for planned growth in the service area, the ADWF flow discharged to the Long Ping SPS will be increased to 5,955m<sup>3</sup>/d. The corresponding peaking factor of 2.5 yields a peak design flow of 14,887m<sup>3</sup>/d, which is well below the SPS design capacity of 17,800m<sup>3</sup>/d. **Table 3.4.4** summarizes the estimated flows to Long Ping SPS.

**Table 3.4.4:** Long Ping Sewage Pumping Station Estimated Flows

Scenario	ADWF (m <sup>3</sup> /d)	Peaking Factor	Design Flow (m <sup>3</sup> /d)	Service Catchment (PVS Zone No.) [1]	Service Catchment Description	Discharge
Existing	2,988	2.5	7,470	177	Long Ping	YLSTW
Planned	5,955	2.5	14,887	177 + portion of PH Site residing in Zone 232	Long Ping + Wang Chau	YLSTW

[1] – Taken from TPEDM 2009

3.4.6.3 Detailed calculations of the estimated combined sewage flow within the YLSTW service catchment refers to **Appendix A**.

## 3.5 Proposed Sewerage Scheme

3.5.1.1 Approximately 1.7km of sewers from size 450Ø to 900Ø are needed within the proposed development and along Fuk Hi Street to convey sewage flows to connection points on the existing sewerage system. **Drawing Nos. 226464/OAP/C/201 – 208** illustrate the proposed sewerage scheme. The distribution of sewage catchment from the proposed development to connection points along the existing system is shown in **Table 3.5.1**.

**Table 3.5.1:** Additional Service Catchments from Project Site to the Existing Sewerage System

Item No.	Existing Sewerage System	Size	Existing and Planned Catchments Being Served (PVS Zone No.) <sup>[1]</sup>	Proposed Additional Catchments	Connection Point to Existing System
1	Gravity pipelines running along Fuk Hi Street and connecting to YLSTW	300Ø to 1800Ø	Existing YLIE and Wang Chau (232)	YLIEE and PH Site Phases 2 and 3	Fuk Hi Street at proposed YLIEE public roadway
2	Gravity pipelines along Long Ping Road and Fung Chi Road discharging to Long Ping Sewage Pumping Station (SPS)	225Ø to 750Ø	Yuen Long Town (177)	PH Site Phase 1	Intersection of Long Ping Road and Fung Chi Road
3	Rising (force) main from Long Ping SPS to YLSTW	600Ø Rising Main	Long Ping SPS Sewage Catchment (177;232)	PH Site Phase 1	Intersection of Long Ping Road and Fung Chi Road
4	Gravity pipelines from Long Ping SPS to YLSTW	1350Ø to 1800Ø	Long Ping SPS Catchment (177;232) Kau Hui SPS Catchment (372) New Housing Site at YL South (368; 181; 373)	PH Site Phase 1	Intersection of Long Ping Road and Fung Chi Road

[1] – Taken from TPEDM 2009

3.5.1.2 It is proposed that sewerage mains be concrete, vitrified clay, ductile iron or cast iron. Adherence to DSD standards should be maintained during detailed design and construction.

## 3.6 Potential Impact to Sewerage Facilities

### 3.6.1 Impacts to Sewage Treatment Works

3.6.1.1 It was agreed between EPD, DSD, HKHA and HKSTP in the meeting on 6 Nov 2012 that the sewage flows from the proposed PH/YLIEE developments shall be conveyed to YLSTW and the proposed EPS upgrading works at YLSTW would be designed to cater for the additional sewage flow from the proposed developments, given that the total 24,000m<sup>3</sup>/day entitlement was not exceeded.

3.6.1.2 Total ADWF from the PH/YLIEE proposed development is estimated to be 19,309m<sup>3</sup>/day which is less than its 24,000m<sup>3</sup>/day entitlement. However, the combined sewage flow from within the YLSTW service area is estimated to be 51,482m<sup>3</sup>/day which exceeds the 46,000m<sup>3</sup>/day originally planned under the EPS project. Therefore under EPS, YLSTW will need to increase its planned design capacity in order to meet future demands within its service area.

3.6.1.3 Under its entitlement agreement, pollutants generated by the proposed development will be removed under the proposed EPS such that no additional pollution will be discharged to Deep Bay. Therefore the



increased sewage flow from the proposed development will have no adverse impact on Deep Bay.

