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Appendix XII
Sewerage Impact Assessment

D02/01 Sewerage Impact Assessment

S12A Rezoning Application for Sai Lam Temple, at Lot Nos. 63, 296 (Part), 331 RP (Part) & 393 S.B. (Part) in D.D. 185, Sheung Wo Che No. 198, Sha Tin

Prepared for Sai Lam (Salvation) Foundation Limited
23 May 2022

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This report is confidential and is provided solely for the purposes of supporting S12A Rezoning Application for Sai Lam Temple, at Lot Nos. 63, 296 (Part), 331 RP (Part) & 393 S.B. (Part) in D.D. 185, Sheung Wo Che No. 198, Sha Tin. This report is provided pursuant to a Consultancy Agreement between SMEC Asia Limited ("SMEC") and Sai Lam (Salvation) Foundation Limited, under which SMEC undertook to perform specific and limited tasks for Sai Lam (Salvation) Foundation Limited. This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications and limitations in it and does not apply by implication to other matters. SMEC makes no representation that the scope, assumptions, qualifications and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes.

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1 INTRODUCTION

1.1 Background

1.1.1 "Sai Lam Temple" comprising Sam Yuen Kung (the Site) is located at Lots Nos. 63, 296 (Part), 331 RP (Part) and 393 S.B (Part) in D.D. 185, Sheung Wo Che No. 198, Sha Tin. It is operated by "Sai Lam (Salvation) Foundation Limited" (the Applicant). As advised by the Applicant, the Site including Sai Lam Temple and Sam Yuen Kung Temple has a long history of community and religious uses since both Sai Lam Temple and Sam Yuen Kung Temple have been built in the 1920s. The Site is currently occupied by worship hall as well as columbarium use that can accommodate up to 10,960 niches.

1.1.2 The Site is zoned "Village Type Development" ("V") under the draft Sha Tin Outline Zoning Plan (OZP) No. S/ST/35. In order to continue the current operation of the Site, it is proposed to rezone the Site from "V" to "Government, Institution or Community (1)" ("(G/IC(1)") under Section 12A of the *Town Planning Ordinance* (TPO). This rezoning application is compatible with the existing land use in Sheung Wo Che, which is a traditional religious district in Sha Tin. The continued operation of the columbarium can also help resolve the currently significant shortage of columbarium supply confirmed by the government [Note 1].

1.1.3 In order to support the aforementioned planning application, SMEC Asia Limited (SMEC) has been appointed by the Applicant to conduct a Sewerage Impact Assessment (SIA).

1.2 Site Description

1.2.1 The Site area is about 2524.4m^2. As shown on ***Figure 1.1***, the Site is surrounded by hillsides, mature trees and burial grounds. Sin Tin Tao Home for the Aged is located to the immediate east of the Site. To the immediate north of the Site is a footpath towards To Fuk Shan Tsz (道福山祠).

1.2.2 The Site is located close to public transport services including Sha Tin MTR Station and its adjoining bus terminus. It spends approximately 10-15 minutes between the Site and the aforesaid public transportation means on foot. Visitors can access to the site either via a footpath from Shatin Rural Committee Road or the track from the unnamed access road connecting Sheung Wo Che Garden and Pai Tau Street.

1.2.3 As stated in ***paragraph 1.1.1***, the Site has been occupied since 1920s. As such, generation of wastewater from the Site is not new to the environment.

1.3 Project Description

1.3.1 The existing ancillary columbarium provides 10,960 niches for placing 13,015 urns. The Site area is about 2,464m^2. The niche number to be applied for will be 10,960 sold niches (8,905 single niches and 2,055 double-urn niches).

1.3.2 The Site is already developed provided with most of the buildings and facilities on ***Figure 1.2***. It comprises two parts namely Part A and Part B that comprising:

[1] The Press Releases dated 28 July 2016 provided by the Secretary for Food and Health (SFH) on Medical Council and columbarium supply, http://www.info.gov.hk/gia/general/201606/28/P201606280882.htm.

Part A

- G/F Worshipping Hall in Building A (H1)
- G/F Storage Room, Ancestral Table Room and 1/F Columbarium in Building B (H2)
- G/F Columbarium and 1/F Columbarium in Building C (H3)
- G/F Columbarium and Worshipping Hall , 1/F Columbarium and 2/F Worshipping Hall in Building D (H4)
- G/F Management Office, Shop and Storage Room and Columbarium, and 1/F Columbarium and Praying Room, Storage Room in Building E (H5)

Part B

- Sitting Out Area (existing)
- Temple of "Sam Yuen Kung", which is a registered temple of the Chinese Temple Committee (existing)
- Surveyed Structures for Storage Use
- Buddha Sculpture (existing)
- Memorial Garden (existing)
- Permanent Toilets (existing)

1.3.3 The operating hours of the Project are from 9am to 6pm during non-festival periods and from 8am to 6pm for festival periods, which include the Ching Ming Festival and the Chung Yeung Festival.

1.3.4 As mentioned in ***paragraph 1.3.2***, most of the buildings and facilities are already in place. Therefore, no major construction works will be carried out. Construction works will involve renovations when necessary. Therefore, adverse environmental impacts including air quality, noise, water quality and waste management arising from this Planning Application are not anticipated.

1.4 Objectives of this Report

1.4.1 This SIA study is undertaken to assess the potential sewerage issues arising from the Project and recommend necessary mitigation measures to alleviate the sewerage impacts.

1.5 Reference Materials

1.5.1 In evaluating the sewerage impact arising from the Project, the following sources have been specifically referred to:

- Magill's Medical Guide, 6th edition, published by Salem Press, 2011
- BEAM Plus New Building Version 1.2, published by BEAM Society, July 2012
- Environmental Protection Department (EPD) publication Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning Version 1.0, March 2005
- Drainage Services Department (DSD) publication Sewerage Manual – Key Planning Issues and Gravity Collection System

