6 Water Quality

6.1 Legislation, Standards and Guidelines

6.1.1.1 The following relevant legislation, standards and guidelines are applicable to the evaluation of water quality impacts associated with the construction and operation of the project.

- Water Pollution Control Ordinance (WPCO) CAP 358;
- Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems Inland and Coastal Waters (TM-DSS);
- Environmental Impact Assessment Ordinance (EIAO) (CAP. 499), Technical Memorandum on Environmental Impact Assessment Process (TM-EIAO);
- No Net Increase in Pollution Loads Requirement in Deep Bay;
- Hong Kong Planning Standards and Guidelines; and
- ProPECC PN 1/94 “Construction Site Drainage.

6.1.2 Water Pollution Control Ordinance, CAP 358

6.1.2.1 The entire Hong Kong waters are divided into Water Control Zones (WCZs) and supplementary WCZs under the Water Pollution Control Ordinance (WPCO) (CAP 358). Each WCZ has a designated set of statutory Water Quality Objectives (WQOs) designed to protect the inland and/or marine environment and its users. The proposed C&C facilities are located within the Deep Bay WCZ and the applicable WQOs for the Deep Bay WCZ for assessing compliance of any effects from the construction and operational phases are presented in **Table 6.1**.

Table 6.1 Water Quality Objectives for Deep Bay WCZ

Parameters	**Objectives**	**Sub-Zone**
Offensive Odour, Tints	Not to be present	Whole zone
Visible foam, oil scum, litter	Not to be present	Whole zone
Dissolved Oxygen (DO) within 2 m of the seabed	Not less than 2.0mg/L for 90% of samples	Outer Marine Subzone excepting Mariculture Subzone
DO within 1 m below surface	Not less than 4.0mg/L for 90% of samples	Inner Marine Subzone excepting Mariculture Subzone
	Not less than 5.0mg/L for 90% of samples	Mariculture Subzone
DO	Not less than 4.0mg/L for 90% of samples	Outer Marine Subzone excepting Mariculture Subzone
	Not less than 4.0mg/L	Yuen Long & Kam Tin (Upper and

Parameters	Objectives	Sub-Zone
		Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone, Water Gathering Ground Subzones and other inland waters of the Zone
5-Day Biochemical Oxygen Demand (BOD_5)	Not to exceed 3mg/L	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	Not to exceed 5mg/L	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
Chemical Oxygen Demand (COD)	Not to exceed 15mg/L	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	Not to exceed 30mg/L	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
pH	To be in the range of 6.5 – 8.5, change due to waste discharges not to exceed 0.2	Marine waters excepting Yung Long Bathing Beach Subzone
	To be in the range of 6.5 – 8.5	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	To be in the range of 6.0 – 9.0	Other inland waters
	To be in the range of 6.0 – 9.0 for 95% samples, change due to waste discharges not to exceed 0.5	Yung Long Bathing Beach Subzone
Salinity	Change due to waste discharges not to exceed 10% of ambient	Whole zone
Temperature	Change due to waste discharges not to exceed 2°C	Whole zone
Suspended solids (SS)	Not to raise the ambient level by 30% caused by waste discharges and shall not affect aquatic communities	Marine waters
	Not to cause the annual median to exceed 20mg/L	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Ganges Subzone, Indus Subzone, Water Gathering Ground Subzones and other inland waters
Unionized Ammonia (UIA)	Annual mean not to exceed 0.021mg/L as unionized form	Whole zone
Nutrients	Shall not cause excessive algal growth	Marine waters

Parameters	Objectives	Sub-Zone
Total Inorganic Nitrogen (TIN)	Annual mean depth-averaged inorganic nitrogen not to exceed 0.7mg/L	Inner Marine Subzone
	Annual mean depth-averaged inorganic nitrogen not to exceed 0.5mg/L	Outer Marine Subzone
Bacteria	Not exceed 610 per 100ml, calculated as the geometric mean of all samples collected in one calendar year	Secondary Contact Recreation Subzones and Mariculture Subzones
	Should be zero per 100 ml, calculated as the running median of the most recent 5 consecutive samples taken between 7 and 21 days.	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	Not exceed 180 per 100ml, calculated as the geometric mean of the collected from March to October inclusive in one calendar year. Samples should be taken at least 3 times in a calendar month at intervals of between 3 and 14 days.	Yung Long Bathing Beach Subzone
	Not exceed 1000 per 100ml, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
Colour	Not to exceed 30 Hazen units	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	Not to exceed 50 Hazen units	Yuen Long & KamTin (Lower) Subzone and other inland waters
Turbidity	Shall not reduce light transmission substantially from the normal level	Yuen Long Bathing Beach Subzone
Phenol	Quantities shall not sufficient to produce a specific odour or more than 0.05mg/L as C_6H_5OH	Yuen Long Bathing Beach Subzone
Toxins	Should not cause a risk to any beneficial uses of the aquatic environment	Whole Zone
	Should not attain such levels as to produce toxic carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms.	Whole Zone

6.1.3 Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems Inland and Coastal Waters (TM-DSS)

6.1.3.1 Apart from the WQOs, Section 21 of the WPCO also specifies the limits to control the physical, chemical and microbial parameters for effluent discharges into drainage and sewerage system at both inland and coastal waters under the Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS). The discharge limits vary with the effluent flow rates. Groups B and C inland water standards in TM-DSS are adopted and the effluent discharge standards are presented in **Tables 6.2** and **6.3** respectively.

Table 6.2 Standards for effluents discharged into Group B inland waters

Parameter[1]	**Flow Rate(m³/day)**							
	≤ 200	**>200 and ≤400**	**> 400 and ≤600**	**> 600 and ≤800**	**>800 and ≤1000**	**> 1000 and ≤1500**	**> 1500 and ≤2000**	**> 2000 and ≤3000**
pH (pH units)	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
Temperature (°C)	35	30	30	30	30	30	30	30
Colour (lovibond units)(25mm cell length)	1	1	1	1	1	1	1	1
Suspended solids (mg/L)	30	30	30	30	30	30	30	30
BOD (mg/L)	20	20	20	20	20	20	20	20
COD (mg/L)	80	80	80	80	80	80	80	80
Oil & Grease (mg/L)	10	10	10	10	10	10	10	10
Iron (mg/L)	10	8	7	5	4	3	2	1
Boron (mg/L)	5	4	3	2.5	2	1.5	1	0.5
Barium (mg/L)	5	4	3	2.5	2	1.5	1	0.5
Mercury (mg/L)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium (mg/L)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Selenium (mg/L)	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1

Parameter[1]	**Flow Rate(m³/day)**							
	≤ 200	**＞200 and ≤400**	**＞ 400 and ≤600**	**＞ 600 and ≤800**	**＞800 and ≤1000**	**＞ 1000 and ≤1500**	**＞ 1500 and ≤2000**	**＞ 2000 and ≤3000**
Other toxic metals individually (mg/L)	0.5	0.5	0.2	0.2	0.2	0.1	0.1	0.1
Total Toxic metals (mg/L)	2	1.5	1	0.5	0.5	0.2	0.2	0.2
Cyanide (mg/L)	0.1	0.1	0.1	0.08	0.08	0.05	0.05	0.03
Phenols (mg/L)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Sulphide (mg/L)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Fluoride (mg/L)	10	10	8	8	8	5	5	3
Sulphate (mg/L)	800	800	600	600	600	400	400	400
Chloride (mg/L)	1000	1000	800	800	800	600	600	400
Total phosphorus (mg/L)	10	10	10	8	8	8	5	5
Ammonia nitrogen (mg/L)	5	5	5	5	5	5	5	5
Nitrate + nitrite nitrogen (mg/L)	30	30	30	20	20	20	10	10
Surfactants (total) (mg/L)	5	5	5	5	5	5	5	5
E. coli (count/100mL)	100	100	100	100	100	100	100	100

Note:
[1] All units in mg/L unless otherwise stated.

