16 SEWERAGE AND SEWAGE TREATMENT IMPLICATIONS

16.1 Introduction

16.1.1 This Section describes the assessment of the impacts on the existing sewerage system in the vicinity of the study area resulting from the planned development, and recommends appropriate mitigation measures where adverse impacts are identified. The new sewerage network within the study area arising from the proposed development is also presented. The criteria and guidelines for evaluating and assessing the sewerage impact of the Project on the public sewerage and sewage treatment and disposal facilities as given in Section 6.5 in Annex 14 of the EIAO-TM are considered in the assessment.

16.1.2 The coverage of this Section includes:

- Present the population and employment data based on the latest KTD development schedule as well as the population figures from the Planning Department
- Present the sewerage catchments of the Kai Tak Development, Kwun Tong Preliminary Treatments Works (KTPTW), and To Kwa Wan Preliminary Treatments Works (TKWPTW)
- Present the hydraulic assessment methodology for sewerage system adopted for the Project
- Present the flow projections for the catchments of the Project
- Assess the impacts to the existing and planned sewerage system, sewage treatment and disposal facilities
- Describe the proposed sewerage system inside KTD
- Summarize the findings and conclusions

16.1.3 The Study has taken note and agreed with EPD on the relevant development arising from Action Plan for Tackling Water-Related Pollution problems at the Kai Tak Approach Channel by relevant departments (sewerage infrastructure related). The Action Plan includes the following elements:

Project Title	Brief Scope of Works	Responsible Department	Target Completion Date
4344DS "Upgrading of Central & East Kowloon Sewerage - Packages 1 to 4"	Upgrading and construction of about 21km long sewers and associated sewerage works in Kwun Tong, Ngau Tau Kok, Yau Tong, Kowloon Bay, Choi Hung, Wong Tai Sin, San Po Kong, Kowloon City, To Kwa Wan, Ma Tau Kok, Hung Hom and Tsim Sha Tsui and upgrading of some existing dry weather flow interceptors in Central and East Kowloon.	DSD	2014 (2012 for relevant upstream sewers of KTAC)
Sewerage Interception in Kowloon City	Divert the flows from Kowloon City and San Po Kong area to the To Kwa Wan Wan PTW.	DSD	2012
Kai Tak Development	Plan and Provide for adequate sewerage infrastructure to serve the planned facilities in KTD.	CEDD	2016
Kai Tak Approach Channel – Expedient Connection Survey	Undertake surveys for identification of expedient connections in public drains/sewers and domestic buildings in Kowloon City, Ngau Tau Kok, Kowloon Bay, Wong Tai Sin and Choi Hung.	EPD	2009
Control of Water Pollution at Jordan Valley Box Culvert	Install interception facility at JVBC to divert polluted water into public sewerage system.	DSD	2012

16.2 Population and Employment Data

Kai Tak Development

16.2.1 The delineation of the sewerage catchments and population within Kai Tak Development (KTD) are based on the latest development schedule of Recommended Outline Development Plan (May08). The intake years of development sites in KTD are presented in **Figure 16.3**.

16.2.2 The development schedule showing the latest population and employment data and the development schedule is presented in **Appendix 16.1**. The categorization of residential population and employment followed DSD's Sewerage Manual Part 1 (1995).

16.2.3 The population projections for Year 2016 and Year 2021 (commissioning of the whole KTD) contributed to the sewerage catchments of KTPTW and TKWPTW are summarized in **Table 16.1 and 16.2** respectively.

Table 16.1 Population and Employment Data for Kai Tak Development to KTPTW

Category	Population	
	Year 2016	**Year 2021**
Domestic		
Public Rental House (RS)	35,000	35,000
R1	0	0
R2	10,812	10,812
R3	0	4,873
Mix Use	0	1,819
Sub-Total	**45,812**	**52,504**
Commercial		
Employees	20,634	48,496
Hotel	3,179	9,238
Hospital	0	800
Sub-Total	**23,813**	**58,535**
School		
Student	8,420	8,420
Total	**78,045**	**119,459**

Table 16.2 Population and Employment Data for Kai Tak Development to TKWPTW

Category	Population	
	Year 2016	Year 2021
Domestic		
Public Rental House (RS)	0	0
R1	4,740	4,740
R2	0	25,891
R3	0	0
Mix Use	2,312	2,312
Sub-Total	**7,052**	**32,944**
Commercial		
Employees	19,477	34,361
Hotel	0	2,832
Hospital	0	0
Sub-Total	**19,477**	**37,193**
School		
Student	4,210	5,480
Total	**30,739**	**75,616**

16.2.4 As advised by LCSD in August 2007, the number of visitors and workers at Runway Park is estimated to be 11,250 persons per day. Since population figures for Metro Park in KTD are not available at this stage, assumption on 11,250 persons per day (visitors and workers) is also applied.

Developments within KTPTW and TKWPTW Sewerage Catchments, Excluding KTD

16.2.5 For the sewerage catchments outside Kai Tak Development, the planning data provided by Planning Department (PlanD) would be adopted for the following design scenarios (**Table 16.3**).

Table 16.3 Planning Data adopted for Design Scenarios

Scenario	Planning Data
2016	Territorial Population and Employment Data Matrix (TPEDM) 2003-based Estimate – Scenario II
2030	Hong Kong 2030: Planning Vision and Strategy (HK2030 Study)
Ultimate	HK2030 Study + 5%

Note: An extra 10% contingency is added to the calculated ADWFs and peak flows. **Para. 16.8.3** refers.

Cruise Vessel

16.2.6 The sewage to be collected from the cruise vessel is based on the number of passengers and crewmembers for different types of vessel to be berthed in the planned Cruise Terminal.

16.2.7 Based on the design of the Marine Works at Kai Tak, a cruise terminal is proposed at the southeast tip of the former Kai Tak runway. The terminal is planned to accommodate two berthing scenarios: (1) one super post-Panamax (SPP) vessel (360m-length) and one post-Panamax (PP) vessel (max length 345m); or (2) two post-Panamax vessels.

16.2.8 For the estimation of passengers and crewmembers of vessels, reference is made to the passengers and crewmembers of the existing and being built vessels. **Table 16.4** shows the passengers and crewmembers of different cruise vessels for sewage flow estimate.

Table 16.4 Passengers and Crewmembers of Cruise Vessels

Population	Vessel Type	
	Super Post-Panamax	Post-Panamax
Passengers	5,400	4,000
Crewmembers	2,000	1,500
TOTAL	**7,400**	**5,500**

Notes: The crewmember to passenger ratio is 37%.

16.3 Sewerage Catchments

16.3.1 The sewerage catchments in KTD have been divided into twelve catchments (A to L). The sewage from seven catchments (E, F, G, H, I, J and L) would be conveyed to Kwun Tong Preliminary Treatment Works (KTPTW) and the sewage from the remaining catchments would be conveyed to To Kwu Wan Preliminary Treatment Works (TKWPTW). The sewerage catchments in the KTD are shown in **Figure 16.1**. The site references of the sub-planning areas are shown in **Figure 16.2**.

16.3.2 The sewerage catchments by Planning Vision and Strategy (PVS) Zones of KTPTW and TKWPTW are shown in **Figure 16.4**. The sewage flows to KTPTW and TKWPTW excluding KTD are based on the EPD's Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning (2005). The following table (**Table 16.5**) shows the sewerage catchments by PVS Zones of KTPTW and TKWPTW excluding KTD catchment.

Table 16.5 Sewerage Catchments of KTPTW and TKWPTW by PVS Zones Excluding KTD Catchment

Kwun Tong Preliminary Treatment Works		To Kwa Wan Preliminary Treatment Works	
PVS Zone No.	Proportion of Sewage Flow of PVS	PVS Zone No.	Proportion of Sewage Flow of PVS
101	1.0	054-057	1.0
102	0.1	058	0.05
103	0.4	059	0.05
104	0.0	062	1.0
105-109	1.0	068-072	1.0
111-129	1.0	073	0.25
219	0.1	075-077	1.0
304	0.3	078	0.5
305	0.4	097	0.15
307-309	1.0	098-100	1.0
-	-	102	0.9
-	-	103	0.6
-	-	104	1.0
-	-	275	1.0
-	-	300-302	1.0
-	-	304	0.7
-	-	305	0.6

Notes: (1) PVS marked with SEKD, i.e. PVS 253, 254, 336 and 337 of KTPTW and PVS 110, 254, 260, 278, 306 and 335 of TKWPTW, would not be included for flow projection under KTPTW or TKWPTW catchments. The flow projection of these PVS zones would be discussed under Kai Tak Development.
(2) Source: Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning Version 1.0, by EPD.

16.3.3 In addition to the sewage flows generated from KTPTW sewerage catchments, sewage discharges from cruise vessels will be included in the assessment. Cruise ships would be berthed in the planned Cruise Terminal in the ex-runway area and the sewage from cruise vessels would be discharged to the planned sewerage system at Cruise Terminal and then conveyed to Kwun Tong Intermediate Pumping Station (KTIPS) and eventually to KTPTW via the existing trunk sewers along Hoi Bun Road.

16.4 Hydraulic Assessment Methodology for Sewerage System

16.4.1 InfoWorks CS version 7.51 developed by Wallingford Software would be used as a tool in the hydraulic assessment. InfoWorks has the capability of modelling urban sewerage systems and is capable of determining the capacity of culverts, pipes, channels and hydraulics structures.

16.4.2 The hydraulic assessment methodology is critical to the result of the assessment. Also, the model simulation result would greatly vary depending on different simulation run parameters used. Different methodology in modeling also yields different results. Hence, in this Section, the basis of the background information together with the adoption of different parameters would be elaborated. In addition, the methodology of modelling would be presented in this Section as well.

16.4.3 The hydraulic assessment methodology is composed of two portions:-

- Hydraulic Assessment Methodology for the New Sewers inside KTD
- Hydraulic Assessment Methodology for the Existing Trunk Sewer

Hydraulic Assessment Methodology for the New Sewers inside KTD

16.4.4 In the proposed sewerage scheme of Kai Tak Development (KTD), sewage generated from the new developments would be conveyed to the existing sewerage system.

16.4.5 For designing the size of the proposed sewers for KTD, the capacity of the new sewer would be assessed by hydraulic modeling.

