ARUP

Appendix F

Sewerage Impact Assessment

Sewerage Impact Assessment

Application for Planning Permission Under Section 16 of the Town Planning Ordinance (Cap. 131) for Proposed Hotel Use and Minor Relaxation of Plot Ratio and Building Height Restrictions at "Other Specified Uses" Annotated "Business" Zone at Tsun Wan Inland Lot No. 46 S.C, Nos. 46-48 Pak Tin Par Street, Tsuen Wan, New Territories

FOR & ON BEHALF OF
A&N ARCHITECT & INTERIOR DESIGNER LTD.

HO CHI LOK
HKIA AUTHORIZED PERSON (ARCHITECT)

Rev. 1 26th Sept., 2025 - revised
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1 Introduction

1.1 The Applicant intends to develop **a hotel development** (hereafter called as "the proposed development") at Tsun Wan Inland Lot No. 46 S.C, Nos. 46-48 Pak Tin Par Street, Tsuen Wan, New Territories (the Site).

1.2 In order to assess the anticipated changes in sewage generation that maybe in caused by the proposed development, A&N Architect & Interior Designer Limited is commissioned to conduct a Sewerage Impact Assessment (SIA) to support this Section 16 planning application.

1.3 The objectives of this SIA aim to assess the potential sewerage impact that may be arising from the proposed development and to recommend the mitigation measures, if necessary, to alleviate the impacts.

2 Site Descriptions

2.1 Site Location

2.1.1 The Site is bounded by Pak Tin Par Street to its north, Tsuen Wan and surrounded by industrial and commercial developments. The site area is approximately 721.59 m2.

2.1.2 The following uses or buildings are located adjacent to the Site:

a North: The Mills and Wah Lik Industrial Centre;

b East: International Enterprise Centre 3;

c South: Superluck Industrial Centre; and

d West: Goodwill Industrial Building.

2.1.3 **Figure 2-1** shows the location of the Site and its environs.

2.2 **Proposed Development Scheme**

2.2.1 The proposed development comprises one 28-storey building tower including G/F. The main entrance of the proposed development is on G/F abutting Pak Tin Par Street.

2.2.2 The schedule of the proposed development is listed in **Table 2-1**.

2.2.3 Development Proposal shall refer to **Appendix A of the Supporting Planning Statement.**

Table 2-1 Proposed Development Schedule

	Floor	Major Uses
a	6/F to 27/F (22 storeys)	Guest room floors
b	5/F	Refuge Floor
c	4/F	Sky Garden
d	3/F	Hotel Lobby
e	2/F	Lobby Lounge
f	1/F	Fitness Centre
g	G/F -	Entrance Lobby, loading and unloading bays / vehicular access road, loading and unloading, carparking and ancillary plant rooms

2.3 Existing Sewerage

2.3.1 The drainage plans (plan nos.: 6-SE-20B-1 and 6-SE-20B-3) obtained from the Drainage Services Department (DSD) have clearly provided the background information on sewerage infrastructure in the vicinity of the Site. The relevant drainage data are extracted from these drainage plans for the purpose of this SIA and they are presented in **Figure 2-2.**

2.3.2 According to the drainage plans, a sewer tapping point (FTH4000540) with 225 mm diameter sewer located at the northern boundary of the Site, connected to a public sewer manhole (FMH4005679), which serves the pre-existing development of the Site **(refer to Figure 2-2).**

3 Sewerage Impact

3.1 Assessment Assumptions and Methodology

3.1.1 All sewage generation from the proposed development will be discharged into the existing 225mm diameter sewer via the sewer tapping point, A0 (FTH4000540) **(refer to Figure 3-1)**. The adequacy in capacities of the sewers located at Pak Tin Par Street and the existing 225mm diameter sewer between tapping point, A0 (FTH4000540) and manhole A1 (FMH4005679) have been checked based on the estimation of the existing upstream / downstream and future sewage generation from the proposed development.

3.1.2 The sewage generations from the Catchments A and B, and TCL Tower **(refer to Figure 3-1)** have been assessed in the upstream and downstream sewerage, as they are connected to the existing sewers along Pak Tin Par Street.

3.1.3 The assessment has been conducted in accordance with "Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning" (hereafter as "GESF") published by Environmental Protection Department (EPD) in 2005.

3.2 Sewage Generation

3.2.1 For the sewage flow estimation from the proposed and pre-existing developments, the planning unit flow factors as stated in the GESF has been adopted.

3.2.2 The sewage generation from the proposed development includes the flow contributions from residents, employees and commercial activities. The estimated number of employees of the proposed development are summarised in **Table 3-1.** The detailed calculations of sewage generation from the pre-existing development and proposed development have been provided in **Annex A** for reference.

Table 3-1 Estimated Sewerage Generation of Proposed Development

Table 3.1 –Estimated Sewerage Generation of the Proposed Development

Use	Floor Area	sumed Floor Area per Emplo		Estimated number of employees	Design flow for commercial employee (Remarks : Tsuen Wan, Kwai Tsing)					Average Sewage Generation Rate		Catchment Inflow Factor	Flow Rate with Catchment Inflow Factor
	(Proposed)	(Refer to Table 8 of CIFSUS)	B(P)R		(m3 / employee / day)			Remarks		Sub-total	Total		
	(sq.m.)	(P/ 100 sq.m.)	(sq.m./P)	(P)	Commercial Employee	Commercial Activities	Total unit flow generated from an employee			(m3 / day)			(m3 / day)
27/F to 6/F (Hotel Guestroom Floors)	299 rooms x 2P/Room			598	0.08	1.5	1.58	J10	(Table T-2 of GESF)	944.84	971.54	1.10	1,068.69
5/F (Refuge Floor)	105.00	(no drainage)		--	--		--	--	--	--			
4/F (Sky Garden)	105.00	(no drainage)		--	--		--	--	--	--			
3/F (Hotel Lobby)	350.00	3.5		13	0.08	1.5	1.58	J10	(Table T-2 of GESF)	20.54			
3/F (Souvenir Shop)	65.03	3.5		3	0.08	0.2	0.28	J4	(Table T-3 of GESF)	0.84			
2/F (Lobby Lounge)	220.00	5.1		12	0.08	0.2	0.28	J10	(Table T-3 of GESF)	3.36			
1/F (Fitness Centre)	205.00	3.3		7	0.08	0.2	0.28	J4	(Table T-3 of GESF)	1.96			
G/F (Lobby)	93.00	(no drainage)		--	--		--	--	--	--			
		(no drainage)		--	--		--	--	--				
		Total no. of employees		633							11.24		12.37
											(l/s)		(l/s)