Table 6.3 Standards for effluents discharged into Group C inland waters

Parameter[1]	**Flow Rate (m³/day)**			
	≤ 100	**> 100 and ≤ 500**	**> 500 and ≤ 1000**	**> 1000 and ≤ 2000**
pH (pH units)	6-9	6-9	6-9	6-9

Parameter[1]	**Flow Rate (m^3/day)**			
	≤ 100	**> 100 and ≤ 500**	**> 500 and ≤ 1000**	**> 1000 and ≤ 2000**
Temperature (˚C)	30	30	30	30
Colour (lovibond units) (25mm cell length)	1	1	1	1
Suspended solids (mg/L)	20	10	10	5
BOD (mg/L)	20	15	10	5
COD (mg/L)	80	60	40	20
Oil & Grease (mg/L)	1	1	1	1
Boron (mg/L)	10	5	4	2
Barium (mg/L)	1	1	1	0.5
Iron (mg/L)	0.5	0.4	0.3	0.2
Mercury (mg/L)	0.001	0.001	0.001	0.001
Cadmium (mg/L)	0.001	0.001	0.001	0.001
Silver (mg/L)	0.1	0.1	0.1	0.1
Copper (mg/L)	0.1	0.1	0.05	0.05
Selenium (mg/L)	0.1	0.1	0.05	0.05
Lead (mg/L)	0.2	0.2	0.2	0.1
Nickel (mg/L)	0.2	0.2	0.2	0.1
Other toxic metals individually (mg/L)	0.5	0.4	0.3	0.2
Total toxic metals (mg/L)	0.5	0.4	0.3	0.2
Cyanide (mg/L)	0.05	0.05	0.05	0.01
Phenols (mg/L)	0.1	0.1	0.1	0.1
Sulphide (mg/L)	0.2	0.2	0.2	0.1
Fluoride (mg/L)	10	7	5	4
Sulphate (mg/L)	800	600	400	200
Chloride (mg/L)	1000	1000	1000	1000
Total phosphorus (mg/L)	10	10	8	8
Ammonia nitrogen (mg/L)	2	2	2	1
Nitrate + nitrite nitrogen (mg/L)	30	30	20	20
Surfactants (total) (mg/L)	2	2	2	1

Parameter[1]	Flow Rate (m^3/day)			
	≤ 100	> 100 and ≤ 500	> 500 and ≤ 1000	> 1000 and ≤ 2000
E. coli (count/100mL)	1000	1000	1000	1000

Note:
[1] All units in mg/L unless otherwise stated.

6.1.4 Environmental Impact Assessment Ordinance (EIAO) (Cap. 499), Technical Memorandum on Environmental Impact Assessment Process (TM-EIAO)

6.1.4.1 The general criteria and guidelines for evaluating and assessing water quality impacts are listed in Annexes 6 and 14 of the TM-EIAO.

6.1.5 No Net Increase in Pollution Loads Requirement in Deep Bay

6.1.5.1 In addition to the provisions of the TM, the ‘No Net Increase in Pollution Loads Requirement’ aims to provide protection to the inland and marine water quality of the Deep Bay WCZ. According to EPD “Deep Bay Water Quality Regional Control Strategy Study”, the pollutions entering into Deep Bay have exceeded the assimilative capacity of the water body [6-1]. Further increasing the pollution loads to the water body is therefore environmentally undesirable.

6.1.5.2 In accordance with Town Planning Board Guideline No.12C, the pollution loads of concern should be offset by equivalent reduction of current loads for new discharge into Deep Bay. The policy ensures that developments within the Deep Bay catchment areas do not result in an increase in pollution loads to both the inland and marine waters.

6.1.6 Hong Kong Planning Standards and Guidelines

6.1.6.1 Chapter 9 of the Hong Kong Planning Standards and Guidelines (HKPSG) outlines environmental requirements that need to be considered in land use planning. The recommended guidelines, standards and guidance cover the selection of suitable locations for the developments and sensitive uses, provision of environmental facilities, and design, layout, phasing and operational controls to minimise the adverse environmental impacts. It also lists out environmental factors influencing land use planning and recommended buffer distances for land uses.

6.1.7 ProPECC PN 1/94 "Construction Site Drainage"

6.1.7.1 Professional Persons Environmental Consultative Committee Practice Notes (ProPECC PN1/94) on Construction Site Drainage provides guidelines for the handling and disposal of construction discharges. It is applicable to this Study for control of site runoff and wastewater generated during the construction phase. The types of discharges from construction sites outlined in the ProPECC PN1/94 include:

- Surface runoff;
- Groundwater;
- Boring and drilling water;
- Wastewater from concrete batching;
- Wheel washing water;
- Bentonite slurries;
- Water for testing and sterilization of water retaining structures and water pipes;
- Wastewater from building construction and site facilities; and
- Acid cleaning, etching and pickling wastewater.

6.2 Description of the Environment

6.2.1 Existing Environment

6.2.1.1 The project site adjoins Ng Tung River and Shenzhen River to the west and north respectively. Ng Tung River, also known as River Indus, is a major river in the northern New Territories. Shenzhen River is the boundary river between the Hong Kong Special Administration Region (HKSAR) and the Shenzhen Special Economic Zone. Ping Yuen River, also known as River Ganges, is located at the upstream of Shenzhen River and about 1.7 km northeast from the project site. Both Ng Tung River and Ping Yuen River will discharge into Shenzhen River which would eventually discharge to Inner Deep Bay. Within Inner Deep Bay area, EPD has been operating a total of 3 marine water quality monitoring stations. **Figure 6.2.1** illustrates the location of the monitoring stations.

6.2.2 Baseline Conditions

Water Quality of River Indus and River Ganges

6.2.2.1 EPD's River Water Quality Monitoring Stations IN1 and GR1 are the closest monitoring stations to the project site for River Indus and River Ganges respectively. According to the EPD Reports 'River Water Quality in Hong Kong' in 2014[6-2], the WQO compliance rate of River

Indus and River Ganges were 82% and 85% in 2014, 84% and 91% in 2013, 46% and 41% in 1997 respectively.

6.2.2.2 For River Indus, the River Water Quality Index (WQI) in 2014 were “Excellent” and “Good” at upstreams and midstreams while “Good” at downstream IN1 due to the backflow from Shenzhen River. For River Ganges, the River WQIs in 2014 were “Excellent” and “Good” at upstreams while “Fair” at downstream GR1. River Ganges is still affected by pollution from livestock farms, unsewered villages and small industrial establishments in the catchment.

6.2.2.3 The latest environmental monitoring data are presented in **Table 6.4** and the locations of these monitoring stations are presented in **Figure 6.2.1**.

Table 6.4 Summary of river water quality monitoring data for the Ng Tung River (River Indus) at station IN1 and Ping Yuen River (River Ganges) at station GR1 (2010-2014)

Parameter	Monitoring Station	Concentration [1]				
		2010	2011	2012	2013	2014
DO (mg/L)	IN1	5.1	3.7	5.0	6.0	6.1
	GR1	6.1	7.4	7.4	7.5	6.9
pH	IN1	7.4	7.3	7.3	7.2	7.2
	GR1	7.4	7.5	7.4	7.3	7.4
Suspended Solid (SS) (mg/L)	IN1	20	36	33	26	21
	GR1	17	16	6	8	7
BOD_5 (mg/L)	IN1	8	7	5	4	4
	GR1	6	7	7	9	6
COD (mg/L)	IN1	18	15	17	14	16
	GR1	22	20	18	14	16

Note:
[1] Data presented are in annual medians of monthly samples.

<u>Water Quality of Shenzhen River</u>

6.2.2.4 The water quality of Shenzhen River is monitored by Shenzhen Environmental Monitoring Centre. As shown in **Figure 6.2.1**, monitoring stations Quarry, Lo Wu and Ludang Village for Shenzhen River are the closest reference stations to the project site. The water quality for 2007-2009 extracted from approved EIA report ‘Regulation of Shenzhen River Stage IV’ (AEIAR-160/2011) [6-3] is presented in **Table 6.5**. It can be seen that the water quality at the upstream station Quarry is much better than that in middle stream at Lo Wu and Ludang Village stations. The level of nutrients, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD_5) and faecal coliforms increases from Quarry to Ludang Village, while Dissolved Oxygen (DO) decreases from upstream to middle stream. Generally, the COD, BOD_5

and DO show non-compliance with the WQOs at stations Lo Wu and Ludang Village.

Table 6.5 Summary of river water quality monitoring data for Shenzhen River at Quarry, Lo Wu and Ludang Village stations (2007-2009)

Parameter	Monitoring Station	Concentration [1], [2]		
		2007	2008	2009
Temperature (˚C)	Quarry	25.1	24.1	22.7
	Lo Wu	24.9	24.0	23.1
	Ludang Village	25.0	24.2	23.3
pH	Quarry	7.34	7.29	7.33
	Lo Wu	7.22	7.08	7.03
	Ludang Village	7.21	7.14	7.10
DO (mg/L)	Quarry	6.402	6.61	5.373
	Lo Wu	**<u>0.955</u>**	**<u>1.64</u>**	**<u>0.728</u>**
	Ludang Village	**<u>0.930</u>**	**<u>1.00</u>**	**<u>0.457</u>**
COD (mg/L)	Quarry	11.8	17.4	12.9
	Lo Wu	22.8	24.3	**<u>45.2</u>**
	Ludang Village	**<u>35.7</u>**	**<u>47.4</u>**	**<u>74.2</u>**
BOD_5 (mg/L)	Quarry	3.21	3.8	2.61
	Lo Wu	**<u>5.38</u>**	**<u>8.1</u>**	**<u>17.04</u>**
	Ludang Village	**<u>12.26</u>**	**<u>17.2</u>**	**<u>26.32</u>**
Ammonia nitrogen (mg/L)	Quarry	8.47	6.44	6.64
	Lo Wu	14.05	12.47	18.32
	Ludang Village	21.13	19.00	30.00
Total phosphorus (mg/L)	Quarry	0.425	0.367	0.435
	Lo Wu	1.122	0.971	1.224
	Ludang Village	1.687	1.563	2.216
Total nitrogen (mg/L)	Quarry	11.15	12.45	13.23
	Lo Wu	16.07	15.18	20.96
	Ludang Village	24.02	21.93	33.54
Faecal Coliforms (10^4 cfu/l)	Quarry	173	30	39
	Lo Wu	5697	540	2783
	Ludang Village	17593	2800	15842

Note:
[1] Data presented are in annual mean of monthly samples in Quarry station, twice per month samples in Lo Wu and Ludang Village stations.
[2] Bold and underlined figures indicate non-compliance with the WQOs.