Figure 1.1: Site Location and its Environs

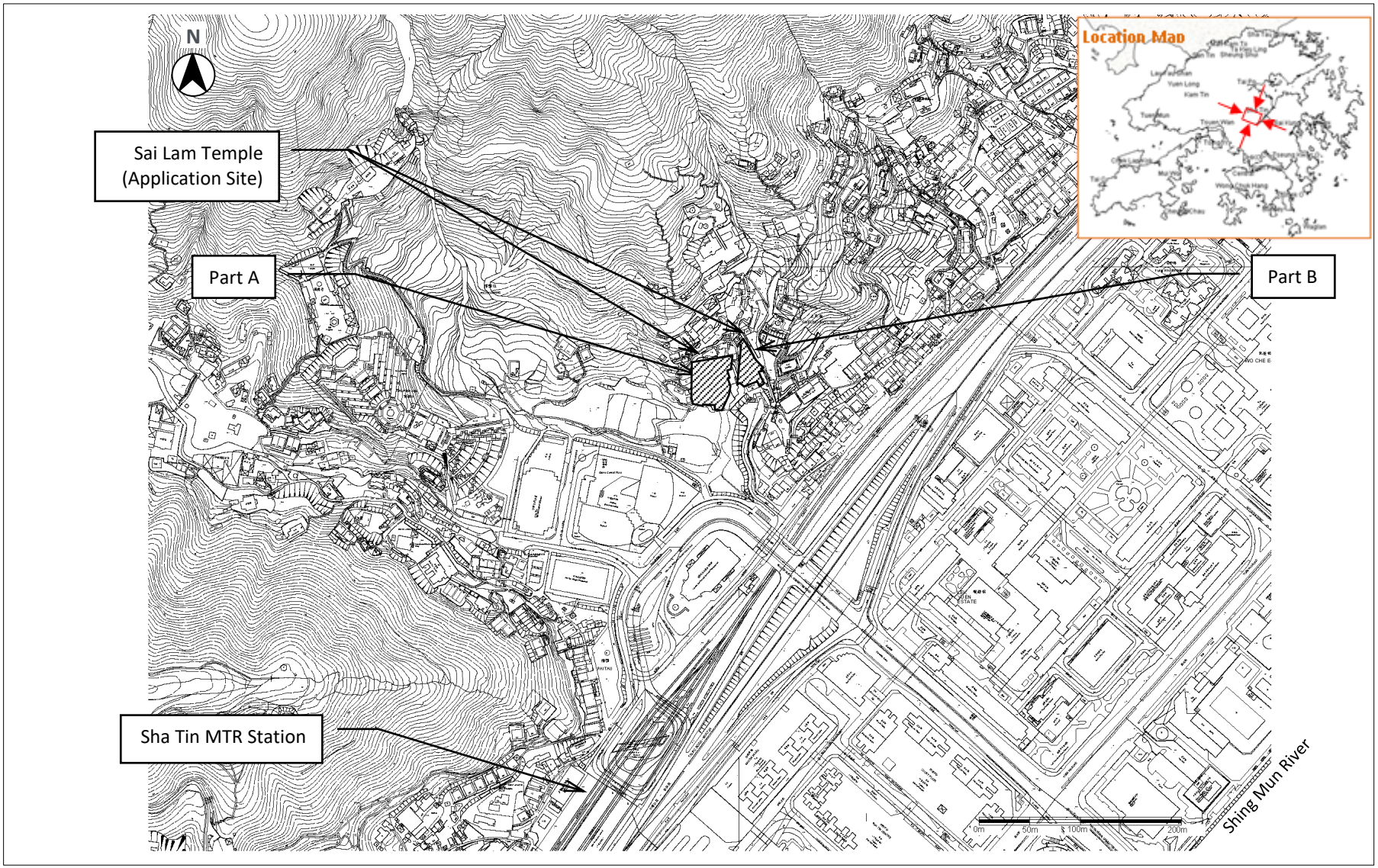


Figure 1.2: Master Layout Plan of the Project

2 DESCRIPTION OF EXISTING ENVIRONMENT AND BASELINE CONDITIONS

2.1 Site Location

2.1.1 The Site is located at Lot Nos. 63, 296 (Part), 331 RP (Part) and 393 S.B (Part) in D.D. 185, Sheung Wo Che No. 198, Shatin. The Site is currently zoned "Village Type Development" ("V") under the draft Sha Tin OZP No. S/ST/35 and is surrounded with hill slopes, mature trees and burial ground.

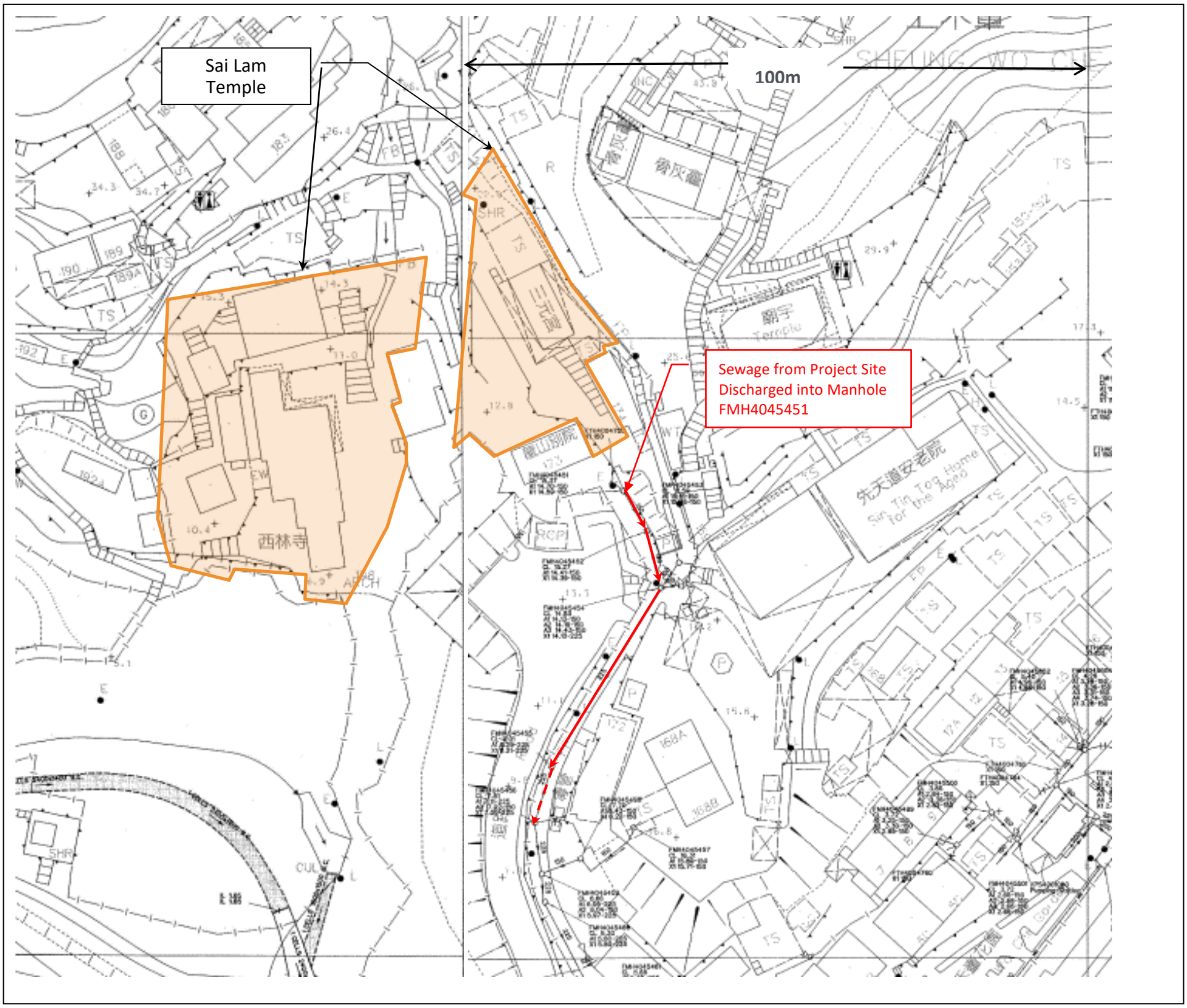
2.2 Existing Baseline Conditions

2.2.1 There is no municipal sewerage system near the downstream of Part A of the Site.

2.2.2 With reference to the sewerage layout plans no. 7se11a-1 and 7sw15b-2, there is a foul manhole FMH4045451 closest to Sam Yuen Kung of Part B of the Site and connecting to 150mm/225mm sewers along the footpath from Sin Tin Tao Home for the Aged to the Sin Tin Rural Committee Road, from north to south.

2.2.3 Manhole FMH4045451 and the sewers in the downstream area of the site are shown on ***Figure 2.1***.

Figure 2.1: Sewerage Layout Plan



3 SEWERAGE ANALYSIS

3.1 Review of Handling of Sewage

3.1.1 The Applicant has advised that catering services are not or will not be provided at the Site, and there are approx. 16 staff and 10 visitors each day during non-festival seasons. The sewage from staff and visitors during non-peak periods is therefore proposed to be discharged to the foul Manhole FMH4045451, as mentioned in ***Section 2.2***, which is connected to the public sewerage system.

