Appendix 9

Sewerage Impact Assessment

Sewerage Impact Assessment

Prepared by DeSPACE (International) Limited

Date: 9 October 2026

CONTENTS

1. INTRODUCTION 2
1.1 Project Background 2
1.2 Description of the Subject Site and Proposed Developments 2
2. METHODOLOGY AND DESIGN CRITERIA 4
2.1 Scope of Work 4
2.2 Methodology and Assessment Criteria 4
2.3 Parameters and Assumptions 4
3. SEWERAGE IMPACT ASSESSMENT 7
3.1 Existing Sewerage System 7
3.2 Sewage Flow Estimation for the Proposed Development 8
3.3 Proposed Sewerage System 8
3.4 Consideration of Avoiding Emergency Discharge 11
3.5 Dual Power Supply to Eliminate the Risk of Power Failure 11
3.6 Provision of onsite storage and tanker away of raw sewage 11
4. OVERALL CONCLUSION 12
Figures 13
Appendix 1 14

FIGRES

Figure 1A Location Plan (Site A – on the southeast of Tai Po Shui Wo Road)
Figure 1B Location Plan (Site B – on the northwest of Tai Po Shui Wo Road)
Figure 2 Existing Sewerage System and Catchment Area in the Vicinity of the Application sites
Figure 3 Catchment Areas for existing development
Figure 4 Proposed Sewer and Existing Sewerage System in the Vicinity of the Application Site

APPENDIX

Appendix 1 Detailed Sewerage Impact Assessment Calculations

1. INTRODUCTION

1.1 Project Background

1.1.1 This Sewerage Impact Assessment is prepared to support two Proposed Developments located at multiple Lots in D.D.8 and adjoining Government land, Lam Tsuen, Tai Po, New Territories abutting Tai Po Shui Wo Road (hereafter referred to as the "Sites"). The Sites are currently zoned "Agriculture" ("AGR") on the Approved Lam Tsuen Outline Zoning Plan (OZP) No. S/NE-LT/11. DeSPACE (International) Limited has been engaged to prepare Section 12A application(s) to the Town Planning Board (TPB) to rezone the Sites to "Government, Institution or Community (1)" ("G/IC(1)") zone to facilitate development of ONE new residential care home for the Elderly (RCHE)/residential care home for Persons with Disabilities (RCHD) building on each of two sites respectively (the Proposed Developments), i.e. Site to the Northeast of Tai Po Shui Wo Road and Site to the Southwest of Tai Po Shui Wo Road.

1.1.2 This SIA has been conducted to quantitatively assess the potential sewerage impact by comparing the estimated sewage flow from the Proposed Developments and the capacity of the existing sewerage system in the vicinity. Accumulative impacts of the two proposed developments are assessed. This SIA confirms the feasibility of the Proposed Developments in terms of its sewerage impact.

1.2 Description of the Subject Site and Proposed Developments

1.2.1 The Sites are located along Tai Po Shui Wo Road leading from Lam Kam Road to the south of Shui Wo Village. The Sites are separated from the village clusters of Shui Wo by the Upper Lam Tsuen River. (**Figure 1A & Figure 1B** – Location Plan).

1.2.2 The Applicant proposes to develop one 9-storey RCHE/D development on Site to the Southwest of Tai Po Shui Wo Road and one 9-storey RCHE/D development on Site to the Southwest of Tai Po Shui Wo Road consisting of RCHE/D dormitories and communal areas. Each development will be provided with its own ancillary/supporting facilities and services on their sites independently to fulfil the relevant licensing requirements. It is anticipated that the Proposed Developments will be completed in 2030.

Table 1 Proposed Development Parameters		
	Site A - to the Southwest of Tai Po Shui Wo Road	**Site B - to the Northeast of Tai Po Shui Wo Road**
Total Site Area (about)	1,202.79 sq.m (including Government land of about 127 sq.m)	2,983 sq.m (including Government land of about 508 sq.m)
Plot Ratio	Not more than 4.00	Not more than 2.80
Total GFA	Not more than 4,811 sqm (About 4,790 sqm in the indicative scheme)	Not more than 8,352 sqm (About 7,955 sqm in the indicative scheme)
Proposed use	RCHE/D (RCHD for the current scheme)	RCHE/D (RCHE for the current scheme)
Site Coverage (about)	Not more than 80%	Not more than 40%
No. of Storeys	Not more than 9	Not more than 9
No. of Beds	183 (or within a range of 150 to 210)	204 (or within a range of 150 to 210)

2. METHODOLOGY AND DESIGN CRITERIA

2.1 Scope of Work

2.1.1 The aim of this SIA is to assess whether the capacity of the existing sewerage network is sufficient to cope with the sewage flow generated from the Proposed Developments during its operation stage and to recommend appropriate mitigation measures to alleviate unacceptable sewerage impact, if any.

2.2 Methodology and Assessment Criteria

2.2.1 The overall unit flow is composed of flows due to residents, employees and the associated activities. The employment population density for the planned RCHE/Ds has been referenced to Table 8 of PlanD's Commercial and Industrial Floor Space Utilization Survey "CIFSUS". The unit flow factor and global peaking factors have adopted the figures stipulated in the Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning (GESF) (Version 1.0) issued by the Environmental Protection Department (EPD) in March 2005 for the purposes of estimating the quantity of the sewage generated from the Proposed Developments and the existing catchment area, which are tabled in Table 1 in **Appendix 1**.

2.3 Parameters and Assumptions

2.3.1. The key parameters used for flow estimation in this SIA as follows:

Unit Flow Factor – Domestic Flows

2.3.2. The Unit Flow Factor (UFF) for domestic sewage flow due to residential population of the proposed development and the existing sewage catchment are shown in Table 2 based on the Table T-1 of GESF.

Table 2 Unit Flow Factor for Domestic Flows

Residential Type	**Unit Flow Factor (m^3/day) (Planning for future)**
Modern Village	0.27
Institutional and special class	0.19

Unit Flow Factor – Commercial Flows

2.3.3. The UFFs for commercial sewage flows due to employed population of the proposed development and the existing sewage catchment are shown in Table 3 based on the Table T-2 of GESF.

2.3.4. The total unit flow generated from an employee in a particular trade is the sum

of the UFF of the employee and the UFF of commercial activities of a particular trade under consideration.

Table 3 Unit Flow Factor for Commercial Flows	
Commercial	**Unit Flow Factor (m^3/day) (Planning for future)**
Commercial Employee	0.08
Commercial Activities	
(a) Specific Trades:	
J11 – Community, Social and Personal Services	0.20

Catchment Inflow Factor

2.3.5. The catchment inflow factor, PCIF of 1.00 (Tai Po), is adopted in catchment calculations.

Peaking Factors

2.3.6. The peaking factors to cater for seasonal/diurnal flow variations, and infiltration and inflow due to storm events are referenced to EPD's GESF and shown in Table 4. With consideration of the reduced hydraulic performance due to the deterioration of sewer pipes with time, peaking factors (including stormwater allowance) is adopted in this study.

Table 4 Peaking Factors for Various Population Ranges (extracted)	
Population Range	**Peaking Factor (Including Stormwater Allowance) for Facility with Existing Upstream Sewerage**
Sewers	
<1,000	8
1,000-5,000	6
Sewage Treatment Works, Preliminary Treatment Works and Pumping Stations	
<10,000	4

Population Density

2.3.7. A person per flat (PPF) ratio of 2.7 is adopted for the estimating the existing population based on the average household size in Tai Po District Council in

"*Table 130-06806: Average household size and median monthly household income of households by District Council district"* of General Household Survey (GHS) from the year 2025.

2.3.8. The employment population density has been referenced to Table 8 of PlanD's Commercial and Industrial Floor Space Utilization Survey "CIFSUS":

- Community, Social & Personal Services: Assume 3.3 employee per 100m^2 of GFA.

Hydraulic Analysis

2.3.9. Colebrook-White Equation is applied for pipe hydraulic analysis. The design roughness coefficients (Ks) for existing pipeline system are assumed to be:

- Velocity, when flowing half full, approximately 0.75 m/s: Ks = 3mm;
- Velocity, when flowing half full, approximately 1.2 m/s: Ks = 0.6 mm.

The design roughness coefficients (Ks) for the proposed pipeline system are in consideration of its reduced hydraulic performance in future due to degradation of material.

2.3.10. For small diameter sewers of diameter less than 300mm, the flow velocity of at least 0.7m/s shall occur daily, or that a gradient of at least 1:DN (i.e. Nominal diameter of the sewer in mm) is provided, provided that a flow of 2 times of Average Dry Weather Flow (ADWF) is assumed to occur at least once daily.

3. SEWERAGE IMPACT ASSESSMENT

3.1 Existing Sewerage System

3.1.1 According to the Drainage Record obtained from DSD, the Application sites are presently unsewered. The nearest public sewerage network is at Lam Kam Road, which is an approx. 4-km Trunk Sewerage System constructed to serve the villages/ areas in the Lam Tsuen Valley area. Sewage generated from the Proposed Developments is proposed to be conveyed and discharged to the 4-km Trunk Sewerage System on Lam Kam Road. The existing sewers in the vicinity of the Application sites are shown in **Figure 2**.

3.1.2 As estimated in **Table 1 of Appendix 1**, the sewage flow generated from the existing development (upstream of proposed development, refer to **Figure 3**) is about 4687 m^3/day (Dry Weather Flow) (DWF), while the peak flow is about 56.3 L/s (with peak factor = 6). Please find the summarized figures in **Table 5**.