3.3 Sewerage Capacity

3.3.1 According to the "Sewerage Manual – Key Planning Issues and Gravity Collection System (Third Edition)" published by DSD in 2013, the capacities of respective sewers have been calculated based on Colebrook-White equation for circular pipes:

$$V = -\sqrt{(8gDs)}\log\left(\frac{ks}{3.7D} + \frac{2.5\,\mathrm{l}v}{D\sqrt{(2gDs)}}\right)$$

where

V = mean velocity (m/s)
g = gravitational acceleration (m/s2)
D = pipe diameter (m)
ks = hydraulic pipeline roughness (m) ("poor" condition of concrete slimed sewers was assumed for the existing sewer)
v = kinematic viscosity of fluid (m2/s)
s = frictional slope (energy gradient due to frictional loss)

3.3.2 The sewerage impact on various segments of the sewer was evaluated by comparing the estimated peak flow against the capacity of the respective sewer segments. The detailed calculations are provided in **Annex B - Estimated peak flow vs sewer segments capacity-without upgrading** for reference.

4 Assessment Results

4.1 Existing Sewerage

4.1.1 The results of the assessment have indicated that the total estimated daily flow of the pre-existing development and the proposed development has been evaluated and are summarised in **Table 4-1.** The estimated daily flow of the proposed development will be higher than that of the pre-existing development by 949.49m3/day.

Table 4-1 Estimated Sewage Flow before and after Development

--	**Estimated Daily Flow (m3/day)**
Pre-existing Development	119.20
Proposed Development	1,068.69
Difference	949.49

4.1.2 The final discharge point from the proposed development will be connected to the existing 225 mm diameter sewer via the sewer tapping point, A0 (FTH4000540) **(refer to Fig 3.1-proposeed sewerage discharge location to ex sewerage- without up-grading)**

4.1.3 Sewerage Generation from Catchments are shown in **Annex A**

4.1.4 The capacity of each segment for the downstream sewers (i.e., from segment A0 to A12 as shown in **Figure 3-1**) between each manhole has been evaluated and are summarised in **Table 4-2**.

Table 4-2 Estimated Downstream Sewer Capacities

Pipe Segment	Diameter, mm	Gradient	Pipe Capacity m3/s	Estimated Cumulative Peak Flow, m3/s	% of Used Capacity
A0-A1	225	0.001	0.013	0.099	773.07%
A1-A2	450	0.004	0.204	0.098	48.24%
A2-A3	450	0.004	0.204	0.098	48%
A3-A4	450	0.023	0.491	0.098	20%
A4-A5	450	0.003	0.153	0.098	64%
A5-A6	450	0.003	0.153	0.098	64%
A6-A7	450	0.003	0.153	0.183	120%
A7-A8	450	0.003	0.153	0.183	120%
A8-A9	450	0.003	0.153	0.183	120%
A9-A10	450	0.003	0.153	0.183	120%
A10-A11	450	0.003	0.153	0.204	134%
A11-A12	450	0.036	0.615	0.170	28%

4.1.5 The percentages of used capacity range for the downstream sewers will be ranged from about 28% to 773.07%. Estimation of the flows and capacities are detailed in **Annex B**- Estimated peak flow vs sewer segments capacity-without upgrading

4.1.6 The results of the assessment as presented in **Annex B** have indicated that the sewage flow for the following segments will exceed the capacity under the worst-case scenario:

a sewer segment A0 to A1 with 225 mm diameter

b sewer segment A6 to A11 with 450 mm diameter

4.1.7 As such, upgrading works on the existing sewerage network is required.

4.2 Proposed Upgrading of Sewerage

4.2.1 The following sewer segments are proposed for upgrading:

a Ex. 225mm diameter sewer for segment A0 to A1 shall be upgraded to 450mm diameter;

b Ex. 450mm diameter sewer for segment A6 to A12 shall be upgraded to 525 mm diameter

4.2.2 Proposed upgrading is shown on **Figure 4-1**

4.2.3 The relevant flow capacity of the proposed upgrading of segment is estimated in **Table 4-3.**

Table 4-3 Estimated Sewer Capacities of Proposed Upgrading

	Pipe Segment	Diameter, mm	Gradient (**)	Pipe Capacity m3/s	Estimated Cumulative Peak Flow, m3/s	% of Used Capacity
	A0-A1	450	0.001	0.101	0.099	97.97%
(*)	A1-A2	450	0.004	0.204	0.098	48.24%
(*)	A2 - A3	450	0.004	0.204	0.098	48%
(*)	A3-A4	450	0.023	0.491	0.098	20%
(*)	A4-A5	450	0.003	0.153	0.098	64%
(*)	A5-A6	450	0.003	0.153	0.098	64%
	A6-A7	525	0.003	0.264	0.183	69%
	A7-A8	525	0.003	0.264	0.183	69%
	A8-A9	525	0.003	0.264	0.183	69%
	A9-A10	525	0.003	0.264	0.183	69%
	A10-A11	525	0.003	0.264	0.204	77%
	A11-A12	525	0.036	0.923	0.204	22%

(*) Existing pipe segment is maintained
(**) Existing pipe gradient is maintained.

Note: (1) proposed sewer pipe material will be precast concrete pipes with" O" ring joints

4.2.4 Estimation of pipe capacity after upgrading is detailed in **Annex C.**

4.2.5 After the upgrading works for sewer segments A0 to A1 & A6 to A12, the flow capacity will be capable to cater the cumulative peak flow from the proposed development and upstream and downstream developments. As such, no adverse sewerage impact arising from the proposed development is anticipated.

