5 WATER QUALITY

5.1 INTRODUCTION

5.1.1 This Section presents an evaluation of the potential water quality impacts from the construction and operation of the Project, and the results were assessed with reference to the relevant environmental legislation, standards and criteria.

5.2 RELEVANT LEGISLATION AND GUIDELINES

5.2.1 Relevant legislations, standards and guidelines governing water quality in Hong Kong include the followings:

- *Cap. 358 Water Pollution Control Ordinance (WPCO)*;
- *Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*;
- Annexes 6 and 14 of the *Technical Memorandum on Environmental Impact Assessment Process* (EIAO-TM); and
- *Practice Note for Professional Persons on Construction Site Drainage* (ProPECC PN 1/94)
- *Hong Kong Planning Standards and Guidelines (HKPSG)*
- *ETWB Technical Circular (Works) No. 5/2005 Protection of Natural Streams/Rivers from Adverse Impacts Arising from Construction Works*

Water Pollution Control Ordinance

5.2.2 The Water Pollution Control Ordinance (WPCO) provides the major statutory framework for the protection and control of water quality in Hong Kong. According to the Ordinance and its subsidiary legislation, Hong Kong waters are divided into ten Water Control Zones (WCZs). Corresponding statements of Water Quality Objectives (WQOs) are stipulated for different water regimes (marine waters, inland waters, bathing beaches subzones, secondary contact recreation subzones and fish culture subzones) in each WCZ based on their beneficial uses. This Project is located in the North Western WCZ. WQOs in North Western WCZ relevant to this assessment are listed in **Table 5.1**.

Table 5.1 Summary of Water Quality Objectives for North Western WCZ

Parameters	Criteria	Sub-zone
Aesthetic Appearance	(a) Waste discharges shall cause no objectionable odours or discolouration of the water.	Whole zone
	(b) Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole zone
	(c) Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole zone
	(d) There should be no recognisable sewage derived debris.	Whole zone

Parameters	Criteria	Sub-zone
	(e) 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.	Whole zone
	(f) Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	Whole zone
Bacteria	(a) The level of Escherichia coli should not exceed 610 per 100 mL, calculated as the geometric mean of all samples collected in a calendar year.	Secondary Contact Recreation Subzones
	(b) The level of Escherichia coli should be less than 1 per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Tuen Mun (A) and Tuen Mun (B) Subzones and Water Gathering Ground Subzones
	(c) The level of Escherichia coli should not exceed 1 000 per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Tuen Mun (C) Subzone and other inland waters
	(d) The level of Escherichia coli should not exceed 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October inclusive. Samples should be taken at least 3 times in one calendar month at intervals of between 3 and 14 days.	Bathing Beach Subzones
Colour	(a) Waste discharges shall not cause the colour of water to exceed 30 Hazen units.	Tuen Mun (A) and Tuen Mun (B) Subzones and Water Gathering Ground Subzones
	(b) Waste discharges shall not cause the colour of water to exceed 50 Hazen units.	Tuen Mun (C) Subzone and other inland waters
Dissolved Oxygen	(a) Waste discharges 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.	Marine waters
	(b) Waste discharges shall not cause the level of dissolved oxygen to be less than 4 mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones, Water Gathering Ground Subzones and other inland waters

Parameters	Criteria	Sub-zone
pH	(a) The pH of the water 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.	Marine waters excepting Bathing Beach Subzones
	(b) Waste discharges shall not cause the pH of the water to exceed the range of 6.5-8.5 units.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
	(c) The pH of the water should be within the range of 6.0-9.0 units.	Other inland waters
	(d) The pH of the water should be within the range of 6.0-9.0 units for 95% of samples collected during the whole year. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 unit.	Bathing Beach Subzones
Temperature	Waste discharges shall not cause the natural daily temperature range to change by more than 2.0°C.	Whole zone
Salinity	Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole zone
Suspended Solids	(a) Waste discharges 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.	Marine waters
	(b) Waste discharges shall not cause the annual median of suspended solids to exceed 20 mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
	(c) Waste discharges shall not cause the annual median of suspended solids to exceed 25 mg per litre.	Other inland waters
Ammonia	The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean).	Whole zone
Nutrients	(a) Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
	(b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.3 mg per litre, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed).	Castle Peak Bay Subzone
	(c) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.5 mg per litre, expressed as annual water column average	Marine waters excepting Castle Peak Bay Subzone

Parameters	Criteria	Sub-zone
	(arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed).	
5-day Biochemical Oxygen Demand	(a) Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 3 mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
	(b) Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 5 mg per litre.	Other inland waters
Chemical Oxygen Demand	(a) Waste discharges shall not cause the chemical oxygen demand to exceed 15 mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
	(b) Waste discharges shall not cause the chemical oxygen demand to exceed 30 mg per litre.	Other inland waters
Toxins	(a) 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. (b) Waste discharges shall not cause a risk to any beneficial use of the aquatic environment.	Whole zone
Phenol	Phenols shall not be present in such quantities as to produce a specific odour, or in concentration greater than 0.05 mg per litre as C_6H_5OH.	Bathing Beach Subzones
Turbidity	Waste discharges shall not reduce light transmission substantially from the normal level.	Bathing Beach Subzones

Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters

5.2.3 All discharges from the construction and operation phases of the proposed Project are required to comply with the *Technical Memorandum Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS)* issued under Section 21 of the WPCO.