Sewage Flows

16.4.6 The dry weather sewage flows of the Kai Tak Development (KTD) sewerage catchments are calculated based on the latest development schedule of KTD with unit flow factors given in the Sewerage Manual Part 1. The unit flow factors adopted in the assessment for KTD are shown as follows **(Table 16.6)**:

Table 16.6 Unit Flow Factors Adopted for KTD

Category	Unit (per)	Unit Flow Factors (m^3/d)
Domestic		
• Public Rental House (RS)	person	0.175
• R1	person	0.240
• R2	person	0.300
• R3	person	0.370
• Mixed Use	person	0.370
Commercial		
• Employment	employee	0.350
• Hotel(1)	person	0.240
• Hospital(1)	person	0.370
School	person	0.025

Note: (1) The unit flow factors for "Hotel' and "Hospital" are based on the agreed values presented in the Technical Report No. TR4E under the Agreement No. CE4/2004(TP) – Kai Tak Planning Review.

16.4.7 For the parks inside KTD, the projected sewage flows are based on the total no. of visitors and workers with the unit flow factor of 0.010 m^3/d/person and 0.025 m^3/d/person respectively. With reference to other local projects containing large scale theme park, the visitors to KTD's recreation parks are assumed to be mobile and will not stay in the park for long period and hence the unit flow factor for visitors and the generated sewage shall be smaller as compared to the theme parks. For the unit flow factor for workers in the park, the same unit flow factor for school is adopted.

16.4.8 For the cruise vessel, the sewage from cruise vessels mainly comprises blackwater and greywater. Blackwater is the toilet water and medical facility water while greywater is the wastewater generated from showers, sinks, food liquid, laundry, etc. Reference has been made to Alaska Cruise Ship Initiative 2000 for the unit flow factors to be adopted in estimating sewage flows from cruise vessels. (**Table 16.7**)

Table 16.7 Unit Flow Factors for Cruise Vessels

Category	Unit (per)	Unit Flow Factors (m^3/d)
Blackwater - Passenger / crewmember	Person	0.019
Greywater - Passenger / crewmember	Person	0.209

Source: Alaska Cruise Ship Initiative 2000.

Pipe Roughness

16.4.9 The pipe roughness is specified as an equivalent sand roughness (ks) used by the Colebrook-White equation. For the hydraulic assessment of the new sewers inside KTD, the roughness coefficient to be used would follow the values proposed in the Design Memorandum (DM) of this study as listed below:- (**Table 16.8**)

Table 16.8 Pipe Roughness Coefficient used inside KTD

Pipe Size	Pipe Material	ks
<600mm	Vitrified Clay Pipe	0.6mm
>=600mm to 2400mm	Precast Concrete Pipes with PVC lining	1.5mm

Global Peaking Factors

16.4.10 The unit flow factor (UFF) and population together with appropriate global peaking factors would be inputted to the hydraulic model for capacity assessment.

16.4.11 The global peaking factor is based on the cumulative contributing population. As the cumulative contributing population increases, the global peaking factor and the peak flow will decrease. Although separate sewerage system and stormwater system will be designed from KTD, as a conservative approach, the global peaking factors including stormwater allowance would be used for assessing the peak flow condition. The global peaking factor is selected in accordance with the following table: (**Table 16.9**)

Table 16.9 Peaking Factor for Sewers in KTD

Population Range	Global Peaking Factor (including stormwater allowance) for sewers
< 1,000	8
1,000 – 5,000	6
5,000 – 10,000	5
10,000 – 50,000	4
> 50,000	$7.3/N^{0.165}$

Note: N is the contributing population in thousands

16.4.12 (Not used)

Peaking Factor Scenarios and Model Runs

16.4.13 Hydraulic analysis of different peaking factor scenarios would be undertaken for assessment of different sections of sewers in the following:-

- Different Global Factor Scenarios for different sections of sewers
- Performance Scenario (a flat DWF profile of 3 times ADWF for simulation runs with duration not less than 3 hours; and a flat DWF profile of 4 times ADWF with duration of 2 hours for sewer size smaller or equal to 375mm diameter)

16.4.14 The Performance Scenario using for hydraulic analysis is made reference to Chapter 11 of the EPD Guidelines for Sewer Network Hydraulic Model Build and Verification for the new sewers inside KTD since the field data for the new catchments inside KTD are not available.

16.4.15 The modelling approach is based on the EPD Guidelines for Sewer Network Hydraulic Model Build and Verification for the hydraulic modelling assessment for the new sewers inside KTD.

Hydraulic Assessment Methodology for the Existing Trunk Sewer

16.4.16 In the proposed sewerage scheme of Kai Tak Development Area (KTD), sewage generated from the new developments would be conveyed to existing trunk sewer and then onward transfer to existing sewage treatment plant for further treatment. Assessment of the capacity of the existing trunk sewer subjected to the additional sewage flow from KTD is necessary in order to justify the feasibility of the proposed sewerage scheme.

Sewage Flows

16.4.17 The sewage flows for the sewerage sub-catchments of the existing trunk sewer outside KTD are projected based on the latest planning data from PlanD and the unit flow factors given in the Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning (GESF) (2005) from EPD. The unit flow factors adopted in the assessment for KTPTW and TKWPTW are shown as follows (**Table 16.10**):

Table 16.10 Unit Flow Factors adopted for KTPTW and TKWPTW Catchments Excluding KTD

Category	Unit (per)	Unit Flow Factor (m^3/day)	
		KTPTW	TKWPTW
Domestic			
• Permanent Housing	person	0.190	0.190
• Other Housing	person	0.175	0.175
• Mobile Residents	person	0.190	0.190
Commercial(1)			
• J2 Electricity Gas & Water	employee	0.330	0.330
• J3 Transport, Storage & Communication	employee	0.180	0.180
• J4 Wholesale & Retail Trades	employee	0.280	0.280
• J5 Import & Export Trades	employee	0.080	0.080
• J6 Finance, Insurance, Real Estate & Business Service	employee	0.080	0.080
• J7 Agriculture & Fishing	employee	0.080	0.080
• J8 Mining & Quarrying	employee	0.080	0.080
• J9 Construction	employee	0.230	0.230
• J10 Restaurants & Hotels	employee	1.580	1.580
• J11 Community, Social & Personal Service	employee	0.280	0.280
• J12 Public Administration	employee	0.080	0.080
School			
• School student	person	0.040	0.040
Industrial			
• J1 Manufacturing	employee	0.530	0.630

Notes: (1) The unit flow factor for commercial shown is the sum of the unit flow factor of employee ($0.080m^3$/day) and the unit flow factor of commercial activities of a particular trade under consideration.

16.4.18 Catchment-inflow-factors (P_{CIF}) are extracted from the EPD's guideline to assess broadly the extent of the overall net excessive inflow situation of every catchment. Net inflow to the sewerage system is the combined effect of two principal effects:

- Undesirable inflow to the sewerage system occurs when stormwater or groundwater enters the sewerage system through cracks in the sewers or when stormwater pipes are incorrectly connected to sewers.

- On the other hand, flow to the sewerage system is reduced when sewage is discharged illegally or inadvertently into stormwater system. These expedient connections tend to occur mostly in the older catchments. Eradication of expedient connections will increase sewage flow to the PTWs.

16.4.19 As described in the Final Report on Flow & Load Projections, issued in Mar 2008 under the HATS project (Agreement No. CE8/2006), the Catchment-inflow-factors were adjusted with more updated flow data. Hence, the P_{CIF} for KTPTW and TKWPTW catchments are 1.14 and 1.00, respectively.

16.4.20 There are inherent uncertainties in the flow estimates due to a number of as-yet unquantified factors (e.g. unit flow factors, catchment-inflow factors, transient population and portions of different types of residential populations). It is proposed to add an extra 10% contingency to the calculated ADWFs and peak flows. It is assumed that the 10% contingency for the uncertainties will be materialised linearly from year 2006 until 2030 (i.e. +2% on Year 2010; +6% on Year 2020 and 10% on Year 2030/Ultimate). This approach is based on the report of "Technical Note Flow and Load Projections" under Agreement No. CE 45/2005(EP) – HATS Stage 2A Environmental Impact Assessment Study – Investigation.

Model Networks and Catchment

16.4.21 The sewerage network model built in 2001 with projected population scenarios for the Central and East Kowloon sewerage catchments was obtained from EPD in March 2007. Recently, the latest sewerage network model for the existing East Kowloon sewerage catchment was available from EPD. However, the latest sewerage network model for the Central Kowloon sewerage catchment is still under preparation by EPD and not yet available. The latest model only covers the flow condition of the existing population scenario without future population scenarios. The existing trunk sewer of the latest model was slightly modified by EPD according to the as-built records in comparison with the model built in 2001. Since the aim of the hydraulic assessment is to check the capacity of the existing trunk sewer, the latest sewerage network model was used and trimmed to a simplified model which contains the network of the concerned trunk sewer only for hydraulic assessment.

Pipe Roughness

16.4.22 The pipe roughness is specified as an equivalent sand roughness (ks) used by the Colebrook-White equation. In this hydraulic assessment, the roughness coefficient to be used for the existing sewer would follow the values (Ks=3mm) adopted in the previous Review of Central and East Kowloon Sewerage Master Plans (RCEKSMP).

Sediments

16.4.23 The presence of sediments inside the trunk sewer will reduce the capacity of the sewer due to the reduction in cross sectional area. Based on the field data from the flow survey conducted under this Project so far, the depth of sediments at various part of the trunk sewer (i.e. box culvert to KTPTW) varies from 0 to 200mm, about 0 to 8.7% of the height of the culvert. The sediment depth used in the model will be referenced to the measured silt depth from the survey data. (The measured silt levels in the trunk sewer conducted by the flow surveys in May 2007 were presented in Appendix B of the report of "Hydraulic Assessment on Trunk Sewer and Treatment Facilities based on the Flow Survey Data" under Agreement No. CE 35/2006(CE) project.) The average value of the silt depths is hence assigned to the whole trunk sewer of the sewerage network models.

Peaking Factors

16.4.24 The peak flow for the corresponding section of trunk sewer is used in the hydraulic assessment to examine the sewerage impact. The peak flow is calculated from multiplying the average dry weather flow (ADWF) by the peaking factor.

16.4.25 The peaking factor is based on the cumulative contributing population. As the cumulative contributing population increases, the peaking factor and the peak flow will decrease. The peaking factor including stormwater allowance is used for the calculation of the peak flow. The peaking factor for the trunk sewer is selected in accordance with the following table (**Table 16.11**):

Table 16.11 Peaking Factor for Existing Trunk Sewer

Population Range	Peaking Factor (including stormwater allowance) for facility with existing upstream sewerage
< 1,000	8
1,000 – 5,000	6
5,000 – 10,000	5
10,000 – 50,000	4
> 50,000	$Max[7.3/N^{0.15}, 2.4]$

Note: N is the contributing population in thousands

16.4.26 The contributing population is equal to the calculated total average flow divided by a factor of 0.27. The factor is taken as an average unit flow factor described in Paragraph 12 of the Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning (GESF) (2005) from EPD.

