[RESTRICTED]

Hong Kong Housing Authority

**AGREEMENT NO. CB20210448 -**
**Term Engineering Consultancy Services for**
**New Territories East Region (2021-2023)**

**Proposed Public Housing Development Site at Po Shek Wu Road**

# Sewerage Impact Assessment (SIA) Report (Issue 6.0)

**SEWERAGE IMPACT ASSESSMENT**

# CONTENTS

**Page**

# LIST OF APPENDICES

## LIST OF ABBREVIATIONS

| Abbreviation | Full title |
|---|---|
| ADWF | Average Dry Weather Flow |
| DSD | Drainage Services Department |
| DCC | Day Care Centre |
| EPD | Environmental Protection Department |
| GESF | Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning |
| HD | Housing Department |
| HKHA | Hong Kong Housing Authority |
| HKPSG | Hong Kong Planning Standard and Guidelines |
| HCS | Home Care Services |
| OZP | Outline Zoning Plan |
| SIA | Sewerage Impact Assessment |
| UFF | Unit Flow Factor |
| WSP | WSP (Asia) Limited |

# 1. INTRODUCTION

## 1.1 General

1.1.1 WSP (Asia) Ltd (WSP) had been commissioned by HKHA, under Term Engineering Consultancy Services for New Area (2021-2023), to carry out the civil engineering consultancy services in respect of SIA for the proposed public housing site at Po Shek Wu Road (hereafter referred to as "the Site" or "the Proposed Development").

## 1.2 Background

1.2.1 The Site is located at the northwest of Sheung Shui Town Centre. It is bounded by San Wan Road and Po Shek Wu Road, opposite to Shek Wu Hui Jockey Club Playground. It is zoned for "Other Use" ("OU") and as temporary bus depot under Short Term Tenancy (STT). The Site is for Subsidised Sale Flats (SSF) Development. It comprises of about 1904 Flats and is envisaged to be complete by Year 2029/30.The site is zoned "Residential (Group A)5. The Site location plan is in **Appendix A.**

1.2.2 Existing sewerage provision is available along San Wan Road. There are two trunk sewers with size DN1800 that were laid along San Wan Road conveying sewage to Shek Wu Hui Sewage Treatment Works (SWHSTW). The sewerage layout plans of the existing sewerage system are in **Appendix A.**

1.2.3 The sewage from the Site will be discharged to the existing sewerage system in San Wan Road. Based on the original development parameters provided by HKHA, JACOBS has prepared and submitted the SIA (Report Ref. R/3509/016 Revision 0), which was approved by EPD and DSD.

1.2.4 Subsequent to the approval of original SIA, HKHA advised that there would be some changes of key development parameters for Po Shek Wu Road. An updated SIA would therefore be required.

## 1.3 Objective

1.3.1 The purpose of this SIA is to update the key development parameters and assess the impact to the existing sewers for the additional flow generated. In general, the design principle and assumption will follow the approved SIA. Mitigation measures to the existing sewerage system including modification or upgrading works will be recommended if necessary.

The scope of the assessment includes:

- Estimate the sewage generated from the proposed development;
- Assess the capacity of the existing sewerage systems downstream to the Site;
- Analyse the impact to the existing sewerage systems downstream to the Site subjected to the discharge due to the proposed development; and
- Propose mitigation measures (i.e. Modification or upgrading works), if any.

## 1.4 Structure of this Report

1.4.1 This SIA report contains the following sections in addition to this introduction:

Section 2 Introduces the general information of the Site.

Section 3 Discusses the methodology and design parameters for the SIA.

Section 4 Presents the sewage flow of existing development and capacity checking of the existing sewage system.

Section 5 Presents the proposed sewerage discharge points and capacity checking of the sewage system.

Section 6 Proposes mitigation measures of the Site.

Section 7 Summarizes the results, conclusions and recommendation of the SIA.

# 2. PROJECT INFORMATION

## 2.1 Existing Project Information

2.1.1 According to the information provided by HKHA, the Site consists of the followings:

HA-funded Items:

a) two blocks (Block A and Block B) with 40 and 41 domestic storeys respectively and with an intermediate refuge floor, providing a total of 1 904 flats;
b) a four-storey podium with shops of approximately 1 800m$^2$ internal floor area (IFA), ancillary carpark for private cars and motorcycles, loading/unloading (L/UL) bays, building services plant rooms and a landscaped garden at its roof;
c) a six-classroom kindergarten;
d) a post office;
e) a district management office and a management office for this PHD;
f) associated ancillary facilities and external works, including open parking spaces for bicycles;
g) a footbridge No. 1 (FB1) connecting the development and Sheung Shui Areas 4 & 30 Site 2 (SSS2); and
h) a footbridge No. 2 (FB2) connecting the development and Po Shek Wu Estate (PSWE) across the East Rail.

Government-funded Items (welfare facilities):

a) a 100-place Child Care Centre (CCC);
b) a 100-place Residential Care Home for the Elderly (RCHE);
c) a main base of Short-term Food Assistance Service Team (STFAST);
d) one team of Home Care Services (HCS) for Frail Elderly Persons; and
e) public footbridge – a footbridge No. 3 (FB3) with lift tower and staircase along San Wan Road connecting to the existing footbridge network leading to Sheung Shui MTR Station to be handed over to the Transport Department (TD) and the Highways Department (HyD) for management and maintenance, with agreement with TD and HyD obtained.

# 3. METHODOLOGY AND DESIGN PARAMETERS FOR SEWERAGE IMPACT ASSESSMENT

## 3.1 Methodology

Assessment Approach

3.1.1 The following approach and methodology have been adopted in this sewerage impact assessment:-

- Carry out the desktop study to collect the relevant information for the assessment;
- Investigate and review the existing and planned sewerage networks and determine the sewage flow generated from the existing development; and
- Determine the potential sewage arising from the proposed development.

3.1.2 For the existing sewers and proposed sewers design, Colebrook-White equation has been used to assess the hydraulic performance.

Collection Information

3.1.3 Desktop study has been undertaken to collect the relevant information for the assessment. The relevant information collected is summarised below:

- Planned Sewerage Layout in the vicinity of the proposed Development; and
- Sewage flow generation from the existing buildings.

Design Standards, Guidelines and Reference

3.1.4 The sewage flow generated from the proposed development is based on the following standards, guidelines and reference for the sewerage and sewage treatment design:-

- Sewerage Manual Part 1 – Key Planning Issues and Gravity Collection System, Third Edition, May 2013 published by DSD;
- Sewerage Manual Part 2 – Pumping Stations and Rising Mains, Second Edition, May 2013 published by DSD;
- Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning (GESF) published by EPD; and
- Commercial and Industrial Floor Space Utilization Survey published by PlanD.

Hydraulic Analysis

3.1.5 The hydraulic conditions of the proposed **sewage system** are designed with spreadsheet calculations. The full-bore flow shall be taken as the design capacity of a sewer. The capacity for gravity sewers is assessed using the Colebrook–White equation.

$$V = -\sqrt{(8gDs)}\log\left(\frac{k_s}{3.7D} + \frac{2.51v}{D\sqrt{(2gDs)}}\right)$$

## 3.2 Basic Design Parameters

Unit Flow Factors

3.2.1 The Unit Flow Factors (UFF) for Domestic Flow and Commercial and Institutional Flow have been adopted in accordance with Table T-1, Table T-2 and Table T-3 of the GESF. The category of the components and the Unit Flow Factors adopted in the assessment are indicated in **Table 3.2.1** below.

**Table 3.2.1 – Unit Flow Factors for Domestic and Commercial Flow**

| Component | Category/ Use | UFF ($m^3$/person/day) |
|---|---|---|
| Domestic Flow | Public Rental / Private housing (R1) | 0.19 |
| | Private housing (R2) | 0.27 |
| | Private housing (R3) | 0.37 |
| | Modern village | 0.27 |
| | Temporary and non-domestic | 0.15 |
| Commercial Flow (Note) | J1 Manufacturing (North District) | 0.63 |
| | J3 Transport, Storage & Communication | 0.18 |
| | J4 Wholesale & Retail | 0.28 |
| | J6 Finance, Insurance, Real Estate & Business Services | 0.08 |
| | J10 Restaurants & Hotels | 1.58 |
| | J11 Community, Social & Personal Services | 0.28 |

Note: The unit flow factor of commercial employee 0.08 $m^3$/h/d is added into the Commercial Flow Factor.

3.2.2 According to the information from HKHA, the Site is seeking the relaxation of the maximum total PR from 7.0 to 7.5 which exceeds the maximum plot ratio residential density zone R2 for New Territories (5). Thus, the Site is assumed to be equivalent to R1 housing and the unit flow factor of the resident adopted in the Site is 0.270$m^3$/person/day. For commercial flow of the Site, several categories will be applied for the estimation. Please refer to **Appendix D** for more details.

3.2.3 An extra 10% population will be applied to the total sewage generation of the Site.

3.2.4 The Catchment Inflow Factors ($P_{cif}$) cater for the net overall ingress of water or wastewater to the sewage system. They are catchment-dependent and applicable to major sewerage facilities of a catchment. They are not applicable to new catchments which are deemed to be free from misconnections and pipe defects. Therefore, the $P_{cif}$ are not applicable in estimating the total flows from the new development areas.

3.2.5 For the existing sewage system in North District, $P_{cif}$ of 1.0 will be adopted in accordance with Table T-4 of the GESF.

**Table 3.2.5 - Catchment Inflow Factors, $P_{cif}$**

| Catchment | Catchment Inflow Factor, $P_{cif}$ |
|---|---|
| Central, North Point, Sandy Bay, Wan Chai, Wah Fu, Stanley, Cental Kowloon, Yuen Long, San Wai, North District, Tai Po, North Lantau, Mui Wo | 1.00 |
| Chai Wan, Tuen Mun, Kwai Chung, Tsing Yi, East Kowloon | 1.10 |
| Sha Tin | 1.15 |
| Tseung Kwan O | 1.20 |
| Shau Kei Wan | 1.25 |
| Aberdeen, Ap Lei Chau, Sai Kung, North West Kowloon | 1.30 |
| Cheung Chau, Shek O | 1.50 |

3.2.6 The average sewage flow, $Q_{average}$, is as follows:

$$Q_{average} = (Q_{domestic} + Q_{commercial} + Q_{other}) \times P_{cif}$$

Peaking Factors

3.2.7 Peaking factors cater for seasonal / diurnal fluctuation and normal amount of infiltration and inflow. The peaking factors shall be in accordance with Table T-5 of GESF and are shown in the **Table 3.2.7**.

**Table 3.2.7 – 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 new upstream sewerage |
|---|---|---|
| (a) For sewers | | |
| <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/ $N^{0.15}$, 2.4) | Max (6/ $N^{0.175}$, 1.6) |
| (b) Sewage Treatment Works, Preliminary Treatment Works and Pumping Stations | | |
| <10,000 | 4 | 3 |
| 10,000 – 25,000 | 3.5 | 2.5 |
| 25,000 – 50,000 | 3 | 2 |
| >50,000 | Max (3.9/ $N^{0.065}$, 2.4) | Max (2.6/ $N^{0.065}$, 1.6) |

Notes: N is the contributing population in thousands.