5.2.4 The *TM-DSS* defines acceptable discharge limits to different types of receiving waters. Under the *TM-DSS*, effluents discharged into the drainage and sewerage systems, inshore and coastal waters of the WCZs are subject to pollutant concentration standards for specified discharge volumes. These are defined by the Environmental Protection Department (EPD) and are specified in licence conditions for any new discharge within a WCZ.

Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM)

5.2.5 Annexes 6 and 14 of the EIAO-TM provide general guidelines and criteria to be used in assessing water quality impacts.

5.2.6 The EIAO-TM recognises that, in the application of the above water quality criteria, it may not be possible to achieve the WQO at the point of discharge as there are areas which are subject to greater impacts (which are termed by the EPD as the mixing zones), where the initial dilution of the discharge takes place. The definition of this area is determined on a case-by-case basis. In general, the criteria for acceptance of the mixing zones are that it must not impair the integrity of the water body as a whole and must not damage the ecosystem.

Practice Note for Professional Persons on Construction Site Drainage (ProPECC PN 1/94)

5.2.7 The Practice Note for Professional Persons on Construction Site Drainage (ProPECC PN 1/94) provides good practice guidelines for dealing with various types of discharge from a construction site. Practices outlined in ProPECC PN 1/94 should be followed as far as possible during construction to minimise the water quality impact due to construction site drainage.

Hong Kong Planning Standards and Guidelines (HKPSG)

5.2.8 The HKPSG stipulated additional guidance and consideration for works close to sensitive uses including bathing beaches and secondary contact recreation subzones. New discharge outlet should not be allowed within 100 m from the boundary of any gazetted beach.

ETWB Technical Circular (Works) No. 5/2005 Protection of Natural Streams/Rivers from Adverse Impacts Arising from Construction Works

5.2.9 This technical circular provides an overview on the best practice for planning and execution of construction works within or close to natural streams. Good practices, precautionary and control measures are provided in the circular and should be followed as much as practicable to ensure streams / rivers in the vicinity of work areas be protected from water quality impact from construction works.

5.3 DESCRIPTION OF THE ENVIRONMENT

Study Area

5.3.1 According to Clause 3.4.6.2 of the EIA Study Brief, the Assessment Area shall include areas within 500 m from the boundary of the Project and shall cover the North Western Water Control Zone (NWWCZ) under the *Water Pollution Control Ordinance* (Cap. 358).

Marine Water Quality

5.3.2 Baseline marine water quality of the Assessment Area has been determined through a review of EPD routine water quality monitoring data collected between 1986 and 2021. This dataset provides Hong Kong's most comprehensive long-term water quality monitoring data and allows an indication of temporal and spatial change in marine water quality in Hong Kong. Water quality monitoring data from EPD monitoring stations that are located within or close to the Assessment Area were used to provide the baseline water quality conditions of the Assessment Area. The monitoring results from 1986 to 2021 at the selected monitoring stations are summarised in **Table 5.2**. Locations of these stations are presented in **Figure 5.1**.

5.3.3 In 2021, the overall WQO compliance rate of the North Western WCZ was 89%. The recorded levels of dissolved oxygen and unionized ammonia fully met the corresponding WQOs while the recorded levels of total inorganic nitrogen (TIN) did not. The recorded levels of TIN were generally high and the annual averages at both NM2 and NM3 were slightly below the corresponding WQO criterion of 0.5 mg/L. The main reason for high concentration of TIN is the contribution from the Pearl River.

Table 5.2 Summary of EPD Marine Water Quality Monitoring Data near the Project Site (1986 – 2021)

Parameters	Pearl Island NM2	Pillar Point NM3
Temperature (°C)	23.7	23.5
	(12.4-31.7)	(12.3-31.5)
Salinity (psu)	28.0	28.6
	(7.0-33.8)	(16.0-33.9)
Dissolved Oxygen ($mg\ L^{-1}$)	6.1	5.9
	(3.2-9.9)	(3.2-14.6)
Dissolved Oxygen ($mg\ L^{-1}$) - Bottom	5.8	5.7
	(2.5-9.6)	(2.2-15.6)
Suspended Solids ($mg\ L^{-1}$)	8.0	9.8
	(1.0-51.5)	(1.5-90.3)
5-day Biochemical Oxygen Demand ($mg\ L^{-1}$)	0.8	0.8
	(0.1-4.9)	(0.1-2.8)
Unionised Ammonia ($mg\ L^{-1}$)	0.004	0.004
	(0.000-0.019)	(0.000-0.018)
Total Inorganic Nitrogen ($mg\ L^{-1}$)	0.48	0.47
	(0.06-2.06)	(0.03-1.48)
Orthophosphate Phosphorus ($mg\ L^{-1}$)	0.025	0.025
	(0.003-0.080)	(0.002-0.056)
Total Phosphorus ($mg\ L^{-1}$)	0.06	0.06
	(0.02-0.49)	(0.02-0.31)
Chlorophyll-*a* ($\mu g\ L^{-1}$)	3.2	2.9
	(0.3-33.9)	(0.3-25.0)
Escherichia coli (cfu/100ml)	185	303
	(1-5400)	(5-85333)

Notes:

a) Data presented are depth-averaged values calculated by taking the means of three depths, i.e. surface (S), mid-depth (M) and bottom (B), except as specified. Ranges are shown in brackets.

b) Data presented are annual arithmetic means except for *E. coli*, which are geometric means.

