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6 SEWERAGE AND SEWAGE TREATMENT IMPLICATIONS

6.1 Introduction

6.1.1 This section presents the assessment on the potential sewerage and sewage treatment implications associated with the construction and operation of the Project. The sewerage and sewage treatment implications have been assessed in accordance with the criteria and guidelines on Annexes 6 and 14 of the Environmental Impact Assessment Process, the requirements of WPCO and the requirements in Section 3.4.6 and Appendix E of the EIA Study Brief (ESB-363/2023).

6.2 Population and Employment Data

Sewage Catchments in North-East New Territories

6.2.1 There is no existing sewerage system near the Development Area. According to the approved EIA report for San Tin Technopole (STT) (Register No.: AEIAR-261/2024), San Tin Effluent Polishing Plant (EPP) is planned under the project. The expected commissioning year of the planned San Tin EPP is in 2031. Sewage generated by the Project would be pumped from the proposed on-site sewage pumping station (SPS) to the San Tin EPP for treatment.

6.2.2 As advised by the Sewerage Infrastructure Group of EPD (EPD/SIG), a total sewage flow of about 15,000 m^3/day discharged from the existing adjacent villages should be collected by the proposed sewerage system under the Project, subject to further review in later stage. In the initial stage, a capacity of 4,000 m^3/day will be reserved in the proposed SPS of the Project for adjacent existing villages and the capacity for adjacent existing villages would ultimately be increased to 15,000 m^3/day after a potential upgrading works at Site G.1 when such need arises.

Population and Employment for Estimation of Sewage Flow

6.2.3 For technical assessments under the Study, a 0% home space enhancement (i.e. 50 m^2 for public housing and 75 m^2 for private housing) was adopted as a more conservative approach. The approximate population of the Project adopted in this assessment is summarised in **Table 6.1**.

Table 6.1 Population Summary of the Project in Recommended Outline Development Plan

	Population	
	Base Case	**Sensitivity Test Scenario**
Residential	38,500	42,200
Employment	26,000	35,700

6.3 Methodology of Sewerage Impact Assessment

Unit Flow Factors

6.3.1 The sewage flows are estimated using unit flow factor (UFF) in Tables T-1 and T-2 of EPD's Guidelines for Estimating Sewage Flows for Sewerage Infrastructure Planning Version 1.0 (GESF). With reference to the GESF, commercial flows comprise flows due to commercial activities and employees. The total UFF is the sum of UFF for employee plus various commercial activities, i.e. J2 to J12 as defined in Table T-2 of

GESF. The unit flows factors that were used to estimate the sewage flows from the Project are listed in **Table 6.2** below.

Table 6.2 Unit Flow Factors for Residential and Commercial Population from GESF

Description	Type	Unit	UFF per Employee (m^3/day)	UFF for Commercial Activities (m^3/day)	Total Unit Flow Factors (UFF) (m^3/day)
Domestic Flows					
Dedicated Rehousing Estate	Private Housing (R2)	Person	/	/	0.27
Private Housing/ Staff Quarter/ Residential Social Welfare Facilities	Private Housing (R2)	Person	/	/	0.27
Student, Hospital and Commercial Flows					
Student	-	Person	/	/	0.04
Hospital Bed	-	Person	/	/	1.25(1)
Wet Lab Staff	J2	Employee	0.08	0.25	0.33
Wet Lab Admin Staff	J6	Employee	0.08	/	0.08
Dry Lab Staff	General	Employee	0.08	0.20	0.28
Dry Lab Admin Staff	J6	Employee	0.08	/	0.08
General Employee	General	Employee	0.08	0.20	0.28

Note:
(1) Referenced from Appendix I of GESF issued by EPD.

Catchment Inflow Factors

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

Peaking Factors

6.3.3 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 EPD's GESF.

6.3.4 Under normal condition, peaking factors (excluding stormwater allowance) are applicable to planning sewage facilities receiving flow from new upstream sewage systems which essentially have no misconnections and defects for infiltration. If the service conditions of the upstream sewage systems for the planning horizons under considerations are unclear, peaking factors (including stormwater allowance) shall be used.