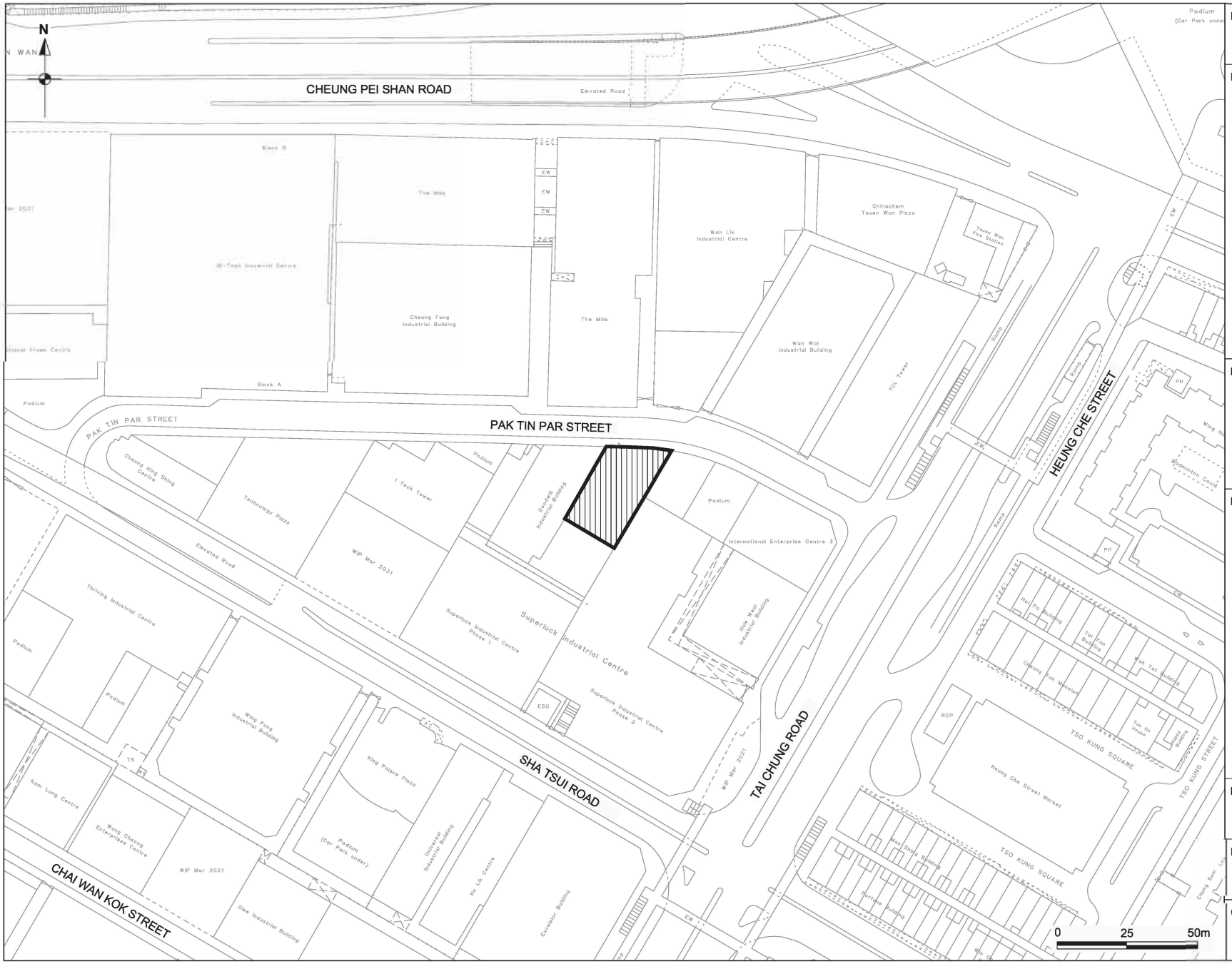
5 Conclusion

5.1 This Sewerage Impact Assessment (SIA) aims to evaluate the sewerage impacts on the local sewerage network due to the operation of the proposed development.

5.2 The findings of the assessment have demonstrated that with the provision of the proposed upgrading sewer work, there should be sufficient sewage capacity for the public sewers located at Pak Tin Par Street to handle sewage generation from the proposed development.

5.3 The project proponent will be responsible for the design and construction of the proposed upgrading works which will be further discussed with DSD at the detailed design stage of the project. The detailed technical studies will be submitted to relevant Government Departments for further consideration thereafter.

5.4 Based on the above, it is concluded that the sewerage impact arising from the proposed development should be acceptable.



PROJECT NO :

2520

PROJECT TITLE :

Proposed Hotel Use and Minor Relaxation of Plot Ratio and Building Height Restrictions at "Other Specified Uses" Annotated "Business" Zone at Tsun Wan Inland Lot No. 46 S.C, Nos. 46-48 Pak Tin Par Street, Tsuen Wan, New Territories

Sewerage Impact Assessment

FIGURE TITLE :

Site Location

LEGEND :

Subject Site

FIGURE NO :