Water Quality in Bathing Beaches

5.3.4 The Castle Peak Beach, the Cafeteria Old Beach and the Kadoorie Beach are located within 500 m from the Project Site. According to *Beach Water Quality in Hong Kong 2022* (EPD, 2023), the water quality at all these three gazetted beaches was rated as “Fair” under Hong Kong’ Annual Beach Ranking System, which represents geometric mean *E. coli* of 25 – 180 counts per 100 mL calculated based on all data collected between March and October. In 2022, the recorded geometric mean *E. coli* based on all data collected between March and October was 162, 31 and 34 counts per 100 mL respectively at the Castle Peak Beach, the Kadoorie Beach and the Cafeteria Old Beach.

Table 5.3 Summary of Water Quality Data of Gazetted Beaches around Project Site, 2022

Parameters	Castle Peak Beach	KadoorieBeach	Cafeteria Old Beach
Dissolved Oxygen (mg/L)	6.6	6.1	6.0
	(4.2-9.3)	(4.2-8.6)	(3.6-8.4)
pH	8.26	8.22	8.24
	(7.95-8.76)	(7.98-8.72)	(8.03-8.67)
Turbidity (NTU)	7.03	5.39	6.43
	(0.86-18.60)	(0.98-17.20)	(1.71-25.20)
Temperature (°C)	28.7	28.4	28.2
	(24.9-32.2)	(24.9-32.1)	(23.9-32.0)
Salinity (psu)	20.1	21.1	21.7
	(4.4-32.7)	(4.4-32.7)	(5.1-32.5)
E.coli (count/100 mL)	162	31	34
	(7-1900)	(2-2600)	(31000)

Notes:

a) PSU: Practical Salinity Unit
b) NTU: Nephelometric Turbidity Unit
c) Data presented are arithmetic means; figures in brackets are ranges; except for *E.coli*, where data presented are geometric mean from March to October.

River Water Quality

5.3.5 The Tuen Mun River is a major river in the Southwestern New Territories and passes through Lam Tei, San Hing Tsuen and Fu Tei in its upstream section, and then the densely populated Tuen Mun town in its mid-stream before draining into the Tuen Mun Typhoon Shelter. Its lower reach is located close to the Project Area and is within the 500 m Assessment Area stipulated in the Study Brief. According to *River Water Quality in Hong 2021* (EPD, 2022), the river showed marked water quality improvement in the last three decades, with its WQO compliance rate rising significantly from 42% in 1991 to 85% in 2021 overall for the river. Monitoring stations TN3 and TN6 at the lower section of the river maintained "Good" WQI grading. The monitoring results from 1986 to 2021 at the nearest monitoring station TN6 are summarised in **Table 5.4**.

Table 5.4 Summary of EPD River Water Quality Monitoring Data from the Lower Reach of the Tuen Mun River (1986 – 2021)

Parameters	Tuen Mun River TN6	Tuen Mun River TN3
Dissolved Oxygen (mg/L)	4.6	4.4
	(0.2-15.4)	(0.2-13.3)
pH	7.5	7.7
	(6.2-8.9)	(6.4-9.2)
Suspended solids (mg/L)	9.6	23.0
	(<0.5-460.0)	(<0.5-750.0)
5-Day Biochemical Oxygen Demand (mg/L)	6.6	12.0
	(<0.1-93.3)	(0.4-330.0)
Chemical Oxygen Demand (mg/L)	92.2	79.7
	(1.0-2900.0)	(1.0-860.0)
	0.6	0.8

Parameters	Tuen Mun River TN6	Tuen Mun River TN3
Oil and Grease (mg/L)	(<0.5-15.0)	(<0.5-23.0)
E. coli (counts/100mL)	11880	23487
	(5-4200000)	(30-11000000)
Faecal Coliforms (counts/100mL)	54918	105870
	(100-4500000)	(140-14000000)
Ammonia-Nitrogen (mg/L)	0.72	1.04
	(0.04-8.80)	(0.05-24.00)
Nitrate-Nitrogen (mg/L)	0.349	0.394
	(<0.002-2.500)	(<0.002-3.700)
Total Kjeldahl Nitrogen (mg/L)	1.50	2.23
	(<0.01-15.00)	(0.26-37.20)
Orthophosphate Phosphorus (mg/L)	0.217	0.289
	(<0.002-2.800)	(0.002-3.500)
Total Phosphorus (mg/L)	0.46	0.62
	(0.04-9.10)	(0.04-9.60)
Sulphide (mg/L)	0.12	0.22
	(<0.01-3.50)	(<0.01-8.00)
Aluminium (µg/L)	126	315
	(0-1800)	(25-24000)
Cadmium (µg/L)	0.3	0.3
	(<0.1-14.0)	(<0.1-16.0)
Chromium (µg/L)	5	7
	(<1-110)	(<1-180)
Copper (µg/L)	8	19
	(<1-160)	(<1-3400)
Lead (µg/L)	4	6
	(<1-340)	(<1-330)
Zinc (µg/L)	20	25
	(<1-100)	(<1-1300)
Flow (m^3/s)	N/A	6
		(0-23)