6.3.5 **Table 6.3** below shows the peaking factors for various population range (including and excluding stormwater allowance) for design of sewer and sewage treatment works.

Table 6.3 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
Sewers		
<1000	8	6
1,100 – 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)
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)

Note:
(1) N = Contributing population in thousands
Contributing population = Calculated total average flow (m^3/day) / 0.27 (m^3/person/day)

6.3.6 The peaking factors (excluding stormwater allowance) should be adopted for the gravity sewer, sewage pumping station and sewage rising mains because the proposed sewerage facilities of the Project will only receive flow from new upstream sewer systems which should have no misconnections and defects for infiltration.

6.4 Existing and Planned Sewerage Infrastructure

Existing and Planned Sewerage Infrastructure

6.4.1 There is no existing sewerage system near the Development Area. Sewage generated by the Project would be pumped from the proposed on-site SPS to the planned San Tin EPP for treatment.

Interface with Planned Sewerage System

6.4.2 Planned sewerage network for the future Ngau Tam Mei (NTM) Station and its associated railway facility (i.e. Ngau Tam Mei Depot (NTD)) under Northern Link (NOL) Main Line (by MTRCL) is anticipated. In the sewerage network design under the Project, it has been planned that the sewage discharged from the operation of NTM Station and NTD will be collected by sewerage under the Project.

6.5 Estimation of Sewage Discharge

Estimated Sewage Discharge from the Development Area

6.5.1 Based on the design parameters and assumptions discussed in **Section 6.3**, the estimated sewage discharge from the Project is summarised in **Table 6.4**.

Table 6.4 Summary of Estimated Sewage Discharge from the Project

Land Use	Total Unit Flow Factor[(1)] (m^3/head/day)	Population/ Employment[(4)]	Total Average Dry Weather Flow (ADWF) (m^3/day)
Dedicated Rehousing Estate (R1)	0.27	2,352	635
Private Housing (R2)	0.27	38,491	10,393
Staff Quarters[(5)] (R2)	0.27	1,331	359
Post-Secondary Hostel Place[(6)] (R2)	0.27	28,196	7,613
Student[(7)]	0.04	49,892	1,996
Wet Lab Staff (J2)	0.33	1,760	581
Wet Lab Admin Staff (J6)	0.08	440	35
Dry Lab Staff (General)	0.28	3,520	986
Dry Lab Admin Staff (J6)	0.08	880	70
Hospital Bed	1.25	3,030	3,788
General Employee	0.28	29,088	8,145
Centralised Cooling Systems for UniTown and Integrated Hospital	/	/	2,101[(2)]
NOL Development	/	/	459[(3)]
		Sub-total	37,159[(8)]
		Total ADWF (with 10% contingency) (m^3/day)	**40,875**

Notes:
(1) Total UFF refers to **Table 6.2**.
(2) The predicted daily wastewater discharge is based on its water consumption.
(3) According to the approved NOL EIA report (Register No.: AEIAR-259/2024), the total ADWF of railway facilities within the Development Area (i.e. NTM Station and NTD) under normal operation is 459 m^3/day.
(4) Population/employment figure adopted in this table is based on the sensitive test scenario.
(5) "Staff Quarter" refers to staff quarter to be provided at Site G.5.
(6) "Post-Secondary Hostel Place" refers to staff quarter and student hostel place to be provided by UniTown.
(7) "Student" refers to students studying in UniTown, proposed kindergarten, and proposed primary and secondary schools.
(8) Value may not be exactly sum up due to the round-off of ADWF in each land use.

6.5.2 With addition of sewage discharge from existing adjacent villages as mentioned in **Section 6.2.2**, the sewage generated within the Development Area will reach approximately 44,875 m^3/day (**Table 6.5** refers). Taking into account the additional sewage flow from the existing adjacent villages (i.e. 11,000 m^3/day), the total sewage generated from the entire Ngau Tam Mei Area (NTMA) will be 55,875 m^3/day in the long term. A buildup of the sewage flow with reference to the population intake based on the Recommended Outline Development Plan (RODP) is shown in **Table 6.6**.