<u>Water Quality of other Streams/Ponds within the Study Area</u>

6.2.2.5 The water quality of Nam Hang Stream (Water Sensitive Receiver WSR 9 in this Study) and fish pond (WSR 10) located in the southeast of the

Project was measured by the previous EIA study for 'Development of Organic Waste Treatment Facilities, Phase 2' (AEIAR-180/2013) [6-4]. Three monitoring stations at locations A, B and C are shown in **Figure 6.2.2** and the results are presented in **Table 6.6**. It is shown that the water quality was compliance with WQOs for the tested parameters at upstream location A and middle stream location B of Nam Hang Stream WSR9, but exceeds in BOD_5 for fish pond WSR10 at location C.

Table 6.6 Summary of water quality monitoring data for watercourse WSR9 and fish pond WSR10 on 15 April 2013

Parameter	Monitoring Station [1], [2]		
	A	B	C
pH	6.8	6.8	8.2
Turbidity (NTU)	19	2	23
DO (mg/L)	5.9	4.3	12.8
DO (%)	72	50	154
Suspended Solids (mg/L)	4	<2	16
BOD_5 (mg/L)	<2	<2	**10**

Note:
[1] Mean value of the sampling.
[2] Bold and underlined figures indicate non-compliance with the WQOs.

6.2.2.6 An additional baseline water quality monitoring has been conducted in both wet season and dry season for Nam Hang Stream WSR 9, between the midstream and downstream section which is along the eastern boundary of the Project. The monitoring was conducted at 2 locations (M1 and M2) in midstream and downstream of Nam Hang Stream and the monitoring locations are shown in **Figure 6.2.3**. A total of 6 sampling events for wet season were carried out on 22, 24, 26, 29 September and 3, 6 October 2014, and 6 sampling events for dry season were carried out on 17, 19, 21, 24, 26 and 28 November 2014. The monitoring data is summarised in **Table 6.7** below. It is noted that the water quality at M1 and M2, indicating the midstream and downstream of Nam Hang Stream, was compliance with the WQOs.

Table 6.7 Summary of water quality monitoring data for Nam Hang Stream WSR 9

Parameter	Wet Season[1]		Dry Season[1]	
	M1	M2	M1	M2
Temperature (°C)	27.1 (24.5 – 28.1)	27.9 (25.1 – 29.1)	22.5 (21.5 – 23.5)	20.5 (13.1 – 23.0)
Flow rate (L/min)	1.5 (1.3 – 1.8)	3.2 (2.0 – 4.1)	1.5 (1.4 – 1.6)	2.4 (2.2 – 2.7)
pH	7.1 (6.7 – 7.7)	6.9 (6.6 – 7.2)	7.2 (7.0 – 7.5)	7.0 (6.3 – 7.3)
Turbidity (NTU)	1.9 (1.4 – 2.1)	7.6 (4.7 – 13.4)	4.5 (2.1 – 11.4)	7.4 (2.9 – 13.0)

Parameter	Wet Season[1]		Dry Season[1]	
	M1	M2	M1	M2
DO (mg/L)	6.1 (5.5 – 6.6)	6.8 (6.5 – 7.1)	8.7 (7.5 – 9.2)	9.6 (8.6 – 11.8)
DO (%)	75.8 (70.2 – 82.3)	86.0 (82.2 – 88.8)	103.1 (99.3 – 107.8)	107.9 (96.8 – 115.2)
Suspended Solids (mg/L)	2.0 (1.4 – 2.7)	8.9 (5.7 – 17.0)	2.3 (0.6 – 4.9)	9.1 (1.6 – 25.4)
BOD_5 (mg/L)	< 2	< 2	< 2	< 2
COD (mg/L)	5 (3.5 – 6)	7.2 (5.5 – 8.5)	6.8 (4.5 – 9.5)	6.3 (5.0 – 8.5)
E.coli (cfu/100ml)	340 (212 – 612)	364 (128 – 590)	571 (214 – 1010)	864 (345 – 2121)
Ammonia-nitrogen (mg/L)	0.06 (0.04 – 0.09)	0.09 (0.08 – 0.1)	0.05 (0.04 – 0.07)	0.09 (0.06 – 0.15)
Nitrate (mg/L)	0.64 (0.6 – 0.7)	0.94 (0.91 – 0.97)	0.71 (0.66 – 0.77)	0.85 (0.81 – 0.90)
Total Kjedahl Nitrogen (TKN) (mg/L)	0.24 (0.2 – 0.4)	0.3 (0.2 – 0.4)	0.33 (0.2 – 0.8)	0.33 (0.2 – 0.4)
Orthophosphate (mg/L)	0.05 (0.03 – 0.06)	0.04 (0.02 – 0.05)	0.04 (0.04 – 0.05)	0.05 (0.04 – 0.06)
Total phosphrous (mg/L)	0.07 (0.05 – 0.1)	0.08 (0.06 – 0.12)	0.06 (0.06 – 0.08)	0.10 (0.08 – 0.11)

Note:
[1] Mean value of the sampling is presented, while the range of data is stated in the brackets.

6.2.2.7 There is no historical data available for the Conservation Area (CA) near Yuen Leng Chai (WSR 3) located at the north of the Project site and the watercourse in the east of San Uk Ling crossing Lin Ma Hang Road (WSR 12). Therefore, baseline monitoring has been conducted in both dry season and wet season at 2 locations M3 and M4 and the monitoring locations are shown in **Figure 6.2.3**. A total of 6 sampling events for wet season were carried out on 22, 24, 26, 29 September and 3, 6 October 2014, and 6 sampling events for dry season were carried out on 17, 19, 21, 24, 26 and 28 November 2014. The monitoring data is summarised in **Table 6.8** below.

Table 6.8 Summary of water monitoring data for Conservation Area M3 and watercourse near Lin Ma Hang Road M4

Parameter	Wet Season[1]		Dry Season[1]	
	M3	M4	M3	M4
Temperature (ºC)	28.7 (27.1 – 30.9)	25.4 (22.8 – 26.8)	22.9 (21.3 – 24.8)	21.7 (20.9 – 22.8)
Flow rate (L/min)	1.6 (1.3 – 2.8)	5.1 (0.5 – 7)	1.3 (1.0 – 1.5)	5.1 (4.4 – 5.7)

Parameter	Wet Season[1]		Dry Season[1]	
	M3	M4	M3	M4
pH	7.1 (6.9 – 7.6)	7.0 (6.5 – 7.4)	7.0 (6.8 – 7.2)	6.8 (6.4 – 7.1)
Turbidity (NTU)	6.4 (4.4 – 10.6)	3.3 (2.4 – 4.0)	8.4 (2.7 – 23.2)	3.1 (1.2 – 5.7)
DO (mg/L)	4.2 (3.6 – 5.5)	7.5 (6.8 – 8.2)	8.4 (6.9 – 9.5)	8.0 (7.6 – 8.7)
DO (%)	56.3 (44.8 – 74.2)	90.3 (82.9 – 98.9)	101.8 (89.5 – 107.0)	93.9 (88.4 – 112.6)
Suspended Solids (mg/L)	6.8 (5.5 – 10.2)	1.8 (0.7 – 2.4)	4.1 (2.7 – 6.0)	2.6 (0.5 – 4.3)
BOD_5 (mg/L)	≤ 2.2 (2 – 3) [3]	< 2	< 2	< 2
COD (mg/L)	8.1 (6 – 11)	3.7 (2 – 5)	8.3 (6.0 – 10.5)	3.7 (3 – 5)
E.coli (cfu/100ml)	110.7 (1 – 259)	**<u>1864.1</u>** (332 – 9022)	88.9 (5 – 260)	375.4 (130 – 782)
Ammonia-nitrogen (mg/L)	0.04 (0.01 – 0.11)	0.07 (0.03 – 0.15)	0.03 (0.01 – 0.05)	0.04 (0.03 – 0.06)
Nitrate (mg/L)	< 0.01	< 0.01	≤ 0.02 (0.01 – 0.05) [3]	0.69 (0.28 – 1.09)
Total Kjedahl Nitrogen (TKN) (mg/L)	0.26 (0.2 – 0.3)	0.18 (0.1 – 0.3)	0.23 (0.2 – 0.35)	0.17 (0.1 – 0.25)
Orthophosphate (mg/L)	≤ 0.02 (0.01 – 0.04) [3]	0.03 (0.02 – 0.04)	≤ 0.02 (0.01 – 0.04) [3]	0.02 (0.01 – 0.03)
Total phosphrous (mg/L)	0.02 (0.01 – 0.08)	0.05 (0.05-0.06)	0.02 (0.01 – 0.02)	0.03 (0.02-0.04)

Note:
[1] Mean value of the sampling is presented, while the range of data is stated in the brackets.
[2] Bold and underlined figures indicate non-compliance with the WQOs.
[3] One or more sampling result is below reporting limit.