Notes:

a) Values at or below laboratory reporting limits are presented as laboratory reporting limits.

b) Data presented are annual median except for faecal coliform and *E. coli*, which are geometric means.

Water Quality in Typhoon Shelters

5.3.6 The water quality of the Tuen Mun Typhoon Shelter is affected by both the marine water of the North Western WCZ and the Tuen Mun River. Elevated level of total inorganic nitrogen was recorded at the Tuen Mun Typhoon Shelter as a result of higher total inorganic nitrogen level from the Tuen Mun River. Other water quality parameters including dissolved oxygen and unionized ammonia levels were generally good and in compliance to the corresponding WQO criteria. The monitoring results from 1986 to 2021 at the Tuen Mun Typhoon Shelter are summarised in **Table 5.5**.

Table 5.5 Summary of EPD Tuen Mun Typhoon Shelter Water Quality Monitoring Data (1986 – 2021)

Parameters	Tuen Mun Typhoon Shelter NT1
Temperature (°C)	24.7
	(16.4-31.9)
Salinity (psu)	25.8
	(10.3-33.7)
Dissolved Oxygen (mg L^{-1})	5.8
	(2.5-11.4)
Dissolved Oxygen (mg L^{-1}) - Bottom	5.7
	(4.0-9.1)
Suspended Solids (mg L^{-1})	8.1
	(0.6-22.0)
5-day Biochemical Oxygen Demand (mg L^{-1})	1.0
	(0.2-6.2)
Unionised Ammonia (mg L^{-1})	0.004
	(0.001-0.020)
Total Inorganic Nitrogen (mg L^{-1})	0.61
	(0.13-1.31)
Orthophosphate Phosphorus (mg L^{-1})	0.022
	(0.003-0.056)
Total Phosphorus (mg L^{-1})	0.06
	(0.02-0.15)
Chlorophyll-*a* (µg L^{-1})	5.9
	(0.8-33.0)
Escherichia coli (cfu/100ml)	114
	(2-35000)

Notes:

a) Data presented are depth-averaged values calculated by taking the means of three depths, i.e. surface (S), mid-depth (M) and bottom (B), except as specified.

b) Data presented are annual arithmetic means except for *E. coli*, which are geometric means.

c) Shaded cells indicate non-compliance with the WQOs.

Water Quality Sensitive Receivers

5.3.7 A number of water quality sensitive receivers (WSRs) were identified within the 500 m Assessment Area according to the requirement stipulated in the Study Brief, namely:

- Major bodies of waters – marine water of the North Western WCZ (and the associated secondary contact recreation subzone), the Tuen Mun River and the Tuen Mun Typhoon Shelter;
- Other surface water features on land – streams running down the hillside of the Tai Lam Country Park and the Castle Peak, catchwater of the Tai Lam Chung Reservoir (and the associated water gathering ground) and stream runs underneath of the Tuen Mun Road near Dragon Inn and Tsing Ha Lane;
- Tai Lam Country Park;
- Gazetted beaches – Castle Peak Beach, Kadoorie Beach and Cafeteria Old Beach; and
- Seawater intake – Seawater intake of Sam Shing Estate.

5.3.8 These identified WSRs are shown in **Figure 5.1** and listed in **Table 5.6** below. Note that some minor and isolated bodies of water, such as pools and fountains for aesthetic purpose in the Tuen Mun Park and Siu Lung Court, which are not considered as WSRs under this Study.