Table 6.5 Summary of Estimated Sewage Discharge

Description	Total ADWF (m^3/day)
Total Sewage Flow from the Project (with 10% contingency)	40,875
Sewage Flow from Existing Adjacent Villages (Initial Stage)	4,000
Sub-total	**44,875**

Description	Total ADWF (m^3/day)
Additional Sewage Flow from Existing Adjacent Villages (Long Term)	11,000
Total	**55,875**

Table 6.6 Build Up of the Sewage Flow within NTMA (1)

Population Intake Year	Cumulative ADWF (m^3/day) (2)
2034	11,013
2036	40,875

Note:
(1) With reference to **Section 2**, the first population intake of the Project will be in Year 2033 for the Dedicated Rehousing Estate (DRE) site within where temporary sewerage arrangement (i.e. septic tank) will be provided. The DRE site will be permanently connected to the proposed sewerage system of the Project in Year 2034.
(2) 10% contingency is added in ADWF for sewerage design.

6.6 Proposed Sewerage Scheme

6.6.1 Sewage collected within the sewerage system under the Project will be conveyed to the proposed on-site SPS with a capacity of 44,875 m^3/day, equivalent to peak flow of 0.97 m^3/s, and to be discharged to San Tin EPP for treatment. Space has been reserved for potential upgrade to 55,875 m^3/day to cater the additional sewage flow from adjacent existing villages in the long term.

6.6.2 The land requirement for the proposed on-site SPS with centrifugal pumps differs significantly from wet well type and wet/dry well type installations. For land reservation purposes, the required land should be estimated from the existing SPSs of similar capacity. **Table 6.7** and **Table 6.8** below are derived from the land uptake of some existing SPSs. The land required for the proposed SPS will be approximately 0.14 ha. The proposed SPS will be located at Site G.1 which is of 0.37 ha. Location of the proposed SPS is shown in **Exhibit 6-1**.

Table 6.7 Summary of Sewage Peak Flow designed for the Proposed SPS

Pumping Capacity (m^3/s)	Area (m^2)
Not exceeding 0.15	400
0.15 – 0.35	400 – 900
0.35 – 1.00	900 – 1400
1.00 – 4.50	1400 – 2500
4.50 – 7.50	2500 – 4000

Table 6.8 Wet Well Arrangement

Pumping Capacity (m^3/s)	Area (m^2)
Not exceeding 0.15	300
0.15 – 0.35	300 – 800
0.35 – 1.00	800 – 1200

6.6.3 The sewage from the proposed SPS will be pumped to San Tin EPP directly via a twin rising mains to be laid across underneath existing roads (e.g. San Tin Highways, cycle track of Castle Peak Road – Mai Po or San Tam Road) and end at San Tin EPP. The connection level of the rising mains at San Tin EPP is subject to further coordination with Drainage Services Department (DSD). A preliminary hydraulic assessment is provided in **Table 6.9**.

Table 6.9 Preliminary Hydraulic Assessment of Rising Main

ADWF (m^3/day)	Peaking Factor	Peak Flow (m^3/s)	Pipe Size(1) (DN) (mm)	Flow Velocity (m^3/s)
44,875	1.86	0.97	680	1.33

Note:
(1) Internal pipe diameter is subjected to change of actual soil cover for the rising main, standard dimension ratio of 13.6 is used for conservative design purpose

6.6.4 Based on the approved EIA report for San Tin Technopole (STT) (Register No.: AEIAR-261/2024), the sewage generated by STT would be approximately 98,700 m^3/day. Taking into the consideration of the sewage from the Project as well as sewage from other nearby projects, there would be potential shortfall of design capacity of San Tin EPP (i.e. larger than 125,000 m^3/day), and thus the sewage from the Project that could be delivered to San Tin EPP would be subject to the residual capacity of the San Tin EPP. Subject to the detailed design stage of the Project, in the event that the estimated sewage generation from the Project exceeds San Tin EPP's design capacity, other possible mitigation measures as mentioned below should be considered.