Table 5 Sewage Flow estimation for the existing development

Existing Development (Pumping Station)	**Peak Flow (m^3/day)**
Catchment Area 1 (Pak Ngau Shek) (Data extracted from DSD's records)	331.00
Existing Development	**DWF (m^3/day)**
Catchment Area 2 (Ng Tung Chai)	187.92
Catchment Area 3 (Chai Kek)	82.95
Catchment Area 4 (Discrete Houses on the east of Lam Kam Road)	13.12
Total ADWF (including inflow factor) (Catchment Areas 2-4 only)	**283.99**
Contributing Population	1052
Peaking Factor	6
Total Estimated Peak Flow (Catchment Areas 2-4 only)	**19.72 L/s**
Total Estimated Peak Flow (All catchment Areas)	**23.55 L/s** **= 2034.93 m^3/day**

3.2 Sewage Flow Estimation for the Proposed Development

3.2.1 The sewage flow generated from the proposed development is about 195.15 m^3/day (DWF), or a peak flow of 18.07 L/s with a peaking factor of 8. The detailed calculations for sewage flow estimation are included in **Table 2 of Appendix 1** or **Table 6** below.

Table 6 Sewage Flow estimation for the proposed development	
Proposed Development	**Figures**
DWF for Site A – RCHD	79.22 m^3/day
Contributing Population	293
Peaking Factor	8
Total Estimated Peak Flow	**7.34 L/s**
DWF for Site B - RCHE	115.93 m^3/day
Contributing Population	429
Peaking Factor	8
Total Estimated Peak Flow	**10.73 L/s**

3.3 Proposed Sewerage System

3.3.1 Two terminal manholes (one of each site respectively) will be constructed to collect sewage generated from the two RCHE/D developments. Sewage will be conveyed to the proposed sewage pit located on both sites respectively by gravity PE sewer sizing DN200 separately. The sewage flow will then be pumped from the proposed pump room to the retention chamber to release the pressure before discharging to the existing manhole FMH1063770 of the public Trunk Sewerage System on Lam Kam Raod through the proposed new Ø200mm rising sewers. (See **Table 3A and 3B** in **Appendix 1** for the design hydraulic parameters for rising sewers) The pump and the rising sewer are proposed with the design flow velocity of 1.0 m/s. Invert levels and pipe sizes of relevant existing and future sewerage system are shown in **Figure 4** and **Table 4 & 5** in **Appendix 1**.

3.3.2 The estimated sewage flow of the Proposed Developments and the sewerage flow from the upstream of FMH1063770 have been compared with the capacity of the existing downstream segments between FMH1063770 to FMH1063653.

3.3.3 According to the calculation results presented in **Table 4 & 5 of Appendix 1** or **Table 7** below, the network under existing condition already exceeds its capacity.

Table 7 Sewers Capacity Check

Location Option	Upstream Manhole	Downstream Manhole	Sewer Size (mm)	Upstream Invert Level (mPD)	Downstream Invert Level (mPD)	% of Max. Peak flow to sewer capacity
Existing Development	FMH1063769	FMH1063770	250	75.80	72.86	16.21%
	FMH1063770	FMH1063771	250	72.86	69.55	14.88%
	FMH1063771	FMH1063772	250	69.55	66.81	16.45%
	FMH1063772	FMH1063622	250	66.80	63.19	13.08%
	FMH1063622	FSH1009080	250	62.60	51.53	26.35%
	FSH1009080	FMH1063624	250	61.52	60.52	13.43%
	FMH1063624	FMH1063625	250	60.51	59.30	18.50%
	FMH1063625	FMH1063626	250	59.30	57.74	21.83%
	FMH1063626	FMH1063628	250	57.731	56.648	21.63%
	FMH1063628	FMH1063630	250	56.643	56.5	60.62%
	FMH1063630	FMH1063642	250	56.499	56.489	129.13%
	FMH1063642	FMH1063643	250	56.488	56.406	108.84%
	FMH1063643	FMH1063644	250	56.405	56.385	91.19%
	FMH1063644	FMH1063645	250	56.38	55.835	50.86%
	FMH1063645	FMH1063646	250	55.83	55.73	84.87%
	FMH1063646	FMH1063648	250	55.725	55.535	43.47%
	FMH1063648	FMH1063653	250	55.42	55.278	81.65%
Proposed Development	RC1	FMH1063770	200	73.24	72.86	7.41%
	RC2	FMH1063770	200	73.24	72.86	10.85%
	FMH1063769	FMH1063770	250	75.80	72.86	16.21%
	FMH1063770	FMH1063771	250	72.86	69.55	21.66%
	FMH1063771	FMH1063772	250	69.55	66.81	23.95%
	FMH1063772	FMH1063622	250	66.80	63.19	19.05%
	FMH1063622	FSH1009080	250	62.60	51.53	38.37%
	FSH1009080	FMH1063624	250	61.52	60.52	19.54%
	FMH1063624	FMH1063625	250	60.51	59.30	26.93%
	FMH1063625	FMH1063626	250	59.30	57.74	31.78%
	FMH1063626	FMH1063628	250	57.731	56.648	31.49%
	FMH1063628	FMH1063630	250	56.643	56.5	78.47%
	FMH1063630	FMH1063642	250	56.499	56.489	167.14%
	FMH1063642	FMH1063643	250	56.488	56.406	140.88%
	FMH1063643	FMH1063644	250	56.405	56.385	118.03%
	FMH1063644	FMH1063645	250	56.38	55.835	65.83%
	FMH1063645	FMH1063646	250	55.83	55.73	109.86%
	FMH1063646	FMH1063648	250	55.725	55.535	56.27%
	FMH1063648	FMH1063653	250	55.42	55.278	95.88%

3.3.4 Parts of the sewerage system along Lam Kam Road are under surcharge condition. Freeboard calculation was also conducted to check whether there are sufficient freeboards for the sewage flow with the consideration of the Proposed Development. Detailed calculations are included in **Table 6A, 6B, 7A & 7B in Appendix 1** or Table 8 below.

Table 8 Freeboard Checking (Proposed Development)

Scenario	Upstream Manhole	Downstream Manhole	Sewer Size (mm)	Upstream Invert Level (mPD)	Downstream Invert Level (mPD)	Freeboard at upstream manhole (m)
Peak flow x 1.0 while freeboard >1m	FMH1063628	FMH1063630	250	56.643	56.5	2.73
	FMH1063630	FMH1063642	250	56.499	56.489	2.50
	FMH1063642	FMH1063643	250	56.488	56.406	2.04
	FMH1063643	FMH1063644	250	56.405	56.385	2.24
	FMH1063644	FMH1063645	250	56.38	55.835	2.21
	FMH1063645	FMH1063646	250	55.83	55.73	1.70
	FMH1063646	FMH1063648	250	55.725	55.535	1.41
	FMH1063648	FMH1063653	250	55.42	55.278	1.24
Peak flow x 1.15 Safety Factor while freeboard >0m	FMH1063628	FMH1063630	250	56.643	56.5	2.51
	FMH1063630	FMH1063642	250	56.499	56.489	2.30
	FMH1063642	FMH1063643	250	56.488	56.406	1.87
	FMH1063643	FMH1063644	250	56.405	56.385	2.09
	FMH1063644	FMH1063645	250	56.38	55.835	2.09
	FMH1063645	FMH1063646	250	55.83	55.73	1.61
	FMH1063646	FMH1063648	250	55.725	55.535	1.34
	FMH1063648	FMH1063653	250	55.42	55.278	1.18

3.3.5 The freeboard calculations confirm that the concerned manholes have adequate capacity, with freeboard substantially exceeding the minimum requirement of 1.0 m. Even after applying a safety factor of 1.15, substantial freeboard would remain available. Accordingly, there would be no risk of overflow under either scenario, and no sewerage upgrading works would be required as a result of the Proposed Development.

3.4 Consideration of Avoiding Emergency Discharge

3.4.1 In the event of emergency, such as power outage or equipment failure, it is essential to provide measures to prevent flooding and deploy tankers to transport away the sewage from proposed sewage pump room to nearby existing sewerage disposal facilities to further increase the buffer time for emergency storage.

3.4.2 In order to minimize the risk of emergency discharge of sewage into the receiving water body, a number of precautionary measures have been taken into account in the design of the sewage pump room. These measures include:

- Provision of dual power supply;
- Provision of standby equipment; and
- Provision of onsite storage of raw sewage.

3.5 Dual Power Supply to Eliminate the Risk of Power Failure

3.5.1 The electrical system of the proposed sewage pump room is proposed to receive two incoming supplies. Such dual supply configuration is to achieve a reliable power supply for continuous operation of the pumps and auxiliary equipment. Also, the arrangement for the two power sources to be fed by two different ring circuits is desirable.

3.6 Provision of onsite storage and tanker away of raw sewage

3.6.1 Subject to detailed design, the proposed sewage pumping room shall be designed with sufficient holding and reserved capacity. An equalization tank will be provided in case of failure of the sewage pump or power failure as it is expected that the plant operation could normally be resumed. An emergency response procedure will be prepared during detailed design stage. In case power shortage occurs at the sewage pump, tanker would be deployed by reputable specialist contractors to transport the sewage away from the sewage pump room to the existing sewerage disposal facilities. The detailed design will investigate and incorporate all practicable precautionary measures to minimize the likelihood of such an event.