3.2.8 Peaking factors (including stormwater allowance) used in this report are usually applied to design sewerage facilities receiving flow from new upstream **sewage system**s which rarely has misconnections and defects for infiltration.

3.2.9 The peak sewage flow, $Q_{peak}$, is calculated as follows:

$$Q_{peak} = Q_{average} \times P$$

Where $Q_{average}$ is the average sewage flow and,

P is the peaking factor

Material

3.2.10 The roughness coefficient for newly concrete sewers used for Colebrook-White ($k_s$) is based on values provided in the Table 5 of DSD Sewerage Manual Part 1 2013. The roughness coefficient for existing concrete sewer used for Colebrook-White ($k_s$) is based on values calculated by the trial-and-error basis. Details refer to **Appendix C. Table 3.2.10** summarized the roughness coefficients for the sewerage design.

**Table 3.2.10 – Roughness Coefficients for Sewerage Design**

| Material | Roughness Coefficients, $k_s$ |
|---|---|
| Concrete (DSD Sewerage Manual) | 3.0 mm |
| Concrete (Trial-and-error Basis) | 3.1mm |

## 3.3 Design Assumptions for Existing System Capacity Estimation

3.3.1 An extra 10% population will be applied to the total sewage generation of the Site.

3.3.2 All of the non-domestic facilities will be assumed to be operated by the time when the construction is completed.

3.3.3 Teachers in the kindergarten will be assumed to be community service (J11) employees. Each classroom will hold 1 class with 30 students on average.

3.3.4 The car park staff will be classified to be transport, storage (J3) employees. The worker density of transport will be adopted for the car park.

3.3.5 Since manhole FMH1004664 locates at the most upstream of a pipe section and the original depot will be demolished, the base flow of pipe section between manhole FMH1004664 and manhole FMH1004662 will be assumed to be 0 before the completion of the Site.

3.3.6 Peak wet weather baseline flows of concerned sewer sections were provided by EPD and no adjustment factors on the data are required.

3.3.7 All existing peak flows provided by DSD has been multiplied by catchment inflow factor $P_{CIF}$ and peak factor P. No further factor is required to be imposed on the data provided.

3.3.8 Sewers at downstream of the scope are considered to have sufficient spare capacity for the new development.

3.3.9 Kinematic viscosity of sewage is assumed to be equal to the kinematic viscosity of water. (i.e. $1 \cdot 10^{-6}$ $m^2/s$).

## 3.4 Other Design Considerations

3.4.1 The existing drainage plans (Plan nos.: 3-SW-6A-2, 3-SW-6A-4, 3-SW-6B-1, 3-SW-6B-3, 3-SW-1C-4 and 3-SW-1C-4) were obtained from the Drainage Services Department (DSD) in September 2016 to gather the background information on existing sewerage system in the vicinity of the Sites. The sewerage layout of the above plans have been redrawn and illustrated in Appendix A.

3.4.2 All capacity and projected peak flows under ultimate scenarios illustrated in Appendix E were obtained from EPD in November 2016 to gather the existing condition of the sewerage system in the vicinity of the Site.

3.4.3 Based on the DSD drainage plans, there is an existing manhole (FMH1004664) connected to a DN225 sewer located inside the Site boundary. This section can be modified into a terminal manhole connect to the existing sewerage system from the Site. The sewage flow generated from the Site will be conveyed to the SWHSTW by a DN1800 existing sewage main trunk along San Wan Road.

3.4.4 There is planned expansion works at the Shek Wu Hui Sewage Treatment Works (SWHSTW) to increase its capacity for meeting the projected district demand. HD had agreed with EPD that sewage arising from the proposed housing development at Sheung Shui Area 30 and Po Shek Wu Road sites could be accommodated by the SWHSTW.

3.4.5 There are several planning developments from the upstream sewerage and will discharge to the sewerage treatment works via the existing 1800dia main trunk. The sewerage flow from the planning developments have been provided by EPD (refer to the **Appendix G**) and the amount will be included into the assessment.

# 4. CAPACITY AND ADEQUACY ASSESSMENT

## 4.1 Introduction

4.1.1 In this assessment, the following flow scenario will be presented: -

1) Condition of the existing sewerage system after the construction of the proposed development with all sewage generated from the proposed development is discharged to FMH1004664 by using the existing sewer FWD1005561

## 4.2 Sewage Discharge Estimation

4.2.1 Population

This SIA divides all population into three cohorts: domestic, transport, storage (J3), commercial (J11) employees and students. The average household size and total domestic population of the two blocks are given by HKHA, whereas the population of the commercial employees is estimated according to the usage ratio in "Commercial and Industrial Floor Space Utilization Survey" conducted by Planning Department.

4.2.2 Flow Generation

Sewage generation in this SIA is estimated by unit flow generation stated in GESF. Each population cohort has a unique unit flow factor listed Table T-1 and Table T-2 in GESF. After retrieving the unit flow of each cohort, total discharge flow generation can be calculated by multiplying the unit flow to the corresponding population.

4.2.3 Peak Factor

From GESF, peaking factor P is determined by contributing population. In this report, peak factor of the flow generated from the Site follows Table T-5 (including stormwater allowance) of GESF, which P=5 are adopted for the SIA.

### 4.2.4 Estimated Sewerage Discharge Flow

**Table 4.2.4** summarized the sewerage discharge flow from the Site after the completion. The details breakdown could refer to **Appendix D.**

**Table 4.2.4 – Estimated Sewerage Discharge Flow from the Site**

| **Categories** | **Item** | **UFF ($m^3$/day)** |
|---|---|---|
| Domestic Flow | Public Residential Building Block: | 1583.8 |
| Commercial and Institutional Flow | Retail | 23.5 |
| | Kindergarten | 17.0 |
| | Post office | 5.0 |
| | A district management office and A management office for the Site | 7.0 |
| | Associated ancillary facilities and external works, including open parking spaces for bicycles; | 52.6 |
| | A 100-place Child Care Centre (CCC); | 28.3 |
| | A 100-place Residential Care Home for the Elderly (RCHE); | 34.1 |
| | A main base of Short-term Food Assistance Service Team (STFAST); | 1.4 |
| | Home Care Services (HCS) for Frail Elderly Persons | 25.2 |
| **Total** | | **1778.0** |

## 4.3 Capacity Checking for the Existing Sewerage System

### 4.3.1 Capacity Calculation

The baseline sewage flow and full-bore capacity of the existing gravity sewers in the vicinity of the proposed development were given by EPD in **Appendix B** and used as baseline information in the assessment. The baseline sewage flow was estimated using computer hydraulic modelling taking into account the sewage flow from the existing and planned developments in the catchment. However, for proposed sewers and sewers with missing data, capacity should be clarified. The capacity of the existing drainage pipes were estimated by Colebrook-White equation stated in the Section 3.1.5.

For the hydraulic pipeline roughness $k_s$, from **Section 5.2.1** of Sewerage Manual, published by DSD, the roughness of slimed sewers shall be adopted from Table 5 in the manual. Assume all sewers are concrete sewers, the $k_s$ value of the sewer will then be estimated by trial and error basis based on the manhole data provided by EPD, and the value with minimal error along the main trunk (i.e. 0.0031m) will be adopted in this report. The detail estimation is shown in **Appendix C** in this report.

### 4.3.2 Utilization Rate

In the context of computer hydraulic modelling, the utilization rate of gravity sewer is defined as the running water depth divided by the sewer diameter. A sewer section is under surcharge if its utilization rate is greater than 1. In this assignment, the estimated sewage flow from the proposed development calculated in **Appendix D** is added to the baseline sewage flow provided by EPD shown in **Appendix B** to project the ultimate flow of concerned sewer sections illustrated in **Appendix E**. The projected flow is then compared against the full-bore capacity. The sewer is expected to have sufficient capacity if its projected flow is lower than the full-bore capacity. **Table 4.3.2a** summarized existing condition of the existing sewerage networks. **Table 4.3.2b** summarized the result of the assessment under Scenario 1. Detail of the result refer to the **Appendix E**.

**Table 4.3.2a – Existing Utilization Rate of Existing Sewerage System before the Development (Including other Planning Developments)**

| Sewers Between Manholes | | Utilization |
|---|---|---|
| **US MH** | **DS MH** | **(%)** |
| FMH1004664 | FMH1004663 | 31.1 |
| FMH1004663 | FMH1004662 | 25.8 |
| FMH1004662 | FMH1004661 | 47.1 |
| FMH1004661 | FMH1004660 | 48.8 |
| FMH1004660 | FMH1004659 | N/A |
| FMH1004659 | FMH1004658 | N/A |
| FMH1004658 | FMH1004657 | 61.9 |
| FMH1004657 | FMH1004629 | 39.3 |
| FMH1004629 | FMH1004030 | 47.9 |
| FMH1004030 | FMH1004031 | 68.6 |

**Table 4.3.2b – Utilization Rate of Existing Sewerage System after the Development**

| Sewers Between Manholes | | Utilization |
|---|---|---|
| **US MH** | **DS MH** | **(%)** |
| FMH1004664 | FMH1004663 | 180.8 |
| FMH1004663 | FMH1004662 | 151.3 |
| FMH1004662 | FMH1004661 | 59.9 |
| FMH1004661 | FMH1004660 | 62.0 |
| FMH1004660 | FMH1004659 | N/A |
| FMH1004659 | FMH1004658 | N/A |
| FMH1004658 | FMH1004657 | 78.6 |
| FMH1004657 | FMH1004629 | 50.0 |
| FMH1004629 | FMH1004030 | 59.3 |
| FMH1004030 | FMH1004031 | 84.9 |

# 5. SEWERAGE IMPACT ASSESSMENT

5.1.1 Under Scenario 1 in Section 4.1.1, the estimated peak flow in the sewer sections between manholes FMH1004664 and FMH1004662 exceed 100% of full-bore capacity. There is significant sewerage impact of the existing sewerage system. Mitigation measures for the existing sewerage system are needed.

5.1.2 Apart from the sewer FWD1005561 between the manhole FMH1004664 and FMH1004662, the downstream sewerage systems are capable to cater the increased sewerage flow form the Site after the completion.

5.1.3 The full-bore capacity of the DN1800 sewer section between manholes FMH1004651 and FMH1004650 is lower than other DN1800 sewer sections in the vicinity due to gentle gradient.

5.1.4 Sewer sections from manhole FMH1004660 to FMH1004658 are at level according to the Drainage Record. Hence, the full-bore capacity could not be determined by the Colebrook-White equation. Computer hydraulic modelling indicated that the baseline utilization rate of the sewer sections ranges from 62 to 63% under previous submission. Although the sewerage flow from the Site have been increase by about 1.5L/s, the impact of the increased flow should be minor. The existing sewers from manhole FMH1004660 to FMH1004658 is capable to cater the increased sewerage flow.