3.1.2 It is expected that a larger number of visitors will visit the Site during festival periods, especially during Ching Ming and Chung Yeung Festivals. Because of the constraints of the Site, provision of portable chemical toilets is the most appropriate solution for handling the sewage generated by the larger number of visitors during festival periods (sewage generated by staff during festival periods will still be discharged to the public sewer as normal).

3.2 Assumptions

3.2.1 Sewage arising from festival periods (Scenario 1) and non-festival periods (Scenario 2) has been assessed in this SIA Report. A comparison of sewage generated under these two scenarios is presented in the following sections.

3.2.2 As advised by the Project Traffic Consultant, the number of visitors and staff expected during festival and non-festival periods are summarised in ***Table 3-1***.

Table 3-1: Estimated Populations During Festival and Non-festival Periods

PERIOD	NO OF PEOPLE PER DAY	
	VISITORS	STAFF*
Festival Period **(Scenario 1)**	4,105	28
Non-festival Period **(Scenario 2)**	10	16

Notes: * Full time and part-time staff.

3.2.3 As no catering services will be provided, visitors to the Site will generally stay on-site for less than an hour, based on the Applicant's observations. Generally, most people urinate every 4 to 6 hours and ~50% of visitors will use toilets, based on the Applicant's observations. Such assumptions form the basis of a realistic situation. With reference to page 3,081 of the sixth edition of Magill's Medical Guide, published by Salem Press in 2011, human micturition (urination) is around 200mℓ on average.

3.2.4 During non-festival periods, approx. 10 people will visit the Site, based on the Applicant's observations. Visitors during non-peak periods will use the permanent toilet facilities to be connected to the public sewer.

3.2.5 In order to alleviate the sewerage impacts during festival periods, one to two portable chemical toilets are proposed to be provided for the visitors. Examples of portable chemical toilets as shown in ***Appendix A*** or other equivalent types with typical flush volume of 1ℓ or less per flush, and each sewage storage tank with volume of ~ 400ℓ are proposed.

3.2.6 With reference to BEAM Plus New Building (current version 1.2), published by BEAM Society, the default assumptions estimate water consumption for non-residential use at 8.3ℓ/min for 10s per hand washing and a toilet flush of 7.5ℓ/flush. Therefore, the sewage generation from a visitor during both peak and non-peak periods using the permanent toilet is:

Unit flow of toilet flushing = 7.5ℓ + 200mℓ = 7.7ℓ/flush

Unit flow of hand washing = 8.3ℓ/min / 60s x 10s = 1.4ℓ/wash

Unit flow of total sewerage = 9.1ℓ/visitor (0.0091m^3)

3.2.7 The unit flow rate of sewage generated from the on-site staff is assumed to be 0.08m^3/person/day, which is the global unit flow factor for commercial employee as recommended in the Guidelines for Estimating Sewerage Flows for Sewerage Infrastructure Planning Version 1.0 published by EPD in 2005.

3.2.8 Peak daily flows generated during festival and non-festival periods are shown in ***Table 3-2***.

Table 3-2: Estimated Peak Daily Flow During Festival and Non-festival Periods

PERIOD	WASTEWATER GENERATION (m^3/DAY)	
	Visitors	Staff*
Festival Period (Scenario 1)	21.48	2.58
	24.06 m^3/day to Public Sewer	
Non-festival Period (Scenario 2)	0.06	1.47
	1.53m^3/day to Public Sewer	

Notes:

1. During festival periods, all sewage generated by the visitors and staff will be discharged to public sewer for the worst-case scenario. Sewage from about 1 - 2 chemical toilets and wastewater from the Smokeless Joss Paper Burner will be tankered away off-site by licenced collector at least once per day.
2. During non-festival periods, sewage from staff and visitors will be discharged to public sewer. And wastewater from the Smokeless Joss Paper Burner will be tankered away off-site by licenced collector regularly.

3.3 Methodology

3.3.1 The capacities of sewers have been calculated using Colebrook-White's Equation as below:

$$V = -\sqrt{32gRs} * \log\left(\frac{ks}{14.8R} + \frac{1.25v}{R\sqrt{32gRs}}\right)$$

where
- V = Mean velocity (m/s)
- g = gravitational acceleration (m/s^2)
- R = hydraulic radius (m)
- k_s = hydraulic pipeline roughness (m)
- υ = kinematic viscosity of fluid (m^2/s)
- s = hydraulic gradient (energy loss per unit length due to friction)

3.3.2 According to ***Table 3-2***, the peak sewage flow from the Project during both the festival and non-festival periods will be discharged into public sewers for the worst-case scenario. . During festival periods, one to two portable chemical toilets will be provided to alleviate the sewerage impact. During non-festival periods, sewage from staff and visitors will be discharged into foul Manhole FMH4045451. If the peak sewage from the Project into foul Manhole FMH4045451 does not exceed the capacity of the downstream sewerage system, then there will be no unacceptable from the Project.

3.4 Results and Discussion

3.4.1 As indicated in ***Table 3-2***, the Average Dry Weather Flows ("ADWFs") from the Site during festival periods (Scenario 1) and non-festival periods (Scenario 2) were calculated to be 24.06m^3/day and 1.53m^3/day, respectively, which will be discharged into Manhole FMH4045451.

3.4.2 To determine the sewerage impact of this flow has on the existing public sewerage system during festival periods and non-festival periods, the capacity of the sewerage system has been evaluated as detailed in ***Appendix B*** and ***Appendix C***, respectively.

3.4.3 During festival periods, the sewage arising from the site staff and visitors of the Site, together with the sewage from the village houses at the upstream of the Site, with a peak flow of 0.00930m^3/s in total will be discharged into foul Manhole FMH4045451. In addition to the wastewater from the downstream catchments including the adjacent village houses and Sin Tin Tao Home for the Aged, approximately 5.8% to 40.1% of the sewer capacities between Manholes FMH4045451 and FMH4045455 (i.e. 150mm to 225mm sewers) will be contributed as summarised on ***Figure 3.1***. This indicates no unacceptable impact on the public sewerage system from the Project during festival periods. Additional one to two portable chemical toilets will also be provided during festival periods and the collected sewage will be tankered away by a licensed contractor at least once per day.

3.4.4 During non-festival periods, the sewage arising from the site staff and visitors of the Site, together with the sewage from the village houses at the upstream of the Site, with a peak flow of 0.00374m^3/s in total will be discharged into foul Manhole FMH4045451. In addition to the wastewater from the downstream catchments including the adjacent village houses and Sin Tin Tao Home for the Aged, approximately 5.2% to 16.1% of the sewer capacities between Manholes FMH4045451 and FMH4045455 (i.e. 150mm to 225mm sewers) will be contributed as summarised on ***Figure 3.2***. This indicates no unacceptable impact from the Project during non-festival periods.

3.4.5 Overall, therefore, no unacceptable impact on the public sewerage system from the Project during festival periods and non-festival periods is anticipated. No upgrading works for the public sewerage system are required.