6.2.2.8 As shown in the above table, the water quality at M3 and M4 generally comply with the WQOs, except the *E.coli* count in M4 has exceeded the WQO in wet season. This may be attributable from the discharge in the vicinity of the village houses of San Uk Ling and the favourable warm condition for *E. coli* growth in wet season.

<u>Water Quality of Deep Bay</u>

6.2.2.9 As discussed in **Section 6.2.1**, the project site is located within the Deep Bay WCZ and EPD has been operating 3 monitoring stations (Stations DM1 to DM3) within the Inner Deep Bay area, where Station DM1 is more than 12km downstream of Shenzhen River from the project site.

6.2.2.10 According to EPD Reports 'Marine Water Quality in Hong Kong' in 2014 [6-5], the compliance level of WQOs at Deep Bay was 40% compared with 40% in Year 2013. The total inorganic nitrogen at three Stations DM1, DM2 and DM3 were 3.48, 2.61 and 1.48 mg/L respectively and exceeded the WQOs of 0.7 mg/L in Deep Bay Water

Control Zone. The inner bay was mostly affected by the discharges from Shenzhen River as well as Kam Tin River, Yuen Long Creek and Tin Shui Wai Nullah from the Hong Kong side. Details of EPD's marine water quality monitoring at Inner Deep Bay are presented in **Table 6.9** and the locations of monitoring stations are presented in **Figure 6.2.1**.

Table 6.9 Summary of marine water quality of Inner Deep Bay (2010-2014)

Parameter	Monitoring Station	Concentration				
		2010	2011	2012	2013	2014
Dissolved Oxygen (mg/L)	DM1	4.2	4.8	4.9	4.3	3.7
	DM2	4.9	5.4	5.6	5.0	4.6
	DM3	6.2	6.8	6.1	6.7	5.5
Ammonia Nitrogen (mg/L)	DM1	2.830	2.520	1.942	2.517	2.080
	DM2	1.930	1.640	1.643	1.953	1.410
	DM3	0.436	0.438	0.433	0.382	0.536
Unionised Ammonia, mg/L (Annual mean)	DM1	0.025	0.024	0.014	0.026	0.026
	DM2	0.025	0.024	0.017	0.028	0.025
	DM3	0.009	0.009	0.006	0.009	0.014
Nitrite Nitrogen, mg/L	DM1	0.348	0.348	0.489	0.350	0.367
	DM2	0.348	0.308	0.420	0.296	0.291
	DM3	0.218	0.187	0.243	0.157	0.184
Nitrate Nitrogen (mg/L)	DM1	0.628	0.735	1.193	0.913	1.030
	DM2	0.687	0.734	1.166	0.815	0.918
	DM3	0.803	1.010	1.135	0.828	0.759
Total Inorganic Nitrogen, mg/L (Annual mean)	DM1	3.81	3.60	3.62	3.78	3.48
	DM2	2.97	2.68	3.23	3.06	2.61
	DM3	1.46	1.63	1.81	1.37	1.48
Total Kjeldahl Nitrogen (mg/L)	DM1	3.24	3.13	2.78	3.34	2.78
	DM2	2.33	2.14	2.15	2.67	1.94
	DM3	0.65	0.79	0.70	0.69	0.85
Total Nitrogen, mg/L	DM1	4.22	4.22	4.47	4.60	4.17
	DM2	3.36	3.18	3.73	3.78	3.15
	DM3	1.68	1.99	2.07	1.67	1.79
Orthophosphate Phosphorus (mg/L)	DM1	0.301	0.276	0.238	0.224	0.213
	DM2	0.236	0.227	0.206	0.185	0.183
	DM3	0.079	0.080	0.099	0.079	0.093
Total	DM1	0.38	0.38	0.34	0.36	0.31

Parameter	Monitoring Station	Concentration				
		2010	2011	2012	2013	2014
Phosphorous (mg/L)	DM2	0.30	0.29	0.26	0.29	0.27
	DM3	0.11	0.13	0.13	0.11	0.13
E.coli (cfu/100ml) (Annual geometric mean)	DM1	1300	1000	6100	4200	1300
	DM2	480	270	2600	2000	380
	DM3	26	19	36	58	37
pH	DM1	7.3	7.3	7.1	7.3	7.4
	DM2	7.5	7.5	7.3	7.5	7.5
	DM3	7.7	7.7	7.4	7.7	7.7
Suspended Solids (mg/L)	DM1	34.3	26.7	49.8	51.3	46.2
	DM2	23.8	16.2	24.9	32.2	23.0
	DM3	10.0	10.6	8.9	11.8	15.5
Salinity (psu)	DM1	17.2	16.9	15.5	13.7	15.5
	DM2	19.0	19.0	16.9	15.6	17.5
	DM3	21.4	23.6	19.8	20.6	21.2

Water Quality of Siu Lam

6.2.2.11 As shown in **Figure 1.3**, a barging point in Siu Lam will be used for the transport of surplus inert construction and demolition (C&D) materials. The barging point is located within the North Western WCZ and EPD there are 3 EPD water quality monitoring stations (Stations NM1 to NM3) near the barging point (see **Figure 6.2.1a**).

6.2.2.12 According to EPD Reports 'Marine Water Quality in Hong Kong' in 2014 [6-5], the compliance level of WQOs at North Western WCZ was 61% compared with 72% in Year 2013 due to a lower compliance rate with the TIN objective. The total inorganic nitrogen at three stations NM1, NM2 and NM3 were 0.42, 0.58 and 0.63 mg/L respectively and exceeded the WQOs of 0.3 mg/L in North Western WCZ. The North Western WCZ was mostly affected by the discharges from the Pearl River. Details of EPD's marine water quality monitoring at North Western WCZ are presented in **Table 6.9a** below.

Table 6.9a Summary of marine water quality of North Western WCZ (2010-2014)

Parameter	Monitoring Station	Concentration				
		2010	2011	2012	2013	2014
Dissolved Oxygen (mg/L)	NM1	6.1	5.7	6.1	5.9	5.6
	NM2	6.4	5.8	6.8	6.1	5.8
	NM3	6.2	6.0	6.3	6.1	5.8

Parameter	Monitoring Station	Concentration				
		2010	2011	2012	2013	2014
Ammonia Nitrogen (mg/L)	NM1	0.116	0.114	0.122	0.104	0.093
	NM2	0.113	0.119	0.140	0.108	0.107
	NM3	0.113	0.116	0.145	0.107	0.108
Unionised Ammonia, mg/L (Annual mean)	NM1	0.004	0.003	0.003	0.003	0.003
	NM2	0.004	0.004	0.003	0.003	0.003
	NM3	0.004	0.003	0.003	0.003	0.003
Nitrite Nitrogen, mg/L	NM1	0.054	0.047	0.058	0.072	0.058
	NM2	0.073	0.065	0.073	0.080	0.081
	NM3	0.064	0.074	0.078	0.081	0.091
Nitrate Nitrogen (mg/L)	NM1	0.243	0.227	0.319	0.317	0.268
	NM2	0.318	0.324	0.484	0.408	0.394
	NM3	0.275	0.351	0.493	0.382	0.426
Total Inorganic Nitrogen, mg/L (Annual mean)	NM1	0.41	0.39	0.50	0.49	0.42
	NM2	0.50	0.51	0.70	0.60	0.58
	NM3	0.45	0.54	0.72	0.57	0.63
Total Kjeldahl Nitrogen (mg/L)	NM1	0.28	0.23	0.29	0.26	0.27
	NM2	0.27	0.25	0.32	0.27	0.30
	NM3	0.26	0.25	0.34	0.27	0.29
Total Nitrogen, mg/L	NM1	0.58	0.51	0.67	0.65	0.59
	NM2	0.66	0.64	0.87	0.76	0.78
	NM3	0.60	0.68	0.91	0.73	0.81
Orthophosphate Phosphorus (mg/L)	NM1	0.021	0.022	0.024	0.025	0.021
	NM2	0.021	0.025	0.025	0.026	0.023
	NM3	0.021	0.025	0.026	0.027	0.025
Total Phosphorous (mg/L)	NM1	0.04	0.04	0.04	0.04	0.04
	NM2	0.04	0.04	0.04	0.04	0.04
	NM3	0.04	0.05	0.05	0.04	0.04
E.coli (cfu/100ml) (Annual geometric mean)	NM1	90	42	34	160	300
	NM2	65	55	69	140	71
	NM3	250	100	180	380	110
pH	NM1	7.9	7.8	7.7	7.9	7.9
	NM2	7.9	7.8	7.7	7.9	7.9