5.1.5 The checking on the existing pipes up to FMH1004031 shows that the DN1800 main trunk provides sufficient capacity to cater for the sewage generated from the housing development and the base flow. Hence, no further checking on the downstream is required.

# 6. MITIGATION MEASURES

## 6.1 Sewerage Impact After the Completion of the Site

6.1.1 As mentioned in **Section 5.1.1**, the utilization of the sewer sections between manholes FMH1004664 and FMH1004662 would exceed 100% of the full-bore capacity. Mitigation measures should be proposed to cater the insufficient capacity of the existing sewerage system between the site and the DSD main sewerage networks.

## 6.2 Upgrading Works for Sewer from FMH1004664 to FMH1004662

6.2.1 To raise the capacity of the section, a pipe with larger nominal diameter shall replace the original DN225 sewers. The existing sewer FWD1005561 shall be upgraded to accommodate sewage arising from the Site.

6.2.2 This section will justify the adequacy of capacity of installing DN300 concrete sewers to replace the original sewers.

6.2.3 **Appendix E** and **Table 6.1.4a** showed the detail calculation of the section, while **Appendix F** and **Table 6.1.4b** illustrate the capacity change of the sewer section before and after adopting the DN300 pipes.

**Table 6.1.4a – Initial Condition of Sewer Sections FMH1004664 to FMH1004662**

| Sewer | Pipe Diameter | US IL | DS IL | Increased Sewage Flow | Cumulative Peak Flow | Pipe Capacity | Utilization |
|---|---|---|---|---|---|---|---|
| | (mm) | (mPD) | (mPD) | (L/sec) | (L/sec) | (L/sec) | (%) |
| FWD1005561 | 225.0 | 6.42 | 6.03 | 20.58 | 102.89 | 56.92 | 180.8 |
| FWD1005560 | 225.0 | 6.03 | 5.47 | 20.58 | 102.89 | 68.01 | 151.3 |

**Table 6.1.4b – Results of the Sewer Sections Adopting DN300 Pipes**

| Sewer | Pipe Diameter | US IL | DS IL | Increased Sewage Flow | Cumulative Peak Flow | Pipe Capacity | Utilization |
|---|---|---|---|---|---|---|---|
| | (mm) | (mPD) | (mPD) | (L/sec) | (L/sec) | (L/sec) | (%) |
| FWD1005561 | 300.0 | 6.42 | 6.03 | 20.58 | 102.89 | 123.59 | 83.3 |
| FWD1005560 | 300.0 | 6.03 | 5.47 | 20.58 | 102.89 | 147.66 | 69.7 |

6.2.4 **Table 6.1.4a** and **Table 6.1.4b** show clearly that the capacity has risen more than double when the original sewers by DN300 concrete pipes. Thus, to summarize, the inadequacy occurs in the sewer sections between manholes FMH1004664 to FMH1004662 can be resolved with replacing the original sewers by DN300 concrete pipes.

# 7. CONCLUSIONS AND RECOMMENDATIONS

7.1.1 The Sewerage Impact Assessment (SIA) has been conducted to evaluate the possible impact on the existing sewerage system due to additional flow generated from the proposed public housing developments.

7.1.2 The main trunk is mainly responsible for transferring the sewage flow of the residential buildings and commercial buildings of Sheung Shui region to SWHSTW. The additional flow generated from the Site would only occupy about 1.5% of the utilization of the main trunk. The main trunk contains about 10% capacity for the further planning. Therefore, the sewage generation from the Site has minimal effect to the existing sewerage system.

7.1.3 Under Scenario 1 in Section 4.1.1, the estimated peak flow in the sewer section between manholes FMH1004664 and FMH1004662 exceeds 100% of full-bore capacity. It is recommended to upgrade the sewer section to 300dia concrete sewer.

7.1.4 The full-bore capacity of the DN1800 sewer section between manholes FMH1004651 and FMH1004650 is lower than other DN1800 sewer sections in the vicinity due to gentle gradient.

# 8. REFERENCES


- Site Layout Plan (with Typical Floor) (Option 10) (Drawing No. NO09/SCHEME B/LO-00/K), HKHA
- EPD/TP1/05 “Guidelines for Estimating Sewerage Flows for Sewage Infrastructure Planning”
- The Hong Kong Planning Standards and Guidelines (HKPSG), PlanD
- Sewerage Manual Part 1, Key Planning Issues and Gravity Collection System, DSD
- Commercial and Industrial Floor Space Utilization Survey, PD
- Guidelines for Registration of a New School, EDB
- Manhole and Flow Data, EPD
- Po Shek Wu Road Sewerage Impact Assessment Report (Report no. R3509/009)

# Appendix A

## Sewerage Layout Plans near the Site

ICU Ref : HD(ICU)S .....

**LEGEND:**

- SITE BOUNDARY
- EXISTING SEWER

| REVISIONS | | INITIAL AND DESIGNATION | | |
|---|---|---|---|---|
| NO | DESCRIPTION AND DATE | DWN | CKD | AUTH. |

wsp

| | | | |
|---|---|---|---|
| AUTHORISED | -- -- | | --/-- |
| ENDORSED | -- -- | | --/-- |
| CHECKED | -- -- | | --/-- |
| DRAWN | -- -- | | --/-- |

AGREEMENT NO. CB 20210448

PROJECT
Term Engineering Consultancy Services for New Territories East Region (2021-2023) - Instruction No. WP04 - Potential Public Housing at Po Shek Wu Road, Sheung Shui – Investigation

JOB NO. 2512243A

DRAWING TITLE
SEWERAGE LAYOUT PLAN (SHEET 1 OF 2)

SCALE 1 : 1000 @ A3

DRAWING NO. WP04/SIA/001

SOURCE

ICU Ref:

AutoCAD 2000 A1 841 x 594

HOUSING DEPARTMENT

COUNTERCHECKED ☐

REF/S.I. No. : _____ DATE: _____

☐ CONTRACTOR's COPY ☐ DE's COPY ☐ PDO's COPY ☐ DFO's COPY
☐ CTR's ADO1 COPY ☐ QE's COPY ☐ RSE's COPY ☐ SE's COPY
☐ _____'s COPY ☐ LA's COPY ☐ BSI's COPY ☐ BSE's COPY

Plot File by :chow, tony kwok-yiu Date : 2023-04-03
Path : \\DCAS3000AT20\PROJECTS2\2512243A - HKHA TERM ENG NTE 2021-23\13_WORKING\WP04 PO SHEK WU ROAD SIA\WORKING\DRAWINGS\CAD\WP04-SIA.DWG

ICU Ref : HD(ICU)S .....

**LEGEND:**

- SITE BOUNDARY
- EXISTING SEWER

| REVISIONS | | INITIAL AND DESIGNATION | | |
|---|---|---|---|---|
| NO | DESCRIPTION AND DATE | DWN | CKD | AUTH |

wsp

| | | | |
|---|---|---|---|
| AUTHORISED | -- -- | | --/-- |
| ENDORSED | -- -- | | --/-- |
| CHECKED | -- -- | | --/-- |
| DRAWN | -- -- | | --/-- |

AGREEMENT NO. CB 20210448

PROJECT
Term Engineering Consultancy Services for New Territories East Region (2021-2023) - Instruction No. WP04 - Potential Public Housing at Po Shek Wu Road, Sheung Shui – Investigation

JOB NO. 2512243A

DRAWING TITLE
SEWERAGE LAYOUT PLAN (SHEET 2 OF 2)

SCALE 1 : 1000 @ A3

DRAWING NO. WP04/SIA/002

SOURCE

ICU Ref:

AutoCAD 2000 A1 841 x 594

HOUSING DEPARTMENT

COUNTERCHECKED ☐

REF'S/Lt. No. : _____ DATE: _____

☐ CONTRACTOR'S COPY
☐ CTR's ADDL COPY
☐ 's COPY
☐ DE's COPY
☐ QE's COPY
☐ LA's COPY
☐ PRSE's COPY
☐ SE's COPY
☐ RSE's COPY
☐ BS's COPY
☐ HM's COPY
☐ SE's COPY
☐ BSE's COPY
☐ COW's COPY

Plot File by :chow, tony kwok-yiu Date : 2023-04-03
Path : \\DCAS\3000DAT20\PROJECTS\2512243A – HKHA TERM ENG NTE 2021-23\13_WORKING\WP04 PO SHEK WU ROAD SIA\WORKING\DRAWINGS\CAD\WP04-SIA.DWG

# Appendix B

Manhole and Flow Data Provided by EPD (Extracted from Previous SIA Report)