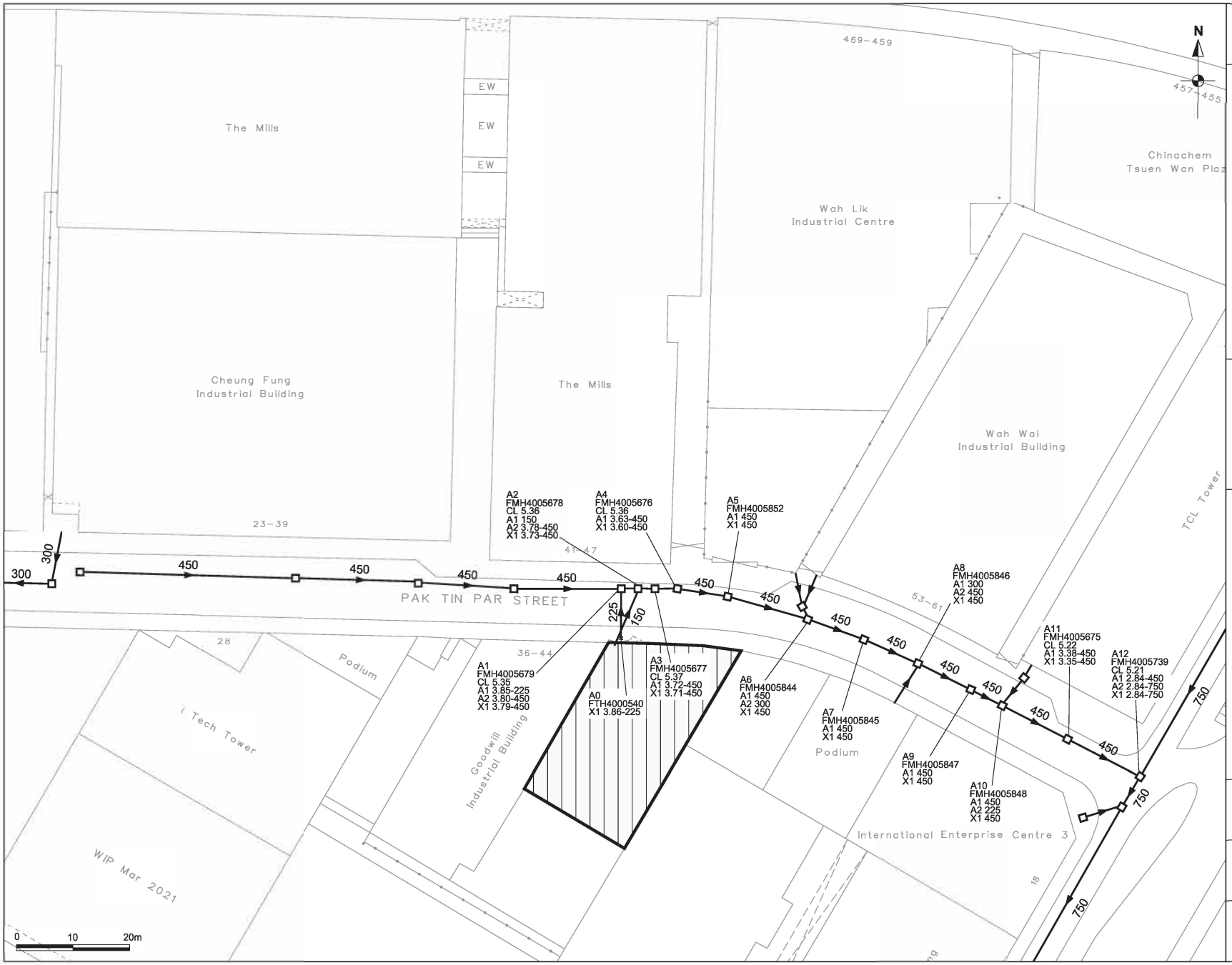
2 - 1

DATE :

11th Sept., 2025

CONSULTANT :

A&N Architect & Interior Designer Liited



PROJECT NO :

2520

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Sewerage Impact Assessment

FIGURE TITLE :

Existing Sewerage

LEGEND :

Proposed Development

Existing Sewer

FMH7013690
CL 4.17
A1 2.56-225
X1 2.55-225

DSD manhole number
Cover level or ground level in mPD
225mm dia. outgoing pipe invert level in mPD
225mm dia. outgoing pipe invert level in mPD

FIGURE NO :

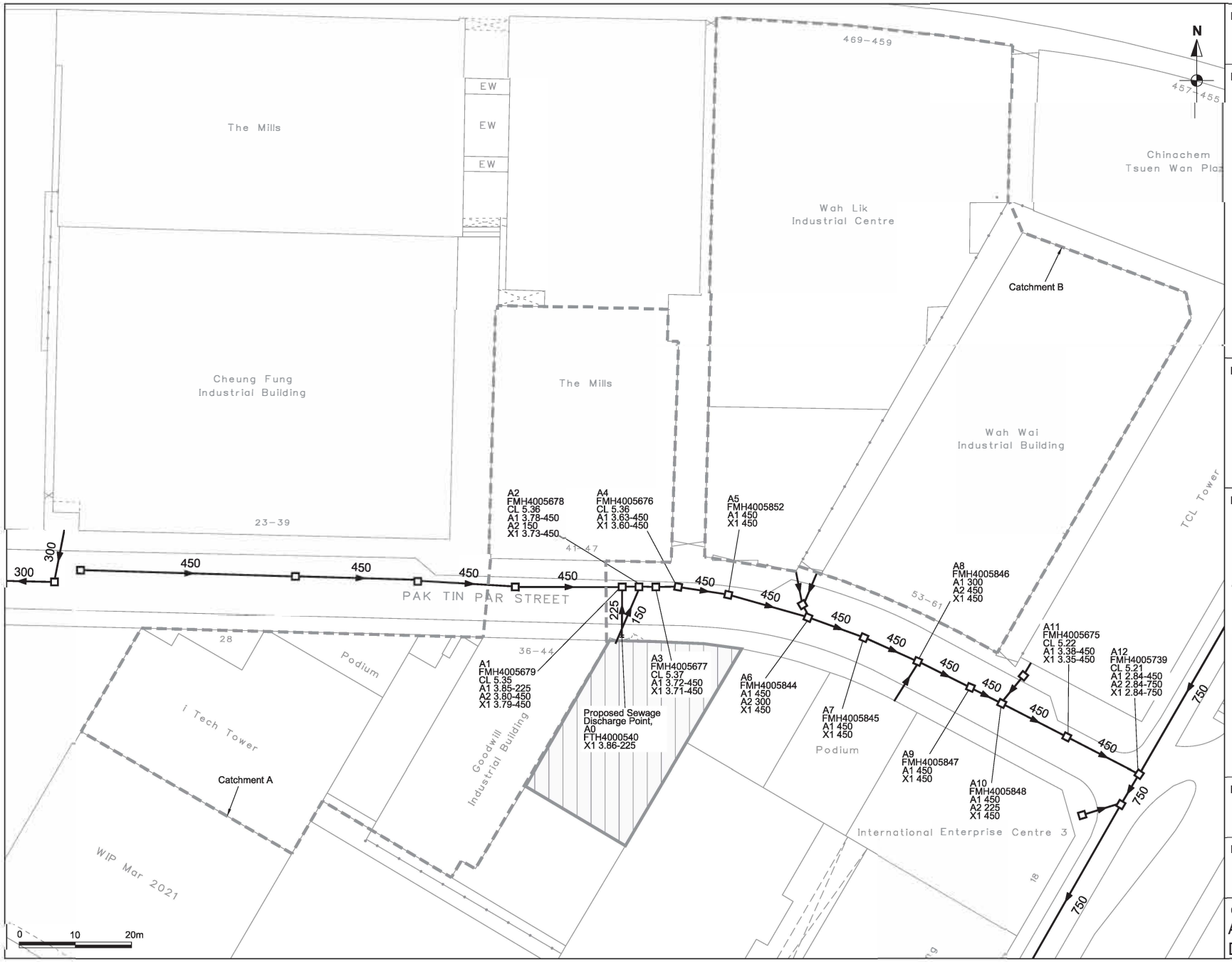
2 - 2

DATE :

11th Sept., 2025

CONSULTANT :

A&N Architect & Interior Designer Limited



PROJECT NO :

2520

PROJECT TITLE :

