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Appendices

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5 Water Quality

5.1 Legislation, Standards and Guidelines

5.1.1.1 This section presents the main legislation, standards and guidelines relevant to the evaluation of water quality impacts associated with the construction and operation of the project. They include:

- Environmental Impact Assessment Ordinance (EIAO) (Cap. 499), Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM);
- Water Pollution Control Ordinance (WPCO) (Cap. 358);
- Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters; and,
- Practice Note for Professional Persons on Construction Site Drainage (ProPECC PN 1/94).

5.1.2 Environmental Impact Assessment Ordinance (EIAO) (Cap. 499)

5.1.2.1 EIAO (Cap. 499) provides the major statutory framework for the environmental impact assessment in Hong Kong. Under Section 16 of the EIAO, the Environmental Protection Department (EPD) issued the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) which specifies the assessment methods and criteria for the EIA. Annexes 6 and 14 of the EIAO-TM stipulate the "Criteria for Evaluating Water Pollution" and "Guidelines for the Assessment of Water Pollution" respectively.

5.1.3 Water Pollution Control Ordinance (WPCO) (Cap. 358)

5.1.3.1 WPCO (Cap. 358) provides the major statutory framework for the protection and control of water quality in Hong Kong. According to the Ordinance and its subsidiary legislation, the entire Hong Kong waters are divided into ten Water Control Zones (WCZs) and four supplementary WCZs. Each WCZ has a designated set of statutory Water Quality Objectives (WQOs). The WQOs set limits for different parameters that should be achieved in order to protect specific beneficial uses and conservation goals of each of the zones. The Project is situated within the North Western WCZ. The North Western waters in the vicinity of the Project site are identified with the following beneficial uses:

- Nature reserves and Site of Special Scientific Interest;
- Maintenance of natural ecosystems and wildlife;
- Boating, fishing and secondary contact recreation;
- Aesthetic enjoyment; and,
- Navigation and shipping.

5.1.3.2 The WQOs of the North Western WCZ applicable to this study are summarized in **Table 5.1** below.

Table 5.1 WQOs of the Northern Western WCZ

Water Quality Objectives
Aesthetic Appearance
• Waste discharges shall cause no objectionable odours or discolouration of the water. • Tarry residues, floating wood, articles made zone of glass, plastic, rubber or of any other substances should be absent. • Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam. • There should be no recognisable sewage-derived debris. • Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent. • Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.
Bacteria
• The level of E coli should not exceed 1000 counts per 100 mL at other inland waters (i.e. inland waters other than those in the Tuen Mun (A), (B) and (C) sub-zones), calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.
Colour
• Waste discharges at other inland waters shall not cause the colour of water to exceed 50 Hazen units.
Dissolved Oxygen
• Waste discharges to marine waters shall not cause the level of dissolved oxygen to fall below 4 mg per litre for 90% of the sampling occasions during the whole year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg per litre within 2 m of the seabed for 90% of the sampling occasions during the whole year. • Waste discharges to other inland waters shall not cause the level of dissolved oxygen to be less than 4 mg per litre.
pH
• The pH of marine waters should be within the range of 6.5-8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 unit. • The pH of other inland waters should be within the range of 6.0-9.0 units.

Water Quality Objectives
Temperature
• Waste discharges shall not cause the natural daily temperature range to change by more than 2.0°C.
Salinity
• Waste Discharges shall not cause the natural ambient salinity to change by more than 10%.
Suspended Solids
• Waste discharges to marine waters shall neither cause the natural ambient level to be raised by more than 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities. • Waste discharges to other inland waters shall not cause the annual median of suspended solids to exceed 25 mg per litre.
Ammonia
• The un-ionised ammoniacal nitrogen level should not be more than 0.021 mg/l calculated as the annual average (arithmetic mean).
Nutrients
• Nutrients should not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants; and • The annual mean depth-averaged total inorganic nitrogen should not exceed 0.5 mg/L in the marine water of the North Western Water Control Zone.
5-day Biochemical Oxygen Demand
• Waste discharges to other inland waters shall not cause the 5-day biochemical oxygen demand to exceed 5 mg per litre.
Chemical Oxygen Demand
• Waste discharges to other inland waters shall not cause the chemical oxygen demand to exceed 30 mg per litre.
Toxins
• Waste discharges shall not cause the toxins in water to attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other. • Waste discharges shall not cause a risk to any beneficial use of the aquatic environment.

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

5.1.4.1 Under Section 21 of the WPCO (Cap. 358), Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS) was issued to control the physical, chemical and microbial quality of effluent discharges into foul sewers, storm water drains, inland and coastal waters. Specific limits apply for different areas and are different between surface waters and sewers. The limits vary with the rate of effluent flow. Standards for effluent discharged into the inshore waters and marine waters of North

Western WCZ are summarized in **Table 5.2** and **Table 5.3** respectively. Standards for effluents discharged into foul sewers leading into Government sewage treatment plants are summarized in **Table 5.4**. Standards for effluents discharged into Group D inland waters (for general amenity and secondary contact recreation) are summarized in **Table 5.5**.