Table 5.6 Identified Water Quality Sensitive Receivers

Water Sensitive Receivers	Shortest Distance from Project Site	Description
Marine water of the North Western WCZ	195 m	It is located south of all work areas and the entire Tuen Mun area. It is the ultimate body of receiving water in the vicinity.
Tuen Mun River	105 m	Flowing from Lam Tei at the north of Tuen Mun and drains into the Tuen Mun Typhoon Shelter. A notable section of it flows passes within 500 m east of the work area along Lung Mun Road and Lung Fu Road.
Tuen Mun Typhoon Shelter	195 m	Located southwest to the work area along the Tuen Mun Road and Hoi Wing Road and receive water from the Tuen Mun River.
Hillside streams running down from the Tai Lam Country Park	Immediate vicinity to the work area along the Tuen Mun Road and Hoi Wing Road	There are a number of small / ephemeral streams running down from the hill side of the Tam Lam Country Park. These rivers drain into urban drainage and eventually be diverted to the sea. The upper reach of these streams are in general higher than the ground level of the Project Site, except for a few that are channelized and pass under the work area. After passing underneath the work area, it is diverted into a drain at around the Dragon Inn / Dragon Inner Court.
Hillside streams running down from the Castle Peak	25 m	There are a number of small / ephemeral streams running down from the hill side of the Castle Peak. These rivers drain into urban drainage and eventually be diverted to the Tuen Mun River and then the sea. These streams are higher than the ground level of the Project Site.
Catchwater of the Tai Lam Chung Reservoir (and the associated water gathering ground)	60 m	The catchment of the Tai Lam Reservoir is located to the east of the two work areas along the Tuen Mun Road and at the periphery of the Tai Lam Country Park. The catchment flow to the southeast direction near the Project site and eventually discharge into the Tai Lam Chung Reservoir. It is at around 70 to 80 mPD and is well above the ground level of the Project Site.
Tai Lam Country Park	50 m	The Country Park is located to the east of the two work areas along the Tuen Mun Road. It is at around 70 to 80mPD and is well above the ground level of the Project Site.
Castle Peak Beach	285 m	It is located south of the work area along the Tuen Mun Road and Hoi Wing Road, east to the breakwater of the Tuen Mun Typhoon Shelter.

Water Sensitive Receivers	Shortest Distance from Project Site	Description
Kadoorie Beach	430 m	It is also located south of the work area along the Tuen Mun Road and Hoi Wing Road, east to the breakwater of the Tuen Mun Typhoon Shelter and southeast to the Castle Peak Beach..
Cafeteria Old Beach	435 m	It is also located south of the work area along the Tuen Mun Road and Hoi Wing Road, further southeast to the Kadoorie Beach..
Seawater intake of Sam Shing Estate	340 m	It is located south / southwest of the work area along the Tuen Mun Road and Hoi Wing Road, east to the breakwater of the Tuen Mun Typhoon Shelter and west to the Castle Peak Beach. It supplies seawater to the Sam Shing Estate.

5.4 APPROACH AND METHODOLOGY

5.4.1 According to Clause 3.4.6.2 of the EIA Study Brief, the Assessment Area shall include areas within 500 m from the boundary of the Project and shall cover the North Western Water Control Zone (NWWCZ) under the *Water Pollution Control Ordinance* (Cap. 358). WSRs within the Assessment Area were identified. Potential sources of water pollution were identified based on work nature and appropriate mitigation measures would be recommended accordingly to minimize the potential water quality impact. Residual impact would be evaluated. Environmental monitoring, if needed, would be recommended.

5.5 POTENTIAL SOURCES OF IMPACT

Construction Phase

5.5.1 Potential sources of water quality impact associated with construction activities for the Project include:

- Construction site runoff;
- General construction activities (including the effluents generated from dewatering associated with piling activities, grouting and concrete washing and those specified in the *ProPECC Practice Note 1/94*);
- Construction works close to inland water;
- Accidental spillage; and
- Sewage effluent from the construction workforce.

Operation Phase

5.5.2 Potential sources of water quality impact associated with operation of the Project include road runoff containing oil/grease and suspended solids. Project does not involve any work within existing river or stream courses and there would not be potential impact in river / stream flow from this Project.

5.6 IMPACT ASSESSMENT

Construction Phase

Construction Site Runoff

5.6.1 Road works involving clearance of existing structures and / vegetation would result in exposed surfaces, which are vulnerable towards erosion in rainstorm if unprotected. Other sources of pollution for construction site runoff may include:

- Erosion from stockpiles and earth working areas;
- Dust suppression sprays;
- Grout, bentonite slurries and concrete washings released;
- Fuel, lubricants or other chemical for construction vehicles and equipment.

5.6.2 Such runoff, as well as stormwater during a rainstorm, could carry the above pollutants from work areas into the surrounding bodies of water, resulting in elevated levels of turbidity, suspended solids, other chemicals / pollutants as well as a reduction in dissolved oxygen levels. Debris washed into drainage system could also obstruct pipes and channels.

5.6.3 However, it is anticipated that no adverse water quality impacts would arise if proper mitigation measures, described in **Section 5.7.2**, are in place to control site runoff.

General Construction Activities

5.6.4 Discharges from the site during land-based construction may contain suspended solids which could be a source of water pollution. Other construction works, such as concreting, dewatering for piling, grouting, general dust suppression, cleaning, polishing, etc. could generate wastewater, which may contain high level of suspended solids, as well as other contaminants within site boundary. With the implementation of good site practices described in **Section 5.7.2**, no unacceptable adverse water quality impacts would be anticipated.

Construction Works close to Inland Water

5.6.5 A number of small hillside streams flow down from both the Tai Lam Chung and Castle Peak hillsides and run close / pass the work areas. Construction works around these areas may cause water quality impact as a result of site runoff and uncontrolled discharge of wastewater from construction, resulting in increased turbidity and changed pH. Contaminants from construction works, including fuels, lubricants and other chemicals, could also be carried by runoff or construction wastewater and affect water quality of nearby inland water. Proper control measures specified under ProPECC PN 1/94 and ETWB TC(W) No. 5/2005 should be implemented to control potential impact to nearby inland water. Detailed measures are provided in **Sections 5.7.2** and **5.7.5**.