Design Scenarios and Model Runs

16.4.27 Hydraulic analysis of different design scenarios would be undertaken for the following:

- 2016 Design Scenario;
- 2030 Design Scenario; and
- Ultimate Scenario (2030 Design Scenario + 5%)

16.4.28 According to **Para 16.4.20**, uncertainty allowances are added to the calculated ADWFs and peak flows.

Modelling Approach

16.4.29 The following approach is applied for the hydraulic modelling assessment without availability of calibrated flows data for the existing trunk sewer:

- Identify the discharge points from the existing sewerage catchments and the Kai Tak Development sewerage catchments for assessment.
- Calculate the average dry weather flows (ADWF) of the sewerage catchments.
- Determine the peaking factors based on the cumulative contributing population at different sections of the trunk sewer for different scenarios.
- Calculate the peak flows for different sections of the trunk sewer at different design scenarios.
- Enter inflow hydrographs with the peak flows to the model for different design scenarios at different sections of the trunk sewer for model runs.
- Conduct model runs for different design scenarios.

16.4.30 When the flow survey data is available, the verification and calibration adjustments will be made to the sewerage model network to achieve a good fit between observed and predicted flows. Afterward a simulation for the total peak flows including a calibrated dry weather diurnal flow and a synthetic storm event (1 in 5 year return period as referenced to "Guidelines for Sewer Network Hydraulic Model Build and Verification" issued by EPD) will be applied to the calibrated sewerage model network to replace the methodology of peaking factors at different sections of the trunk sewer adopted in the above, if the peak flows based on surveyed data is higher than the calculated peak flow described in **Para 16.4.24**.

Model Calibration by Flow Survey Data

1. Dry Weather Flow

16.4.31 The predicted velocity will be adjusted by changing the pipe roughness of the sewer in the model to fit the measured velocity. If the section of the sewer between flow monitors is the same, the average value of pipe roughness will be applied to this section. The pipe roughness of the whole trunk sewer in the model will be adjusted accordingly.

16.4.32 With the flow Survey data from the selected dry weather events, the values of measured flow, water depth and velocity were obtained at flow monitor locations. Plots for the measured flow, water depth and velocity are required to show for a 24 hour daily period.

16.4.33 Dry weather diurnal profile will be obtained from the measured flow data of the most downstream of the flow monitor of the respective sub-catchment. Modifications to the average unit flow factor will be made to each sewerage sub-catchment in order to fit the predicted dry weather flow to the measured dry weather flow.

16.4.34 The predicted water depth will be adjusted by changing the sediment depth of the sewer in the model to fit the measured water depth. The sediment depth used in the model will be based on the measured silt depth from the survey data. The average value of the silt depths amongst the flow monitor location will be applied to the trunk sewer section within the respective sub-catchment. Hence, the sediment depth of the whole trunk sewer in the model is determined.

2. Wet Weather Flow

16.4.35 A suitable storm event from the flow survey data will be selected for storm verification process. Similar to the dry weather event, plots for the measured flow, water depth and velocity are required to show for a 24 hour daily period.

16.4.36 Rainfall data will be obtained from the field raingauge monitoring locations. The rainfall data would be used for a model run to determine the percentage of the surface runoff entered into the sewerage network for each sub-catchment. This percentage represents the infiltration of the storm flows into the sewerage model network for different storm event scenarios.

16.5 Sewage Flow Projections

Kai Tak Development

16.5.1 Based on the population and the unit flow factors, the average dry weather flows of Kai Tak Development (excluding sewage flow from cruise vessels) for Year 2016 and Year 2021 contributed to KTPTW and TKWPTW are estimated as shown in **Table 16.12 and Table 16.13** respectively.

Table 16.12 Estimated Average Dry Weather Flow of KTD to KTIPS and KTPTW

Category	ADWF (m^3/d)	
	Year 2016	Year 2021
Domestic		
• Public Rental House (RS)	6,125	6,125
• R1	0	0
• R2	3,244	3,244
• R3	0	1,803
• Mixed Use	0	673
Sub-Total	**9,369**	**11,845**
Commercial		
• Employment	7,222	16,974
• Hotel	763	2,217
• Hospital	0	296
Sub-Total	**7,985**	**19,487**
School	**211**	**211**
TOTAL	**17,565**	**31,543**

Notes: (1) The breakdown of flow projection of KTD (ADWF) excluding cruise vessels to KTPTW is presented in **Appendix 16.2A-1**.

Table 16.13 Estimated Average Dry Weather Flow for KTD to TKWPTW

Category	ADWF (m^3/d)	
	Year 2016	Year 2021
Domestic		
• Public Rental House (RS)	0	0
• R1	1,138	1,138
• R2	0	7,767
• R3	0	0
• Mixed Use	856	856
Sub-Total	**1,994**	**9,761**
Commercial		
• Employment	6,817	12,026
• Hotel	0	680
• Hospital	0	0
Sub-Total	**6,817**	**12,706**
School	**105**	**137**
Others(1)		
• Handwashing at Toilets in Stadium	950	950
• Showering in Stadium	173	173
• Toilet Flushing in Stadium	4,604	4,604
Sub-Total	**5,727**	**5,727**
TOTAL	**14,642**	**28,330**

Notes: (1) Estimated ADWF in Stadium is quoted from Appendix C - Site No. 2D-1 Stadium Fresh and Salt Water Demand Estimate of *Technical Report No. TR4F: Preliminary Water and Utility Assessments (Final)*

(2) Projected flow is rounded to the nearest integer.

16.5.2 The breakdown of the flow projections inside KTD for Sewerage Catchments A-L (KTPTW and TKWPTW catchments) is presented in the **Appendix 16.2A-2**.

Developments within KTPTW and TKWPTW Catchments, Excluding KTD

16.5.3 Based on the population and the unit flow factors, the average dry weather flows of KTIPS, KTPTW and TKWPTW catchments excluding KTD for Year 2016, Year 2030 and Ultimate Scenarios are estimated as shown in **Tables 16.14 and 16.15.**

Table 16.14 Estimated Average Dry Weather Flows for KTIPS, KTPTW and TKWPTW Catchments, Excluding KTD

Category	Year 2016 ADWF		
	KTIPS (m^3/d)	**KTPTW (m^3/d)**	**TKWPTW (m^3/d)**
Domestic			
• Permanent Housing	120,285	194,309	96,844
• Other Housing	1,366	2,002	2,295
• Mobile Residents	4,222	6,567	3,565
Sub-Total	**125,873**	**202,878**	**102,704**
Commercial			
• J2 Electricity Gas & Water	299	334	227
• J3 Transport, Storage & Communication	8,547	9,824	5,035
• J4 Wholesale & Retail Trades	17,733	19,610	11,287
• J5 Import & Export Trades	10,700	11,090	5,835
• J6 Finance, Insurance, Real Estate & Business Service	7,731	8,129	3,508
• J7 Agriculture & Fishing	18	34	15
• J8 Mining & Quarrying	0	0	0
• J9 Construction	7,177	8,482	3,703
• J10 Restaurants & Hotels	35,330	40,939	60,776
• J11 Community, Social & Personal Service	20,180	29,465	21,952
• J12 Public Administration	329	489	737
Sub-Total	**108,044**	**128,396**	**113,075**
School • School student	**4,241**	**6,233**	**4,236**
Industrial • J1 Manufacturing	**4,009**	**4,858**	**3,563**
Total	**242,167**	**342,365**	**223,578**

Table 16.15 Estimated Average Dry Weather Flows for KTIPS, KTPTW and TKWPTW Catchments, Excluding KTD

Category	Year 2030 ADWF			Ultimate ADWF		
	KTIPS (m^3/d)	KTPTW (m^3/d)	TKWPTW (m^3/d)	KTIPS (m^3/d)	KTPTW (m^3/d)	TKWPTW (m^3/d)
Domestic						
• Permanent Housing	132,208	219,017	113,188	138,818	229,970	118,849
• Other Housing	1,080	1,527	1,393	1,134	1,603	1,462
• Mobile Residents	5,496	8,795	5,013	5,770	9,234	5,263
Sub-Total	**138,784**	**229,339**	**119,594**	**145,722**	**240,807**	**125,574**
Commercial						
• J2 Electricity Gas & Water	240	267	183	252	281	192
• J3 Transport, Storage & Communication	8,721	10,186	6,507	9,157	10,695	6,832
• J4 Wholesale & Retail Trades	10,428	12,480	11,072	10,949	13,103	11,625
• J5 Import & Export Trades	9,655	10,040	5,986	10,137	10,542	6,286
• J6 Finance, Insurance, Real Estate & Business Service	5,101	5,565	4,495	5,356	5,843	4,719
• J7 Agriculture & Fishing	14	26	12	15	28	13
• J8 Mining & Quarrying	0	0	0	0	0	0
• J9 Construction	8,315	10,017	4,552	8,731	10,517	4,779
• J10 Restaurants & Hotels	37,586	44,294	62,257	39,465	46,508	65,370
• J11 Community, Social & Personal Service	22,894	34,528	26,592	24,039	36,254	27,922
• J12 Public Administration	362	491	574	380	515	603
Sub-Total	**103,316**	**127,894**	**122,230**	**108,481**	**134,286**	**128,341**
School • School student	**4,480**	**6,620**	**4,519**	**4,704**	**6,951**	**4,745**
Industrial • J1 Manufacturing	**5,601**	**5,734**	**1,335**	**5,881**	**6,021**	**1,402**
Total	**252,181**	**369,587**	**247,678**	**264,788**	**388,065**	**260,062**

Notes: (1) The breakdowns of the flow projections for the sewage catchments of KTIPS, KTPTW and TWKPTW, excluding KTD, are presented in **Appendix 16.2B-1**.

Cruise Terminal

16.5.4 **Table 16.16** shows the estimated sewage flows for two cruise vessel berthing scenarios and the sewage discharge rates to the Kai Tak sewerage system. It is understood that cruise vessels would normally stop in HK for a minimum of 8 hours. For the worst berthing scenarios (Super Post-Panamax + Post-Panamax and two Post-Panamax), it is assumed the sewage quantity would be pumped to the Kai Tak sewerage system in a shortest duration of 8 hours in order to avoid overly design the Kai Tak sewerage system.