Table 5.2 Standards for effluents discharged into the inshore waters of the North Western WCZ

Flow rate (m^3/day)	**≤10**	**>10 and ≤200**	**>200 and ≤400**	**>400 and ≤600**	**>600 and ≤800**	**>800 and ≤1000**	**>1000 and ≤1500**	**>1500 and ≤2000**	**>2000 and ≤3000**	**>3000 and ≤4000**	**>4000 and ≤5000**	**>5000 and ≤6000**
pH (pH units)	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9
Temperature (°C)	40	40	40	40	40	40	40	40	40	40	40	40
Colour (lovibond units) (25mm cell length)	1	1	1	1	1	1	1	1	1	1	1	1
Suspended solids	50	30	30	30	30	30	30	30	30	30	30	30
BOD	50	20	20	20	20	20	20	20	20	20	20	20
COD	100	80	80	-80	80	80	80	80	80	80	80	80
Oil & Grease	30	20	20	20	20	20	20	20	20	20	20	10
Iron	15	10	10	7	5	4	3	2	1	1	0.8	0.6
Boron	5	4	3	2	2	1.5	1.1	0.8	0.5	0.4	0.3	0.2
Barium	5	4	3	2	2	1.5	1.1	0.8	0.5	0.4	0.3	0.2
Mercury	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	1	1	0.8	0.7	0.5	0.4	0.3	0.2	0.15	0.1	0.1	0.1
Total toxic metals	2	2	1.6	1.4	1	0.8	0.6	0.4	0.3	0.2	0.1	0.1
Cyanide	0.2	0.1	0.1	0.1	0.1	0.1	0.05	0.05	0.03	0.02	0.02	0.01
Phenols	0.5	0.5	0.5	0.3	0.25	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5

Flow rate (m^3/day)	≤10	>10 and ≤200	>200 and ≤400	>400 and ≤600	>600 and ≤800	>800 and ≤1000	>1000 and ≤1500	>1500 and ≤2000	>2000 and ≤3000	>3000 and ≤4000	>4000 and ≤5000	>5000 and ≤6000
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	100	100	80	80	80	80	50	50	50	50	50	30
Total phosphorus	10	10	8	8	8	8	5	5	5	5	5	5
Surfactants (total)	20	15	15	15	15	15	10	10	10	10	10	10
E. coli (count/100ml)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

Note: All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated.

Table 5.3 Standards for effluents discharged into the marine waters of the North Western WCZ

Flow rate (m^3/day)	≤10	>10 and ≤200	>200 and ≤400	>400 and ≤600	>600 and ≤800	>800 and ≤1000	>1000 and ≤1500	>1500 and ≤2000	>2000 and ≤3000	>3000 and ≤4000	>4000 and ≤5000	>5000 and ≤6000
pH (pH units)	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temperature (°C)	45	45	45	45	45	45	45	45	45	45	45	45
Colour (lovibond units) (25mm cell length)	4	1	1	1	1	1	1	1	1	1	1	1
Suspended solids	500	500	500	300	200	200	100	100	50	50	40	30
BOD	500	500	500	300	200	200	100	100	50	50	40	30
COD	1000	1000	1000	700	500	400	300	200	150	100	80	80
Oil & Grease	50	50	50	30	25	20	20	20	20	20	20	20

Flow rate (m^3/day)	**≤10**	**>10 and ≤200**	**>200 and ≤400**	**>400 and ≤600**	**>600 and ≤800**	**>800 and ≤1000**	**>1000 and ≤1500**	**>1500 and ≤2000**	**>2000 and ≤3000**	**>3000 and ≤4000**	**>4000 and ≤5000**	**>5000 and ≤6000**
Iron	20	15	13	10	7	6	4	3	2	1.5	1.2	1
Boron	6	5	4	3.5	2.5	2	1.5	1	0.7	0.5	0.4	0.3
Barium	6	5	4	3.5	2.5	2	1.5	1	0.7	0.5	0.4	0.3
Mercury	0.1	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	2	1.5	1.2	0.8	0.6	0.5	0.32	0.24	0.16	0.12	0.1	0.1
Total toxic metals	4	3	2.4	1.6	1.2	1	0.64	0.48	0.32	0.24	0.2	0.14
Cyanide	1	0.5	0.5	0.5	0.4	0.3	0.2	0.15	0.1	0.08	0.06	0.04
Phenols	0.5	0.5	0.5	0.3	0.25	0.2	0.13	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	100	100	80	80	80	80	50	50	50	50	50	50
Total phosphorus	10	10	8	8	8	8	5	5	5	5	5	5
Surfactants (total)	30	20	20	20	15	15	15	15	15	15	15	15
E. coli (count/100ml)	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000	4000

Note: All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated.

Table 5.4 Standards for effluents discharged into foul sewers leading into Government sewage treatment plants