Job Title: Sewerage Impact Assessment of Po Shek Wu Road

Location: **San Wan Road**
Condition: **Peak Wet Weather Flow**

| | | Sewer | | | | | | | | Full-bore values | | Base Flow at Upstream Manhole | | | | Base Flow at Downstream Manhole | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upstream Manhole No. | Downstream Manhole No. | Diameter (mm) | Length (m) | Upstream G.L. (mPD) | Downstream G.L. (mPD) | Upstream I.L. (mPD) | Downstream I.L. (mPD) | Gradient (abs.) | Grad (1 in) | Capacity ($m^3/s$) | Capacity (l/s) | Water Level (m) | Velocity (m/s) | Flow ($m^3/s$) | Flow (l/s) | Depth (m) | Velocity (m/s) | Flow ($m^3/s$) | Flow (l/s) |
| FMH1004754 | FMH1004753 | 375 | 9.22 | 7.80 | 7.85 | 6.34 | 6.39 | N/A | N/A | N/A | N/A | 0.121 | 0.015 | 0.00038 | 0.38 | 0.072 | 0.042 | 0.00038 | 0.38 |
| FMH1004753 | FMH1004752 | 375 | 7.07 | 12.85 | 7.85 | 6.39 | 5.00 | 0.1966 | 5 | 0.7077 | 708 | 0.072 | 0.042 | 0.00038 | 0.00 | 0.072 | 0.042 | 0.00038 | 0.38 |
| FMH1004752 | FMH1004667 | 1350 | 34.71 | 7.85 | 7.61 | 1.59 | 1.11 | 0.0138 | 72 | 5.5767 | | 0.415 | 1.789 | 0.61818 | 618.18 | 0.810 | 0.842 | 0.61984 | 619.84 |
| FMH1004667 | FMH1004666 | 1800 | 89.14 | 7.61 | 7.14 | 0.81 | 0.73 | 0.0009 | 1114 | 3.0243 | 3024 | 1.110 | 0.711 | 1.04336 | 1043.36 | 1.141 | 0.685 | 1.03666 | 1036.66 |
| FMH1004666 | FMH1004665 | 1800 | 63.70 | 7.14 | 7.85 | 0.73 | 0.72 | 0.0002 | 6370 | 1.2604 | 1260 | 1.140 | 0.685 | 1.03645 | 1036.45 | 1.114 | 0.707 | 1.03206 | 1032.06 |
| FMH1004665 | FMH1004662 | 1800 | 4.4714 | 7.85 | 7.89 | 0.72 | 0.68 | 0.0089 | 112 | 9.5648 | 9565 | 1.11 | 0.71 | 1.03183 | 1031.83 | 1.148 | 0.679 | 1.03154 | 1031.54 |
| FMH1004664 | FMH1004663 | 225 | 19.7226 | 7.03 | 7.82 | 6.42 | 6.03 | 0.0198 | 51 | 0.0573 | 57 | 0.111 | 1.014 | 0.01771 | 17.71 | 0.111 | 1.011 | 0.01761 | 17.61 |
| FMH1004663 | FMH1004662 | 225 | 19.8499 | 7.82 | 7.89 | 6.03 | 5.47 | 0.0282 | 35 | 0.0684 | 68 | 0.103 | 1.132 | 0.01758 | 17.58 | 0.103 | 1.132 | 0.01757 | 17.57 |
| FMH1004662 | FMH1004661 | 1800 | 84.148 | 7.89 | 7.78 | 0.68 | 0.64 | 0.0005 | 2104 | 2.1989 | 2199 | 1.144 | 0.681 | 1.03149 | 1031.49 | 1.139 | 0.686 | 1.02903 | 1029.03 |
| FMH1004661 | FMH1004660 | 1800 | 67.941 | 7.78 | 7.31 | 0.64 | 0.61 | 0.0004 | 2265 | 2.1191 | 2119 | 1.138 | 0.686 | 1.029 | 1029 | 1.131 | 0.693 | 1.02905 | 1029.05 |
| FMH1004660 | FMH1004659 | 1800 | 14.7651 | 7.31 | 7.23 | 0.61 | 0.61 | 0 | N/A | N/A | N/A | 1.13 | 0.693 | 1.02907 | 1029.07 | 1.122 | 0.701 | 1.02917 | 1029.17 |
| FMH1004659 | FMH1004658 | 1800 | 5.3849 | 7.23 | 7.32 | 0.61 | 0.61 | 0 | N/A | N/A | N/A | 1.118 | 0.704 | 1.02918 | 1029.18 | 1.115 | 0.706 | 1.02921 | 1029.21 |
| FMH1004658 | FMH1004657 | 1800 | 36.3597 | 7.32 | 7.19 | 0.61 | 0.6 | 0.0003 | 3636 | 1.6708 | 1671 | 1.111 | 0.709 | 1.02922 | 1029.22 | 1.099 | 0.721 | 1.02979 | 1029.79 |
| FMH1004657 | FMH1004629 | 1800 | 132.4572 | 7.19 | 7.2 | 0.59 | 0.5 | 0.0007 | 1472 | 2.6305 | 2630 | 1.108 | 0.713 | 1.02983 | 1029.83 | 1.121 | 0.708 | 1.03299 | 1032.99 |
| FMH1004629 | FMH1004030 | 1800 | 135.2077 | 7.2 | 7.09 | 0.49 | 0.41 | 0.0006 | 1690 | 2.4542 | 2454 | 1.13 | 0.767 | 1.16964 | 1169.64 | 1.113 | 0.785 | 1.17184 | 1171.84 |
| FMH1004752 | FMH1004749 | 1350 | 4.9997 | 7.85 | 7.77 | 3.31 | 3.31 | 0 | N/A | N/A | N/A | 0.068 | 0 | 0 | 0 | 0.068 | 0 | 0 | 0 |
| FMH1036568 | FMH1004748 | 600 | 28.8367 | 7.8 | 7.61 | 1.84 | 1.73 | 0.0038 | 262 | 0.343 | 343 | 0.352 | 0.945 | 0.11815 | 118.15 | 0.259 | 1.369 | 0.11815 | 118.15 |
| FMH1004751 | FMH1004748 | 450 | 27.0741 | 7.88 | 7.61 | 2.81 | 2.83 | N/A | N/A | N/A | N/A | 0.081 | 0.368 | 0.00428 | 4.28 | 0.076 | 0.419 | 0.00427 | 4.27 |
| FMH1004748 | FMH1004749 | 1350 | 12.8059 | 7.61 | 7.77 | 1.73 | 1.63 | 0.0078 | 128 | 4.1898 | 4190 | 0.5 | 2.499 | 1.20464 | 1204.64 | 0.5 | 2.499 | 1.20464 | 1204.64 |
| FMH1004749 | FMH1004656 | 1800 | 36.1251 | 7.77 | 7.86 | 1.18 | 1.11 | 0.0019 | 516 | 4.4474 | 4447 | 0.928 | 0.925 | 1.20455 | 1204.55 | 0.986 | 0.854 | 1.20359 | 1203.59 |
| FMH1004656 | FMH1004655 | 1800 | 114.5511 | 7.86 | 7.65 | 1.11 | 1.02 | 0.0008 | 1273 | 2.8292 | 2829 | 0.985 | 0.947 | 1.20352 | 1203.52 | 0.901 | 1.25 | 1.20264 | 1202.64 |
| FMH1004655 | FMH1004652 | 1800 | 115.2603 | 7.65 | 7.85 | 1.02 | 0.65 | 0.0032 | 312 | 5.7266 | 5727 | 0.901 | 1.012 | 1.20263 | 1202.63 | 1.242 | 0.656 | 1.20212 | 1202.12 |
| FMH1004654 | FMH1004653 | 225 | 58.7284 | 6.46 | 6.32 | 4.73 | 3.8 | 0.0158 | 63 | 0.0512 | 51 | 0.064 | 0.449 | 0.0032 | 3.2 | 0.095 | 0.23 | 0.00316 | 3.16 |
| FMH1004653 | FMH1004652 | 450 | 8.602 | 6.32 | 7.85 | 3.8 | 3.7 | 0.0116 | 86 | 0.2792 | 279 | 0.095 | 0.196 | 0.00315 | 3.15 | 0.095 | 0.196 | 0.00315 | 3.15 |
| FMH1004652 | FMH1004651 | 1800 | 61.555 | 7.85 | 7.41 | 0.65 | 0.63 | 0.0003 | 3078 | 1.8167 | 1817 | 1.241 | 0.71 | 1.20309 | 1203.09 | 1.226 | 0.724 | 1.20265 | 1202.65 |
| FMH1004651 | FMH1004650 | 1800 | 65.4373 | 7.41 | 7.02 | 0.63 | 0.62 | 0.0002 | 6544 | 1.2435 | 1244 | 1.225 | 0.724 | 1.20263 | 1202.63 | 1.195 | 0.752 | 1.20443 | 1204.43 |
| FMH1004650 | FMH1004630 | 1800 | 133.2058 | 7.02 | 7.57 | 0.62 | 0.53 | 0.0007 | 1480 | 2.6231 | 2623 | 1.194 | 0.816 | 1.35298 | 1352.98 | 1.176 | 0.837 | 1.35562 | 1355.62 |
| FMH1004630 | FMH1004026 | 1800 | 138.0332 | 7.57 | 7.72 | 0.53 | 0.44 | 0.0007 | 1534 | 2.5766 | 2577 | 1.175 | 0.839 | 1.35667 | 1356.67 | 1.144 | 0.879 | 1.3637 | 1363.7 |
| FMH1004026 | FMH1004027 | 1800 | 101.1782 | 7.72 | 7.12 | 0.44 | 0.37 | 0.0007 | 1445 | 2.6544 | 2654 | 1.143 | 0.881 | 1.365 | 1365 | 1.122 | 0.931 | 1.37278 | 1372.78 |
| FMH1004027 | FMH1004029 | 1800 | 101.9799 | 7.12 | 5.4 | 0.37 | 0.29 | 0.0008 | 1275 | 2.827 | 2827 | 1.121 | 0.977 | 1.48 | 1480 | 1.104 | 1.107 | 1.48242 | 1482.42 |
| FMH1004029 | FMH1004111 | 1800 | 67.9412 | 5.4 | 7 | 0.29 | 0.22 | 0.001 | 971 | 3.2409 | 3241 | 1.104 | 0.821 | 1.15233 | 1152.33 | 1.136 | 0.823 | 1.15485 | 1154.85 |
| FMH1004111 | FMH1004113 | 1800 | 12.5305 | 7 | | 0.22 | 0.21 | 0.0008 | 1253 | 2.8514 | 2851 | 1.133 | 0.826 | 1.15499 | 1154.99 | 1.136 | 0.83 | 1.15561 | 1155.61 |
| FMH1004113 | FMH1004115 | 1500 | 61.6195 | | | 0.21 | 0.12 | 0.0015 | 685 | 2.3887 | 2389 | 1.133 | 0.832 | 1.15575 | 1155.75 | 1.195 | 0.805 | 1.15951 | 1159.51 |
| FMH1004030 | FMH1004031 | 1800 | 103.2766 | 7.09 | 5 | 0.39 | 0.36 | 0.0003 | 3443 | 1.7173 | 1717 | 1.132 | 0.766 | 1.17188 | 1171.88 | 1.097 | 0.835 | 1.17336 | 1173.36 |
| FMH1004031 | FMH1004032 | 1800 | 104.6893 | 5 | 6.99 | 0.3 | 0.29 | 0.0001 | 10469 | 0.9816 | 982 | 1.156 | 0.771 | 1.17341 | 1173.41 | 1.104 | 0.88 | 1.17991 | 1179.91 |
| FMH1004032 | FMH1004112 | 1800 | 67.9412 | 6.99 | | 0.25 | 0.18 | 0.001 | 971 | 3.2409 | 3241 | 1.135 | 1.064 | 1.56029 | 1560.29 | 1.14 | 1.15 | 1.56335 | 1563.35 |
| FMH1004112 | FMH1004114 | 1500 | 62.3701 | | | 0.18 | 0.12 | 0.001 | 1040 | 1.9376 | 1938 | 1.139 | 1.04 | 1.56352 | 1563.52 | 1.178 | 1.017 | 1.56752 | 1567.52 |
| FMH1004114 | FMH1004117 | 1800 | 37.5897 | | | 0.12 | 0.08 | 0.0011 | 940 | 3.2938 | 3294 | 1.102 | 2.446 | 3.99102 | 3991.02 | 0.988 | 2.789 | 3.99063 | 3990.63 |
| FMH1004029 | FMH1004032 | 1800 | 5.3851 | 5.4 | 6.99 | 0.29 | 0.29 | 0 | N/A | N/A | N/A | 1.104 | 0.376 | 0.35111 | 351.11 | 1.104 | 0.378 | 0.3516 | 351.6 |
| FMH1004115 | FMH1004114 | 1500 | 9.2193 | | | 0.12 | 0.12 | 0 | N/A | N/A | N/A | 1.184 | 0.931 | 1.15973 | 1159.73 | 1.178 | 0.947 | 1.16029 | 1160.29 |