Table 16.16 Estimated Sewage Flows for Cruise Vessel Discharge

Parameters	Cruise Vessel Berthing Scenarios					
	Super Post-Panamax + Post-Panamax			Two Post-Panamax		
	Super Post-Panamax	Post-Panamax	Total	Post-Panamax 1	Post-Panamax 2	Total
Sewage Generation						
- Blackwater (m^3/day)	141	105	245	105	105	209
- Greywater (m^3/day)	1,547	1,150	2,696	1,150	1,150	2,299
- Total (m^3/day)	1,687	1,254	2,941	1,254	1,254	2,508
Discharge to KT Sewerage System						
- One day quantity (m^3)	1,687	1,254	2,941	1,254	1,254	2,508
- Discharge rate in 8 hours (l/s)	59	44	**103**	44	44	**88**

16.5.5 It should be noted that the phase 1 berth will be commissioned in year 2012 and the phase 2 berth will be scheduled for commissioning after 2015. For the worst case scenario, daily sewage flow discharged from cruise vessels is estimated to be 2,941m^3/day for Year 2016 and beyond.

16.5.6 Additional sewage flow generated from one cruise vessel passengers in the cruise terminal buildings after berthing is assumed to be 30% of the sewage flow generated from the cruise terminal buildings. Average flow generated from two cruise vessel passengers at the cruise terminal buildings is estimated to be 2,016m^3/day for Year 2016 and beyond. According to **Appendix 16.2A-3** showing the projected flows for sub-planning area, the cruise terminal buildings belong to Area 4D and the daily sewage flows (ADWF) is 2,607.9+735+17.5 m^3/d (i.e. 3,360.4 m^3/d). Hence, the sewage flows of the landed passengers at cruise terminal buildings for vessel 1 and 2 are 2 x 3,360 x 30% = 2,016 m^3/d.

Jordan Valley Box Culvert

16.5.7 A sewage pumping station was proposed by EPD under "IP 07-001 Study on the Control of Water pollution at Jordan Valley Box Culvert" at Jordan Valley Box Culvert (JVBC) to alleviate the pollution problem at the Kai Tak Approach Channel. The proposed works will be constructed under the DSD project of "*Control of Water Pollution at Jordan Valley Box Culvert – Investigation, Design and Construction*" in KTD area. The polluted dry weather flow from JVBC will be intercepted to the sewage pumping station at JVBC and then discharged to the existing sewer box culvert at Kai Fuk Road. A preliminary analysis conducted in the feasibility study of "*Control of Water Pollution at Jordan Valley Box Culvert"* reviewed that the capacity of the existing downstream sewerage system would be adequate to deal with the intercepted flow.

16.5.8 The discharge rate of the pumping station at JVBC is 0.5m^3/s. For the projection of the peak flows at KTIPS and KTPTW, an extra 0.5m^3/s is suggested to be added to the estimated PWWFs from KTD, Kwun Tong catchments, cruise ships and the terminal buildings.

Summary of Flow Projections

16.5.9 **Tables 16.17, 16.18 and 16.19** show the average dry weather flows, peaking factors and peak flows respectively for KTIPS, KTPTW and TKWPTW for Year 2016, Year 2030 and Ultimate Scenarios. The breakdown of the flow projections is presented in **Appendices 16.2A-2 and 16.2B-1.**

Table 16.17 Average Dry Weather Flows for Year 2016, Year 2030 and Ultimate Scenarios

Facilities	Projected ADWF (m^3/day)		
	Year 2016	Year 2030	Ultimate
Kwun Tong Intermediate Pumping Station			
Kai Tak Development	17,565	31,543	31,543
Kwun Tong Catchments	242,167	252,181	264,788
Cruise Passenger at Terminal Buildings(1)	2,016	2,016	2,016
Cruise Vessel Discharge	2,941	2,941	2,941
TOTAL	**264,689**	**288,681**	**301,288**
Kwun Tong Preliminary Treatment Works			
Kai Tak Development	17,565	31,543	31,543
Kwun Tong Catchments	342,365	369,587	388,065
Cruise Passenger at Terminal Buildings(1)	2,016	2,016	2,016
Cruise Vessel Discharge	2,941	2,941	2,941
TOTAL	**364,887**	**406,087**	**424,565**
To Kwa Wan Preliminary Treatment Works			
Kai Tak Development	14,642	28,330	28,330
To Kwa Wan Catchments	223,578	247,678	260,062
TOTAL	**238,220**	**276,008**	**288,392**

Notes: (1) Sewage flows generated from cruise passengers at terminal buildings are assumed to be 30% flow of Cruise Terminal Buildings for one berthing.
(2) The above projected ADWF estimated for Kwun Tong Preliminary Treatment Works and Kwun Tong Intermediate under all scenarios exclude the ADWF intercepted from JVBC since the exact quantity of the intercepted flows will be subject to the design under Agreement No. CE13/2008(DS).

Table 16.18 Peaking Factors for KTIPS, KTPTW and TKWPTW

Facilities	Peaking Factors		
	Year 2016	Year 2030	Ultimate
KTIPS	2.49	2.48	2.47
KTPTW	2.44	2.42	2.42
TKWPTW	2.51	2.49	2.48

Notes: (1) Peaking factors (PF) are calculated from EPD's guideline for population>50,000:
Max ($3.9/N^{0.065}$, 2.4),
where N is the contributing population in thousands
Contributing population = Calculated total average flow/0.27

Table 16.19 Projected Peak Flows for Year 2016 and Year 2030 Scenarios

Facilities	Projected PWWF (m^3/s)		
	Year 2016	Year 2030	Ultimate
Kwun Tong Intermediate Pumping Station			
Kai Tak Development	0.51	0.91	0.91
Kwun Tong Catchments	6.99	7.23	7.57
Cruise Passenger at Terminal Buildings(1)	0.06	0.06	0.06
Cruise Vessel Discharge(2)	0.10	0.10	0.10
DWFI from JVBC	0.50	0.50	0.50
TOTAL	**8.15**	**8.80**	**9.14**
Kwun Tong Preliminary Treatment Works			
Kai Tak Development	0.50	0.89	0.89
Kwun Tong Catchments	9.67	10.37	10.86
Cruise Passenger at Terminal Buildings(1)	0.06	0.06	0.06
Cruise Vessel Discharge(2)	0.10	0.10	0.10
DWFI from JVBC	0.50	0.50	0.50
TOTAL	**10.83**	**11.91**	**12.40**
To Kwa Wan Preliminary Treatment Works			
Kai Tak Development	0.43	0.82	0.81
To Kwa Wan Catchments	6.49	7.13	7.46
TOTAL	**6.92**	**7.95**	**8.27**

Notes: (1) Sewage flows generated from cruise passengers at terminal buildings are assumed to be 30% flow of Cruise Terminal Buildings for one berthing.
(2) Cruise vessels discharge to the Kai Tak sewerage system is assumed to be pumped in a period of 8hours (Q_{vessel} (m^3/s) = 2941/60/60/8)
(3) Projected peak flows are rounded to 2 decimal places.

16.6 Assessment of Impact to Existing and Planned Sewerage System

16.6.1 The sewage generated from KTD will be diverted to the existing To Kwa Wan and Kwun Tong Preliminary Treatment Works (PTW). The proposed sewerage system for KTD is sub-divided into two parts. The south-western part of KTD will be diverted to To Kwa Wan PTW while the north-eastern part of KTD will be diverted to Kwun Tong PTW via the existing trunk sewers along Prince Edward Road East, Wang Kwong Road, Kai Fuk Road and Hoi Bun Road. The proposed schematic sewerage network of KTD is shown in **Figure 16.5.**

16.6.2 For assessment of the impacts on the existing and planned sewerage system, sewage treatment and disposal facilities, three flow scenarios (namely Year 2016, Year 2030 and Ultimate Scenarios) were evaluated taken into consideration of the available planning data from Planning Department. The Year 2016 Scenario is used to assess the potential impacts arising from the Cruise Terminal on the existing and planned sewerage system, sewage treatment and disposal facilities. The Year 2030 Scenario and the Ultimate Scenario (Year 2030+5%) are used to assess the long-term impacts arising from the whole KTD on the existing and planned sewerage system, sewage treatment and disposal facilities.

16.6.3 The key components of the sewerage system in the study area as listed below were assessed:-

- Trunk sewers along Hoi Bun Road
- Kwun Tong Intermediate Pumping Station (KTIPS)
- Kwun Tong Preliminary Treatment Works (KTPTW)
- To Kwa Wan Preliminary Treatment Works (TKWPTW)
- Conveyance tunnels from KTPTW to Stonecutters Island STW

Trunk Sewers along Hoi Bun Road

Existing Condition

16.6.4 The sewerage along Wang Kwong Road and Hoi Bun Road are the trunk sewers of Kwun Tong Preliminary Treatment Works (KTPTW) catchment, which convey the sewage flows from upstream catchment to Kwun Tong Intermediate Pumping Station (KTIPS) then to KTPTW.

16.6.5 The sewage generated from the developments and the Cruise Terminal will be conveyed to the existing trunk sewers along Wang Kwong Road and Hoi Bun Road.

16.6.6 The location of this existing trunk sewers is indicated in **Figure 16.10.** The dimensions of the trunk sewers are listed in the following table **(Table 16.20)**.

Table 16.20 Dimensions of the Trunk Sewers along Hoi Bun Road

Section	Dimensions (mm)
A-B	1800 – 2500 x 2300 BC
B-C	2500 x 2300 BC
C-D	2500 x 2300 BC
D-E	3000 x 2300 BC – 3000 x 2300 + 2000 x 2300 BC

Planned Upgrading

16.6.7 There is no further upgrading works currently proposed for the existing trunk sewers.

Future Flows

16.6.8 The projected sewage flows for Year 2016 and Ultimate Scenarios will be used to access the capacity of the trunk sewers.

16.6.9 The sewage generated from three catchments inside KTD would be conveyed to the trunk sewers at three points. The sewage from five existing sewage catchments of KTPTW would be conveyed to the trunk sewer. The breakdown of the flow projections is presented in **Appendix 16.2A-1** and **Appendix 16.2B-2**.

16.6.10 The connection points to the trunk sewers and their corresponding sewage flows to be discharged are shown in **Figure 16.6** and **Figure 16.7**.

Sewage Flow Survey

16.6.11 In order to verify the projected sewage flows on the trunk sewer and conduct the calibration of the sewage hydraulic model, a flow survey on sewerage system was carried out between June and August 2007 for about 90 days during wet season.

16.6.12 Based on the survey data, the average dry weather flows were revised to fit the measured dry weather flows.

16.6.13 The ADWF with surveyed flow data for Year 2016 and Ultimate Scenarios are presented in **Figure 16.8** and **Figure 16.9**. In general, the value of the measured ADWF was less than the predicted ADWF. As a conservative approach, the predicted sewage flows projected under **Para 16.5** with calibrated hydraulic model would be used for hydraulic analysis.