Parameter	Monitoring Station	Concentration				
		2010	2011	2012	2013	2014
	NM3	7.9	7.9	7.7	7.9	7.9
Suspended Solids (mg/L)	NM1	8.0	8.1	5.1	6.8	6.6
	NM2	5.6	5.9	4.0	6.6	4.3
	NM3	6.6	6.8	5.5	6.6	7.6
Salinity (psu)	NM1	30.0	31.0	29.2	29.0	30.2
	NM2	28.8	29.8	26.8	27.2	28.3
	NM3	29.5	29.3	27.5	27.7	28.0

6.3 Water Sensitive Receivers

6.3.1.1 The Water Sensitive Receivers (WSRs) within the 500m assessment area are indicated in **Figure 6.2.2**. They include channelized rivers, wetlands in Conservation Area, a number of fish ponds or ponds and watercourses. The detailed and approximate distances are given in **Table 6.10**.

Table 6.10 WSRs within 500m of assessment area

ID	WSRs	Status	Approx. Dist. from Project Boundary
WSR 1	Shenzhen River	Channelized river	Adjacent to Project Boundary
WSR 2	Ng Tung River (River Indus)	Channelized river	<10m
WSR 3	Wetlands and nearby wet woodland in the Conservation Area (CA) near Yuen Leng Chai	Ponds, marsh and wet woodland	Adjacent to Project Boundary
WSR 4	Fish ponds located at northeast of Project Site	Active fish ponds	Adjacent to Project Boundary
WSR 5	Ponds located at southeast of Project Site	Ponds	270m
WSR 6	Fish ponds located at southwest of Project Site on Lo Wu Station Road	Fish ponds	Adjacent to Project Boundary
WSR 7	Ponds located at southwest of Project Site	Ponds	330m
WSR 8	Conservation Area (CA) located at southwest of project Site in Fai King Road and nearby fish pond	Ponds and fish pond	90m
WSR 9	Nam Hang Stream, running from WSR5 to	Natural stream/ channelized river	Adjacent to Project Boundary

ID	WSRs	Status	Approx. Dist. from Project Boundary
	WSR4 and then to Shenzhen River along the eastern boundary of the project Site	(about 200m before entering Shenzhen River)	
WSR 10	Pond located at southeast of Project Site	Pond	240m
WSR 11	Ponds located at south of Project Site	Ponds	Adjacent to Project Boundary
WSR 12	Watercourse across Lin Ma Hang Road	Natural stream/ channelized river (section from Man Kam To BCP to Shenzhen River)	Adjacent to Project Boundary
WSR 13	Ping Yuen River (River Ganges)	Channelized river	~10m
WSR 14	Watercourse located south of Project Site and across Lo Wu Station Road	Natural stream	80m
WSR 15	Watercourse located south of Project Site near Kong Nga Po Road	Natural stream	200m
WSR 16	Watercourse south of San Uk Ling	Natural stream	80m
WSR 17	Watercrouse located south of Sha Ling Police Post near Ng Tung River	Natural stream	~1km
WSR 18	Watercourse at the west of Project Site and Ng Tung River	Natural stream	330m

Note:
[1] Deep Bay would be included in the Study Area if found being impacted by the Project. However, WSRs in the Deep Bay such as Mai Po Inner Deep Bay Ramsar Site are not listed as they are located downstream far away from the Project Site.

6.4 Construction Phase

6.4.1 Assessment Methodology

6.4.1.1 The assessment would identify the possible pollution sources and evaluate their impact to the Water Sensitive Receivers (WSRs) during the construction phase. The area for water quality impact assessment includes an area within 500m from the site boundary of the Project and covers part of the Deep Bay WCZ. The area would be extended to include other areas such as stream courses and associated water systems, wetlands, fish ponds in the vicinity and Deep Bay being impacted by the

Project if found justifiable. Mitigation measures would then be proposed to minimise / avoid adverse water quality impact.

6.4.1.2 The key pollution sources during construction of the proposed project include construction site runoff and sewage from workforce. As there will be neither dredging nor reclamation works, and all the works will be land-based, therefore water quality modelling is not required.

6.4.1.3 The assessment approach is referred to Annex 6 – Criteria for Evaluating Water Pollution and Annex 14 – Guidelines for Assessment of Water Pollution under the TM-EIAO.

6.4.2 Identification of Environmental Impacts

6.4.2.1 The major pollution sources in construction phase are construction site runoff and sewage from the workforce. Construction site runoff would come from over the works site, roads and slopes during site formation for the development. The surface runoff might be polluted by:

- Runoff and erosion from site surfaces, drainage channels, earth working areas and stockpiles;
- Wash water from dust suppression sprays and wheel washing facilities; and
- Fuel, oil, solvents and lubricants from maintenance of construction machinery and equipment.

6.4.2.2 Sewage arising from the on-site construction work force is likely to cause water pollution if it is discharged improperly. The sewage is characterized by high levels of biochemical oxygen demand (BOD), ammonia, *E. coli* and oil/grease. The watercourses polluted by sewage would have aesthetic and odour problem, and may become hypoxic due to decay of large amount of oxygen demanding material.

6.4.2.3 Road widening work along a section of Lin Ma Hang Road would also span over watercourse WSR 12. Temporary watercourse diversion and extension of existing box culvert may be required which would have potential for water quality impacts.

6.4.2.4 As shown in **Figure 1.3**, a barging point in Siu Lam will be used for the transport of surplus inert construction and demolition (C&D) materials. The surplus inert C&D materials from the construction of the C&C facilities at Sandy Ridge Cemetery and Lin Ma Hang Road will be stored at a temporary stockpile area on-site. The surplus inert C&D materials will be transported to designated barging point facility by lorries, and then transported by barges for the reuse of other concurrent projects. As the current location is an existing barging point used by the Express Rail Link project, and no maintenance dredging is required, adverse water quality impacts are not anticipated. Minor construction works are required for the tipping halls and new ramps. However, considered the small scale of works and the existing barging point environment, adverse water quality impacts are not anticipated.

6.4.3 Prediction and Evaluation of Environmental Impacts

General Site Operation

6.4.3.1 The construction site runoff comprises the following:

- Runoff and erosion from site surfaces, slope works, working areas and stockpiles;
- Wash water from dust suppression sprays and wheel washing facilities; and
- Fuel, oil, solvents and lubricants from maintenance of construction machinery and equipment.

6.4.3.2 Construction runoff may cause physical, biological and chemical effects. The physical effects include potential blockage of drainage channels and increase of SS levels near shore of the project site. Runoff containing significant amounts of concrete and cement-derived material may cause primary chemical effects such as increasing turbidity and discoloration, elevation in pH, and accretion of solids. A number of secondary effects may also result in toxic effects to water biota due to elevated pH values, and reduced decay rates of faecal micro-organisms and photosynthetic rate due to the decreased light penetration. Mitigation measures will be in place to control runoff.

Sewage from Workforce

6.4.3.3 Sewage effluents will arise from the sanitary facilities provided for the on-site construction workforce. According to Table T-2 of Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning, the unit flow is 0.23 m^3/day/employed populations. The characteristics of sewage would include high levels of BOD, ammonia and E. coli counts. Since temporary sanitary facilities e.g. portable chemical toilets, and sewage holding tank will be provided, no adverse water quality impact is anticipated

6.4.3.4 Sewage effluents will arise from the sanitary facilities provided for the on-site construction workforce. According to Table T-2 of Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning, the unit flow is 0.23 m^3/day/employed populations. The characteristics of sewage would include high levels of BOD, ammonia and E. coli counts. Since temporary sanitary facilities e.g. portable chemical toilets, and sewage holding tank will be provided, no adverse water quality impact is anticipated.

Hydrological impact on the watercourse encroached by Lin Ma Hang Road

6.4.3.5 The watercourse WSR 12 is running approximately perpendicular across the existing Lin Ma Hang Road. The intersection between the watercourse and the road is in close vicinity of the northern east edge of San Uk Ling Village.

6.4.3.6 WSR 12 is about 1 to 2m wide at that intersection and there is an existing box culvert to allow water flow from one side to another side of the road. As observed in site, the outfall of the culvert is approximate 1m from the footpath and this space is sufficient for the local widening of the footpath / carriageway on Lin Ma Hang Road. Therefore, the widening works will not encroach upon the watercourse and extension of the existing culvert is not required. Hence, diversion of the watercourse for the construction works is not required and will not cause any adverse impacts.