# Appendix C

Estimation of Pipeline Roughness Coefficient (Extracted from Previous SIA Report)

**Project : Sewerage Impact Assessment for Po Shek Wu Road**
**Project No.: 3509**

| | INITIAL | DATE | REV. |
|---|---|---|---|
| CHECKED BY | AK | Mar-17 | 1 |
| PREPARED BY | LE | Mar-17 | 1 |

Hydraulic pipeline roughness (m) = 0.00312

| Manhole | | Pipe Diameter ( mm ) | Cover Level (mPD) | | Invert Level (mPD) | | Pipe Length (m) | Hydraulic Gradient ( 1 in ) | Capacity by Colebrood-White Equation ( l/s ) | Capacity Provided by EPD ( l/s ) | Error (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| From | To | | Upstream manhole | Downstream manhole | From | To | | | | | |
| FMH1004664 | FMH1004663 | 225 | 7.03 | 7.82 | 6.42 | 6.03 | 19.72 | 50.6 | 57.00 | 57.00 | 0.01 |
| FMH1004663 | FMH1004662 | 225 | 7.82 | 7.89 | 6.03 | 5.47 | 19.8 | 35.4 | 68.09 | 68.00 | 0.13 |
| FMH1004662 | FMH1004661 | 1800 | 7.89 | 7.78 | 0.68 | 0.64 | 84.15 | 2103.7 | 2195.40 | 2199.00 | -0.16 |
| FMH1004661 | FMH1004660 | 1800 | 7.78 | 7.31 | 0.64 | 0.61 | 67.94 | 2264.7 | 2115.92 | 2119.00 | -0.15 |
| FMH1004658 | FMH1004657 | 1800 | 7.32 | 7.19 | 0.61 | 0.60 | 36.36 | 3636.0 | 1669.91 | 1671.00 | -0.06 |
| FMH1004657 | FMH1004629 | 1800 | 7.19 | 7.20 | 0.59 | 0.50 | 132.46 | 1471.7 | 2624.75 | 2630.00 | -0.20 |
| FMH1004629 | FMH1004030 | 1800 | 7.20 | 7.09 | 0.49 | 0.41 | 135.21 | 1690.1 | 2449.34 | 2454.00 | -0.19 |
| FMH1004030 | FMH1004031 | 1800 | 7.09 | 5.00 | 0.39 | 0.36 | 103.28 | 3442.55 | 1716.19 | 1717.00 | -0.05 |
| | | | | | | | | | Total Absolute Error = | | 0.95 |

Hydraulic pipeline roughness (m) = 0.00311

| Manhole | | Pipe Diameter ( mm ) | Cover Level (mPD) | | Invert Level (mPD) | | Pipe Length (m) | Hydraulic Gradient ( 1 in ) | Capacity by Colebrood-White Equation ( l/s ) | Capacity Provided by EPD ( l/s ) | Error (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| From | To | | Upstream manhole | Downstream manhole | From | To | | | | | |
| FMH1004664 | FMH1004663 | 225 | 7.03 | 7.82 | 6.42 | 6.03 | 19.72 | 50.6 | 57.04 | 57.00 | 0.06 |
| FMH1004663 | FMH1004662 | 225 | 7.82 | 7.89 | 6.03 | 5.47 | 19.8 | 35.4 | 68.13 | 68.00 | 0.19 |
| FMH1004662 | FMH1004661 | 1800 | 7.89 | 7.78 | 0.68 | 0.64 | 84.15 | 2103.7 | 2196.32 | 2199.00 | -0.12 |
| FMH1004661 | FMH1004660 | 1800 | 7.78 | 7.31 | 0.64 | 0.61 | 67.94 | 2264.7 | 2116.81 | 2119.00 | -0.10 |
| FMH1004658 | FMH1004657 | 1800 | 7.32 | 7.19 | 0.61 | 0.60 | 36.36 | 3636.0 | 1670.61 | 1671.00 | -0.02 |
| FMH1004657 | FMH1004629 | 1800 | 7.19 | 7.20 | 0.59 | 0.50 | 132.46 | 1471.7 | 2625.85 | 2630.00 | -0.16 |
| FMH1004629 | FMH1004030 | 1800 | 7.20 | 7.09 | 0.49 | 0.41 | 135.21 | 1690.1 | 2450.37 | 2454.00 | -0.15 |
| FMH1004030 | FMH1004031 | 1800 | 7.09 | 5.00 | 0.39 | 0.36 | 103.28 | 3442.55 | 1716.90 | 1717.00 | -0.01 |
| | | | | | | | | | Total Absolute Error = | | 0.81 |

Hydraulic pipeline roughness (m) = 0.00310

| Manhole | | Pipe Diameter ( mm ) | Cover Level (mPD) | | Invert Level (mPD) | | Pipe Length (m) | Hydraulic Gradient ( 1 in ) | Capacity by Colebrood-White Equation ( l/s ) | Capacity Provided by EPD ( l/s ) | Error (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| From | To | | Upstream manhole | Downstream manhole | From | To | | | | | |
| FMH1004664 | FMH1004663 | 225 | 7.03 | 7.82 | 6.42 | 6.03 | 19.72 | 50.6 | 57.07 | 57.00 | 0.12 |
| FMH1004663 | FMH1004662 | 225 | 7.82 | 7.89 | 6.03 | 5.47 | 19.8 | 35.4 | 68.17 | 68.00 | 0.24 |
| FMH1004662 | FMH1004661 | 1800 | 7.89 | 7.78 | 0.68 | 0.64 | 84.15 | 2103.7 | 2197.24 | 2199.00 | -0.08 |
| FMH1004661 | FMH1004660 | 1800 | 7.78 | 7.31 | 0.64 | 0.61 | 67.94 | 2264.7 | 2117.70 | 2119.00 | -0.06 |
| FMH1004658 | FMH1004657 | 1800 | 7.32 | 7.19 | 0.61 | 0.60 | 36.36 | 3636.0 | 1671.32 | 1671.00 | 0.02 |
| FMH1004657 | FMH1004629 | 1800 | 7.19 | 7.20 | 0.59 | 0.50 | 132.46 | 1471.7 | 2626.96 | 2630.00 | -0.12 |
| FMH1004629 | FMH1004030 | 1800 | 7.20 | 7.09 | 0.49 | 0.41 | 135.21 | 1690.1 | 2451.40 | 2454.00 | -0.11 |
| FMH1004030 | FMH1004031 | 1800.00 | 7.09 | 5.00 | 0.39 | 0.36 | 103.28 | 3442.55 | 1717.62 | 1717.00 | 0.04 |
| | | | | | | | | | Total Absolute Error = | | 0.79 |

Hydraulic pipeline roughness (m) = 0.00309

| Manhole | | Pipe Diameter ( mm ) | Cover Level (mPD) | | Invert Level (mPD) | | Pipe Length (m) | Hydraulic Gradient ( 1 in ) | Capacity by Colebrood-White Equation ( l/s ) | Capacity Provided by EPD ( l/s ) | Error (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| From | To | | Upstream manhole | Downstream manhole | From | To | | | | | |
| FMH1004664 | FMH1004663 | 225 | 7.03 | 7.82 | 6.42 | 6.03 | 19.72 | 50.6 | 57.10 | 57.00 | 0.18 |
| FMH1004663 | FMH1004662 | 225 | 7.82 | 7.89 | 6.03 | 5.47 | 19.8 | 35.4 | 68.21 | 68.00 | 0.30 |
| FMH1004662 | FMH1004661 | 1800 | 7.89 | 7.78 | 0.68 | 0.64 | 84.15 | 2103.7 | 2198.16 | 2199.00 | -0.04 |
| FMH1004661 | FMH1004660 | 1800 | 7.78 | 7.31 | 0.64 | 0.61 | 67.94 | 2264.7 | 2118.59 | 2119.00 | -0.02 |
| FMH1004658 | FMH1004657 | 1800 | 7.32 | 7.19 | 0.61 | 0.60 | 36.36 | 3636.0 | 1672.02 | 1671.00 | 0.06 |
| FMH1004657 | FMH1004629 | 1800 | 7.19 | 7.20 | 0.59 | 0.50 | 132.46 | 1471.7 | 2628.06 | 2630.00 | -0.07 |
| FMH1004629 | FMH1004030 | 1800 | 7.20 | 7.09 | 0.49 | 0.41 | 135.21 | 1690.1 | 2452.43 | 2454.00 | -0.06 |
| FMH1004030 | FMH1004031 | 1800 | 7.09 | 5.00 | 0.39 | 0.36 | 103.28 | 3442.55 | 1718.35 | 1717.00 | 0.08 |
| | | | | | | | | | Total Absolute Error = | | 0.82 |

Hydraulic pipeline roughness (m) = 0.00308

| Manhole | | Pipe Diameter ( mm ) | Cover Level (mPD) | | Invert Level (mPD) | | Pipe Length (m) | Hydraulic Gradient ( 1 in ) | Capacity by Colebrood-White Equation ( l/s ) | Capacity Provided by EPD ( l/s ) | Error (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| From | To | | Upstream manhole | Downstream manhole | From | To | | | | | |
| FMH1004664 | FMH1004663 | 225 | 7.03 | 7.82 | 6.42 | 6.03 | 19.72 | 50.6 | 57.14 | 57.00 | 0.24 |
| FMH1004663 | FMH1004662 | 225 | 7.82 | 7.89 | 6.03 | 5.47 | 19.8 | 35.4 | 68.25 | 68.00 | 0.36 |
| FMH1004662 | FMH1004661 | 1800 | 7.89 | 7.78 | 0.68 | 0.64 | 84.15 | 2103.7 | 2199.09 | 2199.00 | 0.00 |
| FMH1004661 | FMH1004660 | 1800 | 7.78 | 7.31 | 0.64 | 0.61 | 67.94 | 2264.7 | 2119.48 | 2119.00 | 0.02 |
| FMH1004658 | FMH1004657 | 1800 | 7.32 | 7.19 | 0.61 | 0.60 | 36.36 | 3636.0 | 1672.73 | 1671.00 | 0.10 |
| FMH1004657 | FMH1004629 | 1800 | 7.19 | 7.20 | 0.59 | 0.50 | 132.46 | 1471.7 | 2629.17 | 2630.00 | -0.03 |
| FMH1004629 | FMH1004030 | 1800 | 7.20 | 7.09 | 0.49 | 0.41 | 135.21 | 1690.1 | 2453.46 | 2454.00 | -0.02 |
| FMH1004030 | FMH1004031 | 1800 | 7.09 | 5.00 | 0.39 | 0.36 | 103.28 | 3442.55 | 1719.07 | 1717.00 | 0.12 |
| | | | | | | | | | Total Absolute Error = | | 0.90 |

Note: The highlighted cells represent the hydraulic pipeline roughness with the calculated capacities best fit the data provided by EPD.