### 3.6.2 Impacts to Existing Sewerage System

- 3.6.2.1 The estimate of flows contributing to the sewerage point of connection at Fuk Hi Street and the proposed YLIEE public roadway shows that the existing sewer main in Fuk Hi Street between YLIEE and Wang Lee Street is insufficiently sized to accommodate combined flows from the YLIEE and the PH Phase 2 and 3 developments.
- 3.6.2.2 There is no existing sewer main in Fuk Hi Street connecting PH Phase 2 and 3 to the existing sewer main at Fuk Hi Street and the proposed YLIEE public roadway.
- 3.6.2.3 The estimate of flows contributing to the sewerage point of connection at Long Ping Road and Fung Chi Road shows that the existing 450Ø sewer main along Fung Chi Road is insufficiently sized to cater for additional sewage flow arising from the PH Phase 1 development. The sewer main along Fung Chi Road is also too high in elevation to accommodate the connection of sewer main by gravity from the proposed development due to the platform grading in PH Phase 1 development.
- 3.6.2.4 With incorporation of the sewage discharge from the proposed development, the estimated ADWF discharge to Long Ping SPS with corresponding peaking factor will increase to 14,887m<sup>3</sup>/d, which is well below the SPS design capacity of 17,800m<sup>3</sup>/d. The estimated velocity of flow within the existing 600Ø rising main from Long Ping SPS is acceptable to cater for additional sewage from the proposed development.
- 3.6.2.5 The capacity of the existing 1350Ø to 1800Ø gravity sewer main between the Long Ping SPS 600Ø rising main and YLSTW is sufficient to cater for additional flows from the proposed development. Therefore, there would be no adverse impact on the Long Ping SPS or associated pipe works between the SPS and YLSTW.

### 3.7 Recommended Mitigation Measures

- 3.7.1.1 To serve buildings in YLIEE development, sewer mains ranging from 600Ø to 750Ø are proposed along the new public roadway connecting to the existing sewer main at Fuk Hi Street.
- 3.7.1.2 To serve buildings in PH Phase 2 and 3 developments, sewer mains ranging from 450Ø to 750Ø are proposed along the new PH Phase 2 and 3 public roadway. A 900Ø sewer main is proposed along Fuk Hi Street from the PH Phase 2 and 3 public roadway to the existing sewer main at the intersection of Fuk Hi Street and the proposed YLIEE public roadway.
- 3.7.1.3 To accommodate additional flow arising from both the PH Phase 2 and 3 development and the YLIEE, it is proposed to on-line upgrade

the existing sewer main along Fuk Hi Street to a size of 900Ø to 1050Ø between the YLIEE public roadway and Wang Lee Street. Care should be taken when constructing these upgrading works as the existing 132kV power cables along Fuk Hi Street are near the existing sewer alignment. There is sufficient space however immediately adjacent to the upgrading works to allow temporary diversion of existing sewage flows by gravity during construction.

- 3.7.1.4 To serve buildings in PH Phase 1, sewer mains ranging from 450Ø to 600Ø are proposed along the new public roadway connecting to the existing sewer main at Fung Chi Road.
- 3.7.1.5 To accommodate the additional flow arising from the PH Phase 1 development, it is proposed to upgrade the existing 450Ø sewer main along Fung Chi Road to 750Ø sewer main between the point of connection at Long Ping Road and Fung Chi Road and the Long Ping SPS. In order to meet the necessary invert levels from the proposed development due to platform grading, the upgrading works in Fung Chi Road will need to be lowered in elevation. The existing invert elevation at Long Ping SPS will remain the same so as not to impact the operation of the pumping works. There is sufficient space immediately adjacent to the upgrading works to allow temporary diversion of existing sewage flows by gravity during construction.
- 3.7.1.6 PH buildings that are not immediately adjacent to proposed sewer mains at the public roadways will be served by internal private sewer mains and maintained by Housing Authority.
- 3.7.1.7 **Drawing Nos. 226464/OAP/C/201–208 and 209** the layout of these proposed and upgrading works and corresponding details including invert levels and gradients. **Drawing No. 226464/OAP/C/701** typical sections show that sufficient space is available within the existing and proposed streets.

## 3.8 Conclusion

- 3.8.1.1 Total estimated ADWF from the proposed development is within its agreed entitlement. Proposed EPS upgrading works at YLSTW would be designed to reduce effluent loading from existing and proposed developments. However, it is estimated that the planned treatment capacity under EPS will need to be increased in order to meet the demands of its entire service area.
- 3.8.1.2 The estimated flows within the Long Ping SPS catchment from existing and planned developments and the proposed development are well below the SPS design capacity.
- 3.8.1.3 Construction of approximately 1.7km of new sewers ranging from size 450mm to 900mm within the Project Site and along Fuk Hi Street are proposed to convey sewage flows to connection points at existing sewers at Fuk Hi Street and Fung Chi Road.

- 3.8.1.4 An upgrade of existing sewers at Fuk Hi Street and Fung Chi Road is necessary to cater for the additional sewage flow arising from the proposed development.

## 3.9 References

- Drainage Services Department Sewerage Manual, May 2013.
- EPD Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning No.: EPD/TP 1/05.
- Hong Kong Planning Standards and Guidelines, August 2011.
- Hong Kong Planning Department Territorial Population Employment Data Matrices, 2009