Figure 3.1: Sewage Flow Schematic (Festival Period)

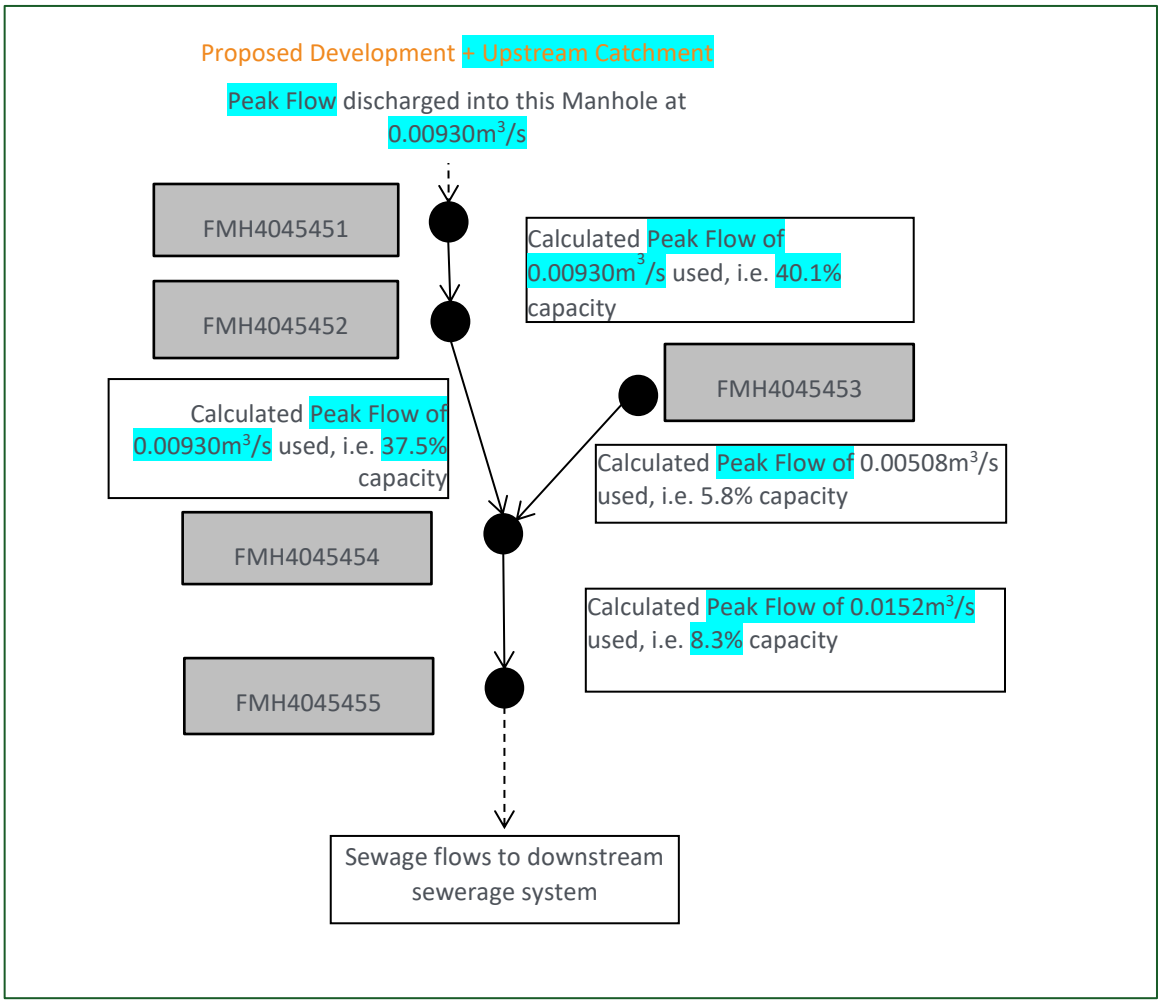


Figure 3.2: Sewage Flow Schematic (Non-festival Period)