Flow rate (m^3/day) Determinand	**≦10**	**＞10 and ≦100**	**＞100 and ≦200**	**＞200 and ≦400**	**＞400 and ≦600**	**＞600 and ≦800**	**＞800 and ≦1000**	**＞1000 and ≦1500**	**＞1500 and ≦2000**	**＞2000 and ≦3000**	**＞3000 and ≦4000**	**＞4000 and ≦5000**	**＞5000 and ≦6000**
pH (pH units)	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temperature (℃)	43	43	43	43	43	43	43	43	43	43	43	43	43
Suspended solids	1200	1000	900	800	800	800	800	800	800	800	800	800	800
Settleable solids	100	100	100	100	100	100	100	100	100	100	100	100	100
BOD	1200	1000	900	800	800	800	800	800	800	800	800	800	800
COD	3000	2500	2200	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Oil & Grease	100	100	50	50	50	40	30	20	20	20	20	20	20
Iron	30	25	25	25	15	12.5	10	7.5	5	3.5	2.5	2	1.5
Boron	8	7	6	5	4	3	2.4	1.6	1.2	0.8	0.6	0.5	0.4
Barium	8	7	6	5	4	3	2.4	1.6	1.2	0.8	0.6	0.5	0.4
Mercury	0.2	0.15	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.2	0.15	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Copper	4	4	4	3	1.5	1.5	1	1	1	1	1	1	1
Nickel	4	3	3	2	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Chromium	2	2	2	2	1	0.7	0.6	0.4	0.3	0.2	0.1	0.1	0.1
Zinc	5	5	4	3	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Silver	4	3	3	2	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Other toxic metals individually	2.5	2.2	2	1.5	1	0.7	0.6	0.4	0.3	0.2	0.15	0.12	0.1

Flow rate (m^3/day) Determinand	**≦10**	**＞10 and ≦100**	**＞100 and ≦200**	**＞200 and ≦400**	**＞400 and ≦600**	**＞600 and ≦800**	**＞800 and ≦1000**	**＞1000 and ≦1500**	**＞1500 and ≦2000**	**＞2000 and ≦3000**	**＞3000 and ≦4000**	**＞4000 and ≦5000**	**＞5000 and ≦6000**
Total toxic metals	10	10	8	7	3	2	2	1.6	1.4	1.2	1.2	1.2	1
Cyanide	2	2	2	1	0.7	0.5	0.4	0.27	0.2	0.13	0.1	0.08	0.06
Phenols	1	1	1	1	0.7	0.5	0.4	0.27	0.2	0.13	0.1	0.1	0.1
Sulphide	10	10	10	10	5	5	4	2	2	2	1	1	1
Sulphate	1000	1000	1000	1000	1000	1000	1000	900	800	600	600	600	600
Total nitrogen	200	200	200	200	200	200	200	100	100	100	100	100	100
Total phosphorus	50	50	50	50	50	50	50	25	25	25	25	25	25
Surfactants (total)	200	150	50	40	30	25	25	25	25	25	25	25	25

Table 5.5 Standards for effluents discharged into Group D inland waters (for general amenity and secondary contact recreation)

Flow rate (m^3/day) / **Determinand**	**≦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)	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temperature (degree Celsius)	30	30	30	30	30	30	30	30
Colour (lovibond units) (25mm cell length)	1	1	1	1	1	1	1	1
Suspended solids	30	30	30	30	30	30	30	30
BOD	20	20	20	20	20	20	20	20
COD	80	80	80	80	80	80	80	80
Oil & Grease	10	10	10	10	10	10	10	10
Iron	10	8	7	5	4	2.7	2	1.3
Boron	5	4	3.5	2.5	2	1.5	1	0.7
Barium	5	4	3.5	2.5	2	1.5	1	0.7
Mercury	0.1	0.05	0	0	0	0	0	0
Cadmium	0.1	0.05	0	0	0	0	0	0
Other toxic metals individually	1	1	0.8	0.8	0.5	0.5	0.2	0.2
Total Toxic metals	2	2	1.6	1.6	1	1	0.5	0.4
Cyanide	0.4	0.4	0.3	0.3	0.2	0.1	0.1	0.05

Flow rate (m^3/day) **Determinand**	**≦200**	**＞200 and ≦400**	**＞400 and ≦600**	**＞600 and ≦800**	**＞800 and ≦1000**	**＞1000 and ≦1500**	**＞1500 and ≦2000**	**＞2000 and ≦3000**
Phenols	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1
Sulphide	1	1	1	1	1	1	1	1
Sulphate	800	600	600	600	600	400	400	400
Chloride	1000	800	800	800	600	600	400	400
Fluoride	10	8	8	8	5	5	3	3
Total phosphorus	10	10	10	8	8	8	5	5
Ammonia nitrogen	20	20	20	20	20	20	20	10
Nitrate + nitrite nitrogen	50	50	50	30	30	30	30	20
Surfactants (total)	15	15	15	15	15	15	15	15
E. coli (count/100ml)	1000	1000	1000	1000	1000	1000	1000	1000

5.1.5 ProPECC PN 1/94 "Construction Site Drainage"

5.1.5.1 The Practice Note for Professional Persons on Construction Site Drainage (ProPECC Note PN1/94) provides guidelines for the handling and disposal of construction discharges. This note is applicable for control of site runoff and wastewater generated during the construction phase of the Project.

5.1.5.2 The types of discharges from construction sites outlined in the ProPECC Note PN1/94 that are relevant would include:

- Surface runoff;
- Wheel washing water;
- Water for testing and sterilization of water pipes;
- Wastewater from building construction and site facilities; and,
- Acid cleaning, etching and pickling wastewater.

5.2 Description of the Environment

5.2.1.1 According to Clause 4(i) in Appendix D of the Study Brief, the assessment shall collect and review background information on affected existing and planned water systems, their respective catchments and sensitive receivers which might be affected by the Project. This section describes the existing and planned water systems which might be affected by the Project.