Proposed Hotel Use and Minor Relaxation of Plot Ratio and Building Height Restrictions at "Other Specified Uses" Annotated "Business" Zone at Tsun Wan Inland Lot No. 46 S.C, Nos. 46-48 Pak Tin Par Street, Tsuen Wan, New Territories

Sewerage Impact Assessment

FIGURE TITLE :

Existing Sewage Discharge Location

LEGEND :

Proposed Development

Existing Sewer

FMH7013690
CL 4.17
A1 2.56-225
X1 2.55-225

DSD manhole number
Cover level or ground level in mPD
225mm dia. outgoing pipe invert level in mPD
225mm dia. outgoing pipe invert level in mPD

FIGURE NO :

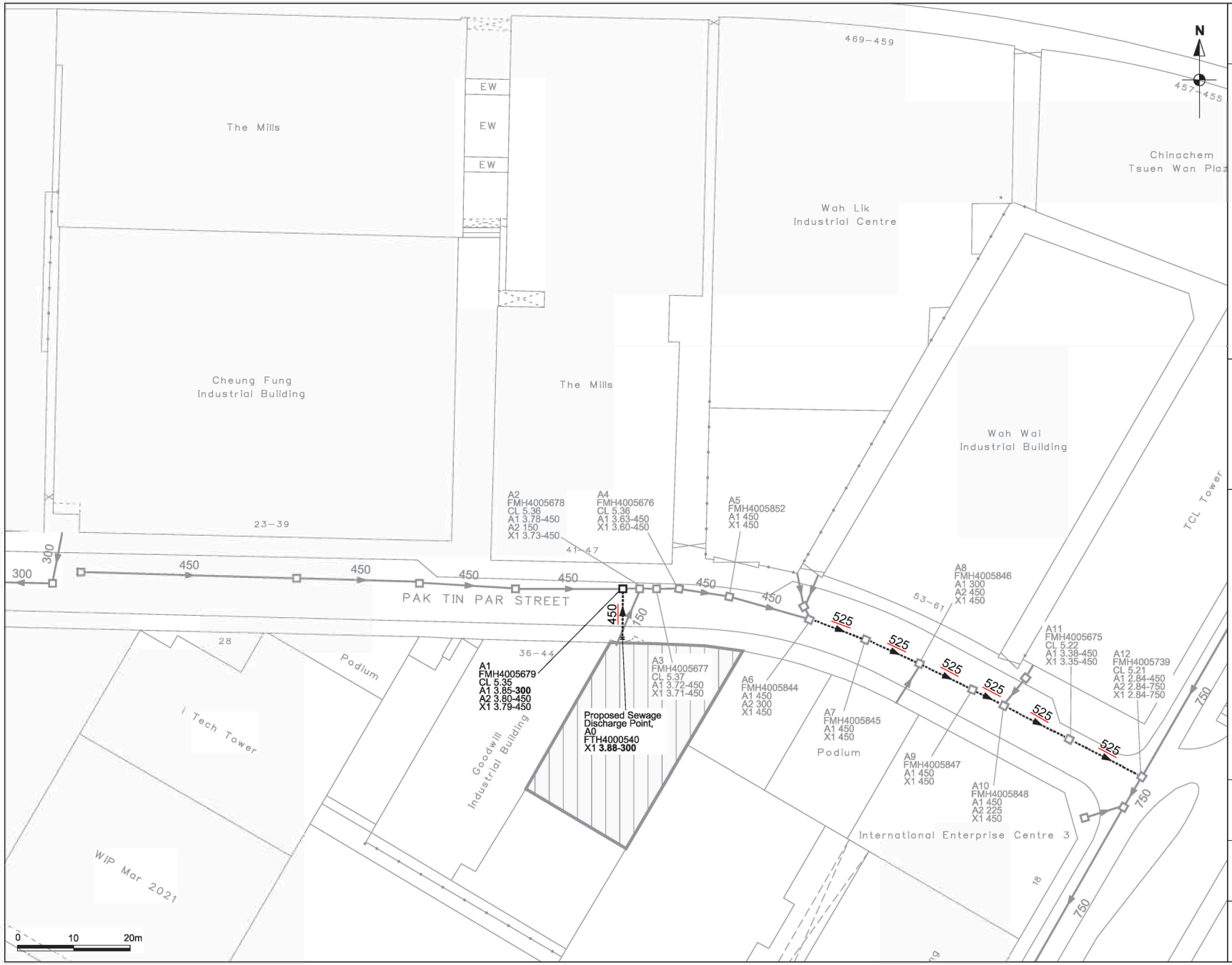
3 - 1

DATE :

11th Sept., 2025

CONSULTANT :

A&N Architect & Interior Designer Limited



PROJECT NO :

2520

PROJECT TITLE :

Proposed Hotel Use and Minor Relaxation of Plot Ratio and Building Height Restrictions at "Other Specified Uses" Annotated "Business" Zone at Tsun Wan Inland Lot No. 46 S.C, Nos. 46-48 Pak Tin Par Street, Tsuen Wan, New Territories

Sewerage Impact Assessment

FIGURE TITLE :

Proposed Upgrading Sewer

LEGEND :

- Proposed Development
- Existing Sewer
- Proposed Upgrading Sewer

FMH7013690 — DSD manhole number
CL 4.17 — Cover level or ground level in mPD
A1 2.56-225 — 225mm dia. outgoing pipe invert level in mPD
X1 2.55-225 — 225mm dia. outgoing pipe invert level in mPD

FIGURE NO :

4 - 1

DATE :

11th Sept., 2025

CONSULTANT :

A&N Architect & Interior Designer Limited

Annex A

Calculations of Sewage Generation

1A Estimation of Sewage Flow from the Pre-Existing Development			**Notes**
Total Industrial Area (GFA)	7,100	m^2	
Assumed worker density	2.3	workers per 100 m^2	Refer to worker density for "Manufacturing" in Table 8 of CIFSUS [(a)].
Total number of employees	163.3	persons	
Unit flow	0.73	m^3/person/day	Refer to the planning unit flow factor for "Industrial Employee" + "Industrial Activities: J1 Manufacturing - Tsuen Wan, Kwai Chung" in Table T-3 of GESF [(b)].
Estimated daily flow	119.2	m^3/day	
Total estimated daily flow	**119.2**	m^3/day	
Catchment inflow factor	1.1		Refer to the Catchment Inflow Factor for "Kwai Chung" in Table T-4 of GESF [(b)].
Estimated daily flow including catchment inflow factor	**131.1**	m^3/day	