Accidental Spillage

5.6.6 Various chemicals would be used for the proposed road works and accordingly different chemical waste would be generated. These chemicals include fuel, spent lubricants, spent acid and alkaline solutions/solvent and other chemicals.

5.6.7 Accidental spillage of these chemicals or chemical wastes would contaminate surface or (for exposed surface) soil. The contaminates surface and soil could be swept up by runoff / stormwater and result in elevated level of pollutants in the receiving waters. Proper clean up kits should be available onsite for the corresponding types of chemicals used for various construction works. Clean up waste should be stored in marked container as chemical wastes for proper disposal.

5.6.8 Proper control and storage of these chemicals as well as the associated wastes should be implemented according to *Waste Disposal Ordinance* (Cap 354) as well as the associated regulations including the *Waste Disposal (Chemical Waste) (General) Regulation* to minimize the risk of spillage and contamination. All chemical wastes should be stored in secured and sheltered area(s) for collection and disposal by licensed contractor.

Sewage Effluent from the Construction Workforce

5.6.9 Construction workforce onsite will generate sewage effluent, which are characterized by high levels of BOD, ammonia and *E.coli* counts. Sufficient number of chemical toilets, properly served, cleaned and emptied regularly by licensed contractor, would be required for each work areas to ensure hygiene and avoid nuisance.

Operation Phase

5.6.10 Operation of the proposed road improvement works would result in slight increase to road runoff of similar nature of existing condition. Such runoff typically contains elevated levels of suspended solids, grits as well as trace amount of oil and grease from vehicles, which could affect the water quality of the receiving waters. Proper road drainage system fitted with appropriate pollutant removal devices (such as grit traps) will be required to ensure pollutants from road runoff be removed before entering receiving bodies of water. With the implementation of proposed mitigation measures and management practices (**Section 5.7.6**), no unacceptable water quality impact associated with road runoff is expected.

5.7 MITIGATION MEASURES

Construction Phase

5.7.1 All the runoff and wastewater generated from the works areas should be treated so that it satisfies all the standards listed in the TM-DSS. The beneficial uses of the treated effluent for other on-site activities such as dust suppression, wheel washing and general cleaning etc., can minimise water consumption and reduce the effluent discharge volume. A WPCO discharge license should be applied for the disposal of effluent from the construction site. If monitoring of the treated effluent quality from the sites is required during the construction phase of the Project, the monitoring should be carried out in accordance with the relevant WPCO licence which is under the ambit of regional office (RO) of EPD. All standards, criteria and requirements stipulated in the relevant license apply.

5.7.2 Suitable control measures stipulated in *ProPECC PN 1/94* should be implemented, including but not limited to:

- Surface run-off from construction sites should be discharged into storm drains via adequately designed sand/silt removal facilities such as sand traps, silt traps and sediment basins. Channels or earth bunds or sand bag barriers should be provided on site to properly direct stormwater to such silt removal facilities. Perimeter channels at site boundaries should be provided where necessary to intercept storm run-off from outside the site so that it will not wash across the site. Catchpits and perimeter channels should be constructed in advance of site formation works and earthworks.
- Silt removal facilities, channels and manholes should be maintained and the deposited silt and grit should be removed regularly, at the onset of and after each rainstorm to ensure that these facilities are functioning properly at all times.
- Minimum distance of 100m should be maintained between the discharge points of construction site run-off and the existing saltwater intakes and gazetted beaches. No effluent will be discharged into typhoon shelter.
- Construction works should be programmed to minimize soil excavation works in rainy seasons (April to September). If excavation in soil could not be avoided in these months

or at any time of year when rainstorms are likely, for the purpose of preventing soil erosion, temporarily exposed slope surfaces should be covered e.g. by tarpaulin. Intercepting channels should be provided (e.g. along the crest/edge of excavation) to prevent storm runoff from washing across exposed soil surfaces. Arrangements should always be in place to ensure that adequate surface protection measures can be safely carried out well before the arrival of a rainstorm.

- Earthworks final surfaces should be well compacted and the subsequent permanent work or surface protection should be carried out immediately after the final surfaces are formed to prevent erosion caused by rainstorms. Appropriate drainage like intercepting channels should be provided where necessary
- Measures should be taken to minimize the ingress of rainwater into trenches. If excavation of trenches in wet seasons is necessary, they should be dug and backfilled in short sections. Rainwater pumped out from trenches or foundation excavations should be discharged into storm drains via silt removal facilities.
- Open stockpiles of construction materials (e.g. aggregates, sand and fill material) on sites 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 from getting into the drainage system, and to prevent storm run-off from getting into foul sewers. Discharge of surface run-off into foul sewers must always be prevented in order not to unduly overload the foul sewerage system.
- Water used in ground boring and drilling for site investigation or rock/soil anchoring should as far as practicable be recirculated after sedimentation. When there is a need for final disposal, the wastewater should be discharged into storm drains via silt removal facilities.
- All vehicles and plant should be cleaned before they leave a construction site to ensure no earth, mud, debris and the like is deposited by them on roads. A wheel washing bay should be provided at every site exit if practicable and wash-water should have sand and silt settled out or removed before discharging into storm drains. The section of construction road between the wheel washing bay and the public road should be paved with backfall to reduce vehicle tracking of soil and to prevent site run-off from entering public road drains.
- Wastewater generated from building construction activities including concreting, cleaning of works and similar activities should not be discharged into the stormwater drainage system. If the wastewater is to be discharged into foul sewers, it should undergo the removal of settleable solids in a silt removal facility, and pH adjustment as necessary.
- 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. If there is no public foul sewer in the vicinity, the neutralized wastewater should be tankered off site for disposal into foul sewers or treated to a standard acceptable to storm drains and the receiving waters.