6.4.4 Mitigation Measures

General Site Operation

6.4.4.1 Sewage effluents will arise from the sanitary facilities provided for the on-site construction workforce. According to Table T-2 of Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning, the unit flow is 0.23 m^3/day/employed populations. The characteristics of sewage would include high levels of BOD, ammonia and E. coli counts. Since temporary sanitary facilities e.g. portable chemical toilets, and sewage holding tank will be provided, no adverse water quality impact is anticipated.

6.4.4.2 Sewage effluents will arise from the sanitary facilities provided for the on-site construction workforce. According to Table T-2 of Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning, the unit flow is 0.23 m^3/day/employed populations. The characteristics of sewage would include high levels of BOD, ammonia and E. coli counts. Since temporary sanitary facilities e.g. portable chemical toilets, and sewage holding tank will be provided, no adverse water quality impact is anticipated.

6.4.4.3 In accordance with the Professional Persons Environmental Consultative Committee Practice Notes on Construction Site Drainage, Environmental Protection Department, 1994 (ProPECC PN 1/94), best management practices should be implemented as far as practicable as below:

- At the start of site establishment, perimeter cut-off drains to direct off-site water around the site should be constructed with internal drainage works. Channels (both temporary and permanent drainage pipes and culverts), earth bunds or sand bag barriers should be provided on site to direct stormwater to silt removal facilities;

- Diversion of natural stormwater should be avoided as far as possible. The design of temporary on-site drainage should prevent runoff going through site surface, construction machinery and equipment in order to avoid or minimise polluted runoff. Sedimentation tanks with sufficient capacity, constructed from pre-formed individual cells of approximately 6 to 8 m^3 capacities, are recommended as a general mitigation measure which can be used for settling surface runoff prior to disposal. The system capacity shall be flexible and able to handle multiple inputs from a variety of sources and suited to applications where the influent is pumped;

- The dikes or embankments for flood protection should be implemented around the boundaries of earthwork areas. Temporary ditches should be provided to facilitate the runoff discharge into an appropriate watercourse, through a silt/sediment trap. The silt/sediment traps should be incorporated in the permanent drainage channels to enhance deposition rates;

- The design of efficient silt removal facilities should be based on the guidelines in Appendix A1 of ProPECC PN 1/94. The detailed design of the sand/silt traps should be undertaken by the contractor prior to the commencement of construction;

- Construction works should be programmed to minimise surface excavation works during the rainy seasons (April to September). All exposed earth areas should be completed and vegetated as soon as possible after earthworks have been completed. If excavation of soil cannot be avoided during the rainy season, or at any time of year when rainstorms are likely, exposed slope surfaces should be covered by tarpaulin or other means;

- All drainage facilities and erosion and sediment control structures should be regularly inspected and maintained to ensure proper and efficient operation at all times and particularly following rainstorms. Deposited silt and grit should be removed regularly and disposed of by spreading evenly over stable, vegetated areas;

- If the excavation of trenches in wet periods is necessary, it should be dug and backfilled in short sections wherever practicable. Water pumped out from trenches or foundation excavations should be discharged into storm drains via silt removal facilities;

- All open stockpiles of construction materials (for example, aggregates, sand and fill material) should be covered with tarpaulin or similar fabric during rainstorms. Measures should be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system;

- Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris being washed into the drainage system and storm runoff being directed into foul sewers;

- Precautions to be taken at any time of year when rainstorms are likely, actions to be taken when a rainstorm is imminent or forecasted, and actions to be taken during or after rainstorms are summarised in Appendix A2 of ProPECC PN 1/94. Particular attention should be paid to the control of silty surface runoff during storm events;
- All vehicles and plant should be cleaned before leaving a construction site to ensure no earth, mud, debris and the like is deposited by them on roads. An adequately designed and sited wheel washing facilities should be provided at every construction site exit where practicable. Wash-water should have sand and silt settled out and removed at least on a weekly basis to ensure the continued efficiency of the process. The section of access road leading to, and exiting from, the wheel-wash bay to the public road should be paved with sufficient backfall toward the wheel-wash bay to prevent vehicle tracking of soil and silty water to public roads and drains;
- Oil interceptors should be provided in the drainage system downstream of any oil/fuel pollution sources. The oil interceptors should be emptied and cleaned regularly to prevent the release of oil and grease into the storm water drainage system after accidental spillage. A bypass should be provided for the oil interceptors to prevent flushing during heavy rain;
- Construction solid waste, debris and rubbish on site should be collected, handled and disposed of properly to avoid water quality impacts;
- All fuel tanks and storage areas should be provided with locks and sited on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank to prevent spilled fuel oils from reaching water sensitive receivers nearby; and
- Regular environmental audit on the construction site should be carried out in order to prevent any malpractices. Notices should be posted at conspicuous locations to remind the workers not to discharge any sewage or wastewater into the water bodies, marsh and ponds.

6.4.4.4 By adopting the best management practices, it is anticipated that the impacts of general site operation will be reduced to satisfactory levels before discharges. The details of best management practices will be highly dependent to actual site condition and Contractor shall apply for a discharge license under WPCO.

<u>Sewage from Workforce</u>

6.4.4.5 Portable chemical toilets and sewage holding tanks should be provided for handling the construction sewage generated by the workforce. A licensed contractor should be employed to provide appropriate and adequate portable toilets to cater 0.23m^3/day/employed population and be responsible for appropriate disposal and maintenance. With reference to **Section 7**, the maximum number of construction workforce is around 190 on site and the total sewage generated per day would be 45m^3 during construction phase (Detail refers to **Section 7**).

6.4.4.6 Notices should be posted at conspicuous locations to remind the workers not to discharge any sewage or wastewater into the nearby environment during the construction phase of the Project. Regular environmental audit on the construction site should be conducted in order to provide an effective control of any malpractices and achieve continual improvement of environmental performance on site. It is anticipated that sewage generation during the construction phase of the Project would not cause water quality impact after undertaking all required measures.

Operation of Barging Point at Siu Lam

6.4.4.7 The following good practice shall apply for the barging facilities operations:

- All barges should be fitted with tight bottom seals to prevent leakage of materials during transport;
- Barges or hoppers should not be filled to a level that will cause overflow of materials or polluted water during loading or transportation;
- All vessels should be sized so that adequate clearance is maintained between vessels and the seabed in all tide conditions, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash; and
- Loading of barges and hoppers should be controlled to prevent splashing of material into the surrounding water.
- Mitigation measures for land-based activities as outlined in **Section 6.4.4** should be applied to minimise water quality impacts from site runoff and open stockpile spoils at the proposed barging facilities where appropriate.

6.4.5 Residual Environmental Impacts

6.4.5.1 No adverse residual impact is anticipated during the construction phase of the Project with the implementation of mitigation measures.

6.5 Operational Phase

6.5.1 Assessment Methodology

6.5.1.1 The assessment would identify the possible pollution sources and evaluate their impact to the Water Sensitive Receivers (WSRs) during operation stage. The area for water quality impact assessment includes area within 500m from the site boundary of the Project and covers the Deep Bay WCZ. The area would be extended to include other areas such as stream courses and associated water systems, wetlands, fish ponds in the vicinity and Deep Bay being impacted by the Project if found justifiable. Mitigation measures would then be proposed to minimise / avoid adverse water quality impact.

6.5.1.2 The key pollution sources during operation of the proposed project include as sewage and non-point source pollution from the project site. The sewage from the project site could be directed to the sewage treatment system. The non-point source pollution from roads and project site runoff would be estimated in worst case scenario.

6.5.1.3 Beside pollution sources, the hydrological impact to WSR3 (wet woodland nearby the Conservation Area) due to the Project would also need to be evaluated. Three aspects would be assessed in the following Study: i) change in groundwater hydrology from Sandy Ridge slope to WSR3 using in-situ ground water monitoring data; ii) water quality impact due to non-point source pollution from the proposed platform; and iii) potential erosion due to increased runoff in high momentum from the proposed platform to WSR3 through the seasonal watercourses.

6.5.2 Identification of Environmental Impacts

6.5.2.1 The key pollution sources in operational phase are sewage from the development and runoff from the project site and roads. It is anticipated that sewage will be generated by visitors and workers, as well as wastewater from cleaning activities in the development.

6.5.2.2 There would be additional pollution loading in association with the increase of runoff, which is a non-point source pollution during operational phase. Substances such as vehicle dust, tyre scraps and oils deposited and accumulated on the road surfaces will be washed into nearby drainage system or watercourses during rainfall events. Under normal condition, runoff will not be generated in low rainfall intensity. However, the worst case scenario to water quality will take place during the first flush under heavy rainstorm events.