3.6.2 As a result, precautionary measures such as routine/ regular checking of equipment, provision of dual power supply, provision of standby equipment, monitoring on the operation of the sewage pump room, installing remote control and monitoring system (SCADA) to allow off-site monitoring and provision of emergency storage will be provided. Hence, with the implementation of above

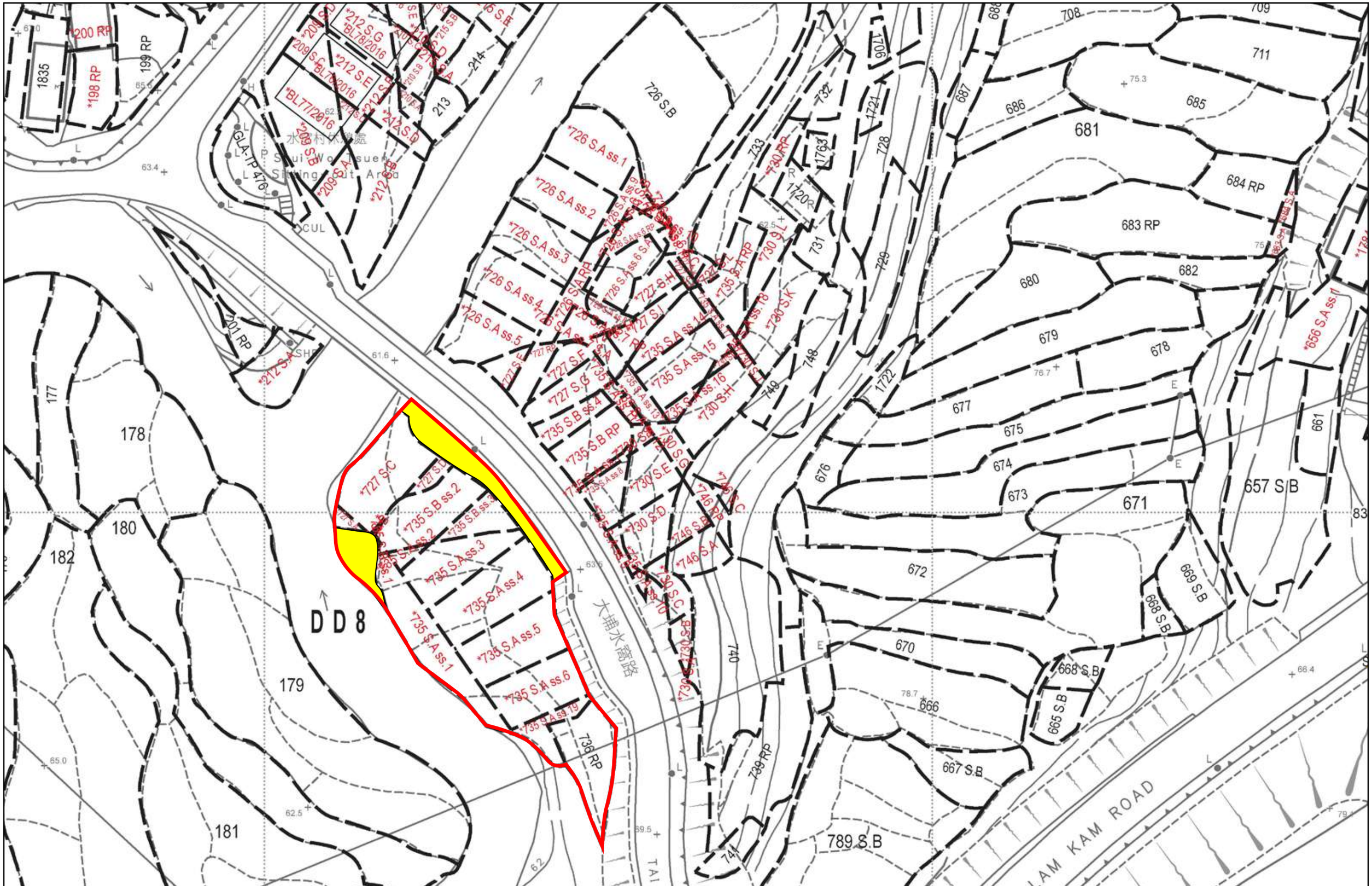
preventive measures, the possibility of sewage overflow from sewage pumping room will be extremely low.

4. OVERALL CONCLUSION

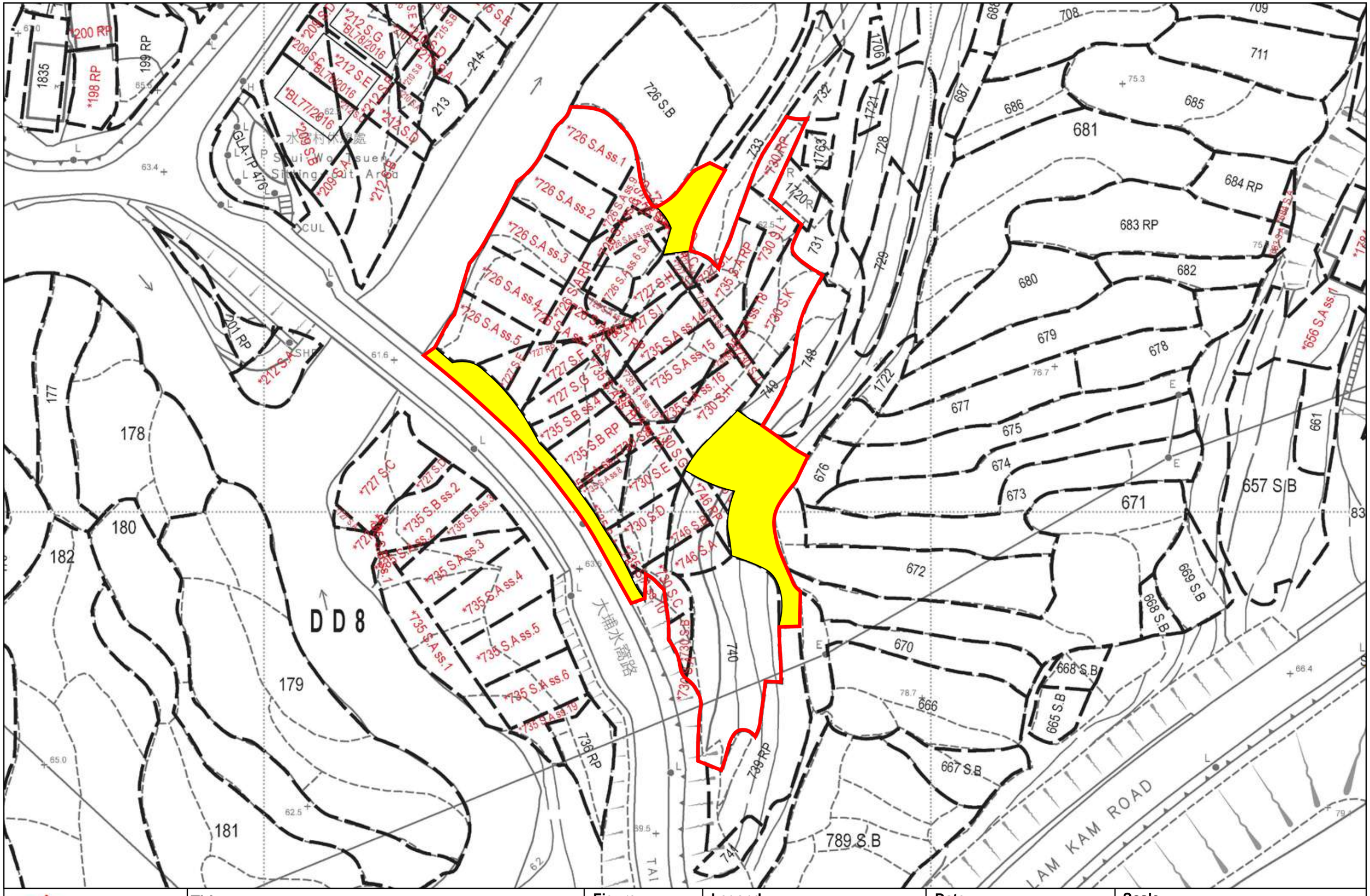
4.1.1 The potential sewerage impact arising from the Application sites has been quantitatively assessed by comparing the estimated sewage flow from the Proposed Developments and the capacity of the existing sewerage system in the vicinity.

4.1.2 According to the calculation results presented in **Tables 5, 6 and 7 of Appendix 1**, the capacity of the existing sewerage system serving the area would be sufficient to accommodate the relatively small additional sewage flow generated by the Proposed Development, together with the upstream flow at the proposed connection point. Therefore, no unacceptable sewerage impact arising from the Proposed Development is anticipated. This SIA confirms that the Proposed Development is feasible from a sewerage-impact perspective.

Figures



DeSPACE (International) Limited	**Title:** Various Lots in D.D. 8, Lam Tsuen, Tai Po	**Figure** 1A	**Legend** Government Land; Application Site	**Date** June 2026	**Scale** 1:500 in A3



DeSPACE (International) Limited	**Title:** Various Lots in D.D. 8, Lam Tsuen, Tai Po	**Figure** 1B	**Legend** Government Land; Application Site	**Date** June 2026	**Scale** 1:500 in A3