6.6.5 Possible measures in mitigating the potential shortfall in the long term could include the provision of another sewerage network to allow sewage from the proposed on-site SPS to be diverted to the existing Nam Sang Wai (NSW) SPS and ultimately to Yuen Long EPP, subject to detailed design stage. Relevant technical studies for the associated sewerage network will be reviewed in detailed design stage during which more design/development information is available, and agreement will be sought on the sewage quantity that needs to be diverted to NSW SPS.

6.6.6 As mentioned in **Section 6.2.2**, the sewage discharge from nearby existing villages would be increased from 4,000 m^3/day to ultimately 15,000 m^3/day, subject to further review in later stage. Therefore, the capacity of the proposed on-site SPS will be potentially upgraded from 44,875 m^3/day to 55,875 m^3/day, when the sewerage network is ready in future for diverting the sewage generated from the nearby existing villages to the proposed SPS. On top of 0.14 ha allowed for the proposed SPS mentioned in **Section 6.6.2**, an additional land of 0.07 ha would be required for the potential upgrade of capacity. The RODP has allowed 0.37 ha at Site G.1 to serve sufficient flexibility for future upgrade to cater the sewage discharge from the existing nearby villages.

6.6.7 The preliminary list of responsible parties of the proposed sewerage and sewage treatment facilities is shown in **Table 6.10**.

Table 6.10 Preliminary List of Responsible Parties of the Proposed Sewerage and Sewage Treatment Facilities

Sewerage/Sewage Treatment Facilities	Parties Responsible for Construction	Parties Responsible for Maintenance
SPS and twin rising mains	CEDD (subject to review during detailed design stage)	DSD (subject to review during detailed design stage)

6.7 Proposed Emergency Bypass

6.7.1 There will also be an emergency bypass discharged to NTM Drainage Channel, and ultimately discharged to Deep Bay control zone. Location of the proposed on-site SPS and the routing of emergency bypass are shown in **Exhibit 6-1**.