6.5.2.3 The platform and its associated foundation structure cover about 2ha area. There would be hydrological change to the downstream area in both groundwater and surface water due to the Project. For groundwater, the infiltration rate to the ground would be reduced and the hydrological flow of underground water may also be potentially interrupted by the foundation of the proposed platform. The amount of surface runoff would increase as the area of slope changes from the neutrally unpaved to artificially paved condition.

6.5.2.4 The surface runoff collected on the platform and the associated road network will be collected by stormwater drainage system and discharged into seasonally wet watercourses leading to the wet woodland of WSR3 downstream. The downstream area would therefore receive extra amount of runoff and sediment, especially during the first flush of a strong rainstorm during which the large momentum of water flow will cause a higher amount of erosion.

6.5.3 Prediction and Evaluation of Environmental Impacts

Sewage and Sewerage System

6.5.3.1 The sewage would be diverted to the upgraded Shek Wu Hui Sewage Treatment Works (SWH STW). The proposed upgraded capacity of SWH STW for North East New Territories New Development Areas project is from 113,000 m^3/day to 190,000 m^3/day with spare capacity about 6,000 m^3/day by 2031 (AEIAR: 175/2013).

6.5.3.2 According to the latest design, the average daily sewage flow are 92.1m^3/day for normal day and 672.7m^3/day for festive period respectively and the details are shown as below:

Table 6.11a Estimated sewage flows during normal days

Source of Sewage	Unit Flow Factor (m^3/h/d)	No. of people	Average Sewage Flow (m^3/day)	Peak Sewage Flow (l/s) [1]
Staff	0.080	140	11.2	0.8
Visitors[2]	0.010	4,980	34.9	2.5
Restaurant[3]	1.580	20	31.6	2.2
Washing facilities	-	-	14.4	1.0
		Total	**92.1**	**6.5**

Note:
[1]: Global Peaking factor = 6 (EPD's GESF Table T-5, population between 1,000 and 5000 including stormwater allowance)
[2] Reference has been made to the sewage flow calculation from the Tai Po Tsz Shan Monastery project, in which 50% of the total number of visitors were assumed to contribute to sewage flow generation. Due to the remoteness of Sandy Ridge site, a more conservative approach has been applied that we have assumed 70% of the total number of visitors will use toilet and contribute to sewage flow generation.
[3] The flow from restaurant is estimated by the number of staff and the corresponding unit flow factor for the staff. The maximum number of staff in restaurant is estimated to be 20 which is considered as the upper bound of sewage flow from restaurant and applicable to both normal and festive days.

Table 6.11b Estimated sewage flows during festive periods

Source of Sewage	Unit Flow Factor (m^3/h/d)	No. of people	Average Sewage Flow (m^3/day)	Peak Sewage Flow (l/s) [1]
Staff	0.080	140	11.2	0.5
Visitors[2]	0.010	86,880	608.3	28.2
Restaurant[3]	1.580	20	31.6	1.5
Washing facilities	-	-	21.6	1.0
		Total	**672.7**	**31.2**

Note:
[1]: Global Peaking factor = 4 (EPD's GESF Table T-5, population greater than 50,000 including stormwater allowance)
[2] Reference has been made to the sewage flow calculation from the Tai Po Tsz Shan Monastery project, in which 50% of the total number of visitors were assumed to

contribute to sewage flow generation. Due to the remoteness of Sandy Ridge site, a more conservative approach has been applied that we have assumed 70% of the total number of visitors will use toilet and contribute to sewage flow generation.
[3] The flow from restaurant is estimated by the number of staff and the corresponding unit flow factor for the staff. The maximum number of staff in restaurant is estimated to be 20 which is considered as the upper bound of sewage flow from restaurant and applicable to both normal and festive days.

6.5.3.3 As the sewage generated from the development is mainly in Ching Ming Festival and Chung Yeung Festival, it is anticipated that the upgraded SWH STW will have enough capacity to handle such relatively small amount of sewage from the development. Thus no adverse impact would be anticipated.

Non-Point Source Pollution Loading

6.5.3.4 The existing area in the vicinity is partially rural area. With the development of the Project, there would be an increase in the total paved area. Such change of pavement around an addition of 8ha will reduce the infiltration rate into the ground, consequently resulting in a higher flood risk as extra stormwater runoff may be generated during rain events. The increase of average daily runoff would be about 300m^3/day.

6.5.3.5 Nevertheless, the whole Deep Bay Catchment covers Sheung Shui, Fanling, Kam Tin and Yuen Long with total area of over 68,000 ha. The change of effective catchment area will only account for less than 0.02% of the whole Deep Bay Catchment and hence it is considered negligible.

6.5.3.6 In terms of water quality impact, there would be additional pollution loading in association with the increase of runoff, which is known as non-point source pollutions during operational phase. Substances such as vehicle dust, tyre scraps and oils deposited and accumulated on the road surfaces and parking area will be washed into nearby drainage system or watercourses during rainfall events. Under normal condition, runoff will not be generated in low rainfall intensity. However, the worst scenario to water quality will take place during the first flush under heavy rainstorm events. Proper drainage systems with silt traps should be installed. The design of road gullies with silt traps should be incorporated in the later detailed design.

6.5.3.7 The total loading of non-point source pollution due to the development is compared with that of existing condition in **Appendix 6.1**. According to the assessment result, the increase of loading in terms of BOD_5, TN and TP are 2.66, 0.24 and 0.02 kg/day respectively. These additional loading generated from the increased surface runoff due to the Project accounts for less than 0.0010% of the total pollution loading to Deep Bay from both Hong Kong SAR and Mainland in Year 2012 (reference to EIA report 'Upgrading of Pillar Point Sewage Treatment Works' AEIAR-118/2008 **[6-6]**). This would be a minor source in pollution loading to the Deep Bay WCZ due to the Project development. Moreover, with the implementation of the mitigation measures stated in **Section 6.5.4**, such as best management practice to remove pollutants on road or other surface area, the pollution loading due to surface runoff would be further reduced.

Hydrological Impact due to Viaduct Section

6.5.3.8 A viaduct is proposed as the access road for the northeast part of the Project (**Figure 6.2.2**). The piers of the proposed viaduct section may alter the seasonally wet watercourses nearby. The water flow through the seasonal watercourses to downstream in wet season may be changed or diverted.

Hydrological Impact to the Wet Woodland

Groundwater Hydrology

6.5.3.9 Three different cross sections showing the existing ground profiles and groundwater monitoring data are presented in **Appendix 6.2**. It can be seen that the proposed platform is approximately 40-50m above the woodland. The inferred underground water levels were interpreted from the preliminary borehole information available.

6.5.3.10 During fine weather, the average inferred water level is only about 1m above the rock head profile. It implies that the groundwater aquifer from the sloping ground at Sandy Ridge is unlikely the major water sources to the wet woodland. Indeed, the groundwater supply of wet woodland is mainly due to the water seepages from the ponds and marsh of WSR3 as shown in **Figure 6.2.2**.

6.5.3.11 During rainstorm events, the peak inferred water levels could rise up to 15-20m from the average water levels. This implies that the permeability of soil layer above the rock head level is relatively high and hence the water level would vary significantly. Site inspections also reveal that the maximum water level would drop quickly after the heaviest rainfall period, typically within one day.

6.5.3.12 It can also be observed from these sections that the proposed platform structure would only marginally encroach into the maximum inferred water level but would not encroach into the average inferred water level. As the maximum inferred water level only occurs during very heavy rainfall, it is considered that proposed platform structure would not significantly affect the groundwater level.

6.5.3.13 Other than proposed platform structure, the sections also illustrate the tentative design for the foundation of the proposed platform structure. According to the current preliminary design, the foundation design would compose of bore piles of about 0.6m in diameter and the spacing between each pile would be approximately 3.5–5m. As compared to other foundation designs such as D-wall or pipepile walls, the proposed small diameter bore pile system would allow a notional free area of about 87 – 91% for groundwater to pass through.

6.5.3.14 Hence, based on the above arguments, it is considered that the proposed platform structure and its associated foundation design would not cause a significant change in the groundwater hydrology connecting to the wet woodland.

Water Quality of Runoff from the Proposed Platform

6.5.3.15 As stated in **Section 6.5.3** as non-point source pollution, the surface runoff collected on the platform and associated road system may contain certain dusty materials and hence may cause pollution to wet woodland in WSR3. Installation of proper silt traps in the drainage systems and road gullies incorporated with silt traps in the design are proved to be practical measure to reduce pollution from surface runoff. Regular cleaning are required such that to avoid debris entering the downstream rivers during first flush.

Erosion from the Runoff from the Proposed Platform

6.5.3.16 There are in total 5 drainage paths (P1 – P5) leading to seasonally wet watercourses which in turn lead to the wet woodland as shown in **Figure 6.5.1**. These catchments and seasonally wet watercourses serve as important pathways for the surface water to reach the woodland, whilst portion of the surface water will infiltrate into the groundwater system.