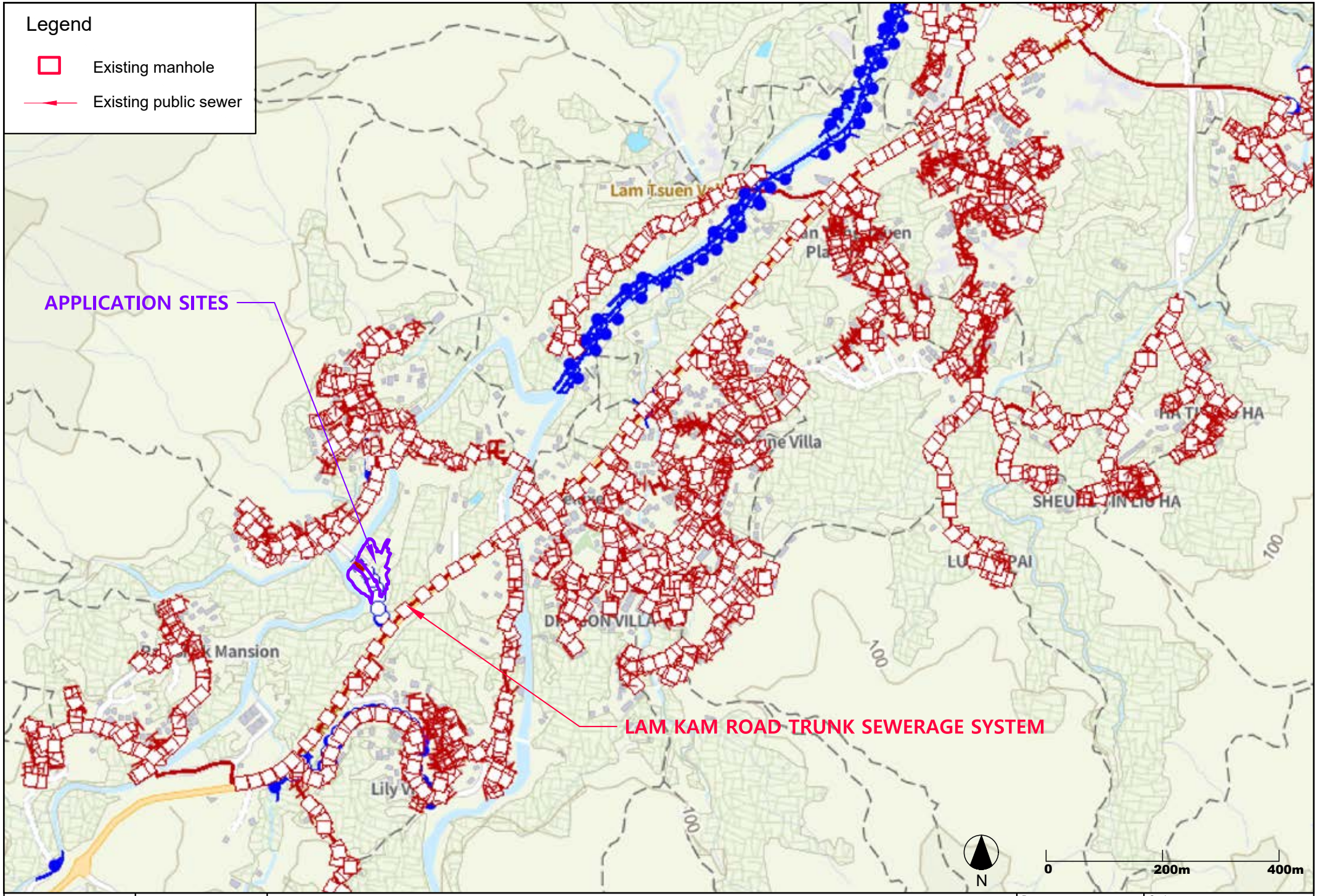
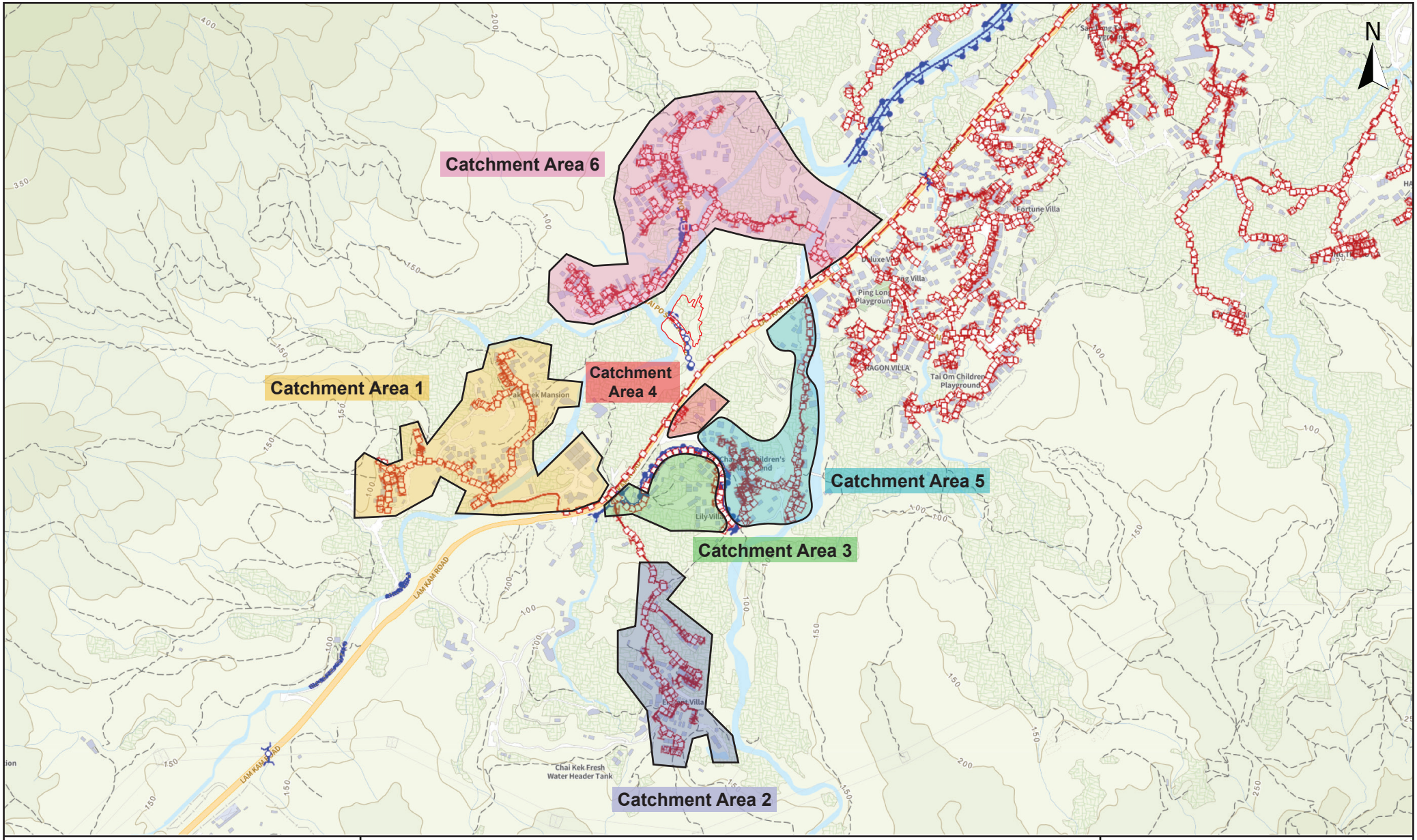
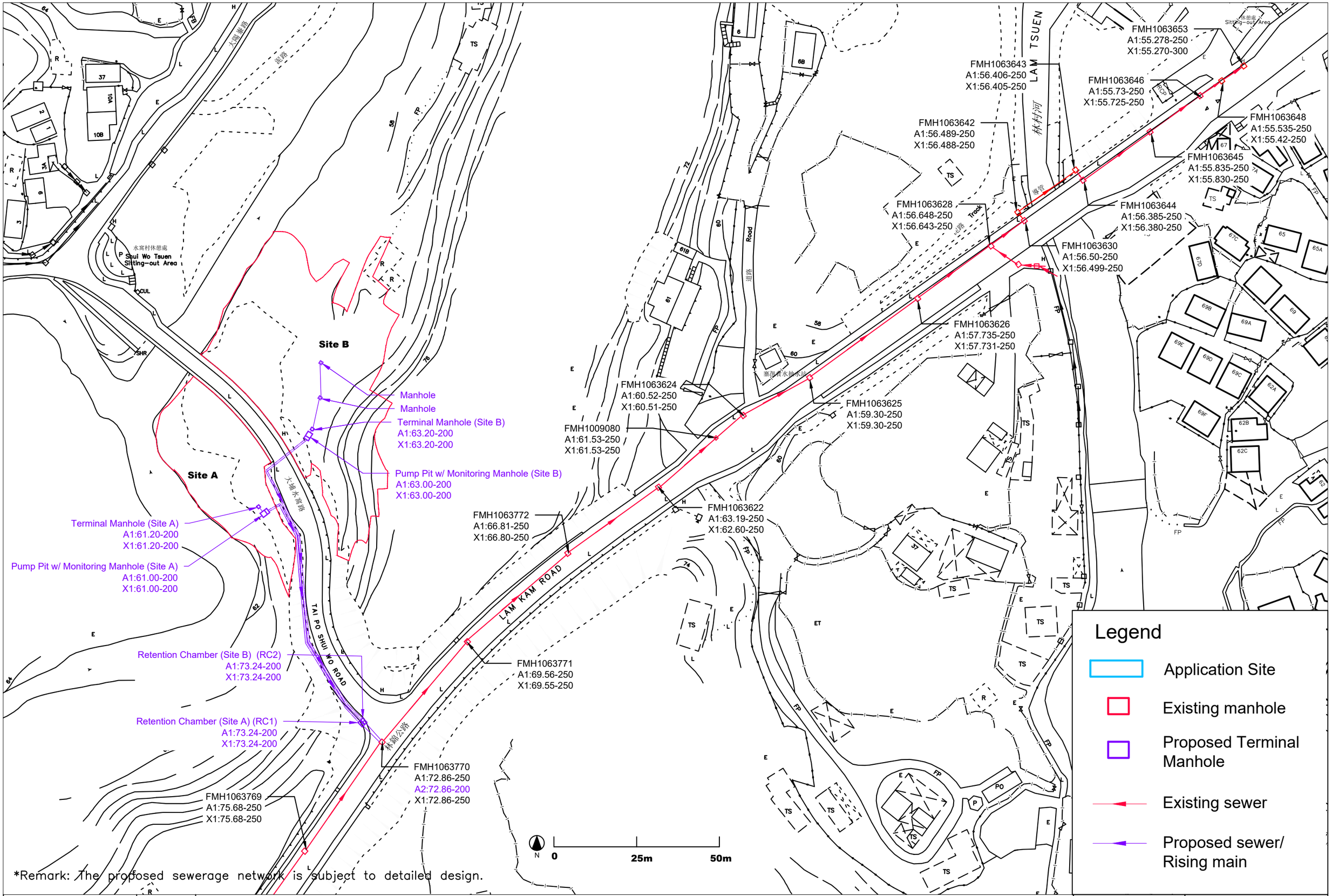


Figure:	Title:	Date	Scale
2	Existing Sewerage System in the Vicinity of the Application Site	Oct 2025	1:8000 in A4



Prepared By: DeSPACE (International) Limited	Legend: Site Boundary; Catchment Areas	Scale: N. T. S.
Title: Overview of Catchment Areas for Existing Development	Figure: **3**	Date: September 2026



*Remark: The proposed sewerage network is subject to detailed design.