# Appendix D

## Sewerage Flow Generated by the Site

**Appendix D - Estimation of Sewage Flow from the Development**

**Pcif = 1.0** **UFF Workers =** 0.28

**1) Domestic Flow**

**1.1 Public Residential Building Block:**

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Flat | = | 1904 | flat | | | |
| Assumed Household Size | = | 2.8 | persons/household | | | |
| Total Population | = | 5332 | | | | |
| Factored Total Population | = | 5866 | people | ( with | 10% | allowence) |
| Unit Flow Factor | = | 0.27 | $m^3$/d/person | (Unit flow for | Subsidised Sales Flats | ) |
| Estimated ADWF | = | 5866 x 0.27 | = | **1583.8** | $m^3$/day | |
| **Total ADWF with CIF 1** | | | | **1583.8** | $m^3$/day | |

**2) Commerical and Institutional Flow**

**2.1 Retail**

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Floor Area (Internal Floor Area) | = | 1800 | $m^2$ | | | |
| GFA | = | 2394 | $m^2$ | (Assume = 1.33*NOFA) | | |
| Worker Density | = | 3.5 | staff/100$m^2$ | (Assumed | Retail Trade | (Commercial and Industrial Floor Space Utilization Survey ) |
| Total numbers of staff | = | 84 | staff | | | |
| Unit Flow Factor for workers | = | 0.28 | $m^3$/d/person | (Unit flow for | J4 Wholesale & Retail | in GEFS) |
| Estimated ADWF | = | | = | **23.5** | $m^3$/day | |
| **Total ADWF with CIF 1** | | | | **23.5** | $m^3$/day | |

**2.2 Kindergarten**

| | | | | | | |
|---|---|---|---|---|---|---|
| Number of Classroom | = | 6 | rooms | | | |
| GFA | = | 985 | $m^2$ | | | |
| Students / Classroom | = | 30 | per classroom | | | |
| Number of Students | = | 180 | students | | | |
| Factored Student's Number | = | 198 | people | ( with | 10% | allowence) |
| Staffs Number | = | 3.3 | staff/100$m^2$ | (Assumed | Community, Social & Personal Services | (Commercial and Industrial Floor Space Utilization Survey ) |
| Total numbers of staffs | = | 33 | staff | | | |
| Unit Flow Factor for staffs | = | 0.28 | $m^3$/d/person | (Unit flow for | J11 Community, Social & Personal Services | in GEFS) |
| Unit Flow Factor for students | = | 0.04 | $m^3$/d/person | (Unit flow for | School student | in GEFS) |
| Estimated ADWF | = | | = | **17.0** | $m^3$/day | |
| **Total ADWF with CIF 1** | | | | **17.0** | $m^3$/day | |

**2.3 Post office**

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Floor Area (Internal Floor Area) | = | 400 | $m^2$ | | | |
| GFA | = | 532 | $m^2$ | (Assume = 1.33*NOFA) | | |
| Worker Density | = | 3.3 | staff/100$m^2$ | (Assumed | Community, Social & Personal Services | (Commercial and Industrial Floor Space Utilization Survey ) |
| Total numbers of staff | = | 18 | staff | | | |
| Unit Flow Factor for workers | = | 0.28 | $m^3$/d/person | (Unit flow for | J11 Community, Social & Personal Services | in GEFS) |
| Estimated ADWF | = | | = | **5.0** | $m^3$/day | |
| **Total ADWF with CIF 1** | | | | **5.0** | $m^3$/day | |

**2.4 A district management office and A management office for the Site**

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Floor Area (Internal Floor Area) | = | 558 | $m^2$ | | | |
| GFA | = | 742.14 | $m^2$ | (Assume = 1.33*NOFA) | | |
| Worker Density | = | 3.3 | staff/100$m^2$ | (Assumed | Community, Social & Personal Services | (Commercial and Industrial Floor Space Utilization Survey ) |
| Total numbers of staff | = | 25 | staff | | | |
| Unit Flow Factor for workers | = | 0.28 | $m^3$/d/person | (Unit flow for | J11 Community, Social & Personal Services | in GEFS) |
| Estimated ADWF | = | | = | **7.0** | $m^3$/day | |
| **Total ADWF with CIF 1** | | | | **7.0** | $m^3$/day | |

**2.5 Associated ancillary facilities and external works, including open parking spaces for bicycles;**

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Floor Area (Internal Floor Area) | = | 5759 | $m^2$ | | | |
| GFA | = | 7659.47 | $m^2$ | (Assume = 1.33*NOFA) | | |
| Worker Density | = | 3.8 | staff/100$m^2$ | (Assumed | Transport | (Commercial and Industrial Floor Space Utilization Survey ) |
| Total numbers of staff | = | 292 | staff | | | |
| Unit Flow Factor for workers | = | 0.18 | $m^3$/d/person | (Unit flow for | J3 Transport, Storage & Communication | in GEFS) |
| Estimated ADWF | = | | = | **52.6** | $m^3$/day | |
| **Total ADWF with CIF 1** | | | | **52.6** | $m^3$/day | |

**2.6 A 100-place Child Care Centre (CCC);**

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Floor Area (Internal Floor Area) | = | 530 | $m^2$ | | | |
| GFA | = | 704.9 | $m^2$ | (Assume = 1.33*NOFA) | | |
| Total numbers of Child | = | 100 | persons | | | |
| Total numbers of staff | = | 33 | staff | (From Notional Staffing Establishments of Social Welfare Department, 1 workers for 3 places) | | |
| Unit Flow Factor for Child | = | 0.19 | $m^3$/d/person | | | |
| Unit Flow Factor for workers | = | 0.28 | $m^3$/d/person | (Unit flow for | J11 Community, Social & Personal Services | in GEFS) |
| Estimated ADWF | = | | = | **28.3** | $m^3$/day | |
| **Total ADWF with CIF 1** | | | | **28.3** | $m^3$/day | |

**2.7 A 100-place Residential Care Home for the Elderly (RCHE);**

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Floor Area (Internal Floor Area) | = | 1354 | $m^2$ | | | |
| GFA | = | 1800.82 | $m^2$ | (Assume = 1.33*NOFA) | | |
| Total numbers of Elderly Persons | = | 100 | persons | | | |
| Total numbers of staff | = | 54 | staff | (From Notional Staffing Establishments of Social Welfare Department, 108 workers for 200 places) | | |
| Unit Flow Factor for Elderly | = | 0.19 | $m^3$/d/person | | | |
| Unit Flow Factor for workers | = | 0.28 | $m^3$/d/person | (Unit flow for | J11 Community, Social & Personal Services | in GEFS) |
| Estimated ADWF | = | | = | **34.1** | $m^3$/day | |
| **Total ADWF with CIF 1** | | | | **34.1** | $m^3$/day | |

**2.8 A main base of Short-term Food Assistance Service Team (STFAST);**

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Floor Area (Internal Floor Area) | = | 92.5 | $m^2$ | | | |
| GFA | = | 123.025 | $m^2$ | (Assume = 1.33*NOFA) | | |
| Worker Density | = | 3.3 | staff/100$m^2$ | (Assumed | Community, Social & Personal Services | (Commercial and Industrial Floor Space Utilization Survey ) |
| Total numbers of staff | = | 5 | staff | | | |
| Unit Flow Factor for workers | = | 0.28 | $m^3$/d/person | (Unit flow for | J11 Community, Social & Personal Services | in GEFS) |
| Estimated ADWF | = | | = | **1.4** | $m^3$/day | |
| **Total ADWF with CIF 1** | | | | **1.4** | $m^3$/day | |

**2.9 Home Care Services (HCS) for Frail Elderly Persons**

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Floor Area (Internal Floor Area) | = | 142 | $m^2$ | | | |
| GFA | = | 188.86 | $m^2$ | (Assume = 1.33*NOFA) | | |
| Total numbers of Elderly Persons | = | 100 | persons | | | |
| Total numbers of staff | = | 22 | staff | (From Notional Staffing Establishments of Social Welfare Department, 15.51 workers for 70 places) | | |
| Unit Flow Factor for Elderly | = | 0.19 | $m^3$/d/person | | | |
| Unit Flow Factor for staffs | = | 0.28 | $m^3$/d/person | (Unit flow for | J11 Community, Social & Personal Services | in GEFS) |
| Estimated ADWF | = | | = | **25.2** | $m^3$/day | |
| **Total ADWF with CIF 1** | | | | **25.2** | $m^3$/day | |

# Appendix E

## Hydraulic Analysis for Existing Sewers

| | | | |
|---|---|---|---|
| | Job No. 2512243A | Sheet No. | Rev. |
| | Proposed Housing Development at Po Shek Wu Road | | A |
| | Member/ Location | | |
| **Proposed Housing Development at Po Shek Wu Road** | Drg. Ref. | | |
| **Appendix E1 - Hydraulic Analysis for Existing Sewers (Including other Planning Developments)** | Made by TC / Date 10-Aug-2023 | | |

**Colebrook-White Equation:**

$$V = -\sqrt{(8gDs)}\,\log\left(\frac{ks}{3.7D} + \frac{2.51v}{D\sqrt{(2gDs)}}\right)$$

**kinematic viscosity of water =** 0.00000114 m2/s
**Vitrified clay pipe:** **ks=** 0.600 mm
**HDPE pipe:** **ks=** 0.300 mm
**Concrete pipe (Existing)** **ks=** 3.100 mm
**g=** 9.81 m/s-2

