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5. WATER QUALITY IMPACT ASSESSMENT

5.1 Introduction

5.1.1 This *Section* presents the water quality impact assessment for the construction and operational phases of the Project. Potential impacts have been identified and their significance on the Water Sensitive Receivers (WSRs) evaluated. Mitigation measures are recommended, where necessary, to reduce the potential water quality impacts in order to control the residual impacts to acceptable levels.

5.2 Environmental Legislation, Policies, Standards and Criteria

5.2.1 The following legislation and relevant guidance or non-statutory guidelines are applicable to the evaluation of water quality impacts associated with the construction and operation of the Project:

- *Water Pollution Control Ordinance (WPCO);*
- *Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM- ICW);*
- *Environmental Impact Assessment Ordinance (Cap. 499. S.16) and the Technical Memorandum on EIA Process (EIAO-TM), Annexes 6 and 14;*
- *Practice Note for Professional Persons, Construction Site Drainage (ProPECC PN1/94)*;
- *ETWB Technical Circular (Works) No. 5/2005 Protection of Natural Streams/Rivers from Adverse Impacts Arising from Construction Works*
- *Drainage Services Department Practice Note No. 3/2021: Guidelines on Design for Revitalisation of River Channel; and*
- *Hong Kong Planning Standards and Guidelines (HKPSG)*

Water Pollution Control Ordinance (WPCO)

5.2.2 The *Water Pollution Control Ordinance (WPCO) (Cap. 358)* is the primary legislation for the control of water pollution and water quality in Hong Kong. Under the WPCO, Hong Kong waters are divided into 10 Water Control Zones (WCZs). Each WCZ has a designated set of statutory Water Quality Objectives (WQOs). The proposed Project is located within the Deep Bay WCZ. The WQOs designated for this zone are thus relevant for assessing the water quality impacts from the construction and operation of the Project (**Table 5.1**).

Table 5.1
Water Quality Objectives for Deep Bay Water Control Zones

Parameters	Objectives	Sub-Zone
Offensive Odour, Tints	Not to be present	Whole zone
Visible foam, oil scum, litter	Not to be present	Whole zone
Dissolved Oxygen (DO) within 2 m of the seabed	Not less than 2.0mg/L for 90% of samples	Outer Marine Subzone excepting Mariculture Subzone
DO within 1 m below surface	Not less than 4.0mg/L for 90% of samples	Inner Marine Subzone excepting Mariculture Subzone
	Not less than 5.0mg/L for 90% of samples	Mariculture Subzone
Depth-averaged DO	Not less than 4.0mg/L for 90% of samples	Outer Marine Subzone excepting Mariculture Subzone
	Not less than 4.0mg/L	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone, Water Gathering Ground Subzones and other inland waters of the Zone
5-Day Biochemical Oxygen Demand (BOD_5)	Not to exceed 3mg/L	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	Not to exceed 5mg/L	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
Chemical Oxygen Demand (COD)	Not to exceed 15mg/L	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground
	Not to exceed 30mg/L	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
pH	To be in the range of 6.5 – 8.5, change due to waste discharges not to exceed 0.2	Marine waters excepting Yung Long Bathing Beach Subzone
	To be in the range of 6.5 – 8.5	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	To be in the range of 6.0 –9.0	Other inland waters
	To be in the range of 6.0 – 9.0 for 95% samples, change due to waste discharges not to exceed 0.5	Yung Long Bathing Beach Subzone
Salinity	Change due to waste discharges not to exceed 10% of ambient	Whole zone
Temperature	Change due to waste discharges not to exceed 2°C	Whole zone
Suspended solids (SS)	Not to raise the ambient level by 30% caused by waste discharges and shall not affect aquatic communities	Marine waters
	Not to cause the annual median to exceed 20mg/L	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Ganges Subzone, Indus Subzone, Water Gathering Ground Subzones and other inland waters
Unionized Ammonia (UIA)	Annual mean not to exceed 0.021mg/L as unionized form	Whole zone
Nutrients	Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Inner and Outer Marine Subzones
Total Inorganic Nitrogen (TIN)	Annual mean depth-averaged inorganic nitrogen not to exceed 0.7mg/L	Inner Marine Subzone
	Annual mean depth-averaged inorganic nitrogen not to exceed 0.5mg/L	Outer Marine Subzone
Bacteria	Not exceed 610per 100ml, calculated as the geometric mean of all samples collected in one calendar year	Secondary Contact Recreation Subzones and Mariculture Subzones
	Should be zero per 100 ml, calculated as the running median of the most recent 5 consecutive samples taken between 7 and 21 days.	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	Not exceed 180per 100ml, calculated as the geometric mean of the collected from March to October inclusive in one calendar year. Samples should be taken at least 3 times in a calendar month at intervals of between 3 and 14days.	Yung Long Bathing Beach Subzone
	Not exceed 1000 per 100ml, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21days	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
Colour	Not to exceed 30 Hazen units	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones

Parameters	Objectives	Sub-Zone
	Not to exceed 50 Hazen units	Yuen Long & KamTin (Lower) Subzone and other inland waters
Turbidity	Shall not reduce light transmission substantially from the normal level	Yung Long Bathing Beach Subzone
Phenol	Quantities shall not sufficient to produce a specific odour or more than 0.05mg/L as C_6H_5OH	Yung Long Bathing Beach Subzone
Toxins	Should not cause a risk to any beneficial uses of the aquatic environment	Whole Zone
	Should not attain such levels as to produce toxic carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms.	Whole Zone

Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM- ICW)

5.2.3 All discharges during both the construction and operation phases of the proposed development are required to comply with the *Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-ICW)* issued under *Section 21* of the *WPCO*. The *TM-ICW* defines acceptable discharge limits to different types of receiving waters. Under the *TM-ICW*, effluents discharged into the drainage and sewerage systems, inland 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

Environmental Impact Assessment Ordinance (Cap. 499. S.16)* and the *Technical Memorandum on EIA Process (EIAO-TM), Annexes 6 and 14

5.2.4 The EIAO-TM was issued by EPD under Section 16 of the EIAO. *Annexes 6* and *14* of the *EIAO-TM* provide general criteria and guidelines to be used in assessing water quality issues.

Practice Note for Professional Persons, Construction Site Drainage

5.2.5 *The Practice Note for Professional Persons, Construction Site Drainage* (*ProPECC PN 1/94*) issued by EPD in 1994, also provide useful non-statutory guidelines on the management of construction site drainage and prevention of water pollution associated with the construction activities.

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

5.2.6 *ETWB Technical Circular (Works) No. 5/2005* provides an administrative framework to better protect all natural streams/rivers from the impacts of construction works. The procedures promulgated under this Circular aim to clarify and strengthen existing measures for protection of natural streams/rivers from government projects and private developments. The guidelines and precautionary

mitigation measures given in the *ETWB TC (Works) No. 5/2005* should be followed as far as possible to protect the inland watercourse at or near the Project area during the construction phase

Drainage Services Department Practice Note No. 3/2021: Guidelines on Design for Revitalisation of River Channel

5.2.7 The Practice Note presents the essential environmental and ecological considerations that should be taken into account in the design of river channels.

Hong Kong Planning Standards and Guidelines (HKPSG)

5.2.8 The Chapter 9 (Environment) of HKPSG, provides additional guidelines against water pollution for sensitive uses such as aquaculture and fisheries zones, bathing waters and other contact recreational waters.

5.3 Baseline Water Quality Conditions

Hydrology and Hydrodynamics

5.3.1 The existing watercourse TKL04 and TKL05 are located at Ping Che/Ta Kwu Ling areas and within the Ganges drainage basin which is part of the Shenzhen River catchment. TKL04 runs from east to west across agricultural lands to the north of Ping Yeung Mural Village while TKL05 is a meandering channel which runs from Ping Che Road at the upstream to the trained Ping Yuen River at the downstream. TKL04 and TKL05 are not subjected to tidal influence from the Deep Bay.

5.3.2 At present, stormwater runoff collected within Ping Che catchment is discharged to Ping Yuen River via the existing watercourse TKL04 and TKL05 which is eventually discharged to Deep Bay through Shenzhen River. The surface runoff collected by three channels/watercourses namely TKL02, TKL04 and TKL07 are discharged to TKL05. The current flood protection standard of existing channel TKL04 and TKL05 is less than 1 in 5 years return period. Areas around Ping Che are susceptible to flooding during severe rainstorms due to inadequate capacity of existing channel TKL04 and TKL05.

5.3.3 The upgraded Drainage Channels TKL02 and TKL07 have flood protection standard of 1 in 10 years return period. As stated in **Section 1.2**, it is anticipated that the flood problem in Ping Che could be worsened subsequent to the completion of the drainage improvement works at Drainage Channel TKL02 and TKL07 as more surface runoff will be conveyed to the existing TKL05. However, the situation will be improved under this Project.

Baseline River Water Quality

5.3.4 The proposed Project starts from Ping Che Road and ends at the trained section of the Ping Yuen River (**Figure 5.1**). Water courses identified within the Study Area (defined as 500 m from the boundary of the Project Site) include the Shenzhen River, and Ping Yuen River.

Water Quality of Ping Yuen River

5.3.5 A routine river water quality monitoring programme has been undertaking in Hong Kong by the EPD since 1986. Two monitoring stations, GR1 and GR2, are located within and downstream of the Project site, respectively (**Figure 5.1**).