DeSPACE (International) Limited	Figure: 4	Title: Proposed Sewer and Existing Sewerage System in the Vicinity of the Application Site	Date: Sept 2026	Scale: 1:1000 in A3

Appendix 1

Detailed Sewerage Impact Assessment Calculations

Table 1 - Estimate for upstream catchment sewerage flow (Villages)

			Reference
Catchment Area No.	1		
Location	Pak Ngau Shek		
			Data Provided by DSD - 2025 Lam Tsuen Valley SPS No.6 (Pak Ngau Shek) Flowmeter Record
Average Daily Flow	82.75	m^3/ day	
Peaking Factor for the flow from Pak Ngau Shek SPS	4		GESF T-5
Peak Flow from Pak Ngau Shek SPS	**331**	**m^3/ day**	
=	**3.83**	**L/s**	
Catchment Area No.	2		
Location	Ng Tung Chai		
Development Name	Discrete Houses along Ng Tung Chai Road		
Number of Houses	83		Geoinfo Map
Number of storeys per Houses (Assuming 3 storeys per House)	3		
Number of Flats (assuming 1 flat per storey)	249	Flats	
			Census and Statistics Department - Table
Size of household/flat	2.7	Persons/flat	130-06806 (2025: Tai Po District)
Population	672	Persons	
Per capita flow - Modern Village	0.27	m^3/ day/person	GESF T-1
Estimated Dry Weather Flow	**181.52**	**m^3/ day**	
Catchment Area No.	2		
Location	Ng Tung Chai		
Development Name	Ng Tung Chai Public Toilet		
Toilet Users	80		Assumption
Global Unit Flow Factors	0.08	m^3/ day/person	GESF T-2
Estimated Dry Weather Flow	**6.40**	**m^3/ day**	
Catchment Area No.	3		
Location	Chai Kek		
Development Name	Discrete Houses on the west of Chai Kek Road (to Lilly Villa)		
Number of Houses	35		Geoinfo Map
Number of storeys per Houses (Assuming 3 storeys per House)	3		
Number of Flats (assuming 1 flat per storey)	105	Flats	
			Census and Statistics Department - Table
Size of household/flat	2.7	Persons/flat	130-06806 (2025: Tai Po District)
Population	284	Persons	
Per capita flow - Modern Village	0.27	m^3/ day/person	GESF T-1
Estimated Dry Weather Flow	**76.55**	**m^3/ day**	
Catchment Area No.	3		
Location	Chai Kek		
Development Name	Chai Kek Village Public Toilet		
Toilet Users	80		Assumption
Global Unit Flow Factors	0.08	m^3/ day/person	GESF T-2
Estimated Dry Weather Flow	**6.40**	**m^3/ day**	
Catchment Area No.	4		
Location	Chai Kek		
Development Name	Discrete Houses on the east of Lam Kam Road		
Number of Houses	6		Geoinfo Map
Number of storeys per Houses (Assuming 3 storeys per House)	3		
Number of Flats (assuming 1 flat per storey)	18	Flats	
			Census and Statistics Department - Table
Size of household/flat	2.7	Persons/flat	130-06806 (2025: Tai Po District)
Population	49	Persons	
Per capita flow - Modern Village	0.27	m^3/ day/person	GESF T-1
Estimated Dry Weather Flow	**13.12**	**m^3/ day**	
Total Upstream Estimation			
Total Estimated Dry Weather Flow (Catchment Areas 2-4)	**283.99**	**m^3/ day**	
Catchment Inflow Factor - Tai Po	1.00		GESF T-4
Total Estimated Dry Water flow (Catchment Areas 2-4) (including catchement inflow factor)	**283.99**	**m^3/ day**	
Contributing Population	1052	**Persons**	GESF Section 12.1
Peaking Factor	6		GESF T-5
Total Estimated Peak Flow (Catchment Areas 2-4)	**19.72**	**L/s**	
Total Estimated Peak Flow (All Catchment Areas)	**23.55**	**L/s**	
=	**2034.93**	**m^3/ day**	

Table 1B - Estimate for downstram catchment sewerage flow (Villages)

Catchment Area No.	5		
Location	Chai Kek		
Development Name	Discrete Houses to the north and east of Chai Kek Road		
Number of Houses	85		Geoinfo Map
Number of storeys per Houses (Assuming 3 storeys per House)	3		
Number of Flats (assuming 1 flat per storey)	255	Flats	
Size of household/flat	2.7	Persons/flat	Census and Statistics Department - Table 130-06806 (2025: Tai Po District)
Population	689	Persons	
Per capita flow - Modern Village	0.27	m^3/ day/person	GESF T-1
Estimated Dry Weather Flow	**185.90**	**m^3/ day**	
Catchment Inflow Factor - Tai Po	1.00		GESF T-4
Total Estimated Dry Water flow (Catchment Areas 5) (including catchement inflow factor)	**185.90**	**m^3/ day**	
Contributing Population	689	**Persons**	GESF Section 12.1
Peaking Factor	6		GESF T-5
Total Estimated Peak Flow (Catchment Areas 5)	**12.91**	**L/s**	
	1115.37	**m^3/ day**	

Catchment Area No.	6A		
Location	Shui Wo		
Development Name	Shui Wo Village Public Toilet		
Toilet Users	80		Assumption
Global Unit Flow Factors	0.08	m^3/ day/person	GESF T-2
Estimated Dry Weather Flow	**6.40**	**m^3/ day**	

Catchment Area No.	6A		
Location	Shui Wo		
Development Name	Discrete Houses at Shui Wo Village		
Number of Houses	45		Geoinfo Map
Number of storeys per Houses (Assuming 3 storeys per House)	3		
Number of Flats (assuming 1 flat per storey)	135	Flats	
Size of household/flat	2.7	Persons/flat	Census and Statistics Department - Table 130-06806 (2025: Tai Po District)
Population	365	Persons	
Per capita flow - Modern Village	0.27	m^3/ day/person	GESF T-1
Estimated Dry Weather Flow	**98.42**	**m^3/ day**	

Catchment Area No.	6B		
Location	Tai Yeung Che		
Development Name	Tai Yeung Che Village Public Toilet		
Toilet Users	80		Assumption
Global Unit Flow Factors	0.08	m^3/ day/person	GESF T-2
Estimated Dry Weather Flow	**6.40**	**m^3/ day**	

Catchment Area No.	6B		
Location	Tai Yeung Che		
Development Name	Discrete Houses at Tai Yeung Che Village		
Number of Houses	106		Geoinfo Map
Number of storeys per Houses (Assuming 3 storeys per House)	3		
Number of Flats (assuming 1 flat per storey)	318	Flats	
Size of household/flat	2.7	Persons/flat	Census and Statistics Department - Table 130-06806 (2025: Tai Po District)
Population	859	Persons	
Per capita flow - Modern Village	0.27	m^3/ day/person	GESF T-1
Estimated Dry Weather Flow	**231.82**	**m^3/ day**	

Catchment Area No.	6C		
Location	Ma Po Mei		
Development Name	Ma Po Mei Village Public Toilet		
Toilet Users	80		Assumption
Global Unit Flow Factors	0.08	m^3/ day/person	GESF T-2
Estimated Dry Weather Flow	**6.40**	**m^3/ day**	

Catchment Area No.	6C		
Location	Ma Po Mei		
Development Name	Discrete Houses at Ma Po Mei Village		
Number of Houses	39		Geoinfo Map
Number of storeys per Houses (Assuming 3 storeys per House)	3		
Number of Flats (assuming 1 flat per storey)	117	Flats	
Size of household/flat	2.7	Persons/flat	Census and Statistics Department - Table 130-06806 (2025: Tai Po District)
Population	316	Persons	
Per capita flow - Modern Village	0.27	m^3/ day/person	GESF T-1
Estimated Dry Weather Flow	**85.29**	**m^3/ day**	
Total Estimated Dry Weather Flow (Catchment Area 6)	**434.73**	**m^3/ day**	
Catchment Inflow Factor - Tai Po	1.00		GESF T-4
Total Estimated Dry Water flow (Catchment Areas 6) (including catchement inflow factor)	**434.73**	**m^3/ day**	
Contributing Population	1610	**Persons**	GESF Section 12.1
Peaking Factor	5		GESF T-5
Total Estimated Peak Flow (Catchment Areas 6)	**25.16**	**L/s**	
	2173.65	**m^3/ day**	

Catchment Area No.	7		
Location	Ping Long		
Development Name	Discrete Houses clustered in part of Ping Long Village		
Number of Houses	30		Geoinfo Map
Number of storeys per Houses (Assuming 3 storeys per House)	3		
Number of Flats (assuming 1 flat per storey)	90	Flats	
Size of household/flat	2.7	Persons/flat	Census and Statistics Department - Table 130-06806 (2025: Tai Po District)
Population	243	Persons	
Per capita flow - Modern Village	0.27	m^3/ day/person	GESF T-1
Estimated Dry Weather Flow	**65.61**	**m^3/ day**	
Total Estimated Dry Weather Flow (Catchment Area 7)	**65.61**	**m^3/ day**	
Catchment Inflow Factor - Tai Po	1.00		GESF T-4
Total Estimated Dry Water flow (Catchment Areas 7) (including catchement inflow factor)	**65.61**	**m^3/ day**	
Contributing Population	243	**Persons**	GESF Section 12.1
Peaking Factor	6		GESF T-5
Total Estimated Peak Flow (Catchment Areas 7)	**4.56**	**L/s**	
	393.66	**m^3/ day**	