**Existing Sewerage System**

| US MH | DS MH | Length | Dia. | Pipe Material | Roughness | US GL | DS GL | US IL | DS IL | US Cover | DS Cover | Gradient | Gradient | Pipe Area | Perimeter | R =A/P | Vel.@ full bore | Contributing Zones | Sewage Flow Increased due to the Site | Existing Peak Flow | Cumulative Sewage Flow | Cumulative Sewage Flow | Contributing Population | Peaking Factor[1] | Cumulative Peak Flow | Pipe Capacity | Utilization (%) | Flow Capacity Check | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | No. | (m) | (mm) | | (mm) | (mPD) | (mPD) | (mPD) | (mPD) | (m) | (m) | | (1 in x) | ($m^2$) | (m) | (m) | (m/sec) | | (L/sec) | (L/sec) | (L/sec) | ($m^3$/day) | | | (L/sec) | (L/sec) | | | |
| FMH1004664 | FMH1004663 | 19.72 | 225 | Concrete pipe (Existing) | 3.10 | 7.03 | 7.82 | 6.42 | 6.03 | 0.36 | 1.54 | 0.0198 | 51 | 0.04 | 0.71 | 0.06 | 1.43 | EPD's Data | 0.00 | 17.7 | 17.71 | 1530.14 | 5667 | 1.00 | 17.71 | 56.92 | 31.1 | YES | |
| FMH1004663 | FMH1004662 | 19.85 | 225 | Concrete pipe (Existing) | 3.10 | 7.82 | 7.89 | 6.03 | 5.47 | 1.54 | 2.17 | 0.0282 | 35 | 0.04 | 0.71 | 0.06 | 1.71 | EPD's Data | 0.00 | 17.6 | 17.58 | 1518.91 | 5626 | 1.00 | 17.58 | 68.01 | 25.8 | YES | |
| FMH1004662 | FMH1004661 | 84.15 | 1800 | Concrete pipe (Existing) | 3.10 | 7.89 | 7.78 | 0.68 | 0.64 | 5.19 | 5.12 | 0.0005 | 2104 | 2.54 | 5.65 | 0.45 | 0.86 | EPD's Data | 0.00 | 1031.5 | 1031.49 | 89120.74 | 330077 | 1.00 | 1031.49 | 2188.68 | 47.1 | YES | |
| FMH1004661 | FMH1004660 | 67.94 | 1800 | Concrete pipe (Existing) | 3.10 | 7.78 | 7.31 | 0.64 | 0.61 | 5.12 | 4.68 | 0.0004 | 2265 | 2.54 | 5.65 | 0.45 | 0.83 | EPD's Data | 0.00 | 1029.0 | 1029.00 | 88905.60 | 329280 | 1.00 | 1029.00 | 2109.19 | 48.8 | YES | |
| FMH1004660 | FMH1004659 | 14.77 | 1800 | Concrete pipe (Existing) | 3.10 | 7.31 | 7.23 | 0.61 | 0.61 | 4.68 | 4.60 | N/A | N/A | 2.54 | 5.65 | 0.45 | N/A | EPD's Data | 0.00 | 1029.1 | 1029.07 | 88911.65 | 329302 | 1.00 | 1029.07 | N/A | N/A | N/A | |
| FMH1004659 | FMH1004658 | 5.38 | 1800 | Concrete pipe (Existing) | 3.10 | 7.23 | 7.32 | 0.61 | 0.61 | 4.60 | 4.69 | N/A | N/A | 2.54 | 5.65 | 0.45 | N/A | EPD's Data | 0.00 | 1029.2 | 1029.18 | 88921.15 | 329338 | 1.00 | 1029.18 | N/A | N/A | N/A | |
| FMH1004658 | FMH1004657 | 36.36 | 1800 | Concrete pipe (Existing) | 3.10 | 7.32 | 7.19 | 0.61 | 0.60 | 4.69 | 4.57 | 0.0003 | 3636 | 2.54 | 5.65 | 0.45 | 0.65 | EPD's Data | 0.00 | 1029.2 | 1029.22 | 88924.61 | 329350 | 1.00 | 1029.22 | 1663.06 | 61.9 | YES | |
| FMH1004657 | FMH1004629 | 132.46 | 1800 | Concrete pipe (Existing) | 3.10 | 7.19 | 7.20 | 0.59 | 0.50 | 4.58 | 4.68 | 0.0007 | 1472 | 2.54 | 5.65 | 0.45 | 1.03 | EPD's Data | 0.00 | 1029.8 | 1029.83 | 88977.31 | 329546 | 1.00 | 1029.83 | 2618.17 | 39.3 | YES | |
| FMH1004629 | FMH1004030 | 135.21 | 1800 | Concrete pipe (Existing) | 3.10 | 7.20 | 7.09 | 0.49 | 0.41 | 4.69 | 4.66 | 0.0006 | 1690 | 2.54 | 5.65 | 0.45 | 0.96 | EPD's Data | 0.00 | 1169.6 | 1169.64 | 101056.90 | 374285 | 1.00 | 1169.64 | 2442.70 | 47.9 | YES | |
| FMH1004030 | FMH1004031 | 103.28 | 1800 | Concrete pipe (Existing) | 3.10 | 7.09 | 5.00 | 0.39 | 0.36 | 4.68 | 2.62 | 0.0003 | 3443 | 2.54 | 5.65 | 0.45 | 0.67 | EPD's Data | 0.00 | 1171.9 | 1171.88 | 101250.43 | 375002 | 1.00 | 1171.88 | 1709.34 | 68.6 | YES | |

1. Peaking factor (including stormwater allowance) is used for existing sewer. Peaking factor is 1 because the existing flow data from EPD has already included peaking factor.

2. The assumption on the basline upstream peak flow is based on EPD's data for the exact sewerage flow from the upstream of the FMH1004662.

3. The sewerage amount from the upstream of manhole FMH1004662 is based on the information from EPD

| | | |
|---|---|---|
| | Job No. 2512243A | Sheet No. |
| | Proposed Housing Development at Po Shek Wu Road | |
| | Member/ Location | |
| **Proposed Housing Development at Po Shek Wu Road** | Drg. Ref. | |
| **Appendix E2 - Hydraulic Analysis for Sewers After Development without Mitigation Measures** | Made by: TC; Date: 10-Aug-2023 | |

Rev.: A

**Colebrook-White Equation:**

$$V = -\sqrt{(8gDs)}\log\left(\frac{ks}{3.7D} + \frac{2.51\nu}{D\sqrt{(2gDs)}}\right)$$

**kinematic viscosity of water =** 0.00000114 m2/s
**Vitrified clay pipe:** **ks=** 0.600 mm
**HDPE pipe:** **ks=** 0.300 mm
**Concrete pipe (Existing)** **ks=** 3.100 mm
**g=** 9.81 m/s-2

**Existing Sewerage System After the Completion of the Development**

| US MH | DS MH | Length | Dia. | Pipe Material | Roughness | US GL | DS GL | US IL | DS IL | US Cover | DS Cover | Gradient | Gradient | Pipe Area | Perimeter | R =A/P | VeL@ full bore | Contributing Zones | Sewage Flow Increased due to the Site | Existing Peak Flow | Cumulative Sewage Flow | Cumulative Sewage Flow | Contributing Population | Peaking Factor[1] | Cumulative Peak Flow | Pipe Capacity | Utilization (%) | Flow Capacity Check | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | No. | (m) | (mm) | | (mm) | (mPD) | (mPD) | (mPD) | (mPD) | (m) | (m) | | (1 in x) | ($m^2$) | (m) | (m) | (m/sec) | | (L/sec) | (L/sec) | (L/sec) | ($m^3$/day) | | | (L/sec) | (L/sec) | | | |
| FMH1004664 | FMH1004663 | 19.72 | 225 | Concrete pipe (Existing) | 3.10 | 7.03 | 7.82 | 6.42 | 6.03 | 0.36 | 1.54 | 0.0198 | 51 | 0.04 | 0.71 | 0.06 | 1.43 | the Site | 20.58 | 0.00 | 20.58 | 1778.02 | 6585 | 5.00 | 102.89 | 56.92 | 180.8 | NO!!! | |
| FMH1004663 | FMH1004662 | 19.85 | 225 | Concrete pipe (Existing) | 3.10 | 7.82 | 7.89 | 6.03 | 5.47 | 1.54 | 2.17 | 0.0282 | 35 | 0.04 | 0.71 | 0.06 | 1.71 | the Site | 20.58 | 0.00 | 20.58 | 1778.02 | 6585 | 5.00 | 102.89 | 68.01 | 151.3 | NO!!! | |
| FMH1004662 | FMH1004661 | 84.15 | 1800 | Concrete pipe (Existing) | 3.10 | 7.89 | 7.78 | 0.68 | 0.64 | 5.19 | 5.12 | 0.0005 | 2104 | 2.54 | 5.65 | 0.45 | 0.86 | Planning Developments/ Applications (EPD's Info) | 283.92 | 1031.49 | 1315.41 | 113650.99 | 420930 | 2.40 | 3156.97 | 2188.68 | 144.2 | NO!!! | |
| FMH1004661 | FMH1004660 | 67.94 | 1800 | Concrete pipe (Existing) | 3.10 | 7.78 | 7.31 | 0.64 | 0.61 | 5.12 | 4.68 | 0.0004 | 2265 | 2.54 | 5.65 | 0.45 | 0.83 | | 283.92 | 1029.00 | 1312.92 | 113435.86 | 420133 | 1.00 | 1312.92 | 2109.19 | 62.2 | YES | |
| FMH1004660 | FMH1004659 | 14.77 | 1800 | Concrete pipe (Existing) | 3.10 | 7.31 | 7.23 | 0.61 | 0.61 | 4.68 | 4.60 | N/A | N/A | 2.54 | 5.65 | 0.45 | N/A | | 283.92 | 1029.07 | 1312.99 | 113441.91 | 420155 | 1.00 | 1312.99 | N/A | N/A | N/A | |
| FMH1004659 | FMH1004658 | 5.38 | 1800 | Concrete pipe (Existing) | 3.10 | 7.23 | 7.32 | 0.61 | 0.61 | 4.60 | 4.69 | N/A | N/A | 2.54 | 5.65 | 0.45 | N/A | | 283.92 | 1029.18 | 1313.10 | 113451.41 | 420190 | 1.00 | 1313.10 | N/A | N/A | N/A | |
| FMH1004658 | FMH1004657 | 36.36 | 1800 | Concrete pipe (Existing) | 3.10 | 7.32 | 7.19 | 0.61 | 0.60 | 4.69 | 4.57 | 0.0003 | 3636 | 2.54 | 5.65 | 0.45 | 0.65 | | 283.92 | 1029.22 | 1313.14 | 113454.87 | 420203 | 1.00 | 1313.14 | 1663.06 | 79.0 | YES | |
| FMH1004657 | FMH1004629 | 132.46 | 1800 | Concrete pipe (Existing) | 3.10 | 7.19 | 7.20 | 0.59 | 0.50 | 4.58 | 4.68 | 0.0007 | 1472 | 2.54 | 5.65 | 0.45 | 1.03 | | 283.92 | 1029.83 | 1313.75 | 113507.57 | 420398 | 1.00 | 1313.75 | 2618.17 | 50.2 | YES | |
| FMH1004630 | FMH1004629 | 135.21 | 1800 | Concrete pipe (Existing) | 3.10 | 7.20 | 7.09 | 0.49 | 0.41 | 4.69 | 4.66 | 0.0006 | 1690 | 2.54 | 5.65 | 0.45 | 0.96 | | 283.92 | 1169.64 | 1453.56 | 125587.15 | 465138 | 1.00 | 1453.56 | 2442.70 | 59.5 | YES | |
| FMH1004030 | FMH1004031 | 103.28 | 1800 | Concrete pipe (Existing) | 3.10 | 7.09 | 5.00 | 0.39 | 0.36 | 4.68 | 2.62 | 0.0003 | 3443 | 2.54 | 5.65 | 0.45 | 0.67 | | 283.92 | 1171.88 | 1455.80 | 125780.69 | 465854 | 1.00 | 1455.80 | 1709.34 | 85.2 | YES | |

1. Peaking factor (including stormwater allowance) is used for existing sewer. Peaking factor is 1 because the existing flow data from EPD has already included peaking factor.

2. The assumption on the basline upstream peak flow is based on EPD's data for the exact sewerage flow from the upstream of the FMH1004662.