5.7.3 Sufficient number of chemical toilets should be required for each work area. These toilets should be regularly cleaned, maintained and emptied by licensed contractor. Notices should be posted at conspicuous locations to remind the workers not to discharge any sewage or wastewater into the surrounding environment. Regular environmental audit of the construction site will provide an effective control of any malpractices and can encourage continual improvement of environmental performance on site.

5.7.4 Under the *Waste Disposal Ordinance* (Cap 354), the contractor must register as a chemical waste producer if chemical wastes would be produced from the construction activities. The *Waste Disposal Ordinance* and its associated regulations including the *Waste Disposal (Chemical Waste) (General) Regulation*, should be observed for handling, storage and disposal

of chemical wastes. Detailed requirements for the handling, storage and disposal of chemical wastes are provided in the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* published under the *Waste Disposal Ordinance*, including the followings:

- Suitable containers should be used to hold the chemical wastes to avoid leakage or spillage during storage, handling and transport.
- Chemical waste containers should be suitably labelled, to notify and warn the personnel who are handling the wastes, to avoid accidents.
- Storage area should be selected at a safe location on site and adequate space should be allocated to the storage area.

5.7.5 To ensure construction works at work areas close to stream / surface channel would not result in adverse change in water quality in the overflow channel, the following control measures from ETWB TCW No. 5/2005 *Protection of Natural Streams/Rivers from Adverse Impacts arising from Construction Works* should be considered where applicable:

- The use of less or smaller construction plant may be specified to reduce disturbance to the riverbed where aquatic inhabitants are located.
- Temporary sewerage system should be designed and installed to collect wastewater and prevent it from entering rivers and streams.
- The proposed works site inside or in the proximity of natural rivers and streams should be temporarily isolated, such as by placing of sandbags or silt curtains with lead edge at bottom and properly supported props, to prevent adverse impacts on the stream water qualities. Other protective measures should also be taken to ensure that no pollution or siltation occurs to the water gathering grounds of the work site.
- Proper locations well away from rivers/streams for temporary storage of materials (e.g. equipment, filling materials, chemicals and fuel) and temporary stockpile of construction debris and spoil should be identified before commencement of the works. Stockpiling of construction materials should be properly covered.
- Construction debris and spoil should be covered up and/or properly disposed of as soon as possible to avoid being washed into nearby rivers/streams by rain. e. Construction effluent, site run-off and sewage should be properly collected and/or treated. Wastewater from a construction site should be managed with the following approach in descending order:
    - (i) minimisation of wastewater generation;
    - (ii) reuse and recycle;
    - (iii) treatment.

  Proper locations for discharge outlets of wastewater treatment facilities well away from the natural streams/rivers should be identified.
- Supervisory staff should be assigned to station on site to closely supervise and monitor the works.

Operation Phase

5.7.6 Drainage system should be fitted with appropriate design measures to control pollution of drainage water, namely,

- Standard screening designs such as gully grating should be provided to stop large objects from entering;
- Exposed surface shall be avoided to minimize soil erosion.
- Where appropriate, silt traps and oil interceptors should be provided to remove pollutants from runoff / stormwater.

5.7.7 These facilities should also be cleaned, maintained and inspected regularly and particularly before and after a rainstorm.

5.8 CUMULATIVE IMPACT

5.8.1 Known concurrent project in the vicinity are listed in **Table 2.8**. The potential cumulative water quality impact from the construction and operation of these concurrent projects are discussed below.

Construction Phase

Site Formation and Infrastructure Works for Public Housing Developments at Tuen Mun Central – Phase 1

5.8.2 Based on the latest available information, the site area of Phase 1 works of this project overlaps with the construction of our proposed works of the Project for a tentative period of 1 to 2 quarters. In view of the limited temporal overlapping, the potential cumulative impact due to the construction works of the Site Formation and Infrastructure Works and that of the Project is envisaged to be negligible.

Construction of Public Housing Development (PHD) at Yip Wong Road Phase 1 and Phase 2

5.8.3 Based on the planning brief and website of the Housing Department, the construction of PHD are not a designated project under EIAO. The construction works of PHD commenced in 2020 for completion by 2024 or 2025. Potential cumulative water quality impact from such project at vicinity, particularly in terms of site runoff, could be an issue if uncontrolled.