5.2.1.2 Siu Ho Wan Depot (SHD), with a site area of about 30ha reclaimed over 20 years ago, is located in Northshore Lantau at approximately 5km east of Tung Chung New Town and Hong Kong International Airport (HKIA). It is bounded by an existing seawall maintenance access road to its north and the Lautau Airport Railway (LAR) and the North Lantau Highway (NLH) to its south (**Figure 1.1**). Located on a reclaimed land, there is neither natural nor man-made watercourse within the site area of SHD.

5.2.1.3 SHD is approximately 260m from the mouth of Tai Ho Bay, which is the mouth of Tai Ho Stream. The bay is currently connected to the open sea via an opening of approximately 20m wide underneath a short section of deck of NLH.

5.2.1.4 There are other water systems which are located further away from the Project. They include Tai Ho Stream Site of Scientific Interest (SSSI) and coral communities in the Brothers Islands. Other receivers including Ma Wan fish culture zone, seawater intake point at Sunny Bay and gazetted beaches in Tuen Mun are located much further away.

5.2.2 Marine Water

5.2.2.1 SHD is situated within the North Western WCZ and is located along the Northshore Lantau facing the North Western waters which are situated at the mouth of the Pearl River Estuary. The location of the North Western WCZ makes it strongly influenced by the fresh water flows from the Pearl River. Ebb tide currents flow to the southeast whilst the flood tide currents flow to the northwest.

5.2.2.2 A summary of the marine water quality collected at the monitoring stations, namely NM1, NM2 and NM3 in the central area of the North Western WCZ which are located in the vicinity of the Project is given in **Table 5.6**. The locations of these monitoring stations are indicated in **Figure 5.1**. According to the EPD's publication "Marine Water Quality in Hong Kong 2015", full compliance of the depth-averaged DO levels was recorded at these stations, except NM1. Non-compliance of TIN levels at NM2 and NM3 might be associated with the higher background level of the discharges from Pearl River, and other local discharges. The bottom DO and UIA levels recorded in these monitoring stations fully complied with the relevant WQOs.

Table 5.6 Summary of EPD's Routine Marine Water Quality Data for North Western Water Quality Control Zone in 2015

Parameters		North Western WCZ [1][2]		
		NM1	NM2	NM3
Temperature (°C)		23.7 (16.9 – 27.4)	24.0 (16.9 – 27.8)	24.2 (17.0 – 27.7)
Salinity		29.9 (25.2 – 31.7)	28.1 (18.9 – 31.3)	27.9 (21.0 – 31.3)
Dissolved Oxygen (mg/L)	Depth Average	5.4 (3.7 – 7.2)	5.7 (4.3 – 7.4)	5.6 (4.3 – 7.3)
	Bottom	5.2 (2.5 – 7.3)	5.4 (3.2 – 7.3)	5.3 (3.0 – 7.4)
Dissolved Oxygen (% Saturation)	Depth Average	75 (53 – 90)	79 (62 – 92)	78 (62 – 91)
	Bottom	72 (36 – 92)	75 (46 – 91)	74 (44 – 91)
pH		7.8 (7.7 – 8.0)	7.8 (7.6 – 8.0)	7.8 (7.6 – 8.0)
Secchi Disc Depth (m)		2.5 (1.6 – 3.5)	2.4 (1.3 – 3.8)	2.2 (1.5 – 3.0)
Turbidity (NTU)		6.0 (3.3 – 10.5)	5.5 (2.9 – 11.4)	7.5 (3.2 – 13.9)
SS (mg/L)		8.0 (1.3 – 22.0)	6.6 (2.7 – 20.3)	10.8 (4.2 – 30.3)
5-day Biochemical Oxygen Demand (mg/L)		0.6 (<0.1 – 2.6)	0.8 (<0.1 – 2.8)	0.8 (<0.1 – 2.8)

Parameters	North Western WCZ [1][2]		
	NM1	NM2	NM3
Ammonia Nitrogen (mg/L)	0.107 (0.016 – 0.177)	0.106 (0.014 – 0.180)	0.110 (0.013 – 0.203)
Unionised Ammonia (mg/L)	0.003 (<0.001 – 0.006)	0.003 (<0.001 – 0.009)	0.003 (<0.001 – 0.008)
Nitrite Nitrogen (mg/L)	0.052 (0.016 – 0.130)	0.066 (0.017 – 0.131)	0.070 (0.018 – 0.153)
Nitrate Nitrogen (mg/L)	0.286 (0.127 – 0.723)	0.421 (0.133 – 1.230)	0.429 (0.137 – 0.963)
Total Inorganic Nitrogen (mg/L)	0.44 (0.27 – 0.84)	0.59 (0.29 – 1.36)	0.61 (0.31 – 1.09)
Total Kjeldahl Nitrogen (mg/L)	0.37 (0.18 - 0.59)	0.37 (0.15 – 0.69)	0.38 (0.19 – 0.80)
Total Nitrogen (mg/L)	0.71 (0.56 – 1.06)	0.86 (0.52 – 1.61)	0.88 (0.55 – 1.28)
Orthophosphate Phosphorus (mg/L)	0.022 (0.008 – 0.031)	0.024 (0.013 – 0.039)	0.025 (0.011 – 0.040)
Total Phosphorus (mg/L)	0.05 (0.03 – 0.07)	0.05 (0.03 – 0.08)	0.06 (0.04 – 0.09)
Silica (as SiO_2) (mg/L)	1.58 (0.24 – 3.83)	2.18 (0.27 – 6.87)	2.17 (0.29 – 5.30)
Chlorophyll-a (µg/L)	1.6 (0.4 – 4.6)	1.8 (0.4 – 5.8)	1.7 (0.7 – 4.1)
E.coli (count/100mL)	97 (7 – 510)	31 (2 – 220)	59 (10 – 220)
Faecal Coliforms (count/100mL)	200 (48 – 650)	70 (4-340)	130 (23-580)

Notes:

[1] Data presented are depth averaged and are the annual arithmetic mean except for *E. coli* and faecal coliforms which are annual geometric means.