Table 2 - Estimate for Sewage Discharge from Proposed Development

Site A - RCHD	Residential		***Reference***
Total Population	183		
Per Capita Flow - Institutional and special class	0.19		GESF T-1
Estimated Dry Weather Flow	**34.77**	**m^3/ day**	
	Staff		
GFA	4811	m^2	
Employee per GFA (in 100 m2)	3.3	Persons/GFA	Table 8 of Commercial and Industrial Floor Space Utilization Survey
Employee Population	159	Persons	
Per Capita Flow - J11	0.28	m^3/ day/person	GESF T-2
Estimated Dry Weather Flow	**44.45**	**m^3/ day**	
Total Esimated Dry Weather Flow	**79.22**	**m^3/ day**	
Catchment Inflow Factor - Tai Po	1.0		GESF T-4
Total Estimated Dry Weather Flow (with catchment inflow factor)	**79.22**	**m^3/ day**	
Contributing Population	293	Persons	GESF Section 12.1
Peaking Factor	8		GESF T-5
Total Estimated Peak Flow for Site A	**7.34**	**L/s**	
Site B - RCHE	Residential		
Total Population	204		
Per Capita Flow - Institutional and special class	0.19		
Estimated Dry Weather Flow	**38.76**	**m^3/ day**	
	Staff		
GFA	8352	m^2	
Employee per GFA (in 100 m2)	3.3	Persons/GFA	Table 8 of Commercial and Industrial Floor Space Utilization Survey
Employee Population	276	Persons	
Per Capita Flow - J11	0.28	m^3/ day/person	GESF T-2
Estimated Dry Weather Flow	**77.17**	**m^3/ day**	
Total Esimated Dry Weather Flow	**115.93**	**m^3/ day**	
Catchment Inflow Factor - Tai Po	1.0		
Total Estimated Dry Weather Flow (with catchment inflow factor)	**115.93**	**m^3/ day**	
Contributing Population	429	Persons	GESF Section 12.1
Peaking Factor	8		GESF T-5
Total Estimated Peak Flow for Site B	**10.73**	**L/s**	

Table 3A - Design Parameters for Rising Main (Site A - to the southeast of Tai Po Shui Wo Road)

Total Estimated Dry Weather Flow (with catchment inflow factor)	=	79.22	m3/day
Contributing Population	=	293	Persons
Peaking Factor	=	8	
Total Estaimated Peak Flow	=	7.34	L/s
	=	0.00734	m3/s
Assumed Holding Capacity of Sump Pit (Assumed as 5*8*3 m)	=	120	m3
	=	120000	L
Filling Time (with inflow of 7.58 L/s)	=	16358.75352	s
	=	272.6458921	mins
Assumed Diameter of rising main	=	200	mm
Cross-sectional Area of rising main	=	0.031415927	m2
Assumed Design Velocity	=	1	m/s
Assumed Pump Rate (>2 times of the inflow rate)	=	31.41592654	L/s
Pump Discharge Time	=	3.819718634	s
Time elapsed when "Pump Run" and Water Level Drop to "Pump Stop" (Assuming Mean Inflow = Peak Inflow / 3)	=	4.142108499	s
Frequency of Pump Operation per hour	=	0.220009959	cycle/hour

Table 3B - Design Parameters for Rising Main (Site B - to the northwest of Tai Po Shui Wo Road)

Total Estimated Dry Weather Flow (with catchment inflow factor)	=	115.93	m3/day
Contributing Population	=	429	Persons
Peaking Factor	=	8	
Total Estaimated Peak Flow	=	10.73	L/s
	=	0.01073	m3/s
Assumed Holding Capacity of Sump Pit (6.5*8*3 m)	=	156	m3
	=	156000	L
Filling Time (with inflow of 7.58 L/s)	=	14532.5969	s
	=	242.2099484	mins
Assumed Diameter of rising main	=	200	mm
Cross-sectional Area of rising main	=	0.031415927	m2
Assumed Design Velocity	=	1	m/s
Assumed Pump Rate (>2 times of the inflow rate)	=	31.41592654	L/s
Pump Discharge Time	=	4.965634224	s
Time elapsed when "Pump Run" and Water Level Drop to "Pump Stop" (Assuming Mean Inflow = Peak Inflow / 3)	=	5.603898445	s
Frequency of Pump Operation per hour	=	0.247623489	cycle/hour

Table 4 - Existing System Checking

v= 0.000001 m2/s
ks= 0.003 m

	Segment	Upstream Manhole	Downstream Manhole	USGL (mPD)	DSGL (mPD)	USIL (mPD)	DSIL (mPD)	Length (m)	s Gradient	Pipe Diameter (mm)	A Area (m2)	R (m)	V Pipe Full-bore Velocity, V (m/s)	Q Pipe Design Velocity (m3/s)	Additional ADWF (m3/day)	Accumulated ADWF (m3/day)	Peak Flow (m3/s)	Additional Flow (m3/s)	Capacity Check (%)	**Status Check**
1 to 4	S1-S2	FMH1063769	FMH1063770	77.71	74.76	75.68	72.86	39.04	0.072	250	0.049	0.063	2.96	0.15	2034.93	2034.93	0.0236	0	16.21%	**OK**
	S2-S3	FMH1063770	FMH1063771	74.76	71.43	72.86	69.56	38.48	0.086	250	0.049	0.063	3.23	0.16	0	2034.93	0.0236	0	14.88%	**OK**
	S3-S4	FMH1063771	FMH1063772	71.43	67.99	69.55	66.805	39.12	0.070	250	0.049	0.063	2.92	0.14	0	2034.93	0.0236	0	16.45%	**OK**
	S4-S5	FMH1063772	FMH1063622	67.99	65.06	66.80	63.186	32.58	0.111	250	0.049	0.063	3.67	0.18	0	2034.93	0.0236	0	13.08%	**OK**
	S5-S6	FMH1063622	FSH1009080	65.06	63.32	62.60	61.525	39.12	0.027	250	0.049	0.063	1.82	0.09	0	2034.93	0.0236	0	26.35%	**OK**
	S7-S8	FSH1009080	FMH1063624	63.32	62.4	61.52	60.52	9.54	0.105	250	0.049	0.063	3.58	0.18	0	2034.93	0.0236	0	13.43%	**OK**
	S8-S9	FMH1063624	FMH1063625	62.4	61.14	60.51	59.30	21.80	0.056	250	0.049	0.063	2.59	0.13	0	2034.93	0.0236	0	18.50%	**OK**
	S9-S10	FMH1063625	FMH1063626	61.14	59.62	59.30	57.74	39.13	0.040	250	0.049	0.063	2.20	0.11	0	2034.93	0.0236	0	21.83%	**OK**
	S10-S11	FMH1063626	FMH1063628	59.62	58.98	57.731	56.648	26.666	0.041	250	0.049	0.063	2.22	0.11	0	2034.93	0.0236	0	21.63%	**OK**
5	S11-S12	FMH1063628	FMH1063630	58.98	58.68	56.643	56.5	11.515	0.012	250	0.049	0.063	1.23	0.06	1115.37	3150.30	0.0365	0	60.62%	**OK**
	S12-S13	FMH1063630	FMH1063642	58.68	58.17	56.499	56.489	3.636	0.003	250	0.049	0.063	0.58	0.03	0	3150.30	0.0365	0	129.13%	**Spill**
	S13-S14	FMH1063642	FMH1063643	58.17	58.28	56.488	56.406	21.212	0.004	250	0.049	0.063	0.68	0.03	0	3150.30	0.0365	0	108.84%	**Spill**
	S14-S15	FMH1063643	FMH1063644	58.28	58.2	56.405	56.385	3.636	0.006	250	0.049	0.063	0.82	0.04	0	3150.30	0.0365	0	91.19%	**Spill**
	S15-S16	FMH1063644	FMH1063645	58.2	57.58	56.38	55.835	30.909	0.018	250	0.049	0.063	1.46	0.07	0	3150.30	0.0365	0	50.86%	**OK**
	S16-S17	FMH1063645	FMH1063646	57.58	57.21	55.83	55.73	15.757	0.006	250	0.049	0.063	0.88	0.04	0	3150.30	0.0365	0	84.87%	**OK**
	S17-S18	FMH1063646	FMH1063648	57.21	56.97	55.725	55.535	7.878	0.024	250	0.049	0.063	1.71	0.08	0	3150.30	0.0365	0	43.47%	**OK**
6	S18-S19	FMH1063648	FMH1063653	56.97	56.81	55.42	55.278	7.27	0.020	250	0.049	0.063	1.54	0.08	2173.65	5323.95	0.0616	0	81.65%	**OK**

Remarks: Pipe Full-bore Velocity

$$V = -\sqrt{32gRS}\log\left[\frac{k_s}{14.8R} + \frac{1.255v}{\mathrm{R}\sqrt{32gRS}}\right] \quad \text{..... (A.4)}$$

where
V = velocity (in m/s)
g = gravitation acceleration (in m/s^2)
R = hydraulic mean depth = A/P
A = wetted cross sectional area (in m^2)
P = wetted perimeter (in m)
S = gradient of channel
k_s = effective roughness
v = kinematic viscosity of fluid.