3. The sewerage amount from the upstream of manhole FMH1004662 is based on the information from EPD

# Appendix F

Sewerage Layout Plan and Hydraulic Analysis for Mitigation Measures

| | | | |
|---|---|---|---|
| | Job No. 2512243A | Sheet No. | Rev. |
| | Proposed Housing Development at Po Shek Wu Road | | A |
| | Member/ Location | | |
| **Proposed Housing Development at Po Shek Wu Road** | Drg. Ref. | | |
| **Appendix F1 - Hydraulic Analysis for Sewers After Development with Mitigation Measures** | Made by TC / Date 10-Aug-2023 | | |

**Colebrook-White Equation:** $V = -\sqrt{(8gDs)}\,\log\left(\frac{ks}{3.7D} + \frac{2.51v}{D\sqrt{(2gDs)}}\right)$

| | | | |
|---|---|---|---|
| **kinematic viscosity of water =** | | 0.00000114 | m2/s |
| **Vitrified clay pipe** | **ks=** | 0.600 | mm |
| **HDPE pipe** | **ks=** | 0.300 | mm |
| **Concrete pipe (Existing)** | **ks=** | 3.100 | mm |
| **Concrete pipe (Proposed)** | **ks=** | 3.000 | mm |
| | **g=** | 9.81 | m/s-2 |

**Existing Sewerage System After Upgrading Works**

| US MH | DS MH | Length | Dia. | Pipe Material | Roughness | US GL | DS GL | US IL | DS IL | US Cover | DS Cover | Gradient | Gradient | Pipe Area | Perimeter | R =A/P | Vel.@ full bore | Contributing Zones | Sewage Flow Increased due to the Site | Existing Peak Flow | Cumulative Sewage Flow | Cumulative Sewage Flow | Contributing Population | Peaking Factor(1) | Cumulative Peak Flow | Pipe Capacity | Utilization (%) | Flow Capacity Check | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | No. | (m) | (mm) | | (mm) | (mPD) | (mPD) | (mPD) | (mPD) | (m) | (m) | | (1 in x) | ($m^2$) | (m) | (m) | (m/sec) | | (L/sec) | (L/sec) | (L/sec) | ($m^3$/day) | | | (L/sec) | (L/sec) | | | |
| FMH1004664 | FMH1004663 | 19.72 | 300 | Concrete pipe (Proposed) | 3.00 | 7.30 | 7.82 | 6.42 | 6.03 | 0.54 | 1.45 | 0.0198 | 51 | 0.07 | 0.94 | 0.08 | 1.75 | the Site | 20.58 | 0.00 | 20.58 | 1778.02 | 6585 | 5.00 | 102.89 | 123.59 | 83.3 | YES | Upgraded to 300dia pipe |
| FMH1004663 | FMH1004662 | 19.85 | 300 | Concrete pipe (Proposed) | 3.00 | 7.82 | 7.89 | 6.03 | 5.47 | 1.45 | 2.08 | 0.0282 | 35 | 0.07 | 0.94 | 0.08 | 2.09 | the Site | 20.58 | 0.00 | 20.58 | 1778.02 | 6585 | 5.00 | 102.89 | 147.66 | 69.7 | YES | Upgraded to 300dia pipe |
| FMH1004662 | FMH1004661 | 84.15 | 1800 | Concrete pipe (Existing) | 3.10 | 7.89 | 7.78 | 0.68 | 0.64 | 5.19 | 5.12 | 0.0005 | 2104 | 2.54 | 5.65 | 0.45 | 0.86 | Planning Developments/ Applications (EPD's Info) | 283.92 | 1031.49 | 1315.41 | 113650.99 | 420930 | 1.00 | 1315.41 | 2188.68 | 60.1 | YES | |
| FMH1004661 | FMH1004660 | 67.94 | 1800 | Concrete pipe (Existing) | 3.10 | 7.78 | 7.31 | 0.64 | 0.61 | 5.12 | 4.68 | 0.0004 | 2265 | 2.54 | 5.65 | 0.45 | 0.83 | | 283.92 | 1029.00 | 1312.92 | 113435.86 | 420133 | 1.00 | 1312.92 | 2109.19 | 62.2 | YES | |
| FMH1004660 | FMH1004659 | 14.77 | 1800 | Concrete pipe (Existing) | 3.10 | 7.31 | 7.23 | 0.61 | 0.61 | 4.68 | 4.60 | N/A | N/A | 2.54 | 5.65 | 0.45 | N/A | | 283.92 | 1029.07 | 1312.99 | 113441.91 | 420155 | 1.00 | 1312.99 | N/A | N/A | N/A | |
| FMH1004659 | FMH1004658 | 5.38 | 1800 | Concrete pipe (Existing) | 3.10 | 7.23 | 7.32 | 0.61 | 0.61 | 4.60 | 4.69 | N/A | N/A | 2.54 | 5.65 | 0.45 | N/A | | 283.92 | 1029.18 | 1313.10 | 113451.41 | 420190 | 1.00 | 1313.10 | N/A | N/A | N/A | |
| FMH1004658 | FMH1004657 | 36.36 | 1800 | Concrete pipe (Existing) | 3.10 | 7.32 | 7.19 | 0.61 | 0.60 | 4.69 | 4.57 | 0.0003 | 3636 | 2.54 | 5.65 | 0.45 | 0.65 | | 283.92 | 1029.22 | 1313.14 | 113454.87 | 420203 | 1.00 | 1313.14 | 1663.06 | 79.0 | YES | |
| FMH1004657 | FMH1004629 | 132.46 | 1800 | Concrete pipe (Existing) | 3.10 | 7.19 | 7.20 | 0.59 | 0.50 | 4.58 | 4.68 | 0.0007 | 1472 | 2.54 | 5.65 | 0.45 | 1.03 | | 283.92 | 1029.83 | 1313.75 | 113507.57 | 420398 | 1.00 | 1313.75 | 2618.17 | 50.2 | YES | |
| FMH1004629 | FMH1004030 | 135.21 | 1800 | Concrete pipe (Existing) | 3.10 | 7.20 | 7.09 | 0.49 | 0.41 | 4.69 | 4.66 | 0.0006 | 1690 | 2.54 | 5.65 | 0.45 | 0.96 | | 283.92 | 1169.64 | 1453.56 | 125587.15 | 465138 | 1.00 | 1453.56 | 2442.70 | 59.5 | YES | |
| FMH1004030 | FMH1004031 | 103.28 | 1800 | Concrete pipe (Existing) | 3.10 | 7.09 | 5.00 | 0.39 | 0.36 | 4.68 | 2.62 | 0.0003 | 3443 | 2.54 | 5.65 | 0.45 | 0.67 | | 283.92 | 1171.88 | 1455.80 | 125780.69 | 465854 | 1.00 | 1455.80 | 1709.34 | 85.2 | YES | |

1. Peaking factor (including stormwater allowance) is used for existing sewer. Peaking factor is 1 because the existing flow data from EPD has already included peaking factor.
2. Existing Sewer from FMH1004664 to FMH1004662 will be upgraded to 300 dia pipe
3. The assumption on the basline upstream peak flow is based on EPD's data for the exact sewerage flow from the upstream of the FMH1004662.
4. The sewerage amount from the upstream of manhole FMH1004662 is based on the information from EPD

ICU Ref : HD(ICU)S .....

**LEGEND:**

- SITE BOUNDARY
- EXISTING SEWER
- PROPOSED SEWER

| REVISIONS | | INITIAL AND DESIGNATION | | |
|---|---|---|---|---|
| NO | DESCRIPTION AND DATE | DWN | CKD | AUTH. |
| | | | | |

wsp

| | | | |
|---|---|---|---|
| AUTHORISED | -- -- | | --/-- |
| ENDORSED | -- -- | | --/-- |
| CHECKED | -- -- | | --/-- |
| DRAWN | -- -- | | --/-- |

AGREEMENT NO. CB 20210448

PROJECT
Term Engineering Consultancy Services for New Territories East Region (2021-2023) - Instruction No. WP04 - Potential Public Housing at Po Shek Wu Road, Sheung Shui – Investigation

JOB NO. 2512243A

DRAWING TITLE
PROPOSED MITIGATION MEASURE

SCALE 1 : 1000 @ A3

DRAWING NO. WP04/SIA/003

SOURCE

ICU Ref:

AutoCAD 2000 A1 841 x 594

HOUSING DEPARTMENT

REF/S.I. No. : ____ DATE: ____

☐ CONTRACTOR's COPY ☐ DE's COPY ☐ PDO's COPY ☐ DSV's COPY ☐ OFFICE's COPY
☐ CTR's ADO's COPY ☐ QE's COPY ☐ RSE's COPY ☐ SE's COPY ☐ IHM's COPY
☐ ____'s COPY ☐ LA's COPY ☐ BSI's COPY ☐ BSE's COPY ☐ COW's COPY

COUNTERCHECKED ☐

Plot File by :chow, tony kwok-yiu Date : 2023-04-25
Path : \\DCAS3000\AT20\PROJECTS2\2512243A - HKHA TERM ENG NTE 2021-23\13_WORKING\WP04 PO SHEK WU ROAD SIA\WORKING\DRAWINGS\CAD\WP04-SIADWG

# Appendix G

Sewerage Amount from the Planning Development / Applications (EPD's Information)

# Appendix G - Sewerage Amount from the Planning Development / Applications (EPD's Information)

| Planning Developments/ Applications | ADWF (m3/day) | Peak Flow (l/s) | Discharge Manhole |
|---|---|---|---|
| Public Housing Development at Ching Hui Road | 628 | 43.3 | FMH1025202 |
| Community Health Centre Cum Social Welfare Facilities | 237 | 22 | FMH1003889 |
| Expansion of North District Hospital | 1892 | 110 | FMH1003880 |
| Residential Development at Lot no. 4076 in DD 91 | 610.9 | 42.4 | FMH1003863 |
| A/NE-KTS/460 | 2.2 | 0.2 | FMH1029682 |
| Y/NE-KTS/13 | 343 | 37.8 | FMH1029683 |
| Y/KTN/2 | 492 | 38 | FMH1021543 |
| A/KTS/506 | 2007 | 124 | FMH1030384 |
| A/NE-KTS/466 | 49 | 5 | FMH1029681 |
| A/NE-KTS/484 | 704 | 50 | FMH1030364 |
| Beas River Equestrian Centre | 272 | 19 | FMH1028616 |
| Y/FSS/19 | 799 | 56 | FMH1023220 |
| Y/NE-KTS/14 | 1153 | 80 | FMH1030367 |
| Y/NE-KTS/17 | 291 | 20 | FMH1030367 |
| | | | |
| Total Sewerage Flow (m3/day) | 9480.1 | | |
| Total Sewerage Flow (L/s) [1] | 109.7 | | |
| Peaking Factor | 2.4 | | |
| Total Sewerage Flow (L/s) [1] | 263.3 | | |

1. The peaking factors for the planning development will adopt 2.4