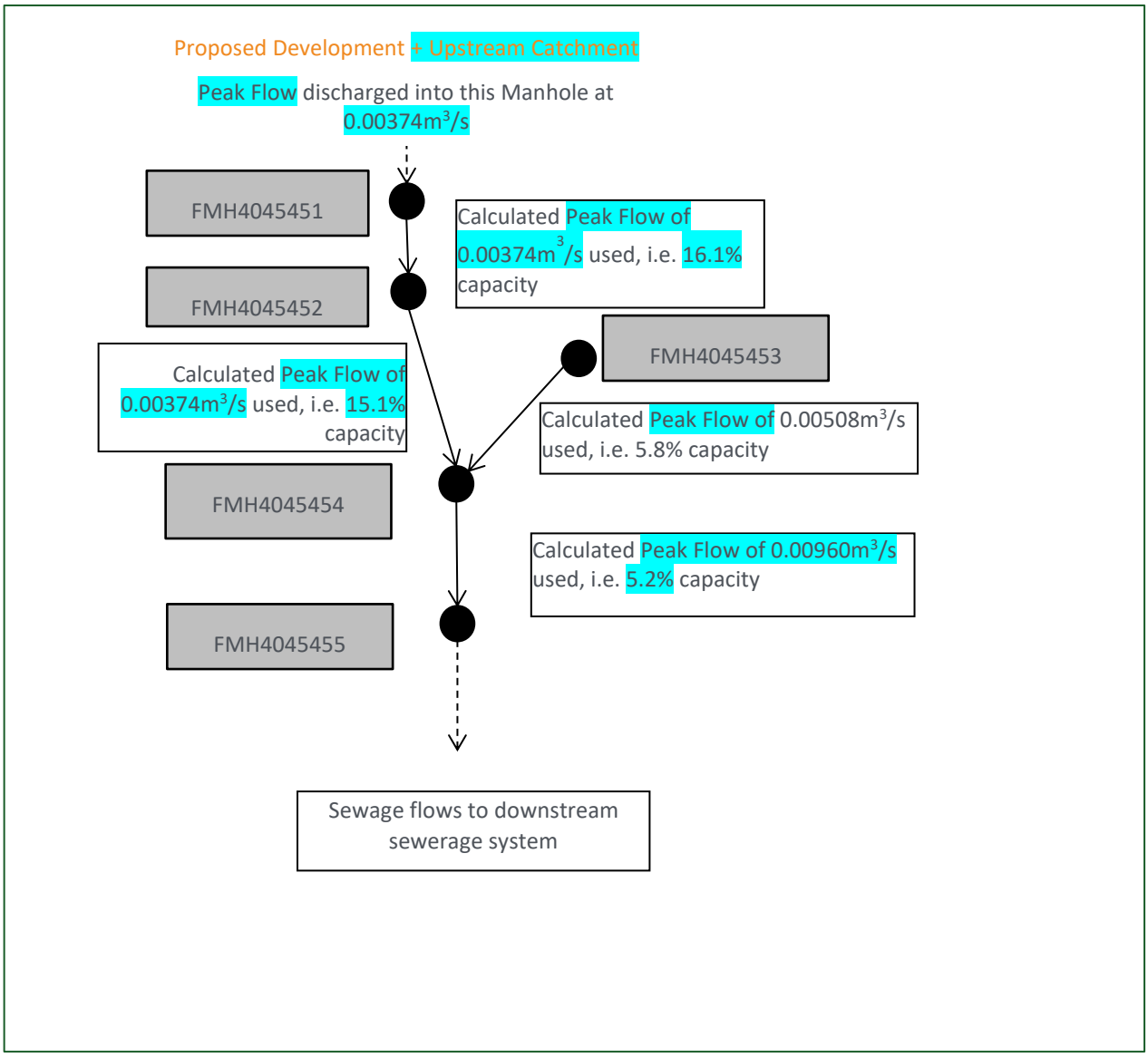
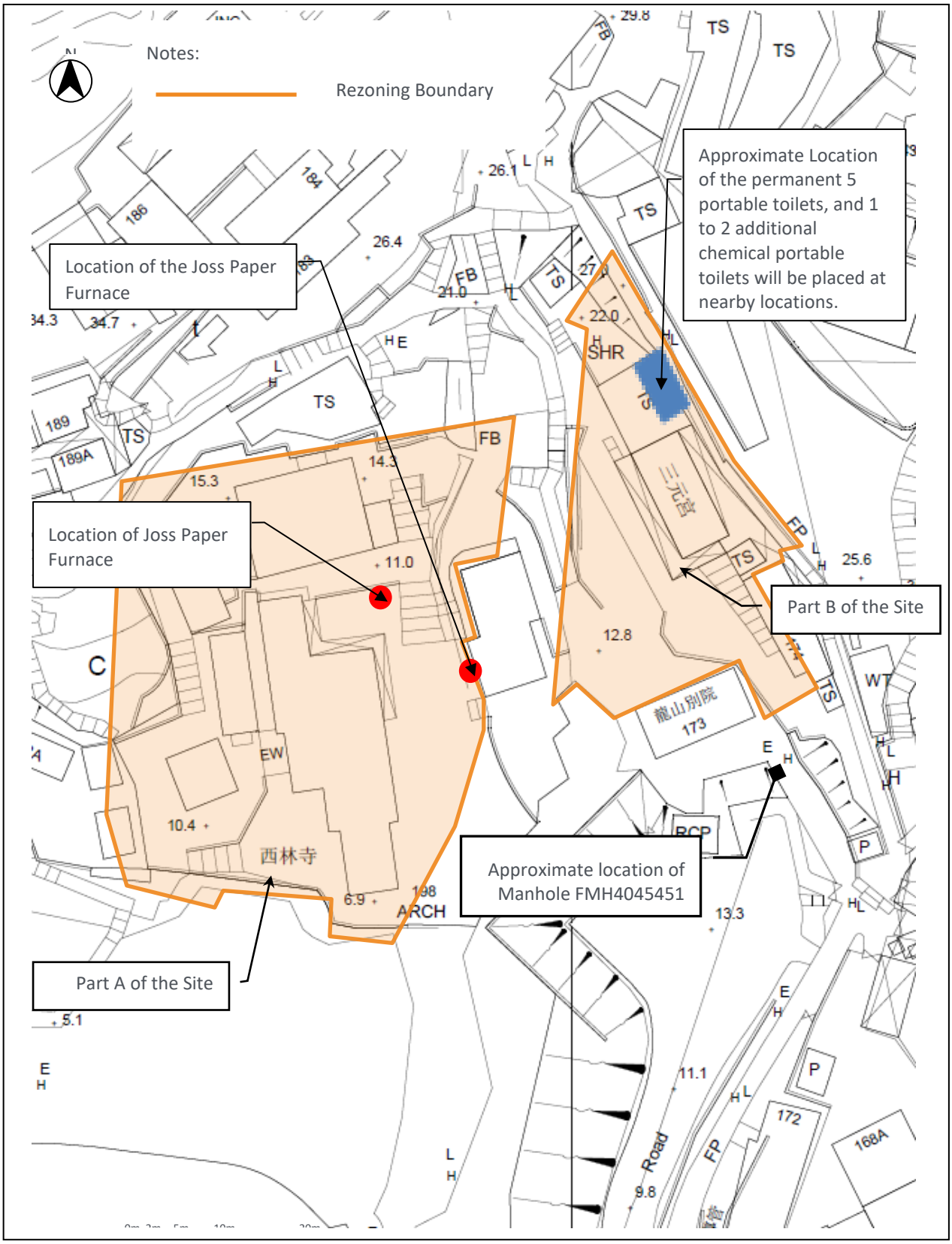


Figure 3.3: Indicative Location of the Permanent Toilet



4 CONCLUSIONS AND RECOMMENDATIONS

4.1.1 A Sewerage Impact Assessment (SIA) has been conducted to evaluate the possible sewerage impacts and to recommend the most suitable handling of sewage for the rezoning application of Sai Lam Temple at Lot Nos. 63, 296 (Part), 331 RP (Part) and 393 S.B. (Part) in D.D. 185, Sheung Wo Che No. 198, Shatin, from "V" (V) to "G/IC".

4.1.2 Two scenarios have been identified for the purpose of assessment: Scenario 1, during festival periods (i.e. Ching Ming Festival and Chung Yeung Festival) when there will be a large number of visitors; and Scenario 2, during non-festival periods, when there will be fewer visitors.

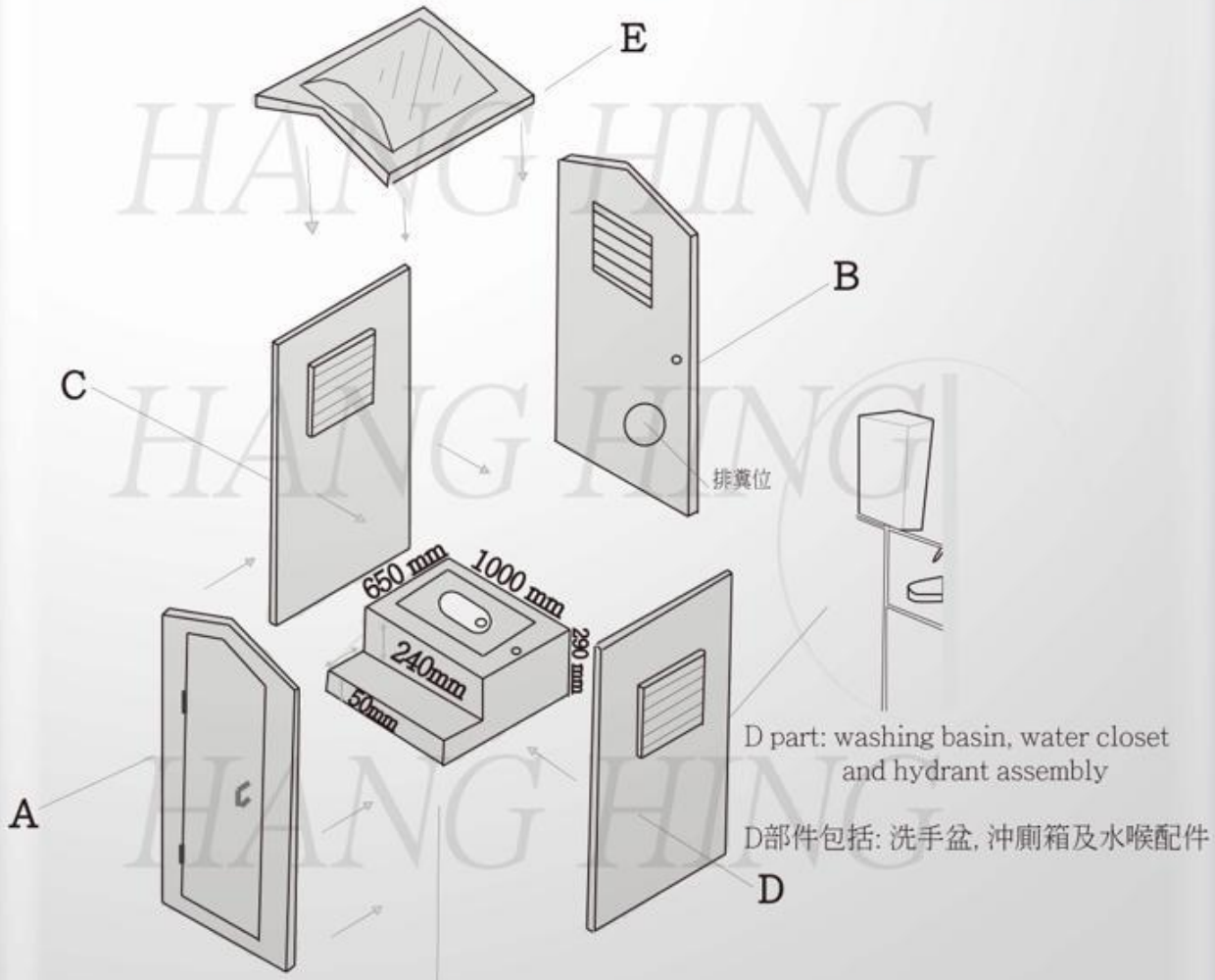
4.1.3 Under Scenario 1, sewage from staff and visitors during peak periods will be discharged into the public sewerage system. All sewage from staff and visitors of the Site during peak periods together with the sewage from the village houses at the upstream of the Site, with a peak flow of 0.00930m^3/s in total will be discharged into the public sewerage system via foul Manhole FMH4045451. In order to alleviate the sewerage impact during festival periods, it is recommended to provide additional one to two portable chemical toilets for collecting the sewage generated from the visitors.