[2] Data in brackets indicate ranges.

[3] Extracted from EPD Marine Water Quality in Hong Kong 2015

5.2.3 Watercourses in the vicinity

5.2.3.1 The watercourses to the southeast of the Project site are identified as WSR3 in **Figure 5.2**. These watercourses and particularly their upstream sections are mostly located in undeveloped area. The water flows, if any, would be mainly rainwater with low pollution levels. The Railway EIA has conducted a survey for a sample of these watercourses. The summary of the survey results could be found in the Railway EIA.

5.3 Assessment Area and Water Sensitive Receivers

5.3.1 Assessment Area

5.3.1.1 The assessment area for the water quality impact assessment is stated in Clause 3.4.6.2 of EIA Study Brief (ESB-294/2016). It shall include the North Western Water Control Zone (WCZ) and the water sensitive receivers in the vicinity of the Project. The assessment area can be extended to include other areas such as stream courses, existing and new drainage systems and other water system(s) in the vicinity, if they are found also being affected by the Project and have a bearing on the environmental acceptability of the Project.

5.3.1.2 As discussed in **Section 2**, all the works of this Project would be land-based and there would be no marine works. The sewage generated from SHD development will be conveyed to Siu Ho Wan Sewage Treatment Works (SHWSTW). Hence, a 500m assessment area is considered adequate for the water quality assessment for this Project.

5.3.2 Water Sensitive Receivers

5.3.2.1 The Water Sensitive Receivers (WSRs) are identified and indicated in **Figure 5.2**. They include Tai Ho Bay, the Brothers Marine Park, watercourses in the vicinity and channelised watercourses near the Siu Ho Wan Sewage Treatment Works and the Tai Ho Offtake and Pigging Station, as summarised below in **Table 5.7**.

Table 5.7 WSRs within 500m assessment area

WSR ID	WSD Description	Approximate distance from project boundary
WSR 1	Tai Ho Bay	270m
WSR 2	The Brothers Marine Park	200m
WSR 3	Watercourses in the vicinity [1]	90m
WSR 4	Channelised watercourse / ditch near the Siu Ho Wan Sewage Treatment Works (SHWSTW)	140m from the Subject Site / <10m from the proposed utilities outside the site boundary
WSR 5	Channelised watercourse / ditch near the Tai Ho Offtake and Pigging Station	110m
WSR 6	Channelised watercourse / ditch near the Siu Ho Wan Water Treatment Works (SHWWTW)	520m

Note: [1] The watercourses run along the terrain.

5.4 Construction Phase Assessment

5.4.1 Identification of Environmental Impacts

5.4.1.1 The potential environmental impacts stem from point discharges and non-point sources to surface runoff, sewage from workforce and

future users. Identification of sources of potential water quality impact include identifying point discharges and non-point sources.

5.4.1.2 As the Project would be land-based and neither dredging nor relevant marine works would be required, the major pollution sources in construction phase are construction site runoff and sewage from the workforce.

5.4.1.3 The construction works of the Project would include the following:

- Phases 1-4: podium deck, superstructure;
- The ultimate sewage pumping station with design capacity (Average Dry Weather Flow [ADWF]) of 12,100 m^3 / day;
- Utilities outside development: pipe laying; and,
- Eastern and western access roads: site formation, foundation and superstructure.

5.4.1.4 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 are listed in **Section 5.4.3** to control runoff.

5.4.1.5 According to the latest design, all the bored piling works for foundation works would be conducted by the Railway EIA, and hence bored piling work is not required for the topside development. Furthermore, no diversion, reconstruction and re-alignment of streams and water courses, and existing box culvert will be required for the Project.

5.4.1.6 Sewage arising from the on-site construction workforce is characterized by high levels of biochemical oxygen demand (BOD), ammonia, E. coli and some oil / grease. If there is no proper management, it is likely to cause water pollution.

5.4.1.7 It is identified that some of the construction works areas might have land contamination issues which are linked to potential groundwater contamination. However, because the land contamination issues would be addressed during depot replanning (addressed in another EIA study of Siu Ho Wan Station and Siu Ho Wan Depot Replanning Works) before the launch of topside development, there would be no anticipated groundwater contamination issue.

5.4.2 Prediction and Evaluation of Environmental Impacts

General Site Operation

5.4.2.1 Construction site runoff would come from all over the works sites during the Project. The surface runoff might be polluted by:

- Wheel washing water;
- Water for testing and sterilization of water pipes commonly performed using chlorinated water;
- Wastewater from building construction, site facilities and road works;
- Acid cleaning, etching and pickling wastewater; and,
- Accidental spillage of chemicals.