Capacity Evaluation

16.6.14 The InfoWorks model obtained from EPD was used for the hydraulic analysis exercise. Since the hydraulic analysis will only focus on the trunk sewer along Hoi Bun Road instead of the whole sewerage networks in KTPTW catchments, we have simplified the hydraulic model obtained from EPD by inputting the sewage flows into 8 discharge points along the trunk sewer. The peak sewage flows were calculated based on the latest planning data from Planning Department and the latest development schedule of KTD. The hydraulic model for the trunk sewer was run to assess the hydraulic performance of the trunk sewer under the Year 2016 and Ultimate flow conditions. It is considered that this approach is sufficient for the assessment of the trunk sewer. The assessment results for Year 2016 and Ultimate Scenarios are indicated in **Figure 16.10** and **Figure 16.11.**

16.6.15 The hydraulic modeling networks and results of the simplified models for assessment of the hydraulic performance of the trunk sewers along Hoi Bun road are provided in the **Appendix 16.3.**

Summary

16.6.16 Based on the latest flow projections with implementation of the flow survey data for model calibration, the capacity of the existing trunk sewer along Hoi Bun Road will be sufficient to cater for the projected flows in Year 2016 and Ultimate scenarios.

Kwun Tong Intermediate Sewage Pumping Station

Existing Facilities and Flows

16.6.17 Kung Tong Intermediate Pumping Station (KTIPS) is located at Wai Yi Street, northwest to the existing KTPTW. It is required to lift the flow from Kwun Tung and Kai Tak catchments and deliver it to the KTPTW. The design capacity of the KTIPS is of 9.2m^3/s. Its existing facilities comprise five screw-type inlet lifting pumps, four duty and one standby (see **Table 16.21**).

Table 16.21 Existing Facilities of KTIPS

Key Equipments	No. of Units		Capacity of Duty Units (m^3/s)
	Duty	Standby	
Screw Inlet Pumps	4	1	9.2

Planned Upgrading

16.6.18 There is no further upgrading works currently proposed for the KTIPS.

Future Flows

16.6.19 With reference to the latest projected flows in **Para. 16.5.9**, the projected peak wet weather flow of KTIPS including flows from DWFI at JVBC will be of 8.15m^3/s, 8.80m^3/s and 9.14m^3/s for Year 2016, Year 2030 and Ultimate Scenarios respectively. (See **Table 16.22**).

Table 16.22 Projected Flows of KTIPS

Sewage Flows	Year 2016	Year 2030	Ultimate
PWWF (m^3/s)	8.15	8.80	9.14
ADWF (m^3/day)	264,689	288,681	301,288

Capacity Evaluation

16.6.20 Based on the assessment results, it was found that the existing capacity of KTIPS should be able to handle the additional flows from KTD under Year 2016, Year 2030 and Ultimate Scenarios. The capacity assessment of existing sewage treatment and disposal facilities for Year 2016 Scenario, Year 2030 Scenario and Ultimate Scenario is shown in **Figure 16.12, Figure 16.13** and **Figure 16.14**.

Summary

16.6.21 Based on the latest flow projection, the existing capacity of KTIPS will be sufficient to handle the increased flow for Year 2016, Year 2030 and Ultimate Scenarios. No plant upgrade is required.

Kwun Tong Preliminary Treatment Works

Existing Facilities and Flow Capacity

16.6.22 Kwun Tong Preliminary Treatment Works (KTPTW) is located at Wai Yip Road, south east to the existing KTIPS. The designed capacity of KTPTW is 10.93 m^3/s.

16.6.23 The existing facilities of the KTPTW comprise four 150mm spacing hand raked coarse screen, six screw-type inlet pumps, four mechanically raked fine screens with 6mm screen spacing and four detritors. The capacities of existing treatment units of KTPTW are shown in **Table 16.23**.

Table 16.23 Existing Facilities of KTPTW

Key Equipments	No. of Units		Capacity of Duty Units (m^3/s)
	Duty	Standby	
Hand raked coarse screen (150mm spacing)	3	1	11.8
Screw inlet pump	5	1	11.8
Mechanical raked fine screen (6mm spacing)	3	1	11.8
Detritor	4	0	10.93

Planned Upgrading

16.6.24 Hydraulic adequacy of the existing KTPTW was reviewed in the Review of Central and East Kowloon Sewerage Master Plans (RCEKSMP) and the Kai Tak Planning Review (TR4E) in 2003 and 2006, respectively.

16.6.25 Based on the RCEKSMP, the current treatment capacity of KTPTW (10.93m^3/s) would be adequate for the expected 2006 and 2011 flows, but not for flows from the 2016 scenario and beyond (see **Table 16.24**).

Table 16.24 Projected Flows of KTPTW under RCESMP (2003)

Scenario	Design Capacity	Year			
		2006	2011	2016	Ultimate
PWWF (m^3/s)	10.93	9.94	10.82	11.86	13.10
Excess Flow to PTW (m^3/s)	--	N/A	N/A	0.93	2.17

Notes: (1) PTW peak flows are based on the peaking factors from the DSD Sewerage Manual.

16.6.26 With reference to the prediction from the RCEKSMP, the estimated sewage flows were further reviewed in the TR4E. The projected flows under the ultimate flow scenario with and without development of Kai Tak Development (KTD) are shown in **Table 16.25**. Capacity shortfall in KTPTW was still found under the TR4E based on the proposed population of 86,000 under the revised PODP.

Table 16.25 Projected Flows of KTPTW under TR4E (2006)

Scenario	Design Capcacity	Ult. Sewage Flow w/o Dev. in KTD	Ult. Sewage Flow w Dev. in KTD
PWWF (m^3/s)	10.93	11.94	12.66

16.6.27 The following mitigation measures were proposed in the RCEKSMP and the TR4E:

- Balancing tanks at KTPTW or the upstream pumping stations of KTD; and
- Telemetry system and variable speed drives in the upstream pumping stations of KTD to control the pumped flow to the KTPTW.

16.6.28 Under the OZP, an area of approximately 15,000m^2 (1.5ha) to the south-east of the existing KTPTW, on the southern side of Kwun Tong Nullah, has been allocated for the expansion of KTPTW.

16.6.29 EPD will study the need, scopes and programme for upgrading the existing KTPTW. The upgrading plan of the KTPTW would subject to EPD's future study findings.

Future Flows

16.6.30 With reference to the latest flow projection conducted under this Study (see **Para. 16.5.9**), the projected flows for KTPTW will be of 10.83m^3/s, 11.91m^3/s and 12.40m^3/s for Year 2016, Year 2030 and Ultimate Scenarios. (See **Table 16.26**)

Table 16.26 Projected Flows of KTPTW

Sewage Flows	Year 2016	Year 2030	Ultimate
PWWF (m^3/s)	10.83	11.91	12.40
ADWF (m^3/day)	346,887	406,087	424,565

Capacity Evaluation

16.6.31 The existing capacity of KTPTW is 10.93m^3/s, which should be sufficient to handle the flows for Year 2016 (10.83m^3/s) Scenario. For the long-term impact, Year 2030 and Ultimate Scenarios are used and the assessment results show that the capacity of KTPTW would be exceeded only because of the potential population increase in KTPTW catchments in 2030 and beyond. It is understood that the project of investigation for the upgrading of KTPTW as mentioned in **Para. 16.6.29** will commence in June/July 2008 and will last for about 17 months. The planned upgrading plant of KTPTW would consider the long term projected flows for KTD such as Year 2030 and Ultimate Scenarios. The details of the upgrading of KTPTW will be determined under this EPD's project. The capacity assessment of existing sewage treatment and disposal facilities can be referred to **Figure 16.12, Figure 16.13** and **Figure 16.14.**

16.6.32 In addition, capacities of individual facilities on a unit process basis are assessed to identify if any inadequate areas would be encountered in the KTPTW operation. The existing capacities of the coarse screening, inlet pumping and fine screening systems are of 11.80m^3/s, which is adequate to handle the projected flows for Year 2016 scenario only. For Year 2030 and Ultimate Scenarios, standby unit shall be utilized to handle the increased flows but no standby unit is available to secure stable operation in case of maintenance or breakdown. The need of an additional equipment of the coarse screening, inlet pumping and fine screening systems should be reviewed to secure operation reliability in the coming EPD's Study.

16.6.33 The design capacity of detritor is of 10.93m^3/s when all four units are in operation. No standby unit is available during the peak flow period. According to the latest flow projection in **Para. 16.6.30**, the design capacity of the detritor system is insufficient to cater for the projected peak flow for Year 2030 and Ultimate Scenarios of 11.91m^3/s and 12.40m^3/s respectively. The upgrading details of detritor system should be reviewed in the coming consultancy by EPD's Study.

Summary

16.6.34 Based on the findings of RCEKSMP conducted in 2003 and the TR4E conducted in 2006, the flow capacity of KTPTW was identified to be insufficient to accommodate the additional sewage flows from KTD under the ultimate development scenario. An area of approximately 15,000m^2 (15ha) to the south-east of existing KTPTW has been allocated for future expansion.

16.6.35 The flow projections have been reviewed under this Study based on the latest planning data from Planning Department, and the latest development schedule of KTD. The peak wet weather flow for ultimate scenario will be reduced to 12.40m^3/s. The existing capacity of KTPTW will be adequate to handle the additional sewage from KTD for Scenario Year 2016 only. For Year 2030 and Ultimate Scenarios, the sewage flows would exceed the existing capacity of KTPTW. The planned upgrading plant of KTPTW would consider the long term projected flows for KTD such as Year 2030 and Ultimate Scenarios. The details of the upgrading of KTPTW will be determined under the project of "*the upgrading of Kwun Tong Sewage Preliminary Treatment Works*" by EPD.

To Kwa Wan Preliminary Treatment Works

Existing Facilities and Flow Capacity

16.6.36 To Kwa Wan Preliminary Treatment Works (TKWPTW) is located at Sung Ping Street. The design capacity of TKWPTW is 9.32m^3/s.

16.6.37 The existing facilities of the TKWPTW comprise three 150mm spacing hand raked coarse screen, eight screw-type inlet pumps, five mechanically raked fine screens with 6mm screen spacing and four detritors. The capacities of existing treatment units of KTPTW are shown in **Table 16.27.**

Table 16.27 Existing Facilities of TKWPTW

Key Equipments	No. of Units		Capacity of Duty Units (m^3/s)
	Duty	Standby	
Hand raked coarse screen (150mm spacing)	2	1	9.32
Screw inlet pump	7	1	9.32
Mechanical raked fine screen (6mm spacing)	4	1	9.32
Detritor	4	0	10.64

Planned Upgrading

16.6.38 Based on the RCEKSMP, the current treatment capacity of TKWPTW ($9.32m^3/s$) would have adequate capacity for the expected flows, except in the ultimate development scenario (see **Table 16.28**). An area of approximately $4,000m^2$ (0.4ha) adjacent to TKWPTW (to the north) is allocated for extension of the PTW.