4.1.4 All sewage from staff and visitors under Scenario 2 of the Site during non-peak periods, together with the sewage from the village houses at the upstream of the Site, with a peak flow of 0.00374m^3/s in total will be discharged into the public sewerage system via foul Manhole FMH4045451.

4.1.5 As mentioned in ***paragraph 3.4.3***, approximately 5.8% to 40.1% of the sewer capacities between Manholes FMH4045451 and FMH4045455 (i.e. 150mm to 225mm sewers) will be contributed under Scenario 1. As mentioned in ***paragraph 3.4.4***, approximately 5.2% to 16.1% of the sewer capacities between Manholes FMH4045451 and FMH4045455 will be contributed. As such, there will be no unacceptable sewerage impact arising from the Site. No upgrading works for the public sewerage system are therefore required.

Appendix A CATALOGUES OF PORTABLE TOILET

恒興玻璃纖維製品廠有限公司
Hang Hing Fibre Glass Products Manufacturer Co., LTD
香港荃灣沙咀道26-38號滙力工業中心18字樓8室 傳真: 2412 0810
E-mail: info@hang-hing.com.hk www.hang-hing.com.hk
Flat 8, 18/F., Thriving Industrial Centre, 26-38 Sha Tsui Road, Tsuen Wan, N.T., Hong Kong.
TeL: 2490 8822



D part: washing basin, water closet and hydrant assembly

D部件包括: 洗手盆, 沖廁箱及水喉配件

From	Hang Hing Fibre Glass Products Manufacturer Co., Ltd
item / products	流動廁所
Date	6 June 2012
Sales	Tony Ling


TOILET
2012/5/5
永旺(香港)百貨
25周年植樹日
參加者專用


TOILET

Appendix B CALCULATIONS OF SEWAGE GENERATION DURING PEAK PERIOD

1 - 13,015 urns in place during peak periods **Sewage Generation from Visitors to be collected in Permanent Toilets and Discharged to Public Sewer**			
Total No. of Visitors	=	4,105 visitors/day	Maximum number of visitor in Ching Ming Festival, as advised by the Traffic Consultant
Unit Flow Rate (Visitors)	=	0.0091 m^3/person/visit	200ml micturtion[Note 1]+7.5L flushing[Note 2]+1.4L Hand-washing[Note 3]
Percentage of Visitors will Use the Toilet	=	50 %	~50% of the visitors do use toilets, based on the Applicant's observations
Operation Hours	=	9 Hours	Operation Hour shall be from 09:00 to 18:00
Estimated Average Dry Weather Flow	=	18.680 m^3/day	Total No. of Visitors x Unit Flow Rate (Visitors) x Percentage of Visitors that will use the Toilet
Catchment Inflow Factor	=	1.15	For Sha Tin
Average Dry Weather Flow (with Catchment Inflow Factor)	= =	21.48 m^3/day 0.000663 m^3/s	
2 - Sewage from Staff of the Site			
No. of Staff	=	28 staff	As advised by the Applicant
Unit Flow Rate (Site Staff)	=	0.08 m^3/person/day	Refer to EPD GESF[Note 2]
Estimated Average Dry Weather Flow	=	2.24 m^3/day	No. of Staff x Unit Flow Rate (Site Staff)
Operation hour per day	=	9 hours	
Catchment Inflow Factor	=	1.15	For Sha Tin
Average Dry Weather Flow (with Catchment Inflow Factor)	= =	2.58 m^3/day 0.000080 m^3/s	
3 - Sewage from Village Houses in the Upstream Area (North of Sai Lam Temple)			
Total No. of Village Houses (North of Sai Lam Temple)	=	13 houses	Including No. 179A - 192, Sheung Wo Che Road
Estimated No. of Residents in Each House	=	9 people	By Assumption
Estimated Total No. of Residents (Southwest of Sai Lam Temple)	=	117 people	Total No. of Village Houses (North of Sai Lam Temple) x Estimated No. of Residents in Each House
Unit Flow Rate (Residents)	=	0.27 m^3/day	The Unit Flow Rate of Private village (Type R2) is stated in Table T-1 of Ref. 2[Note 2].
Estimated Average Dry Weather Flow	=	31.59 m^3/day	Estimated Total No. of Residents (Southwest of Sai Lam Temple) x Unit Flow Rate (Residents)
Catchment Inflow Factor	=	1.15	For Sha Tin
Average Dry Weather Flow (with Catchment Inflow Factor)	= =	36.33 m^3/day 0.000420 m^3/s	
4 - Sewage from Village Houses No. 168A, 168B and 172 (Southwest of Sai Lam Temple)			
Total No. of Village Houses (Southwest of Sai Lam Temple)	=	3 houses	Including No. 168A, 168B and 172, Sheung Wo Che Road
Estimated No. of Residents in Each House	=	9 people	By Assumption
Estimated Total No. of Residents (Southwest of Sai Lam Temple)	=	27 people	Total No. of Village Houses (Southwest of Sai Lam Temple) x Estimated No. of Residents in Each House
Unit Flow Rate (Residents)	=	0.27 m^3/person/day	The Unit Flow Rate of Private village (Type R2) is stated in Table T-1 of Ref. 2[Note 2].
Estimated Average Dry Weather Flow	=	7.29 m^3/day	Estimated Total No. of Residents (Southwest of Sai Lam Temple) x Unit Flow Rate (Residents)
Catchment Inflow Factor	=	1.15	For Sha Tin
Average Dry Weather Flow (with Catchment Inflow Factor)	= =	8.38 m^3/day 0.000097 m^3/s	