5.4.2.2 Sterilizing water and acidic water will be pre-treated as necessary to meet the standards of TM-DSS. Handling of these wastewaters is further described in **Sections 5.4.3.15** and **5.4.3.16**. With the measures taken place, their potential impact to fish and other aquatic organism can be avoided.

5.4.2.3 For the construction site runoff, the waste water and surface water runoff would be characterized with higher content of suspended solids.

5.4.2.4 With proper implementation of mitigation measures (see **Section 5.4.3**), it is anticipated that no adverse water quality impact would be resulted.

Sewage from Workforce

5.4.2.5 According to Table T-2 of Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning, the unit flow is 0.23 m^3/day/employee. The number of work force (clerical staff and workers) to be employed for the Project is around maximum 600 at the peak of construction period for Phase 1, Phase 2, Phase 3 and Phase 4 topside development while a maximum of 50 at the peak of construction for sewage pumping stations and utilities outside site boundary. It is estimated that the volume of sewage from workforce would be around 150 m^3/day. Because temporary sanitary facilities, e.g. portable chemical toilets, and sewage holding tank will be provided, no adverse water quality impact is anticipated.

Environmental Impacts on Watercourses in the Vicinity and the channelized watercourses near the Tai Ho Offtake and Pigging Station and the SHWWTW

5.4.2.6 There is no watercourse within the site boundary. However, there are watercourses and channelised watercourses in the vicinity at the southeast of the proposed development (WSR3, WSR5 and WSR6 in **Figure 5.2**). Except the proposed utilities works, these watercourses and the channelised watercourse are separated from the SHD by NLH

which is more than 50m wide. They are also upstream of the SHD. Because of these factors, it is anticipated that there would be no significant water quality impacts on them.

Environmental Impacts on the channelised watercourse near SHWSTW

5.4.2.7 Given the proximity (<10m) of the semi-natural stream course (WSR4) to the proposed utilities outside the site boundary, mitigation measures identified in **Section 5.4.3** need to be duly implemented to avoid the potential impacts from general site operation which are discussed in **Sections 5.4.2.1 – 5.4.2.3**. As discussed in **Section 5.4.2.4**, the proper implementation of mitigation measures would result in no adverse water quality impact to be anticipated.

5.4.3 Mitigation Measures

General Site Operation

5.4.3.1 To reduce the potential water quality impact due to construction site runoff, the following good site practices in accordance to Practice Note for Professional Persons on Construction Site Drainage, Environmental Protection Department, 1994 (ProPECC PN 1/94) should be implemented to avoid potential adverse water quality impacts.

5.4.3.2 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 and erosion and sedimentation control facilities implemented. 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. The design of the temporary on-site drainage system will be undertaken by the contractor prior to the commencement of construction.

5.4.3.3 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.

5.4.3.4 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.

5.4.3.5 Construction works should be programmed to minimize 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.

5.4.3.6 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.

5.4.3.7 Measures should be taken to minimise the ingress of site drainage into excavations. 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.

5.4.3.8 All construction materials at temporary storage area 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.

5.4.3.9 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.

5.4.3.10 Precautions 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 summarized in Appendix A2 of ProPECC PN 1/94. Particular attention should be paid to the control of silty surface runoff during storm events.

5.4.3.11 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.

5.4.3.12 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.

5.4.3.13 Construction solid waste, debris and rubbish on site should be collected, handled and disposed of properly to avoid water quality impacts.

5.4.3.14 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

5.4.3.15 New fresh water mains must be cleaned and sterilized before putting into operation. In the case water mains are sterilized by chlorination, the sterilizing water will be pre-treated as necessary to meet the relevant discharge requirements stipulated in TM-DSS before discharging to foul sewer. The amount of sterilizing water is anticipated to be insignificant, it should be reused wherever practicable and handling of it will be in accordance to ProPECC PN 1/94.

5.4.3.16 Acidic wastewater generated from acid cleaning, etching, pickling and similar activities should be neutralized to within the pH range of 6 to 10 before discharging into foul sewers in accordance to ProPECC PN 1/94.

Sewage from workforce

5.4.3.17 To mitigate the water quality impacts of sewage arising from the on-site construction workers, temporary sanitary facilities, e.g. portable chemical toilets, can be provided to collect the sewage. With proper temporary sanitary facilities, no adverse water quality impact is anticipated.

5.4.3.18 In addition, notices should be posted at conspicuous locations to remind the workers not to discharge any sewage or wastewater into the surrounding environment during the construction phase of the Project.

5.4.4 Cumulative Impacts from Concurrent Project

5.4.4.1 Concurrent projects in the vicinity are identified in **Table 1.1** of **Section 1**. With the implementation of the mitigation measures, it is anticipated that the water quality impacts generated would be localized and there would be no adverse cumulative water quality impacts.

5.4.5 Residual Environmental Impacts

5.4.5.1 With implementation of the aforementioned mitigation measures, no adverse residual environmental impacts are anticipated.

5.5 Operational Phase Assessment

5.5.1 Identification of Environmental Impacts

5.5.1.1 The key pollution sources / impacts during the operational phase include:

- Drainage discharge and surface runoff;
- Sewerage / sewage discharge;
- Emergency discharge, if any, from the ultimate sewage pumping station;
- Road runoff from paved road.

5.5.1.2 With increased paved area compared to the existing environment (**Appendix 5.1**), it is anticipated that there would be increased surface runoff. The assessment has included the scenario upon ultimate development and hence has represented the worst case scenario for drainage assessment.