6.5.3.17 According to the current platform design, the existing drainage flow path P1 to P4 will not be affected but the catchment areas for drainage path P5 would be reduced as a result of site formation, by an amount of 7,350m^2 for P5.

6.5.3.18 However, a certain portion of the runoff from the platforms formed in the vicinity of P5 will be diverted to natural watercourses as well. **Figure 6.5.2** illustrates the latest arrangement for the platforms formed. It can be seen that there are a total of 3 new platforms, including Platform 1, Platform 2a and Platform 2b. Out of these 3 platforms, part of the runoff from Platform 1 will be diverted to natural watercourse downstream of P4 and P5. The remaining runoff from Platform 1 and those runoff from Platform 2a and 2b will be drained to other engineering drainage system in vicinity and ultimately to Shenzhen River.

6.5.3.19 The following table summarises the catchment areas leading to the seasonal watercourse for both the existing conditions and the conditions after the platforms are completed.

Table 6.12 Catchment areas before and after completion of the Project

Catchment Leading to Watercourses	Catchment Area (m^2)			
	Existing	After Site Formation	W/ New Platforms	Total
P1	5,450	5,450	0	5,450
P2	16,560	16,560	0	16,560
P3	8,910	8,910	0	8,910

Catchment Leading to Watercourses	Catchment Area (m^2)			
	Existing	After Site Formation	W/ New Platforms	Total
P4	23,950	23,950	0	23,950
P5	22,900	14,300	1,250	15,550

Note:
[1] Only part of the runoff will be drained into the watercourses downstream of P5.

6.5.3.20 However, it should be noted that the catchment area within P5 are permeable and that the new platforms will be paved and impermeable. The current design has ensured that the total flow rate leading to the seasonal watercourses downstream of P5 would be insignificant. However, the volumetric flow rate and hence the maximum velocity from the first flux would inevitably increase. According to the current design, the maximum velocity for the seasonal watercourses downstream for P5 will be increased from 0.65m/s to 2.63m/s. The following table summarises the changes in terms of volumetric flow rates and maximum velocity.

Table 6.13 Estimated surface runoff into seasonal watercourses before and after completion of the Project

Catchment Leading to Seasonal Watercourse	Existing [1], [2]		After Site formation [1], [2]		Change	
	Flow (m^3/s)	Speed (m/s)	Flow (m^3/s)	Speed (m/s)	Flow (m^3/s)	Speed (m/s)
P1	0.18	0.98	0.18	0.98	0	0
P2	0.51	1.05	0.51	1.05	0	0
P3	0.28	0.90	0.28	0.90	0	0
P4	0.71	1.55	0.71	1.55	0	0
P5	0.65	0.79	0.65	2.63	0	+1.84

Note:
[1] Flow rate and speed connecting to the seasonal watercourse.
[2] Data from one in 50 years design return period.

6.5.3.21 The increase in maximum velocity along the seasonal watercourse downstream of P5 may increase the potential for soil erosion. In order to reduce the velocity and hence the potential for soil erosion, energy dissipaters would be installed at the seasonally wet watercourses downstream of P5. **Appendix 6.3** shows the typical configuration of the energy dissipaters which comprises of a number of concrete steps to allow water velocity to decelerate. The actual dimensions of the energy dissipaters would be subject to detailed design.

Hydrological impact on the watercourse encroached by Lin Ma Hang Road

6.5.3.22 As discussed in **Section 6.4.3**, road widening work will be carried out along a section of Lin Ma Hang Road spanning over the watercourse WSR 12. However, the drainage system would not be affected and hence, the watercourse WSR 12 will not be affected during operational phase of the Project.

6.5.4 Mitigation Measures

Sewage and Sewerage System

6.5.4.1 Sewage generated by visitors and workers, as well as wastewater from cleaning activities in the development should be connected to the foul sewerage system. Detention tank will be provided for interim stage such that emergency discharge is generally avoided as a consequence of pause of power supply, pump failure or etc.

Change in Hydrological Flow, Drainage System and Road Runoff

6.5.4.2 According to the current design, small bore piles of about 0.6m in diameter and pile to pile spacing 3.5–5m approximately would be adopted for foundation of the proposed platform structure. As compared to other foundation design options such as D-wall or pipepile walls, this proposed small diameter bore pile design would allow free passage for groundwater to run through and would not significantly interrupt the groundwater hydrology.

6.5.4.3 The piers of the proposed viaduct section would span over the seasonally wet watercourses. The alternation of water flow through the seasonal watercourses in wet season would be minimised.

6.5.4.4 During operational phase, vehicle dust, tyre scraps and oils might be washed away from the road surface and parking area to the nearby watercourses by surface runoff or road surface cleaning. Proper drainage systems with silt traps and oil interceptors should be installed. The design of road gullies with silt traps should be incorporated in the later detailed design especially for the catchment leading to the existing wet woodland area located at the north of the site.

6.5.4.5 The pollution induced from surface runoff can be controlled by best management practice. Runoff will be intercepted by properly designed and managed silt traps at appropriate spacing, so that the common roadside debris, refuse and fallen leaves etc. can be captured before allowing the runoff to drain into watercourse along the east boundary of the Project and Shenzhen River. The silt traps and oil interceptors are recommended to clean the trapped dirt regularly, especially before peak seasons of the visitors in Ching Ming Festival and Chung Yeung Festival, so that designed removal efficiency of the silt or oils can be achieved. The road and parking area should be cleaned prior to the occurrence of a tropical storm to avoid debris entering the downstream rivers during first flush. Each of the cleaning events should be carried out during low traffic flow period. Manual methods or mechanical means such as vacuum sweeper/truck equipped with side broom are preferable, which can sweep road sludge and debris into the suction nozzle to increase the removal efficiency of pollutants. The collected pollutants would be tankered away for off-site disposal at landfill sites. With the interception and removal of the pollutants, the pollution loading of stormwater to the sensitive receivers nearby would be much reduced.

6.5.4.6 The pollution induced from surface runoff can be controlled by best management practice. Runoff will be intercepted by properly designed and managed silt traps at appropriate spacing, so that the common roadside debris, refuse and fallen leaves etc. can be captured before allowing the runoff to drain into watercourse along the east boundary of the Project and Shenzhen River. The silt traps and oil interceptors are recommended to clean the trapped dirt regularly, especially before peak seasons of the visitors in Ching Ming Festival and Chung Yeung Festival, so that designed removal efficiency of the silt or oils can be achieved. The road and parking area should be cleaned prior to the occurrence of a tropical storm to avoid debris entering the downstream rivers during first flush. Each of the cleaning events should be carried out during low traffic flow period. Manual methods or mechanical means such as vacuum sweeper/truck equipped with side broom are preferable, which can sweep road sludge and debris into the suction nozzle to increase the removal efficiency of pollutants. The collected pollutants would be tankered away for off-site disposal at landfill sites. With the interception and removal of the pollutants, the pollution loading of stormwater to the sensitive receivers nearby would be much reduced.

6.5.4.7 In order to minimise the erosion impact to the wet woodland due to high momentum from first flush, a by-pass drainage will be provided from the platform and the associated road network and extra runoff amount would be diverted away from the wet woodland and pond. Energy dissipaters would be installed at the seasonally wet watercourses to reduce the magnitude of the first flush. **Appendix 6.3** illustrates the standard design of stepped channel which is a common practice for energy dissipation of a watercourse in steep slope. The opportunity of undesirable erosion along the existing seasonally wet watercourses would be minimised.

6.5.5 Residual Environmental Impacts

6.5.5.1 According to the assessment of environment impact from sewage generated and non-point source pollution loading due to Project in **Section 6.5.3**, the increase of pollution loads to Deep Bay from sewage and surface run-off due to the Project is relatively small. No adverse residual impact is anticipated during the operational phase of the Project with the implementation of mitigation measures.

6.6 Conclusion

6.6.1.1 By optimizing the design of the platform, foundation design and the drainage system, hydrological impact including groundwater and surface water to the wet woodland located at the north of the site has been minimised.

6.6.1.2 With full implementation of the mitigation measures including proper sewerage and drainage systems, adverse water quality impact is not anticipated during both the construction and operational phases of the Project.

6.7 References

[6-1] EPD, Deep Bay Water Quality Regional Control Strategy Study, (ACE Paper 55/98)

[6-2] EPD, 2010-2014, River Water Quality Reports

[6-3] AEIAR-160/2011, Regulation of Shenzhen River Stage IV

[6-4] AEIAR-180/2013, Development of Organic Waste Treatment Facilities, Phase 2

[6-5] EPD, 2010-2014, Marine Water Quality Reports

[6-6] AEIAR-118/2008, Upgrading of Pillar Point Sewage Treatment Works