5 - Sewage from Sin Tin Toa Home for the Aged			
Maximum Number of Residents	=	198 people	Stated in Licence of Residential Care Home for the Elderly (Licence No.: 11563 valid until 31 October 2017), classified as "care and attention home".
Unit flow rate of Residents	=	0.19 m^3/person/day	The unit flow rate of institutional and special class in Table T-1 of Ref. 2 [Note 2].
Estimated Average Dry Weather Flow	=	37.62 m^3/day	
Employee			
Home Manager	=	1 person	Required for care and attention home of Ref. 4[Note 4]
Ancillary worker	=	5 person	1 ancillary worker for every 40 residents or part thereof, between 7 a.m. and 6 p.m. for care and attention home of Ref. 4[Note 4]
Care worker (07:00 - 15:00)	=	10 person	1 care worker for every 20 residents or part thereof, between 7 a.m. and 3 p.m. for care and attention home of Ref. 4[Note 4]
Care worker (15:00 - 20:00)	=	5 person	1 care worker for every 40 residents or part thereof, between 3 p.m. and 10 p.m. for care and attention home of Ref. 4[Note 4]
Care worker (20:00 - 07:00)	=	3 person	1 care worker for every 60 residents or part thereof, between 10 p.m. and 7 a.m. for care and attention home of Ref. 4[Note 4]
Health worker	=	7 person	Unless a nurse is present, 1 health worker for every 30 residents or part thereof, between 7 a.m. and 6 p.m. for care and attention home of Ref. 4[Note 4]
Nurse	=	3 person	Unless a health worker is present, 1 nurse for every 60 residents or part thereof, between 7 a.m. and 6 p.m. for care and attention home of Ref. 4[Note 4]
Additional Employees	=	2 person	As an additional requirement for a care and attention home or an aged home, any 2 persons being a home manager, an ancillary worker, a care worker, a health worker or a nurse shall be on duty between 6 p.m. and 7 a.m. of Ref. 4[Note 4]
Total No. of Employees	=	36 employees	
Unit flow rate	=	0.28 m^3/employee/day	Assume the characteristics of the unit flow rate is the same as that of "Commercial Employee" and "Community, Social & Personal Services" in Table T-2 of 2 [Note 2].
Estimated Average Dry Weather Flow	=	10.08 m^3/day	
Estimated Average Dry Weather Flow (total)	=	47.7 m^3/day	
Catchment Inflow Factor	=	1.15	
Average Dry Weather Flow (with Catchment Inflow Factor, total)	=	54.86 m^3/day	
	=	0.000635 m^3/s	

Note:

1. Human's micturition is assumed to be 200mL in accordance with p. 3081 of "Magill's Medical Guide", 6th ed., various medical editors, Salem Press, USA, 2011.
2. Environmental Protection Department (EPD) publication Guidelines for Estimating Sewage Flows (GESF) for Sewage Infrastructure Planning Version 1.0, March 2005
3. BEAM Plus New Buildings Version 1.2 in July 2012
4. Schedule 1 of CAP 459A Residential Care Homes (Elderly Persons) Regulation.

Calculation of Flow Capacity

Manhole		Length	Level (Out)	Level (In)	d	d'	r	d'-r	θ	β	A_w	P_w	R	s	k_s	V	Q_C	ADWF	P_c	P	Q_p	Catchment	Is $Q_c > Q_p$?	% of capacity
		m	mPD	mPD	m	m	m	m	radian	radian	m^2	m	m	-	mm	m/s	m^3/s	m^3/day			m^3/s		Y/N	%
FMH4045451	FMH4045452	6.78	14.59	14.41	0.15	0.143	0.075	0.068	0.871	5.412	0.017	0.406	0.04187	0.02655	3	1.3649	0.0232	60.387	223.654	8	0.00930	Sewage from upstream village houses + The Site (During Peak: staff + visitors)	Y	40.1%
FMH4045452	FMH4045454	8.58	14.39	14.13	0.15	0.143	0.075	0.068	0.871	5.412	0.017	0.406	0.04187	0.0303	3	1.4583	0.025	60.387	223.65	8	0.00930	Sewage from upstream village houses + The Site (During Peak: staff + visitors)	Y	37.5%
FMH4045453	FMH4045454	4.24	15.76	14.16	0.15	0.143	0.075	0.068	0.871	5.412	0.017	0.406	0.04187	0.37721	3	5.1523	0.088	54.855	203.17	8	0.00508	Sin Tin Tao Home for the Aged	Y	5.8%
FMH4045454	FMH4045455	33.12	14.10	8.29	0.225	0.214	0.1125	0.1015	0.892	5.391	0.039	0.606	0.06436	0.17542	3	4.707	0.184	123.625	457.87	8	0.0152	Sewage from upstream village houses + The Site (During Peak: staff + visitors) + Sin Tin Tao Home for the Aged + village houses to the southwest of Sai Lam Temple (No. 168A, 168B and 172)	Y	8.3%

Legend

d = pipe diameter, m

d' = flow depth (m) of the maximum flow rate without surcharge (i.e., full bore flow) = 0.95d

r = pipe radius (m) = 0.5d

θ = angle (radian) of air space in a circular pipe = $2\cos^{-1}[(d'-r)/r]$

β = angle (radian) of wetted perimeter in a circular pipe = $2\pi - \theta$

A_w = wetted area (m^2) = $(r^2/2)(\beta + \sin\theta)$

P_w = wetted perimeter (m) = βr

R = Hydraulic radius (m) = A_w/P_w

s = Slope of the total energy line

k_s = equivalent sand roughness, mm

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

Q_c = Flow Capacity, m^3/s

Q_p = Estimated total peak flow from the Site during peak season, m^3/s

P_c = Contributing Population = ADWF/0.27

P = Peaking Factor (including stormwater allowance) for facility with existing upstream sewerage ADWF (mulitiplied by Catchment Inflow Factor) = Total Average Dry Weather Flow, m^3/day

Appendix C CALCULATIONS OF SEWAGE GENERATION DURING NORMAL DAYS

1 - 13,016 urns in place and the absence of public sewer during normal days				
Sewage Generation from Visitors				
Total No. of Visitors	=	10	visitors/day	Maximum number of visitor during normal days, as advised by the Traffic Consultant
Unit Flow Rate (Visitors)	=	0.0091	m3/person/visit	200ml micturtion[Note 1]+7.5L flushing[Note 2]+1.4L Hand-washing[Note 3]
Percentage of Visitors will Use the Toilet	=	50	%	~50% of the visitors do use toilets, based on the Applicant's observations
Estimated Average Dry Weather Flow	=	0.05	m^3/day	Total No. of Visitors x Unit Flow Rate (Visitors) x Percentage of Visitors that will use the Toilet
Operation hour per day	=	9	hours	
Catchment Inflow Factor	=	1.15		
Average Dry Weather Flow (with Catchment Inflow Factor)	=	0.06	m^3/day	
	=	0.000002	m^3/s	
2. Sewage from Staff of the Site				
No. of Staff	=	16	staff	As advised by the Applicant
Unit Flow Rate (Site Staff)	=	0.08	m^3/person/day	Refer to EPD GESF[Note 2]
Estimated Average Dry Weather Flow	=	1.28	m^3/day	No. of Staff x Unit Flow Rate (Site Staff)
Operation hour per day	=	9	hours	
Catchment Inflow Factor	=	1.15		
Average Dry Weather Flow (with Catchment Inflow Factor)	=	1.47	m^3/day	
	=	0.0000454	m^3/s	
3 - Sewage from Village Houses in the Upstream Area (North of Sai Lam Temple)				
Total No. of Village Houses (North of Sai Lam Temple)	=	13	houses	Including No. 179A - 192, Sheung Wo Che Road
Estimated No. of Residents in Each House	=	9	people	By Assumption
Estimated Total No. of Residents (Southwest of Sai Lam Temple)	=	117	people	Total No. of Village Houses (North of Sai Lam Temple) x Estimated No. of Residents in Each House
Unit Flow Rate (Residents)	=	0.27	m^3/day	The Unit Flow Rate of Private village (Type R2) is stated in Table T-1 of Ref. 2[Note 2].
Estimated Average Dry Weather Flow	=	31.59	m^3/day	Estimated Total No. of Residents (Southwest of Sai Lam Temple) x Unit Flow Rate (Residents)
Catchment Inflow Factor	=	1.15		For Sha Tin
Average Dry Weather Flow (with Catchment Inflow Factor)	=	36.33	m^3/day	
	=	0.0004205	m^3/s	
4 - Sewage from Village Houses No. 168A, 168B and 172 (Southwest of Sai Lam Temple)				
Total No. of Village Houses (Southwest of Sai Lam Temple)	=	3	houses	Including No. 168A, 168B and 172, Sheung Wo Che Road
Estimated No. of Residents in Each House	=	9	people	By Assumption
Estimated Total No. of Residents (Southwest of Sai Lam Temple)	=	27	people	Total No. of Village Houses (Southwest of Sai Lam Temple) x Estimated No. of Residents in Each House
Unit Flow Rate (Residents)	=	0.27	m^3/person/day	The Unit Flow Rate of Private village (Type R2) is stated in Table T-1 of Ref. 2 [Note 2].
Estimated Average Dry Weather Flow	=	7.29	m^3/day	Estimated Total No. of Residents (Southwest of Sai Lam Temple) x Unit Flow Rate (Residents)
Catchment Inflow Factor	=	1.15		For Sha Tin
Average Dry Weather Flow (with Catchment Inflow Factor)	=	8.38	m^3/day	
	=	0.0000970	m^3/s	