5.5.1.3 Drainage discharge and surface runoff is estimated to have the following loadings (as per Update on Cumulative Water Quality and Hydrological Effect of Coastal Developments and Upgrading of Assessment Tool – Pollution Loading Inventory Report): 5-day Biological Oxygen Demand (BOD_5) for 22.5mg/L; total nitrogen (TN) for 2.0 mg/L and total phosphate (TP) for 0.2 mg/L.

5.5.1.4 A new sewerage system will be provided to serve the proposed development. It is currently proposed that the sewage generated from the proposed development to be collected from the sewerage system (including local pump sumps / sewage pumping stations and associated rising mains) and then discharged to the ultimate sewage pumping station via rising mains.

5.5.1.5 Road runoff from paved road contains substances, such as vehicle dust, tyre scraps and oils deposited, are accumulated on the road surfaces and parking area. During rainfall events, these substances are washed into nearby water bodies.

5.5.1.6 Cleaning of vehicles may be performed at the proposed public transport interchange. The wastewater generated from the cleaning activities may contain grease, leading to adverse water quality impacts.

5.5.1.7 Domestic wastewater contains components of organic matter, oil and grease, microorganisms / pathogens, etc. Without proper treatment, it would pollute water bodies. Any uncontrolled emergency discharge from sewage pumping stations would also pollute the receiving water bodies, leading to undesirable impacts on water quality.

5.5.2 Prediction and Evaluation of Environmental Impacts

Drainage Discharge and Surface Runoff

5.5.2.1 The change in pollution loading from drainage can be estimated with reference to the technical reports of Drainage Services Department's (DSD) Stormwater Drainage Manual and EPD's report on Update on Cumulative Water Quality and Hydrological Effect of Coastal Developments and Upgrading of Assessment Tool-Pollution Loading

Inventory Report (Pollution Loading Report). It is estimated that the paved area would increase by approximately 12.5 ha in the "with development" scenario (see **Appendix 5.1**). Given the size of the catchment of approximately 300 ha, the increase in paved area and associated surface runoff would be approximately 4%, resulting in no significant change in the whole catchment. With incorporation of the recommended mitigation measures, the water quality impact due to the non-point source would be minimized.

5.5.2.2 Same as the identified watercourses and ditches, the drainage within the Project site would eventually discharge to the marine water via the existing box culvert.

Road runoff from widened Eastern access road on Sham Shui Kok Drive and western access via Tai Ho Interchange

5.5.2.3 The Eastern access road would be widened slightly along Sham Shui Kok Drive while western access via Tai Ho Interchange would be constructed in form of viaduct section with about 50m long. The road runoff can be controlled by the best management practices such as properly designed silt traps with appropriate spacing, sufficient cleaning frequency for silt traps and road gullies, etc. With the best management practices, it is anticipated that the road runoff would be controlled to an acceptable level.

Sewerage / sewage

5.5.2.4 During the operational phase, the major pollution source would be the sewage generated from the Project. It is proposed that the sewage generated from the Project would be conveyed to Siu Ho Wan Sewage Treatment Works (SHWSTW). With proper treatment in SHWSTW, it is anticipated that the treated sewage would meet statutory requirements and thereby there would be no adverse water quality impacts. Mitigation measure is therefore not required.

Minimise chances of Emergency Discharge

5.5.2.5 To minimise the likelihood of emergency discharge, the Project would implant a series of measures (see **Section 5.5.3**). With all these appropriate mitigation measures adopted, emergency sewage discharge to the North Western WCZ is of low likelihood.

Hydrological Impact

5.5.2.6 As there is no reclamation or dredging works for the Project, it is anticipated that the Project would not induce significant hydrological change in the nearby water bodies.

5.5.3 Mitigation Measures

Drainage discharge and surface runoff and Road runoff from widened Eastern access road

5.5.3.1 To reduce the impacts of water pollution from drainage discharge, surface runoff and road runoff, drainage system should be installed with standard silt traps. In particular, the road runoff can be controlled by the best management practices such as properly designed silt traps with appropriate spacing, sufficient cleaning frequency for silt traps and road gullies, etc. With the best management practices, it is anticipated that the road runoff would be controlled to an acceptable level.

5.5.3.2 To control non-point source best storm water management practices are recommended for the Project to minimize the non-point source pollution. The best practices include adequate storm drainage system with suitable pollutant removal devices.

Provision of oil interceptors at the public transport interchange

5.5.3.3 To avoid adverse impacts of wastewater generated from cleaning activities at the public transport interchange, oil interceptors are proposed at the associated drainage system.

Enhancement and Additional Provisions for Sewage Pumping Stations

5.5.3.4 Due to the key concerns of the ecological sensitivity of The Brothers Marine Park in The Brothers (islands) within the vicinity to the site, the following provisions are proposed for the proposed DN450 rising mains to enhance the sewerage network reliability and minimize environmental impacts due to system failure or in case of emergency situations:

- Twin rising mains would be provided for the proposed sewerage network. It is proposed to use both mains as duty from an economical and operational point of view. Should one of the duty mains be suspended from operation for maintenance, the remaining one would still be able to deliver the peak flow from the proposed development to SHWSTW at a higher velocity (exceeding 3m/s) during that period.
- High density polyethylene (HDPE) or ductile iron pipe for proposed DN450 rising mains would be adopted. Further protection on proposed DN450 rising mains with concrete surround (whole length) will be provided to prevent the rising mains from bursting. With the above proposed measures, it is expected there will be no bursting discharge from rising mains. There will be no impact on water quality or ecology due to sewer bursting discharge.