Table 16.28 Projected Flows to TKWPTW under RCESMP (2003)

Scenario	Design Capacity	Year			
		2006	2011	2016	Ultimate
Peak Flow to PTW (m^3/s)	9.32	8.83	8.47	8.99	10.00
Excess Flow to PTW (m^3/s)	--	N/A	N/A	N/A	0.68

Notes: (1) PTW peak flows are based on the peaking factors from the DSD Sewerage Manual.

16.6.39 Under the TR4E, the capacity of TKWPTW was further reviewed based on the latest population data and revised PODP for KTD (see **Table 16.29**). The TR4E concluded in 2006 that TKWPTW would have adequate treatment capacity to handle the sewage flow from the study area.

Table 16.29 Projected Flows to TKWPTW under TR4E (2006)

Scenario	Design Capacity	Ult. Sewage Flow w/o Dev. in KTD	Ult. Sewage Flow w Dev. in KTD
Peak Flow (m^3/s)	9.32	7.71	8.27

Future Flows

16.6.40 With reference to the latest flow projection conducted in **Para 16.5.9**, the projected flows of TKWPTW have further reduced and the peak wet weather flow to TKWPTW will be of $6.92m^3/s$, $7.95m^3/s$ and $8.27m^3/s$ for year 2016, year 2030 and Ultimate Scenarios, respectively. (See **Table 16.30**)

Table 16.30 Projected Flows for TKWPTW

Sewage Flows	Year 2016	Year 2030	Ultimate
PWWF (m^3/s)	6.92	7.95	8.27
ADWF (m^3/day)	238,220	276,008	288,392

Capacity Evaluation

16.6.41 The existing capacity of TKWPTW is 9.32m^3/s, which should be sufficient to handle the flows for Year 2016 (6.92m^3/s), Year 2030 (7.95m^3/s) and Ultimate (8.27m^3/s) Scenarios. The capacity assessment of existing sewage treatment and disposal facilities can be referred to **Figure 16.12, Figure 16.13** and **Figure 16.14.**

16.6.42 In addition, capacities of individual facilities on a unit process basis are assessed to identify if any inadequate areas would be encountered in the TKWPTW operation. The existing capacities of the coarse screening, inlet pumping and fine screening systems are of 9.32m^3/s, which is adequate to handle the projected flows up to Year 2030 or Ultimate Scenarios. Standby unit is also available to secure a stable operation in case of maintenance or break-up.

16.6.43 The design capacity of detritor is of 10.64m^3/s when all four units are in operation. Although the design capacity of the detritor unit is sufficient to cater for the projected peak flow for ultimate scenario of 8.27m^3/s, no standby unit is available during the peak period. There is no standby unit in the original design but an improvement option for provision of a standby unit would be beneficial to the system for maintenance or emergency reason. The existing TKWPTW should be able to handle the additional sewage flow from KTD.

Summary

16.6.44 Based on the RCEKSMP, the flow capacity of TKWPTW was identified to be insufficient to accommodate the additional sewage flows from KTD under ultimate development scenario. An area of approximately 4,000m^2 (0.4ha) adjacent to the PTW was allocated for future extension. The estimated flows were reviewed in the TR4E, the estimated flows were reduced because of the smaller projected population in KTD under PODP, and the existing capacity (9.32m^3/s) of TKWPTW would be adequate for the peak flow condition in ultimate scenario.

16.6.45 The flow projection is further reviewed under this Study with the latest population data. The projected peak flows of Ultimate Scenario is of 8.27m^3/s, which is smaller than the current capacity of TKWPTW. The existing TKWPTW should be able to handle the additional sewage from KTD.

Conveyance Tunnel

Existing Facilities and Flows

16.6.46 Three sections of Conveyance Tunnels are assessed. The schematic alignment is shown in the following Diagram 1.

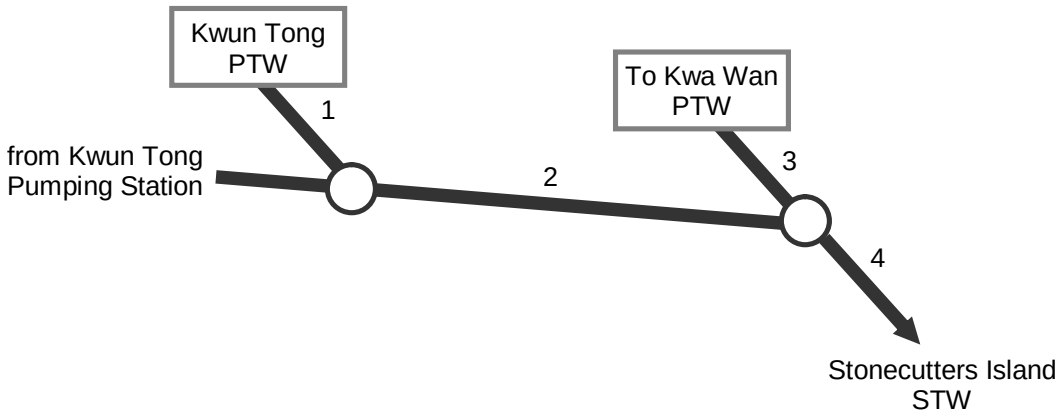

Diagram 1 – Schematic Diagram of Conveyance System

16.6.47 Based on the design memorandum of Harbour Area Treatment Scheme (HATS) Stage 1 (formerly Strategic Sewage Disposal Scheme (SSDS) Stage 1), the deep tunnels were not designed to take into account of the unusual high, and relatively infrequent, wet weather flows. Instead, a peaking factor was selected to ensure that all normal dry weather diurnal variations applying to average wet season flows (July – August) would be transferred into the tunnels. A peaking factor of 2.0 for the large sewage catchments including KTPTW and TKWPTW catchments was adopted for the design of the conveyance tunnels.

16.6.48 **Table 16.31** shows the design capacity of the conveyance tunnels.

Table 16.31 Design Capacities of the Conveyance Tunnels

	Conveyance Tunnel	Design Capacity (m^3/s)
1	KTPTW → KTPTW Drop Shaft	7.70
2	KTPTW Drop Shaft → TKWPTW Drop Shaft	14.81
3	TKWPTW → TKWPTW Drop Shaft	6.99
4	TKWPTW Drop Shaft → SCISTW	21.80

16.6.49 During the design stage of the tunnels, the estimated PWWF at ultimate stage was larger than the design capacity of the tunnels. Hence, an overflow situation was anticipated and allowed in the original design. Relevant PWWFs are listed in **Table 16.32** below.

Table 16.32 PWWFs at Ultimate Stage for the Design of Conveyance Tunnels

	Conveyance Tunnel	PWWF (m^3/s)
1	KTPTW → KTPTW Drop Shaft	10.93
2	KTPTW Drop Shaft → TKWPTW Drop Shaft	12.15
3	TKWPTW → TKWPTW Drop Shaft	9.32
4	TKWPTW Drop Shaft → SCISTW	17.64

Planned Upgrading

16.6.50 Currently, there are no planned upgrading works for the existing conveyance tunnels.

Future Flows

16.6.51 **Table 16.33** shows the projected peak flows of KTPTW and TKWPTW. The sewage flows from KTPTW and TKWPTW to the conveyance tunnels would be limited by the tunnel capacities.

Table 16.33 Projected Peak Wet Weather Flows to KTPTW and TKWPTW

PTW	Year 2016 Scenario (m^3/s)	Year 2030 Scenario (m^3/s)	Ultimate Scenario (m^3/s)
KTPTW	10.83	11.91	12.40
TKWPTW	6.92	7.95	8.27

Capacity Evaluation

16.6.52 A Working Paper No. 5 – Flows, Loads and Stage 1 System Capacity Constraints Analysis (Final) issued July 2005 under the project of "*Environmental and Engineering Feasibility Assessment Studies in Relation to the Way Forward of the Harbour Area Treatment Scheme*" (EEFS) evaluated the capacity constraint, if any, in the existing HATS Stage I system. The Working Paper No. 5 conducted the analysis of the overflows on the water quality condition. The finding showed that the total volume of overflow was small compared to the total annual volume of sewage and the overflow was insignificant.

16.6.53 The Working Paper No. 5 concluded that there is no capacity constraint with respect to the HATS Stage I system. Compared with the population data using in the KTD project, the higher population set was adopted in the Working Paper No. 5 under EEFS. Hence, based on EEFS's argument, it is concluded that the capacity of the HATS conveyance tunnels should be able to handle the additional sewage flow from KTD.

16.6.54 The sewage flows from KTPTW and TKWPTW to the conveyance tunnels would be limited by the tunnel capacities. The overflows from KTPTW and TKWPTW are anticipated and unavoidable during wet peak wet weather flows. The estimated overflows based on the latest flow projections are shown in **Table 16.34** below:

Table 16.34 Comparison of Estimated Overflow

Conveyance Tunnel		Estimated Overflow (m^3/s)
		2016 Scenario
1	KTPTW to KTPTW Drop Shaft	3.13
2	TKWPTW to TKWPTW Drop Shaft	0
		2030 Scenario
1	KTPTW to KTPTW Drop Shaft	4.21
2	TKWPTW to TKWPTW Drop Shaft	0.96
		Ultimate Scenario
1	KTPTW to KTPTW Drop Shaft	4.70
2	TKWPTW to TKWPTW Drop Shaft	1.28

16.6.55 The results are also indicated in **Figure 16.12, Figure 16.13 and Figure 16.14** for Year 2016, Year 2030 and Ultimate Scenarios.

Summary

16.6.56 The sewage flows from KTPTW and TKWPTW to the conveyance tunnels would be limited by the tunnel capacities. The deep tunnels were not designed to take account of the unusual high, and relatively infrequent, wet weather flows. A peaking factor of 2.0 for the large sewage catchments including KTPTW and TKWPTW catchments was adopted for tunnel design. Overflows from KTPTW and TKWPTW are anticipated during peak wet weather flows for year 2016, 2030 and ultimate scenarios. However, the capacity of the HATS conveyance tunnels should be able to handle the additional sewage flow from KTD.

16.7 Proposed Sewerage System inside KTD

16.7.1 Based on the population and employment data from the development schedule of KTD, a new sewerage system is designed forming a sewerage master layout plan for KTD.