Pipe Design Velocity Q=VA

Table 5 - Proposed System Checking

v= 0.000001 m2/s
ks= 0.003 m

	Segment	Upstream Manhole	Downstream Manhole	USGL (mPD)	DSGL (mPD)	USIL (mPD)	DSIL (mPD)	Length (m)	S Gradient	Pipe Diameter (mm)	A Area (m2)	R (m)	V Pipe Full-bore Velocity, V (m/s)	Q Pipe Design Velocity (m3/s)	Additional ADWF (m3/day)	Accumulated ADWF (m3/day)	Contributing Population	Peaking Factor	Peak Flow (m3/s)	Capacity Check (%)	**Status Check**
	SITE A	RC1	FMH1063770	*75.00*	74.76	*73.24*	72.86	3.43	0.111	200	0.031	0.050	3.15	0.10	79.22	79.22	293	8.00	0.0073	7.41%	**OK**
	SITE B	RC2	FMH1063770	*75.00*	74.76	*73.24*	72.86	3.43	0.111	200	0.031	0.050	3.15	0.10	115.93	115.93	429	8.00	0.0107	10.85%	**OK**
1 to 4	S1-S2	FMH1063769	FMH1063770	77.71	74.76	75.68	72.86	39.04	0.072	250	0.049	0.063	2.96	0.15	2034.93	2034.93	2800	6.00	0.0236	16.21%	**OK**
A+B	S2-S3	FMH1063770	FMH1063771	74.76	71.43	72.86	69.56	38.48	0.086	250	0.049	0.063	3.23	0.16	195.16	2230.08	3523	6.00	0.0343	21.66%	**OK**
	S3-S4	FMH1063771	FMH1063772	71.43	67.99	69.55	66.805	39.12	0.070	250	0.049	0.063	2.92	0.14	0.00	2230.08	3523	6.00	0.0343	23.95%	**OK**
	S4-S5	FMH1063772	FMH1063622	67.99	65.06	66.80	63.186	32.58	0.111	250	0.049	0.063	3.67	0.18	0.00	2230.08	3523	6.00	0.0343	19.05%	**OK**
	S5-S6	FMH1063622	FSH1009080	65.06	63.32	62.60	61.525	39.12	0.027	250	0.049	0.063	1.82	0.09	0.00	2230.08	3523	6.00	0.0343	38.37%	**OK**
	S7-S8	FSH1009080	FMH1063624	63.32	62.4	61.52	60.52	9.54	0.105	250	0.049	0.063	3.58	0.18	0.00	2230.08	3523	6.00	0.0343	19.54%	**OK**
	S8-S9	FMH1063624	FMH1063625	62.4	61.14	60.51	59.30	21.80	0.056	250	0.049	0.063	2.59	0.13	0.00	2230.08	3523	6.00	0.0343	26.93%	**OK**
	S9-S10	FMH1063625	FMH1063626	61.14	59.62	59.30	57.74	39.13	0.040	250	0.049	0.063	2.20	0.11	0.00	2230.08	3523	6.00	0.0343	31.78%	**OK**
	S10-S11	FMH1063626	FMH1063628	59.62	58.98	57.731	56.648	26.666	0.041	250	0.049	0.063	2.22	0.11	0.00	2230.08	3523	6.00	0.0343	31.49%	**OK**
5	S11-S12	FMH1063628	FMH1063630	58.98	58.68	56.643	56.5	11.515	0.012	250	0.049	0.063	1.23	0.06	1115.37	3345.45	4211	6.00	0.0472	78.47%	**OK**
	S12-S13	FMH1063630	FMH1063642	58.68	58.17	56.499	56.489	3.636	0.003	250	0.049	0.063	0.58	0.03	0.00	3345.45	4211	6.00	0.0472	167.14%	**Spill**
	S13-S14	FMH1063642	FMH1063643	58.17	58.28	56.488	56.406	21.212	0.004	250	0.049	0.063	0.68	0.03	0.00	3345.45	4211	6.00	0.0472	140.88%	**Spill**
	S14-S15	FMH1063643	FMH1063644	58.28	58.2	56.405	56.385	3.636	0.006	250	0.049	0.063	0.82	0.04	0.00	3345.45	4211	6.00	0.0472	118.03%	**Spill**
	S15-S16	FMH1063644	FMH1063645	58.2	57.58	56.38	55.835	30.909	0.018	250	0.049	0.063	1.46	0.07	0.00	3345.45	4211	6.00	0.0472	65.83%	**OK**
	S16-S17	FMH1063645	FMH1063646	57.58	57.21	55.83	55.73	15.757	0.006	250	0.049	0.063	0.88	0.04	0.00	3345.45	4211	6.00	0.0472	109.86%	**Spill**
	S17-S18	FMH1063646	FMH1063648	57.21	56.97	55.725	55.535	7.878	0.024	250	0.049	0.063	1.71	0.08	0.00	3345.45	4211	6.00	0.0472	56.27%	**OK**
6	S18-S19	FMH1063648	FMH1063653	56.97	56.81	55.42	55.278	7.27	0.020	250	0.049	0.063	1.54	0.08	2173.65	5519.10	5821	5.00	0.0724	95.88%	**Spill**

Calculations: Pipe Full-bore Velocity

$$V = -\sqrt{32gRS}\log\left[\frac{k_s}{14.8R} + \frac{1.255v}{R\sqrt{32gRS}}\right] \quad \text{..... (A.4)}$$

where
- V = velocity (in m/s)
- g = gravitation acceleration (in m/s^2)
- R = hydraulic mean depth = A/P
- A = wetted cross sectional area (in m^2)
- P = wetted perimeter (in m)
- S = gradient of channel
- k_s = effective roughness
- v = kinematic viscosity of fluid.

Pipe Design Velocity Q=VA

Remarks: The Invert Levels for two Proposed Manholes are by estimations and subject to changes in the detail design stage.

Table 6A - Existing System Checking (Freeboard Calculation)

Step								1: Reynolds Number				2: Friction Factor		3. Hydraulic Gradient		4. Friction Loss	5a. Entry Loss	5b. Exit Loss	Foulwater level 1	Foulwater level 2	Freeboard Level 1	Freeboard level 2	Checking
Item	Pipe Dia. (D)	Pipe Length (L)	Invert Level 1	Invert Level 2	Cover Level 1	Cover Level 2	Area	Peak Flow	kinetatic viscosity of water (v)	Flow Velocity (V)	**Reynolds Number (Re)**	roughness coeffeicient (Ks)	**Friction factor (f)**	gravity (g)	**Hydraulic Gradient (s)**	**Friction Loss (Hf)**	**Entry Loss (h1)**	**Exit Loss (h2)**					
Unit	mm	m	mPD	mPD	mPD	mPD	m2	L/s	m/s	m/s		m		m/s^2		**m**	**m**	**m**					
S10-S11	250	26.666	57.731	56.648	59.62	58.98	0.05	23.55	0.000001004	0.4798	**119473.53**	0.003	**0.017**	9.810	**0.001**	**0.022**	**0.006**	**0.012**		56.19		**2.79**	OK
S11-S12	250	11.515	56.643	56.5	58.98	58.68	0.05	36.46	0.000001004	0.7428	**184958.50**	0.003	**0.016**	9.810	**0.002**	**0.020**	**0.014**	**0.028**	56.19	56.12	**2.79**	**2.56**	OK
S12-S13	250	3.636	56.499	56.489	58.68	58.17	0.05	36.46	0.000001004	0.7428	**184958.50**	0.003	**0.016**	9.810	**0.002**	**0.006**	**0.014**	**0.028**	56.12	56.08	**2.56**	**2.09**	OK
S13-S14	250	21.212	56.488	56.406	58.17	58.28	0.05	36.46	0.000001004	0.7428	**184958.50**	0.003	**0.016**	9.810	**0.002**	**0.038**	**0.014**	**0.028**	56.08	56.00	**2.09**	**2.28**	OK
S14-S15	250	3.636	56.405	56.385	58.28	58.2	0.05	36.46	0.000001004	0.7428	**184958.50**	0.003	**0.016**	9.810	**0.002**	**0.006**	**0.014**	**0.028**	56.00	55.95	**2.28**	**2.25**	OK
S15-S16	250	30.909	56.38	55.835	58.2	57.58	0.05	36.46	0.000001004	0.7428	**184958.50**	0.003	**0.016**	9.810	**0.002**	**0.055**	**0.014**	**0.028**	55.95	55.85	**2.25**	**1.73**	OK
S16-S17	250	15.757	55.83	55.73	57.58	57.21	0.05	36.46	0.000001004	0.7428	**184958.50**	0.003	**0.016**	9.810	**0.002**	**0.028**	**0.014**	**0.028**	55.85	55.78	**1.73**	**1.43**	OK
S17-S18	250	7.878	55.725	55.535	57.21	56.97	0.05	36.46	0.000001004	0.7428	**184958.50**	0.003	**0.016**	9.810	**0.002**	**0.014**	**0.014**	**0.028**	55.78	55.72	**1.43**	**1.25**	OK
S18-S19	250	7.27	55.42	55.278	56.97	56.81	0.05	61.62	0.000001004	1.2553	**312576.60**	0.003	**0.014**	9.810	**0.005**	**0.033**	**0.040**	**0.080**	55.72	55.57	**1.25**	**1.24**	OK

Table 6B - Existing System Checking (Freeboard Calculation with 1.15 Safety Factor)