5 - Sewage from Sin Tin Toa Home for the Aged				
Maximum Number of Residents	=	198	people	Stated in Licence of Residential Care Home for the Elderly (Licence No.: 11563 valid until 31 October 2017), classified as "care and attention home".
Unit flow rate of Residents	=	0.19	m^3/person/day	The unit flow rate of institutional and special class in Table T-1 of Ref. 2 [Note 2].
Estimated Average Dry Weather Flow	=	37.62	m^3/day	
Employee				
Home Manager	=	1	person	Required for care and attention home of Ref. 4 [Note 4]
Ancillary worker	=	5	person	1 ancillary worker for every 40 residents or part thereof, between 7 a.m. and 6 p.m. for care and attention home of Ref. 4 [Note 4]
Care worker (07:00 - 15:00)	=	10	person	1 care worker for every 20 residents or part thereof, between 7 a.m. and 3 p.m. for care and attention home of Ref. 4 [Note 4]
Care worker (15:00 - 20:00)	=	5	person	1 care worker for every 40 residents or part thereof, between 3 p.m. and 10 p.m. for care and attention home of Ref. 4[Note 4]
Care worker (20:00 - 07:00)	=	3	person	1 care worker for every 60 residents or part thereof, between 10 p.m. and 7 a.m. for care and attention home of Ref. 4 [Note 4]
Health worker	=	7	person	Unless a nurse is present, 1 health worker for every 30 residents or part thereof, between 7 a.m. and 6 p.m. for care and attention home of Ref. 4 [Note 4]
Nurse	=	3	person	Unless a health worker is present, 1 nurse for every 60 residents or part thereof, between 7 a.m. and 6 p.m. for care and attention home of Ref. 4 [Note 4]
Additional Employees	=	2	person	As an additional requirement for a care and attention home or an aged home, any 2 persons being a home manager, an ancillary worker, a care worker, a health worker or a nurse shall be on duty between 6 p.m. and 7 a.m. of Ref. 4 [Note 4]
Total No. of Employees	=	36	employees	
Unit flow rate	=	0.28	m^3/employee/day	Assume the characteristics of the unit flow rate is the same as that of "Commercial Employee" and "Community, Social & Personal Services" in Table T-2 of 2 [Note 2].
Estimated Average Dry Weather Flow	=	10.08	m^3/day	
Estimated Average Dry Weather Flow (total)	=	47.7	m^3/day	
Assume operation hour per day	=	24	hours	
Catchment Inflow Factor	=	1.15		For Sha Tin
Average Dry Weather Flow (with Catchment Inflow Factor)	=	54.86	m^3/day	
	=	0.0006349	m^3/s	

Note:

1. Human's micturition is assumed to be 200mL in accordance with p. 3081 of "Magill's Medical Guide", 6th ed., various medical editors, Salem Press, USA, 2011.
2. Environmental Protection Department (EPD) publication Guidelines for Estimating Sewage Flows (GESF) for Sewage Infrastructure Planning Version 1.0, March 2005
3. BEAM Plus New Buildings Version 1.2 in July 2012
4. Schedule 1 of CAP 459A Residential Care Homes (Elderly Persons) Regulation.

Calculation of Flow Capacity

Manhole		Length m	Level (Out) mPD	Level (In) mPD	d m	d' m	r m	d'-r m	θ radian	β radian	Aw m2	Pw m	R m	s -	ks mm	V m/s	QC m^3/s	ADWF m^3/day	P_c	P	Qp m3/s	Catchment	Is Qc > Qp? Y/N	% of capacity %
FMH4045451	FMH4045452	6.78	14.59	14.41	0.15	0.143	0.075	0.068	0.871	5.412	0.017	0.406	0.04187	0.02655	3	1.3649	0.0232	37.858	140.215	8	0.00374	Sewage from upstream village houses + The Site (Normal Days)	Y	16.1%
FMH4045452	FMH4045454	8.58	14.39	14.13	0.15	0.143	0.075	0.068	0.871	5.412	0.017	0.406	0.04187	0.0303	3	1.4583	0.0248	37.858	140.215	8	0.00374	Sewage from upstream village houses + The Site (Normal Days)	Y	15.1%
FMH4045453	FMH4045454	4.24	15.76	14.16	0.15	0.143	0.075	0.068	0.871	5.412	0.017	0.406	0.04187	0.37721	3	5.1523	0.0876	54.855	203.167	8	0.00508	Sin Tin Tao Home for the Aged	Y	5.8%
FMH4045454	FMH4045455	33.12	14.10	8.29	0.225	0.214	0.1125	0.1015	0.892	5.391	0.039	0.606	0.06436	0.17542	3	4.707	0.184	101.097	374.431	8	0.00960	Sewage from upstream village houses + The Site (Normal Days) + Sin Tin Tao Home for the Aged + village houses to the southwest of Sai Lam Temple (No. 168A, 168B and 172)	Y	5.2%

Legend

d = pipe diameter, m

d' = flow depth (m) of the maximum flow rate without surcharge (i.e., full bore flow) = 0.95d

r = pipe radius (m) = 0.5d

q = angle (radian) of air space in a circular pipe = 2cos-1[(d'-r)/r]

b = angle (radian) of wetted perimeter in a circular pipe = 2p - q

Aw = wetted area (m2) = (r2/2) (b + sinq)

Pw = wetted perimeter (m) = br

R = Hydraulic radius (m) = Aw/Pw

s = Slope of the total energy line

ks = equivalent sand roughness, mm

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

Qc = Flow Capacity, m^3/s

Qc = Flow Capacity, m^3/s

P_c = Contributing Population = ADWF/0.27

P = Peaking Factor (including stormwater allowance) for facility with existing upstream sewerage

ADWF (mulitiplied by Catchment Inflow Factor) = Total Average Dry Weather Flow, m^3/day