16.7.2 To cope with the phasing development of KTD, the proposed sewerage system will be implemented under 2 schemes, namely Interim Scheme and Ultimate Scheme. The Interim Scheme is designed for the sewage flows from the Cruise Terminal, Advance Works developments and the early developments in North Apron areas including the Public Rental Housing (PRH) Sites and Kai Tak Government Offices (KTGO) for intake by 2012, whereas the Ultimate Scheme is designed to cater for all the developments in KTD at ultimate stage.

16.7.3 **Figures 16.16** and **16.26** show the Interim Scheme and Ultimate Scheme of the proposed sewerage network inside KTD respectively.

16.7.4 As stated in the previous sections, the sewage generated in KTD will be diverted to KTPTW and TKWPTW. The flows generated from sewerage catchments A, B, C, D and K will be conveyed to TKWPTW whereas the flows generated from sewerage catchment E, F, G, H, I, J and L will be conveyed to KTPTW.

Interim Scheme

16.7.5 Interim Scheme is proposed for cruise terminal developments near the tip of the ex-runway, and PRH and KTGO in North Apron. The assessment of the sewerage impacts due to the above developments at early phase was conducted in the previous section using the latest planning data from the Planning Department and the latest development schedule of KTD under Year 2016 Scenario. No adverse impacts were identified.

16.7.6 The proposed sewerage systems for the Interim Scheme are designed in accordance with the methodology stated in **Para. 16.4** for the new sewers inside KTD.

16.7.7 The proposed sewerage networks under the Interim Scheme are presented in **Figures 16.16 to 16.25**.

Cruise Terminal

16.7.8 Gravity sewer is proposed to be laid along Road L14 and Road D3 to convey the flows from the residential development, commercial development and the cruise terminal to Pumping Station PS6.

16.7.9 The PS6 lifts the sewage from a lower level to a higher level at Cheung Yip Street. The proposed gravity sewer at Cheung Yip Street would be connected to the existing trunk sewer at the junction of Hoi Bun Road and Cheung Yip Street.

Public Rental Housing

16.7.10 In view that the Pumping Station PS1A may not be able to commission at the time of occupation of the PRH development in 2012, the sewage collected from Site 1A (1A-1, 1A-2, 1A-3 and 1A-4) and Site 1B (1B-1 and 1B-4) is proposed to be conveyed by gravity sewer directly to the existing manhole immediately upstream of the existing inverted siphon at Eastern Road temporarily before PS1A is in place where the sewage would be ultimately conveyed to the existing trunk box culvert along Wang Kwong Road. The internal sewer system of the two PRH sites would be gravitated towards the Junction of Eastern Road/Road L2/Road L3 leading to the inverted siphon at Eastern Road. The sizes of the sewers serving for Site 1A (1A-1, 1A-2, 1A-3 and 1A-4) and Site 1B (1B-1 and 1B-4) vary from 300mm to 675mm in diameter.

KTGO

16.7.11 As discussed with DSD/SP for the interfacing project "*Agreement No. CE 4/2007, Sewage Interception Scheme in Kowloon City – Investigation*", the deletion of PS4 was concluded and only PS1 and PS3 are required to be constructed. DSD/SP mentioned that the project (Agreement No. CE 4/2007) only caters for sewage flows from the hinterland of Kowloon City. A short section of sewer is proposed to be constructed along the realigned Concorde Road on the southern side of KTGO to Pumping Station PS1 to be constructed by DSD for commissioning in 2012, subject to the approval of CEDD's Schedule 3 EIA Study and their funding arrangement which could meet the project programme of PWP Item No. 4357DS. The small amount of flow from the KTD catchment (i.e. Sewage from Catchment A of KTD and the ADWF amount is about 0.089m^3/s) is allowed to discharge to PS1 and then to PS3, but it is envisaged that structural upgrading pumping station of the pumping stations is not required. In this case, no sewerage impact to the existing system will be induced by KTGO.

16.7.12 In case the pumping stations PS1 and PS3 could not be completed by 2012, the fallback option will be to temporarily discharge the sewage generated from the KTGO directly to the existing sewerage system. According to **Appendix 16.2C**, the ADWF of the KTGO (Site 1D-4) is about 875 m^3/d and the peak flow is about 6x875m^3/d=0.06 m^3/s with peaking factor of 6. The capacity of the 900mm diameter existing sewer to be discharged is about 1.45m^3/s and the discharge flows occupy about 4.1% of existing pipe capacity (Note: Pipe gradient= 1 in 150). The sewage discharge from KTGO is insignificant compared to the capacity of the existing sewer for the fallback option.

<u>Ultimate Scheme</u>

16.7.13 The Ultimate Scheme is designed to serve the whole KTD. The assessment of the impacts due to the whole KTD was conducted in the previous section using the latest planning data from Planning Department and the latest development schedule of KTD under Ultimate Scenario. No adverse impacts were identified.

16.7.14 The proposed sewerage systems for the Ultimate Scheme are designed in accordance with the methodology stated in **Section. 16.4** for the new sewers inside KTD.

16.7.15 The proposed sewerage networks in ultimate scenarios are presented in **Figures 16.26 to 16.39.**

Sewerage System for Flows generated from KTD Sewerage catchments to KTPTW

16.7.16 Further to the sewers constructed for PRH under Interim Scheme, gravity sewer extension for catchment L and G are proposed for the north apron area. The flows will be intercepted by Pumping Station PS1A and then conveyed by rising mains to the existing trunk sewer as mentioned in **Para 16.6.5**.

16.7.17 The gravity sewer system for Catchment F proposed for ex-runway area will be collected by Pumping Station PS6 and transferred to the gravity sewers at Cheung Yip Street, which intercepts the gravity system for Catchment H and eventually discharges to the existing box culvert at Hoi Bun Road.

16.7.18 For catchment E, an independent sewerage system is proposed to convey the flows directly to the existing trunk sewer. For catchment I, all are the existing developments and hence no sewerage impact was identified. For catchment J, there is only 1 new tunnel administration building at Site Area 6B-3 (ADWF=3.5m^3/d and the peak flow is about 8x3.5m^3/d=0.324 L/s) and the generated sewage flows are insignificant, and only 0.1% increase of the capacity of the existing 675mm diameter sewer (Note: Pipe gradient = 1 in 900 and pipe capacity = 0.3m^3/s).

16.7.19 A pumping station (JVBC-PS) proposed by DSD/CM at Jordan Valley Box Culvert to intercept the dry weather flow and discharged to the existing trunk sewer box culvert at Kai Fuk Road.

Sewerage System for Flows generated from KTD Sewerage catchments to TKWPTW

16.7.20 The assessment of the sewerage impact to the existing TKWPTW due to the sewage flows generated in KTD was conducted (i.e. the assessment for TKWPTW) in previous section using the planning data from Planning Department and the latest development schedule of KTD under ultimate Scenario. No adverse impacts were identified.

16.7.21 Within the sewerage sub-catchments of KTWPTW, there are 2 pumping stations (PS1 and PS3) which were recommended to be funded by EPD for construction by DSD to cater for sewage flow from the hinterland as well as to allow future expansion to cope with the flow generated within KTD. After review of various possible options in consideration of the interface issues due to cost and implementation programme, a proposed scheme (integrated with PS1 and PS3) agreed with relevant offices of DSD and EPD was developed. The proposed scheme would collect sewage from Catchment A of KTD into PS1 and then to PS3 and the ADWF amount from Catchment A of KTD is about 0.089m^3/s for intake of year 2021 and beyond. The schematic arrangement of this scheme is presented in **Figure 16.15**. Based on the proposed scheme, there are two scenarios on the arrangement of PS1 and PS3 in below: Both scenarios will deal with the sewage from the Catchment A of KTD and would not cause any sewerage impact.

- Scenario 1 – construct the two pumping stations (PS1 and PS3) in one go under PWP Item No. 4357DS by DSD to cater for the sewage flows from both hinterland (ADWF: 0.79m^3/s to PS1) and Catchment A of KTD (ADWF: 0.089m^3/s) (i.e. the total flow is approximate 117% of the hinterland flow). This is DSD/SP's fallback option on EP application; and

- Scenario 2 – construct the two pumping stations (PS1 and PS3) under PWP Item No. 4357DS by DSD to cater for the sewage flows from hinterland only and then upgrade PS1 and PS3 by CEDD to cater for the sewage flows from Catchment A of KTD (ADWF: ADWF: 0.089m^3/s) (i.e. the total flow is approximate 17% of the hinterland flow).

16.7.22 Under this scheme, a pumping station NPS is proposed to intercept the sewage flows from pumping station PS2 intercepting the flows from Catchments B and K, Catchment C and part of Catchment D as well as to serve as a replacement DWFI at Sung Wang Toi Road.

Hydraulic Modelling Networks and Results

16.7.23 The hydraulic modeling networks and results for the new sewerage systems in KTD are provided in **Appendix 16.4**.

16.8 Summary

Flow Projection

16.8.1 Flow projection was conducted based on the latest planning data from Planning Department and the latest implementation schedule of KTD. **Table 16.35** summarizes the projected average dry weather flows (ADWF) for KTD. **Table 16.36** summarizes the projected ADWF for Kwun Tong Intermediate Pumping Station (KTIPS), Kwun Tong Preliminary Treatment Works (KTPTW) and To Kwa Wan Preliminary Treatment Works (TKWPTW) catchments excluding KTD. **Table 16.37** summarizes the estimated sewage flow for cruise vessels discharge.

Table 16.35 Estimated ADWF for Kai Tak Development

Category	Year 2016 (m^3/day)		Year 2021 (m^3/day)	
	Flow to KTIPS and KTPTW	Flow to TKWPTW	Flow to KTIPS and KTPTW	Flow to TKWPTW
Domestic	9,369	1,994	11,834	9,761
Commercial	7,985	6,817	19,487	12,706
School	211	105	211	137
Others (1)	-	5,727	-	5,727
TOTAL	**17,565**	**14,642**	**31,543**	**28,330**

Notes: (1) Included sewage flows for hand-washing at toilets, showering and toilet flushing in Stadium. The sewage flows are based on water demands and this approach has been agreed in the Kai Tak Planning Review.