1B Estimation of Sewage Flow from the Proposed Development			**Notes**
i) Generation from Employees Activities for Office			
Total Office Area (GFA)	7,793	m^2	
Assumed floor area per person	20	m^2/person	Refer to the worker density for "Business Use" in Table 2 of Chapter 5, HKPSG [(c)].
Total number of employees	389.7	persons	
Unit flow	0.28	m^3/person/day	Refer to the planning unit flow factor for "Commercial Employee" + "Commercial Activities: General–territorial average" in Table T-2 of GESF [(b)].
Estimated daily flow	109.1	m^3/day	
ii) Generation from Employees Activities for Eating Place and Shop & Services			
Total Area of Eating Place and Shop & Services	433	m^2	
Assumed total Area of Eating Place (GFA)	433	m^2	Assume 100% area of "Eating Place and Shop & Services" is used for eating place as a worst-case scenario.
Assumed worker density	5.1	workers per 100 m^2	Refer to worker density for "Restaurants" in Table 8 of CIFSUS [(a)].
Total number of employees	22.1	persons	
Unit flow	1.58	m^3/person/day	Refer to the planning unit flow factor for "Commercial Employee" + "Commercial Activities J10 - Restaurants & Hotels" in Table T-2 of GESF [(b)].
Estimated daily flow	34.9	m^3/day	
iii) Generation from Employees Activities for Property Management			
Total number of employees	10	persons	
Unit flow	0.28	m^3/person/day	Refer to the planning unit flow factor for "Commercial Employee" + "Commercial Activities: General–territorial average" in Table T-2 of GESF [(b)].
Estimated daily flow	2.8	m^3/day	
Total estimated daily flow	**146.8**	m^3/day	
Catchment inflow factor	1.1		Refer to the Catchment Inflow Factor for "Kwai Chung" in Table T-4 of GESF [(b)].
Estimated daily flow including catchment inflow factor	**161.5**	m^3/day	

	Generation from Catchment A			**Notes**
2A	**i Tech Tower (24-32 Pak Tin Par Street)**			
	Total Storage Area (GFA)	17,700	m^2	
	Assumed worker density	0.4	workers per 100 m^2	Refer to worker density for "Storage" in Table 8 of CIFSUS [(a)].
	Total number of employees	70.8	persons	
	Unit flow	0.18	m^3/person/day	Refer to the planning unit flow factor for "Commercial Employee" + "Commercial Activities: J3 Transport, Storage & Communication" in Table T-2 of GESF [(b)].
	Estimated daily flow	12.7	m^3/day	
2B	**The Mills (41-47 Pak Tin Par Street)**			
i)	**Generation from Employees Activities for Retail**			
	Total Retail Area (GFA)	1,220	m^2	
	Assumed worker density	3.5	workers per 100 m^2	Refer to worker density for "Retail Trade" in Table 8 of CIFSUS [(a)].
	Total number of employees	42.7	persons	
	Unit flow	0.28	m^3/person/day	Refer to the planning unit flow factor for "Commercial Employee" + "Commercial Activities: J4 Wholesale & Retail" in Table T-2 of GESF [(b)].
	Estimated daily flow	12.0	m^3/day	
ii)	**Generation from Employees Activities for Fashion Gallery & Design Training Centre**			
	Total Fashion Gallery & Design Training Centre Area (GFA)	1,220	m^2	
	Assumed worker density	3.3	workers per 100 m^2	Refer to worker density for "Community, Social & Personal Services" in Table 8 of CIFSUS [(a)].
	Total number of employees	40.3	persons	
	Unit flow	0.28	m^3/person/day	Refer to the planning unit flow factor for "Commercial Employee" + "Commercial Activities: J11 Community, Social & Personal Services" in Table T-2 of GESF [(b)].
	Estimated daily flow	11.3	m^3/day	
iii)	**Generation from Employees Activities for Restaurant**			
	Total Restaurant Area (GFA)	610	m^2	
	Assumed worker density	5.1	workers per 100 m^2	Refer to worker density for "Restaurants - All Types" in Table 8 of CIFSUS [(a)].
	Total number of employees	31.1	persons	
	Unit flow	1.58	m^3/person/day	Refer to the planning unit flow factor for "Commercial Employee" + "Commercial Activities J10 - Restaurants & Hotels" in Table T-2 of GESF [(b)].
	Estimated daily flow	49.2	m^3/day	
2C	**Goodwill Industrial Building (36-44 Pak Tin Par Street)**			
	Total Industrial Area (GFA)	13,800	m^2	
	Assumed worker density	2.3	workers per 100 m^2	Refer to worker density for "Manufacturing" in Table 8 of CIFSUS [(a)].
	Total number of employees	317.4	persons	
	Unit flow	0.73	m^3/person/day	Refer to the planning unit flow factor for "Industrial employee" + "Industrial activities: J1 Manufacturing - Tsuen Wan, Kwai Chung" in Table T-3 of GESF [(b)].
	Estimated daily flow	231.7	m^3/day	
	Total estimated daily flow	**316.8**	m^3/day	
	Catchment inflow factor	1.1		Refer to the Catchment Inflow Factor for "Kwai Chung" in Table T-4 of GESF [(b)].
	Estimated daily flow including catchment inflow factor	**348.5**	m^3/day	