Step									1: Reynolds Number				2: Friction Factor		3. Hydraulic Gradient		4. Friction Loss	5a. Entry Loss	5b. Exit Loss	Foulwater level 1	Foulwater level 2	Freeboard Level 1	Freeboard level 2	Checking
Item	Pipe Dia. (D)	Pipe Length (L)	Invert Level 1	Invert Level 2	Cover Level 1	Cover Level 2	Area	Peak Flow (with 1.15 Safety Factor)	kinetatic viscosity of water (v)	Flow Velocity (V)	**Reynolds Number (Re)**	roughness coeffeicient (Ks)	**Friction factor (f)**	gravity (g)	**Hydraulic Gradient (s)**	**Friction Loss (Hf)**	**Entry Loss (h1)**	**Exit Loss (h2)**					
Unit	mm	m	mPD	mPD	mPD	mPD	m2	L/s	m/s	m/s		m		m/s^2		**m**	**m**	**m**					
S10-S11	250	26.666	57.731	56.648	59.62	58.98	0.05	27.09	0.000001004	0.5518	**137394.56**	0.003	**0.017**	9.8100	**0.001**	**0.028**	**0.008**	**0.016**		56.38		**2.60**	OK
S11-S12	250	11.515	56.643	56.5	58.98	58.68	0.05	41.93	0.000001004	0.8542	**212702.27**	0.003	**0.015**	9.8100	**0.002**	**0.026**	**0.019**	**0.037**	56.38	56.30	**2.60**	**2.38**	OK
S12-S13	250	3.636	56.499	56.489	58.68	58.17	0.05	41.93	0.000001004	0.8542	**212702.27**	0.003	**0.015**	9.8100	**0.002**	**0.008**	**0.019**	**0.037**	56.30	56.23	**2.38**	**1.94**	OK
S13-S14	250	21.212	56.488	56.406	58.17	58.28	0.05	41.93	0.000001004	0.8542	**212702.27**	0.003	**0.015**	9.8100	**0.002**	**0.048**	**0.019**	**0.037**	56.23	56.13	**1.94**	**2.15**	OK
S14-S15	250	3.636	56.405	56.385	58.28	58.2	0.05	41.93	0.000001004	0.8542	**212702.27**	0.003	**0.015**	9.8100	**0.002**	**0.008**	**0.019**	**0.037**	56.13	56.06	**2.15**	**2.14**	OK
S15-S16	250	30.909	56.38	55.835	58.2	57.58	0.05	41.93	0.000001004	0.8542	**212702.27**	0.003	**0.015**	9.8100	**0.002**	**0.070**	**0.019**	**0.037**	56.06	55.94	**2.14**	**1.64**	OK
S16-S17	250	15.757	55.83	55.73	57.58	57.21	0.05	41.93	0.000001004	0.8542	**212702.27**	0.003	**0.015**	9.8100	**0.002**	**0.036**	**0.019**	**0.037**	55.94	55.85	**1.64**	**1.36**	OK
S17-S18	250	7.878	55.725	55.535	57.21	56.97	0.05	41.93	0.000001004	0.8542	**212702.27**	0.003	**0.015**	9.8100	**0.002**	**0.018**	**0.019**	**0.037**	55.85	55.77	**1.36**	**1.20**	OK
S18-S19	250	7.27	55.42	55.278	56.97	56.81	0.05	70.86	0.000001004	1.4436	**359463.09**	0.003	**0.014**	9.8100	**0.006**	**0.043**	**0.053**	**0.106**	55.77	55.57	**1.20**	**1.24**	OK

Table 7A - Future System Checking with the Subject Development included (Freeboard Calculation)

Step								1: Reynolds Number				2: Friction Factor		3. Hydraulic Gradient		4. Friction Loss	5a. Entry Loss	5b. Exit Loss	Foulwater level 1	Foulwater level 2	Freeboard Level 1	Freeboard level 2	Checking
Item	Pipe Dia. (D)	Pipe Length (L)	Invert Level 1	Invert Level 2	Cover Level 1	Cover Level 2	Area	Peak Flow	kinetatic viscosity of water (v)	Flow Velocity (V)	**Reynolds Number (Re)**	roughness coeffeicient (Ks)	**Friction factor (f)**	gravity (g)	**Hydraulic Gradient (s)**	**Friction Loss (Hf)**	**Entry Loss (h1)**	**Exit Loss (h2)**					
Unit	mm	m	mPD	mPD	mPD	mPD	m2	L/s	m/s	m/s		m		m/s^2		**m**	**m**	**m**					
S10-S11	250	26.666	57.731	56.648	59.62	58.98	0.05	25.81	0.000001004	0.5258	**130931.43**	0.003	**0.017**	9.8100	**0.001**	**0.025**	**0.007**	**0.014**		56.25		2.73	OK
S11-S12	250	11.515	56.643	56.5	58.98	58.68	0.05	38.72	0.000001004	0.7888	**196416.39**	0.003	**0.016**	9.8100	**0.002**	**0.023**	**0.016**	**0.032**	56.25	56.18	2.73	2.50	OK
S12-S13	250	3.636	56.499	56.489	58.68	58.17	0.05	38.72	0.000001004	0.7888	**196416.39**	0.003	**0.016**	9.8100	**0.002**	**0.007**	**0.016**	**0.032**	56.18	56.13	2.50	2.04	OK
S13-S14	250	21.212	56.488	56.406	58.17	58.28	0.05	38.72	0.000001004	0.7888	**196416.39**	0.003	**0.016**	9.8100	**0.002**	**0.042**	**0.016**	**0.032**	56.13	56.04	2.04	2.24	OK
S14-S15	250	3.636	56.405	56.385	58.28	58.2	0.05	38.72	0.000001004	0.7888	**196416.39**	0.003	**0.016**	9.8100	**0.002**	**0.007**	**0.016**	**0.032**	56.04	55.99	2.24	2.21	OK
S15-S16	250	30.909	56.38	55.835	58.2	57.58	0.05	38.72	0.000001004	0.7888	**196416.39**	0.003	**0.016**	9.8100	**0.002**	**0.061**	**0.016**	**0.032**	55.99	55.88	2.21	1.70	OK
S16-S17	250	15.757	55.83	55.73	57.58	57.21	0.05	38.72	0.000001004	0.7888	**196416.39**	0.003	**0.016**	9.8100	**0.002**	**0.031**	**0.016**	**0.032**	55.88	55.80	1.70	1.41	OK
S17-S18	250	7.878	55.725	55.535	57.21	56.97	0.05	38.72	0.000001004	0.7888	**196416.39**	0.003	**0.016**	9.8100	**0.002**	**0.016**	**0.016**	**0.032**	55.80	55.73	1.41	1.24	OK
S18-S19	250	7.27	55.42	55.278	56.97	56.81	0.05	63.88	0.000001004	1.3013	**324034.49**	0.003	**0.014**	9.8100	**0.005**	**0.035**	**0.043**	**0.086**	55.73	55.57	1.24	1.24	OK

Table 7B - Future System Checking with the Subject Development included (Freeboard Calculation with 1.15 Safety Factor)

Step								1: Reynolds Number				2: Friction Factor		3. Hydraulic Gradient		4. Friction Loss	5a. Entry Loss	5b. Exit Loss	Foulwater level 1	Foulwater level 2	Freeboard Level 1	Freeboard level 2	Checking
Item	Pipe Dia. (D)	Pipe Length (L)	Invert Level 1	Invert Level 2	Cover Level 1	Cover Level 2	Area	Peak Flow (with 1.15 Safety Factor)	kinetatic viscosity of water (v)	Flow Velocity (V)	**Reynolds Number (Re)**	roughness coeffeicient (Ks)	**Friction factor (f)**	gravity (g)	**Hydraulic Gradient (s)**	**Friction Loss (Hf)**	**Entry Loss (h1)**	**Exit Loss (h2)**					
Unit	mm	m	mPD	mPD	mPD	mPD	m2	L/s	m/s	m/s		m		m/s^2		**m**	**m**	**m**					
S10-S11	250	26.666	57.731	56.648	59.62	58.98	0.05	29.68	0.000001004	0.6047	**150571.14**	0.003	**0.016**	9.8100	**0.001**	**0.033**	**0.009**	**0.019**		56.47		2.51	**OK**
S11-S12	250	11.515	56.643	56.5	58.98	58.68	0.05	44.53	0.000001004	0.9071	**225878.85**	0.003	**0.015**	9.8100	**0.003**	**0.029**	**0.021**	**0.042**	56.47	56.38	2.51	2.30	**OK**
S12-S13	250	3.636	56.499	56.489	58.68	58.17	0.05	44.53	0.000001004	0.9071	**225878.85**	0.003	**0.015**	9.8100	**0.003**	**0.009**	**0.021**	**0.042**	56.38	56.30	2.30	1.87	**OK**
S13-S14	250	21.212	56.488	56.406	58.17	58.28	0.05	44.53	0.000001004	0.9071	**225878.85**	0.003	**0.015**	9.8100	**0.003**	**0.054**	**0.021**	**0.042**	56.30	56.19	1.87	2.09	**OK**
S14-S15	250	3.636	56.405	56.385	58.28	58.2	0.05	44.53	0.000001004	0.9071	**225878.85**	0.003	**0.015**	9.8100	**0.003**	**0.009**	**0.021**	**0.042**	56.19	56.11	2.09	2.09	**OK**
S15-S16	250	30.909	56.38	55.835	58.2	57.58	0.05	44.53	0.000001004	0.9071	**225878.85**	0.003	**0.015**	9.8100	**0.003**	**0.079**	**0.021**	**0.042**	56.11	55.97	2.09	1.61	**OK**
S16-S17	250	15.757	55.83	55.73	57.58	57.21	0.05	44.53	0.000001004	0.9071	**225878.85**	0.003	**0.015**	9.8100	**0.003**	**0.040**	**0.021**	**0.042**	55.97	55.87	1.61	1.34	**OK**
S17-S18	250	7.878	55.725	55.535	57.21	56.97	0.05	44.53	0.000001004	0.9071	**225878.85**	0.003	**0.015**	9.8100	**0.003**	**0.020**	**0.021**	**0.042**	55.87	55.79	1.34	1.18	**OK**
S18-S19	250	7.27	55.42	55.278	56.97	56.81	0.05	73.46	0.000001004	1.4965	**372639.67**	0.003	**0.014**	9.8100	**0.006**	**0.046**	**0.057**	**0.114**	55.79	55.57	1.18	1.24	**OK**