5.8.4 With the implementation of good site practices and standard measures, notable change from water quality from site runoff as well as other potential sources of water quality pollution are not expected from this Project. No unacceptable cumulative water quality impact is anticipated.

Cycle track between Tsuen Wan and Tuen Mun (Tuen Mun to So Kwun Wat Section)

5.8.5 Based on the latest available information, the tentative construction work for the entire cycle tracks will commence in 2023 for completion by 2026. As the road pavement works at the section near Castle Peak Road undertaken will be completed in 2024 while the construction of the Project will commence in mid-2024, potential cumulative impact due to the construction of the cycle tracks will be anticipated in this EIA study. To minimise potential cumulative water quality impact, the tentative construction programme and works at the interface area between two projects could be arranged efficiently, e.g. scheduling works to be carried out during specified period, through close liaison between HyD's contractors of the Construction of Cycle Tracks and the Project respectively to avoid construction works of respective works contracts to be carried out concurrently at the same interfacing areas. With such arrangement in place, cumulative construction environmental impacts could be minimised. Other good site practices and standard measures would also be implemented to control and minimise potential cumulative water quality impact, as such, no unacceptable cumulative water quality impact is anticipated.

Tuen Mun South Extension

5.8.6 According to the latest available information from the EIA of the Tuen Mun South Extension Project, this project involves land-based works as well as construction works in the Tuen Mun River Channel. While the Tuen Mun South Extension Project is located within 500 m from the Project, these two projects are at least 200 m apart from each other, with the implementation of control / mitigation measures stipulated under **Section 5.7** above, no unacceptable construction phase water quality impact would be expected from the Project, and thus no unacceptable cumulative water quality impact for construction phase.

Tuen Mun Bypass Project

5.8.7 According to the latest available information from the EIA of the Tuen Mun Bypass Project, this project involves construct and operate a dual two-lane carriageway connecting Tuen Mun-Chek Lap Kok Tunnel (TM-CLKT) in the south and Yuen Long Highway (YLH) (near Lam Tei Quarry) and Kong Sham Western Highway (KSWH). The majority of the Tuen Mun Bypass Project, including the entirety of section within 500 m from this Project, is underground tunnel, and thus requires minimal to nil surface level construction works. With the implementation of control / mitigation measures stipulated under **Section 5.7** above, no unacceptable construction phase water quality impact would be expected from the Project, and thus no unacceptable cumulative water quality impact for construction phase.

Reprovision of Tuen Mun Swimming Pool, Tuen Mun Golf Centre Practice Green, Pet Garden and Community Green Station

5.8.8 According to the latest available information, multiple improvement works would be conducted at different parts of Tuen Mun from 2023 to 2030 within 500 m from this Project. While the these improvement works are located within 500 m from the Project, given the physical separation, nature of construction works required and operation phase activities involved, no unacceptable construction phase water quality impact would be expected from the Project, and thus no unacceptable cumulative water quality impact for construction phase with the implementation of control / mitigation measures stipulated under **Section 5.7** above.

Sports Ground and Open Space in Area 16, Tuen Mun

5.8.9 According to the latest available information, this project involves the development of sports ground and open space at the coastal area of Tuen Mun Area 16. Given the project area for this development is at least 200 m apart from the Project, with the implementation of control / mitigation measures stipulated under **Section 5.7** above, no unacceptable construction phase water quality impact would be expected from the Project, and thus no unacceptable cumulative water quality impact for construction phase.

Operation Phase

5.8.10 Potential water quality impact from operation of the Project is expected to be minimal. No unacceptable cumulative water quality impact for operation phase is expected.

5.9 RESIDUAL IMPACT

5.9.1 With the implementation of the recommended mitigation measures, no residual water quality impact associated with the construction and operation of the proposed road improvement works would be expected.

5.10 ENVIRONMENTAL MONITORING AND AUDIT

Construction Phase

5.10.1 With the implementation of the recommended mitigation measures, no residual water quality impact is expected during Project construction. Environmental monitoring is not considered necessary for water quality. Regular site inspection should be conducted during construction to ensure the proper implementation of the recommended mitigation measures.

Operation Phase

5.10.2 As there is no unacceptable water quality impact expected during the operation of the Project, water quality monitoring for operation phase is not considered necessary.

5.11 CONCLUSION

5.11.1 The environment and baseline condition at and around the Project Site has been reviewed based on historic record of water quality data from nearby EPD marine and river water quality monitoring stations. Applicable environmental legislations and guidelines related to construction and operation phase water quality impacts were identified. Potential sources of water quality impact from construction and operation phase of the proposed road improvement works have been identified and evaluated. These sources of impacts include, construction site runoff; general construction activities, accidental spillage and sewage effluent from the construction workforce for construction phase, as well as increase road runoff for operation phase. Suitable mitigation / control measures were recommended based on standard guidelines including *ProPECC PN 1/94*, *ETWB TCW No. 5/2005* and *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes*. No residual water quality impact is expected from the construction and operation of the Project with the implementation of proposed migration measures.