	Generation from Catchment B			
3A	**Wah Lik Industrial Centre (459-469 Castle Peak Road - Tsuen Wan)**			
	Total Industrial Area (GFA)	37,100	m^2	
	Assumed worker density	2.3	workers per 100 m^2	Refer to worker density for "Manufacturing" in Table 8 of CIFSUS (a).
	Total number of employees	853.3	persons	
	Unit flow	0.73	m^3/person/day	Refer to the planning unit flow factor for "Industrial employee" + "Industrial activities: J1 Manufacturing - Tsuen Wan, Kwai Chung" in Table T-3 of GESF (b).
	Estimated daily flow	622.9	m^3/day	
3B	**Wah Wai Industrial Building (53-61 Pak Tin Par Street)**			
	Total Industrial Area (GFA)	28,800	m^2	
	Assumed worker density	2.3	workers per 100 m^2	Refer to worker density for "Manufacturing" in Table 8 of CIFSUS (a).
	Total number of employees	662.4	persons	
	Unit flow	0.73	m^3/person/day	Refer to the planning unit flow factor for "Industrial employee" + "Industrial activities: J1 Manufacturing - Tsuen Wan, Kwai Chung" in Table T-3 of GESF (b).
	Estimated daily flow	483.6	m^3/day	
	Total estimated daily flow	**1,106.5**	m^3/day	
	Catchment inflow factor	1.1		Refer to the Catchment Inflow Factor for "Kwai Chung" in Table T-4 of GESF (b).
	Estimated daily flow including catchment inflow factor	**1,217.1**	m^3/day	
4	**TCL Tower (8 Tai Chung Road)**			**Notes**
	Total Industrial Area (GFA)	16,700	m^2	
	Assumed worker density	2.3	workers per 100 m^2	Refer to worker density for "Manufacturing" in Table 8 of CIFSUS (a).
	Total number of employees	384.1	persons	
	Unit flow	0.73	m^3/person/day	Refer to the planning unit flow factor for "Industrial employee" + "Industrial activities: J1 Manufacturing - Tsuen Wan, Kwai Chung" in Table T-3 of GESF (b).
	Estimated daily flow	280.4	m^3/day	
	Total estimated daily flow	**280.4**	m^3/day	
	Catchment inflow factor	1.1		Refer to the Catchment Inflow Factor for "Kwai Chung" in Table T-4 of GESF (b).
	Estimated daily flow including catchment inflow factor	**308.4**	m^3/day	

Note:

(a) CIFSUS - "*Commercial and Industrial Floor Space Utilization Survey*" published by Planning Department (PlanD).

(b) GESF - "*Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning* " published by Environmental Protection Department (EPD).

(c) HKPSG – "*Hong Kong Planning Standards and Guidelines* " published by PlanD.

Annex B - Calculations of Sewer Capacities - Existing Conditions Without Up-grading

Sewer Pipe	Manhole No.		Length	Level (in)	Level (out)	d	Aw	Ks (1)		v	s	g	V	Qc	Qd	PF (2)	Qp	Is Qc>Qp ?	% of capacity	Notes
	upstream	downstream	m	mPD (*)		m	m2	m	mm	m2/sec	--	m/s2	m/s	m3/s	l/s	--	m3/s	Y / N	%	
A0-A1	FTH4000540	FMH4005679	8.5	3.86	3.85	0.225	0.040	0.0030	3.0000	1.14E-06	0.001	9.806	0.322	0.013	12.37	8	0.099	N	773.07%	Qd = estimated daily flow of the proposed development.
A1-A2	FMH4005679	FMH4005678	2.5	3.79	3.78	0.450	0.159	0.0006	0.6000	1.14E-06	0.004	9.806	1.280	0.204	16.40	6	0.098	Y	48.24%	Qd = estimated daily flow of the proposed development and Catchment A.
A2 - A3	FMH4005678	FMH4005677	2.5	3.73	3.72	0.450	0.159	0.0006	0.6000	1.14E-06	0.004	9.806	1.280	0.204	16.40	6	0.098	Y	48%	Qd = estimated daily flow of former segment A1-A2.
A3-A4	FMH4005677	FMH4005676	3.5	3.71	3.63	0.450	0.159	0.0006	0.6000	1.14E-06	0.023	9.806	3.090	0.491	16.40	6	0.098	Y	20%	Qd = estimated daily flow of former segment A2-A3.
A4-A5	FMH4005676	FMH4005852	8.6	3.6	3.57	0.450	0.159	0.0018	1.8000	1.14E-06	0.003	9.806	0.961	0.153	16.40	6	0.098	Y	64%	As no invert level is provided at manhole A5 on the drainage record, the invert level is estimated by interpolation between manholes A4 and A11. Qd = estimated daily flow of former segment A3-A4.
A5-A6	FMH4005852	FMH4005844	14.3	3.57	3.53	0.450	0.159	0.0018	1.8000	1.14E-06	0.003	9.806	0.961	0.153	16.40	6	0.098	Y	64%	As no invert level is provided at manholes A5 and A6 on the drainage record, the invert level is estimated by interpolation between manholes A4 and A11. Qd = estimated daily flow of former segment A4-A5.
A6-A7	FMH4005844	FMH4005845	10.2	3.53	3.50	0.450	0.159	0.0018	1.8000	1.14E-06	0.003	9.806	0.961	0.153	30.49	6	0.183	N	120%	As no invert level is provided at manholes A6 and A7 on the drainage record, the invert level is estimated by interpolation between manholes A4 and A11. Qd = estimated daily flow of former segment A5-A6 and Catchment B.
A7-A8	FMH4005845	FMH4005846	10	3.50	3.47	0.450	0.159	0.0018	1.8000	1.14E-06	0.003	9.806	0.961	0.153	30.49	6	0.183	N	120%	As no invert level is provided at manholes A7 and A8 on the drainage record, the invert level is estimated by interpolation between manholes A4 and A11. Qd = estimated daily flow of former segment A6-A7.
A8-A9	FMH4005846	FMH4005847	10	3.47	3.44	0.450	0.159	0.0018	1.8000	1.14E-06	0.003	9.806	0.961	0.153	30.49	6	0.183	N	120%	As no invert level is provided at manholes A8 and A9 on the drainage record, the invert level is estimated by interpolation between manholes A4 and A11. Qd = estimated daily flow of former segment A7-A8.
A9-A10	FMH4005847	FMH4005848	5.8	3.44	3.42	0.450	0.159	0.0018	1.8000	1.14E-06	0.003	9.806	0.961	0.153	30.49	6	0.183	N	120%	As no invert level is provided at manholes A9 and A10 on the drainage record, the invert level is estimated by interpolation between manholes A4 and A11. Qd = estimated daily flow of former segment A8-A9.
A10-A11	FMH4005848	FMH4005675	12.6	3.42	3.38	0.450	0.159	0.0018	1.8000	1.14E-06	0.003	9.806	0.961	0.153	34.06	6	0.204	N	134%	As no invert level is provided at manhole A10 on the drainage record, the invert level is estimated by interpolation between manholes A4 and A11. Qd = estimated daily flow of former segment A9-A10 and TCL Tower.
A11-A12	FMH4005675	FMH4005739	14.1	3.35	2.84	0.450	0.159	0.0006	0.6000	1.14E-06	0.036	9.806	3.870	0.615	34.06	5	0.170	Y	28%	Qd = estimated daily flow of former segment A10-A11.