Table 16.36 Estimated ADWF for KTIPS, KTPTW and TKWPTW Catchments Excluding KTD

Category	Year 2016 (m^3/day)		
	KTIPS	KTPTW	TKWPTW
Domestic	125,873	202,878	102,704
Commercial	108,044	128,396	113,075
School	4,241	6,233	4,236
Industrial	4,009	4,858	3,563
TOTAL	**242,167**	**342,365**	**223,578**
Category	**Year 2030 (m^3/day)**		
	KTIPS	**KTPTW**	**TKWPTW**
Domestic	138,784	229,339	119,594
Commercial	103,316	127,894	122,230
School	4,480	6,620	4,519
Industrial	5,601	5,734	1,335
TOTAL	**252,181**	**369,587**	**247,678**
Category	**Ultimate (m^3/day)**		
	KTIPS	**KTPTW**	**TKWPTW**
Domestic	145,722	240,807	125,574
Commercial	108,481	134,286	128,341
School	4,704	6,951	4,745
Industrial	5,881	6,021	1,402
TOTAL	**264,788**	**388,065**	**260,062**

Notes: (1) Catchment Inflow Factors (P_{CIF}) are included.
(2) Projected flows for ultimate scenario are assumed to be the estimated flows for Year 2030 scenario plus an additional 5%.
(3) Uncertainty allowance is included.

Table 16.37 Estimated Sewage Flows for Cruise Vessel Discharge

Category	Cruise Vessel Berthing in HK		
	Super Post-Panamax	Post-Panamax	Total
Sewage Quantity (m^3/day)	1,687	1,254	2,941
Discharge to KT Sewerage System in 8 Hours (l/s)	59	44	103

Notes: (1) Sewage flows generated from cruise passengers at the cruise terminal buildings (30% flow of the sewage flows generated from cruise terminal buildings) are excluded.

Capacity Assessment

16.8.2 For assessment of the impacts on the existing and planned sewerage system, sewage treatment and disposal facilities, three flow scenarios are selected taken into consideration the available planning data from Planning Department, namely Year 2016, Year 2030 and ultimate (Year 2030 + 5%). The Year 2016 Scenario is used to access the potential impacts arising from the Cruise Terminal and the early development on the existing and planned sewerage system, sewage treatment and disposal facilities. The Year 2030 and Ultimate Scenarios are used to assess the long term impacts arising from the whole KTD on the existing and planned sewerage system, sewage treatment and disposal facilities.

16.8.3 There are inherent uncertainties in the flow estimates due to a number of as-yet unquantified factors. It is proposed to add an extra 10% contingency to the calculated ADWFs and peak flows. It is assumed that the 10% contingency for the uncertainties will be materialised linearly from year 2006 until 2030 (i.e. +2% on Year 2010; +6% on Year 2020 and 10% on Year 2030/Ultimate).

16.8.4 The projected flows including the Average Dry Weather Flow (ADWF) and the Peak Wet Weather Flow (PWWF) for KTPTW, KTIPS and TKWPTW are summarized in the following tables (**Table 16.38 and 16.39**)

Table 16.38 Projected ADWF for KTIPS, KTPTW and TKWPTW

Facilities	Projected ADWF (m^3/day)		
	Year 2016	Year 2030	Ultimate
KTIPS	264,689	288,681	301,288
KTPTW	346,887	406,087	424,565
TKWPTW	238,220	276,008	288,392

Table 16.39 Projected PWWF for KTIPS, KTPTW and TKWPTW

Facilities	Projected Peak Flows (m^3/s)		
	Year 2016	Year 2030	Ultimate
KTIPS	8.15	8.80	9.14
KTPTW	10.83	11.91	12.40
TKWPTW	6.92	7.95	8.27

16.8.5 The sewage generated from KTD will be diverted to the existing To Kwa Wan Preliminary Treatment Works (TKWPTW) and Kwun Tong Preliminary Treatment Works (KTPTW).

16.8.6 Capacity assessment was conducted to access the hydraulic capacities of the trunk sewers along Hoi Bun Road, KTIPS, KTPTW, TKWPTW and the conveyance tunnels from KTPTW to Stonecutters Island STW (SCISTW). The assessment results reveal that the existing trunk sewers along Hoi Bun Road, KTIPS and TKWPTW should be able to handle the additional sewage flows from KTD for Year 2016, Year 2030 and Ultimate Scenarios. For KTPTW, the assessment results indicate that the projected flows would exceed its capacity in Year 2030 and Ultimate Scenarios. The planned upgrading plant of KTPTW by EPD would consider the long term projected flows for KTD such as Year 2030 and Ultimate Scenarios. The details of the upgrading of KTPTW will be determined under the EPD project.

16.8.7 The design capacities and the projected PWWF of KTIPS, KTPTW and TKWPTW are shown in **Table 16.40.**

Table 16.40 Capacities and Projected PWWF of KTIPS and KTPTW

Facilities	Design Capacity (m^3/s)	Projected PWWF (m^3/s)		
		Year 2016	Year 2030	Ultimate
KTIPS	9.20	8.15	8.80	9.14
KTPTW	10.93	10.83	11.91	12.40
TKWPTW	9.32	6.92	7.95	8.27

16.8.8 The deep tunnels were not designed to take account of the unusual high, and relatively infrequent, wet weather flows. A peaking factor of 2.0 for the large sewerage catchments including KTPTW and TKWPTW catchments was adopted for the tunnel design. Overflow from KTPTW and TKWPTW are anticipated during peak wet weather flows.

16.8.9 The sewage flow from KTPTW and TKWPTW to the conveyance tunnels would be limited by the tunnel capacity. EEFS concluded that there is no capacity constraint with respect to the HATS Stage I system. Based on EEFS's argument, it is concluded that the capacity of the HATS conveyance tunnels should be able to handle the additional sewage flow from KTD.

16.8.10 As the assessment results show that the existing trunk sewers along Hoi Bun Road, KTIPS and TKWPTW should be able to handle the additional sewage flows from KTD for Year 2016, Year 2030 and Ultimate Scenarios, and that KTPTW should be able to handle the additional sewage flows from KTD for Year 2016 Scenario. The planned upgrading of KTPTW should consider the long term projected flows such as Year 2030 and Ultimate Scenarios. In addition, the capacity of the HATS conveyance tunnels should be able to handle the additional sewage flow from KTD. There would be no adverse sewerage impacts to the existing and planned facilities. No mitigation measures are required.

Proposed Sewerage System for KTD

16.8.11 Based on the population and employment data from the latest development schedule of KTD, new sewers are designed and the sewerage master layout plan is formed. Interim and Ultimate Schemes are developed for the KTD.

16.8.12 The proposed sewerage networks under the Interim Scheme are presented in **Figure 16.16 to 16.25**. The proposed sewerage networks under the Ultimate Scheme are presented in **Figure 16.26 to 16.39**.

16.8.13 The proposed pumping stations scheme (PS1 and PS3) for the TKWPTW Catchment agreed with relevant offices of DSD and EPD was developed.

16.9 Reference

16.9.1 The Report has made reference to the following reports, manuals and design guidelines:

- Agreement No. CE 25/98 – Review of Central and East Kowloon Sewerage Master Plans, *Final Report*.
- Agreement No. CE4/2004(TP) - South East Kowloon Development Comprehensive Planning and Engineering Review Stage 1: Planning Review, *Technical Report No. TR4E – Preliminary Drainage and Sewerage Assessment*.
- Agreement No. CE43/2005(EP) – Harbour Area Treatment Scheme (HATS) Stage 2A Environmental Impact Assessment Study – Investigation, *Technical Note – Flow and Load Projections (Parts 1 and 2)*.
- Agreement No. CE 8/2006/DS - HATS 2A Upgrading of Stonecutter's Island Sewage treatment Works and Preliminary Treatment Works, *Final Report on Flow & Load Projections*.
- Agreement No. CE 42/2001 – Environmental and Engineering Feasibility Assessment Studies in Relation to the Way Forward of the Harbour Area Treatment Scheme, *Working Paper No. 5 – Flows, Loads and Stage 1 System Capacity Constraints Analysis (Final)*.
- Agreement No. CE 4/2007 – Sewage Interception Scheme in Kowloon City – Investigation, *Final Adoptive Review Report*.
- IP 07-001 – Study on the Control of Water Pollution at Jordan Valley Box Culvert, *Final Information Review Report*.
- IP 07-001 – Study on the Control of Water Pollution at Jordan Valley Box Culvert, *Final Working Paper on Options and Evaluation*.
- Agreement No. CE 35/2006(CE) - Kai Tak Development Engineering Study cum Design and Construction of Advance Works – Investigation, Design and Construction, *Hydraulic Assessment on Trunk Sewer and Treatment Facilities based on the Flow Survey Data*.
- Agreement No. CE 35/2006(CE) - Kai Tak Development Engineering Study cum Design and Construction of Advance Works – Investigation, Design and Construction, *Working Paper on Assessment of Existing and Planned Sewerage, Sewage Treatment and Disposal Facilities*.
- Agreement No. CE 35/2006(CE) - Kai Tak Development Engineering Study cum Design and Construction of Advance Works – Investigation, Design and Construction, *Discussion Paper on Options for Sewage Conveyance Systems at North Apron without Sewage Pumping Station*.
- Agreement No. CE 35/2006(CE) - Kai Tak Development Engineering Study cum Design and Construction of Advance Works – Investigation, Design and Construction, *Final Review Report*.
- Agreement No. CE 35/2006(CE) - Kai Tak Development Engineering Study cum Design and Construction of Advance Works – Investigation, Design and Construction, *Essential Infrastructure Serving the Kai Tak Government Office and Public Rental Housing in North Apron*.
- Agreement No. CE 35/2006(CE) - Kai Tak Development Engineering Study cum Design and Construction of Advance Works – Investigation, Design and Construction, *Preliminary Design Report - Essential Infrastructure Serving the Kai Tak Government Office and Public Rental Housing in North Apron*.
- Agreement No. CE 35/2006(CE) - Kai Tak Development Engineering Study cum Design and Construction of Advance Works – Investigation, Design and Construction, *Final Preliminary Design Report for Advance Works*.
- Agreement No. CE 35/2006(CE) - Kai Tak Development Engineering Study cum Design and Construction of Advance Works – Investigation, Design and Construction, *Final Focus Assessment Report for Advance Works*.

- Agreement No. CE42/2000 – South East Kowloon Development Infrastructure at North Apron Area of Kai Tak Airport – Design and Construction
- Agreement No. CE32/99 – Comprehensive Feasibility Study for the Revised Scheme of South East Kowloon Development
- IP 06-074 – Kai Tak Approach Channel Expedient Connection Survey
- Sewerage Manual (Volume 1), issued by Drainage Services Department
- Sewerage Manual (Volume 2), issued by Drainage Services Department
- Technical Paper Report No.: EPD/TP 1/05 – Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning Version 1.0, issued by Environmental Protection Department
- Guidelines for Sewer Network hydraulic Model Build and Verification, issued by Infrastructure Planning Group of Environmental Protection Department
- Code of Practice for the Hydraulic Modelling of Sewer Systems Version 3.001, issued by Wastewater Planning Users Group (WaPUG)
- Tables for the Hydraulic Design of Pipes and Sewers, issued by Hydraulics Research, Wallingford