5.5.3.5 Emergency discharge of sewage from the proposed development is minimised. The occurrence of any single emergency event has been

considered due to the following risks: pump failure; power failure; and stormwater infiltration causing excessive inflow to the sewage pumping stations.

5.5.3.6 To mitigate the risks of pump and/or power failure, the following measures are proposed for the proposed sewage pumping stations to minimise the possibility of emergency discharge:

a) 100% standby pumping capacity within each Sewage Pumping Station (SPS), with spare pump up to 50% pumping capacity stockpiled in each SPS for any emergency use. The standby pump will be automatically take off the failed duty pump;

b) dual-feed power supply for each SPS;

c) emergency storage tank providing up to 3-hours ADWF capacity at the ultimate SPS. This emergency storage will be provided adjacent to the wet well chamber. The inlet of the emergency storage will be at the same level as the invert level of incoming pipe of wet well chamber. It is noted that this emergency storage will be provided at the ultimate SPS located at ground level of the eastern end of the proposed development and will consider all sewage flow from the development;

d) Monitoring and Control System (MACS) providing real-time notification of alert signal in emergency situation;

e) Project Proponent's term contractor to provide 24-7 emergency repair service in case of emergency situation;

f) Qualified personnel appointed by the Project Proponent carrying out regular inspection, routine maintenance and repairing of the facilities and equipment.

5.5.3.7 For the proposed 3-hours ADWF emergency storage capacity (equivalent to 1 hour peak flow) at the ultimate SPS, it should be noted that, unlike other government pumping stations which are typically unmanned and hence require mobilizing off-site maintenance staff to travel to the site during emergency, the ultimate SPS will be manned within the Project boundary. Besides, the Project Proponent will appoint a maintenance contractor to provide 24 hours attendance for instant maintenance and emergency repair to ensure there will be no overflow that will affect the downstream water quality in the unlikely event of total pump failure.

5.5.3.8 To mitigate the risk of excessive inflow of stormwater to the sewage pumping stations, the design peak flow capacity of each SPS in the proposed development has considered a peaking factor which includes stormwater allowance.

5.5.3.9 Considering the possible emergency situations and respective risks, as well as the practicality of construction, the above mitigation measures are considered the most appropriate and practical measures to deal

with the emergency situations of the proposed SPSs within the proposed development atop Siu Ho Wan Depot development. With incorporation of the recommended preventive measures and no emergency discharge outlet at the sewage pumping station, no emergency sewage discharge during the operation of the SHD Topside Development is anticipated. Therefore, the potential water quality impact in the extremely remote event that emergency sewage discharge does occur would be minimised.

5.5.3.10 Operational and maintenance manual of sewage pumping stations would be prepared during detailed design stage.

5.5.4 Residual Environmental Impacts

5.5.4.1 No residual adverse water quality impact is anticipated in operational phase.

5.6 Water Quality Impact Caused by Elements to be Implemented by SHO and SHD Replanning Works

5.6.1.1 As discussed in **Section 1.3**, the latest implementation strategy has recommended the following items in EIA Study Brief ESB-296/2016 will be separately implemented by the SHO and SHD Replanning Works project.

- Railway depot replanning works within the existing site boundary;
- Podium deck and property enabling works for the topside development;
- A new SHO and associated track works, as well as local access roads and emergency vehicular access (EVA); and
- Provision of the sewerage network with sewage pumping stations to cater sewage generated by SHO and SHD Replanning Works.

5.6.1.2 According to Railway EIA findings and recommendations, all the practicable measures to avoid, minimise and mitigate the water quality impact during both construction and operational phases have been exhausted. Railway EIA report has also recommended a series of mitigation measures similar to those as described in **Section 5.4.3** and **Section 5.5.3** of this EIA report for implementation. Railway EIA has concluded that, with the implementation of those mitigation measures, adverse residual water quality impacts are not anticipated.

5.7 Conclusions

5.7.1 Construction Phase

5.7.1.1 Construction site runoff and sewage arising from the on-site construction workforce are the key identified environmental impacts. According to the current design, the construction works would be land-based and there would not be any marine works. Good site practices in accordance to Practice Note for Professional Persons on Construction Site Drainage, Environmental Protection Department, 1994 (ProPECC PN 1/94) would be implemented and proper temporary sanitary facilities (e.g. portable chemical toilet) would be provided to properly collect the on-site sewage generated from the construction workers. Various mitigation measures are proposed. With proper implementation of those mitigation measures, it is anticipated that there would be no residual adverse water quality impact.

5.7.2 Operational Phase

5.7.2.1 During the operational phase, drainage discharge, surface runoff, sewage from residential and commercial development are the key identified environmental impacts. The sewage from the proposed development would be conveyed to SHWSTW for treatment and there would be other mitigation measures such as silt traps. To minimise the chances of emergency discharge from sewage pumping stations, additional facilities such as standby pumps, twin rising mains and emergency storage tanks would be provided. With the mitigation measures implemented, residual adverse environmental impacts are not anticipated.