Note:

(1) Assume k s is at "Poor" condition for the existing sewer.

(2) Adopted Peaking Factor (PF) is based on the contributing population of the upstream development(s) and referred to Table T-5 of GESF.

Legend

Aw = wetted area, m 2

k s = equivalent sand roughness, m

v = kinematic viscosity of fluid, m 2 /s

s = slope of the total energy line

g = gravitational acceleration, m/s 2

V = velocity of flow calculated based on Colebrook-White Equation, m/s

Qc = flow capacity, m 3 /s

Qd = estimated cumulative daily flow, m 3 /day

PF = Peaking Factor

Qp = estimated cumulative peak flow, m 3 /s

$$Q=-2\sqrt{2gDS}\log\left[\frac{ks}{3.7D}+\frac{2.51v}{D\sqrt{2gDS}}\right]A$$

Annex C - Assessmenet of Public Sewers - Existing Conditions With Up-grading

Sewer Pipe	Manhole No.		Length	Level (in)	Level (out)	d	Aw	Ks (1)		v	s	g	V	Qc	Qd	PF (2)	Qp	Is Qc>Qp ?	% of capacity	Notes
	upstream	downstream	m	mPD (*)		m	m2	m	mm	m2/sec	--	m/s2	m/s	m3/s	m3/day	--	m3/s	Y / N	%	
A0-A1	FTH4000540	FMH4005679	8.5	3.86	3.85	0.450	0.159	0.0006	0.6000	1.14E-06	0.001	9.806	0.635	0.101	1,068.69	8	0.099	Y	97.97%	Qd = estimated daily flow of the proposed development.
A1-A2	FMH4005679	FMH4005678	2.5	3.79	3.78	0.450	0.159	0.0006	0.6000	1.14E-06	0.004	9.806	1.280	0.204	1417.194	6	0.098	Y	48.24%	Qd = estimated daily flow of the proposed development and Catchment A.
A2 - A3	FMH4005678	FMH4005677	2.5	3.73	3.72	0.450	0.159	0.0006	0.6000	1.14E-06	0.004	9.806	1.280	0.204	1417.194	6	0.098	Y	48%	Qd = estimated daily flow of former segment A1-A2.
A3-A4	FMH4005677	FMH4005676	3.5	3.71	3.63	0.450	0.159	0.0006	0.6000	1.14E-06	0.023	9.806	3.090	0.491	1417.194	6	0.098	Y	20%	Qd = estimated daily flow of former segment A2-A3.
A4-A5	FMH4005676	FMH4005852	8.6	3.6	3.57	0.450	0.159	0.0018	1.8000	1.14E-06	0.003	9.806	0.961	0.153	1417.194	6	0.098	Y	64%	As no invert level is provided at manhole A5 on the drainage record, the invert level is estimated by interpolation between manholes A4 and A11. Qd = estimated daily flow of former segment A3-A4.
A5-A6	FMH4005852	FMH4005844	14.3	3.57	3.53	0.450	0.159	0.0018	1.8000	1.14E-06	0.003	9.806	0.961	0.153	1417.194	6	0.098	Y	64%	As no invert level is provided at manholes A5 and A6 on the drainage record, the invert level is estimated by interpolation between manholes A4 and A11. Qd = estimated daily flow of former segment A4-A5.
A6-A7	FMH4005844	FMH4005845	10.2	3.53	3.50	0.525	0.159	0.0006	0.6000	1.14E-06	0.003	9.806	1.220	0.264	2634.294	6	0.183	Y	69%	As no invert level is provided at manholes A6 and A7 on the drainage record, the invert level is estimated by interpolation between manholes A4 and A11. Qd = estimated daily flow of former segment A5-A6 and Catchment B.
A7-A8	FMH4005845	FMH4005846	10	3.50	3.47	0.525	0.159	0.0006	0.6000	1.14E-06	0.003	9.806	1.220	0.264	2634.294	6	0.183	Y	69%	As no invert level is provided at manholes A7 and A8 on the drainage record, the invert level is estimated by interpolation between manholes A4 and A11. Qd = estimated daily flow of former segment A6-A7.
A8-A9	FMH4005846	FMH4005847	10	3.47	3.44	0.525	0.159	0.0006	0.6000	1.14E-06	0.003	9.806	1.220	0.264	2634.294	6	0.183	Y	69%	As no invert level is provided at manholes A8 and A9 on the drainage record, the invert level is estimated by interpolation between manholes A4 and A11. Qd = estimated daily flow of former segment A7-A8.
A9-A10	FMH4005847	FMH4005848	5.8	3.44	3.42	0.525	0.159	0.0006	0.6000	1.14E-06	0.003	9.806	1.220	0.264	2634.294	6	0.183	Y	69%	As no invert level is provided at manholes A9 and A10 on the drainage record, the invert level is estimated by interpolation between manholes A4 and A11. Qd = estimated daily flow of former segment A8-A9.
A10-A11	FMH4005848	FMH4005675	12.6	3.42	3.38	0.525	0.159	0.0006	0.6000	1.14E-06	0.003	9.806	1.220	0.264	2942.694	6	0.204	Y	77%	As no invert level is provided at manhole A10 on the drainage record, the invert level is estimated by interpolation between manholes A4 and A11. Qd = estimated daily flow of former segment A9-A10 and TCL Tower.
A11-A12	FMH4005675	FMH4005739	14.1	3.35	2.84	0.525	0.159	0.0006	0.6000	1.14E-06	0.036	9.806	4.260	0.923	2942.694	6	0.204	Y	22%	Qd = estimated daily flow of former segment A10-A11.

Note:

(1) Assume k s is at "Poor" condition for the existing sewer.

(2) Adopted Peaking Factor (PF) is based on the contributing population of the upstream development(s) and referred to Table T-5 of GESF.

Legend

Aw = wetted area, m 2

k s = equivalent sand roughness, m

v = kinematic viscosity of fluid, m 2 /s

s = slope of the total energy line

g = gravitational acceleration, m/s 2

V = velocity of flow calculated based on Colebrook-White Equation, m/s

Qc = flow capacity, m 3 /s

Qd = estimated cumulative daily flow, m 3 /day

PF = Peaking Factor

Qp = estimated cumulative peak flow, m 3 /s

$$Q=-2\sqrt{2gDS}\log\left[\frac{ks}{3.7D}+\frac{2.51v}{D\sqrt{2gDS}}\right]A$$