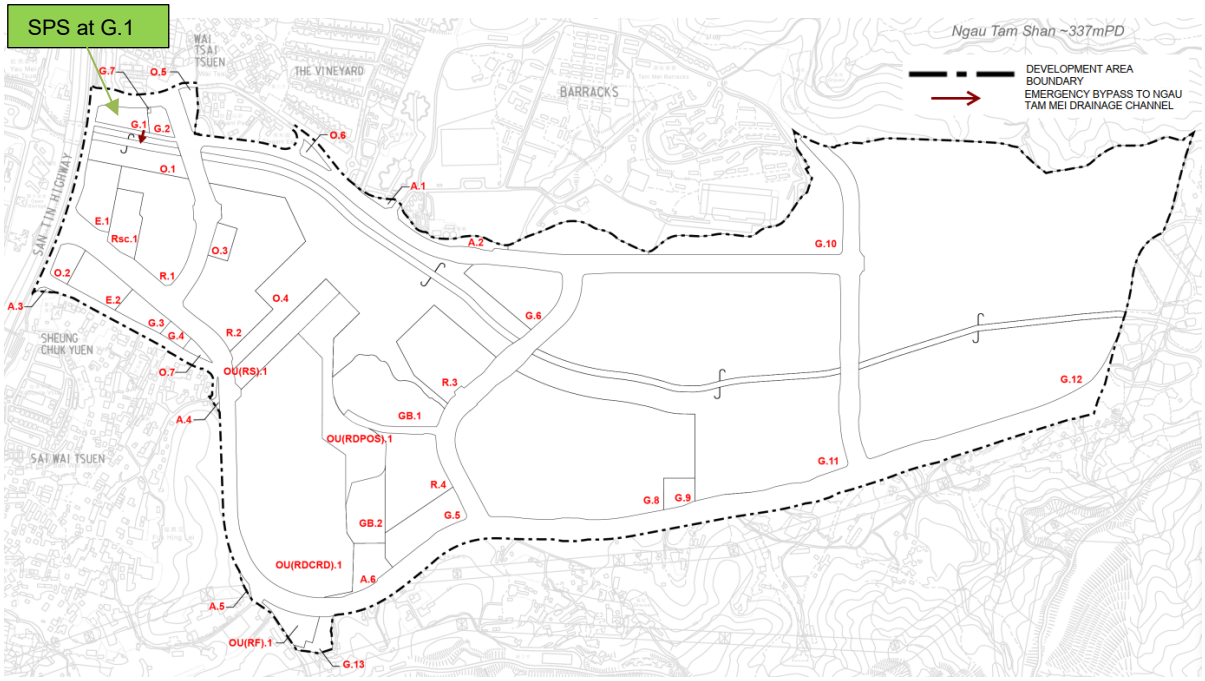

Exhibit 6-1 Proposed Location of SPS and Emergency Bypass Alignment

6.8 Implementation Phasing

6.8.1 The DRE site with population intake in Year 2033 will have its own temporary sewerage arrangement and will permanently connect to the proposed sewerage system of the Project in Year 2034. The full sewage discharge buildup is expected to be in Year 2036 for full population intake.

6.9 Potential Impacts by the Proposed Sewerage System

6.9.1 For the proposed SPS and rising mains serving Development Area, those facilities have to be completed and commissioned early on the Development Area, but it can be years before they receive the design flows from full occupancy of the Development Area. This results in low flows entering the wet well and long retention times in the rising mains give the opportunity for bacteria to multiply in the anaerobic conditions in which formation of Hydrogen Sulphide would occur.

6.9.2 Odour impact is one of the possible impacts generated from the operation of the sewage system. The main odour nuisances can be attributed to the wet wells/ retention tanks of the proposed SPS. Use of chemical dosing to oxygen injection for septicity control should be considered in the detailed design.

6.10 Recommended Mitigation Measures

6.10.1 Sewage septicity control measures should be considered for the proposed SPS and rising mains. Non-dosing solutions should be considered prior to dosing solutions.

6.10.2 At this preliminary stage, direct injection of oxygen into the rising mains and pre-aeration in the wet well of the proposed SPS should be adopted as the sewage septicity control measures with details to be addressed in the detailed design stage.

6.10.3 Enclosing the proposed SPS inside a building structure is considered as an odour mitigation measure. The structure should be equipped with adequate odour control measures such as scrubber and activated charcoal filter at the exhaust of the ventilation system. The vent should be located away from both existing and planned air sensitive uses as far as practicable.

6.11 Conclusion

6.11.1 There is no existing sewerage system near the Development Area. An on-site SPS with a capacity of 44,875 m^3/day, requiring 0.14 ha land, is proposed to cater for the sewage generated from the Project including the operation of future NOL Main Line (i.e. 504 m^3/day, with 10% contingency) and the existing villages (i.e. 4,000 m^3/day) in initial stage. Subject to residual capacity of San Tin EPP, the collected sewage could be pumped from the proposed SPS to San Tin EPP for treatment.

6.11.2 Since there will be a potential shortfall in the long term for the sewage treatment capacity in San Tin EPP, potential mitigation measure such as providing another sewerage network to allow diversion of sewage from the proposed on-site SPS to NSW SPS could be considered, subject to detailed design in the next stage of the Project.

6.11.3 The sewage discharge from nearby existing villages would be increased from 4,000 m^3/day to ultimately 15,000 m^3/day at the proposed on-site SPS in the long term, subject to further review in later stage. As such, the proposed on-site SPS would be further upgraded from 44,875 m^3/day to 55,875 m^3/day when need arises. Space has been reserved at Site G.1 for the potential upgrade.

6.11.4 Sewage septicity control measures should be considered for the proposed SPS and the associated sewerage system. Non-dosing solutions should be considered prior to dosing solutions.

6.11.5 Based on the findings of preliminary sewerage impact assessment as described in this section, it is anticipated that the proposed developments under the Project would be sustainable from sewerage collection, treatment and disposal perspective, and thus there would be no identified insurmountable sewerage and sewage treatment implications arising from the Project.