5.3.6 A summary of river water quality data collected at stations GR1 and GR2 of Ping Yuen River by EPD from 2018 to 2020 [(1)(2)(3)] is shown in **Table 5.2**.

Table 5.2
Summary of River Water Quality Monitoring Data collected by EPD River Water Quality Monitoring Programme for Stations GR1 and GR2 of Ping Yuen River (2018 - 2020)

Parameter	Unit	WQO	GR1			GR2		
			2018	2019	2020	2018	2019	2020
Dissolved oxygen (DO)	mg/L	≥4	8.4 (6.8-14.0)	7.6 (4.7 - 8.7)	6.7 (5.2 - 9.2)	5.5 (3.1-7.4)	5.4 (2.6 - 7.0)	4.7 (3.2 - 6.6)
pH	-	6.5-8.5	7.4 (6.9-8.6)	7.2 (7.1 - 7.5)	7.5 (7.2 - 7.7)	6.8 (6.5-7.3)	7.3 (7.0 - 7.7)	7.3 (6.7 - 7.6)
Suspended solids (SS)	mg/L	≤20	11 (5.4-69)	12.0 (6.8 - 19.0)	16.0 (6.4 - 22.0)	9.5 (3.8-29.0)	10.0 (8.0 - 25.0)	9.7 (3.9 - 22.0)
5-Day Biochemical Oxygen Demand (BOD_5)	mg/L	≤3	6.6 (1.6-26.0)	5.4 (0.4 - 12.0)	7.3 (2.8 - 20.0)	4.2 (1.5-7.5)	3.5 (0.2 - 9.5)	3.8 (1.9 - 5.3)
Chemical Oxygen Demand (COD)	mg/L	≤15	16 (11-34)	17 (13 - 25)	20 (11 - 30)	12 (7-21)	16 (11 - 25)	18 (9 - 23)
Oil & Grease	mg/L	-	<0.5 (<0.5-<0.5)	<0.5 (<0.5 - <0.5)	<0.5 (<0.5 - <0.5)	<0.5 (<0.5-0.6)	<0.5 (<0.5 - 2.1)	<0.5 (<0.5 - <0.5)
Faecal coliforms	cfu/100 mL	-	11,100 (1,300-81,000)	12,000 (4,900 – 25,000)	5,700 (570 – 21,000)	13,000 (930-74,000)	23,000 (3,600 – 330,000)	4,300 (1,000 – 53,000)
Escherichia coli	cfu/100	-	4,100	4,600	14,000	3,400	4,900	14,000

(1) EPD (2018) Annual River Water Quality Report. https://www.epd.gov.hk/epd/sites/default/files/epd/english/environmentinhk/water/hkwqrc/files/waterquality/annual-report/riverreport2018.pdf
(2) EPD (2019) Annual River Water Quality Report. https://www.epd.gov.hk/epd/sites/default/files/epd/english/environmentinhk/water/hkwqrc/files/waterquality/annual-report/riverreport2019.pdf
(3) EPD (2020) Annual River Water Quality Report. https://www.epd.gov.hk/epd/sites/default/files/epd/english/environmentinhk/water/hkwqrc/files/waterquality/annual-report/riverreport2020.pdf

Parameter	Unit	WQO	GR1			GR2		
			2018	2019	2020	2018	2019	2020
(E.coli)	mL		(700-70,000)	(580 – 13,000)	(810 - 170,000)	(380-16,000)	(800 – 51,000)	(2,400 – 100,000)
Ammonia-nitrogen (NH_3-N)	mg/L	-	5.50 (0.31-32.00)	4.30 (0.44 - 21.00)	11.00 (0.52 - 30.00)	5.30 (0.24-26.00)	7.40 (0.30 - 31.00)	7.70 (0.42 - 38.00)
Nitrate-nitrogen	mg/L	-	1.150 (0.900-2.500)	1.020 (0.680 - 2.300)	1.200 (0.32 - 2.20)	0.865 (0.027-1.700)	0.600 (0.055 - 1.500)	0.385 (0.065 - 1.800)
Total Kjeldahl nitrogen (TKN)	mg/L	-	6.40 (1.00-36.00)	5.40 (0.80 - 21.00)	13.00 (0.89 - 32.00)	6.00 (0.40-28.00)	9.15 (1.40 - 34.00)	10.50 (0.59 - 40.00)
Ortho-phosphate	mg/L	-	0.480 (0.160-3.000)	0.555 (0.120 - 2.100)	0.660 (0.130 - 1.100)	0.180 (0.067-0.730)	0.230 (<0.002 - 0.620)	0.240 (0.120 - 0.540)
Total phosphorus	mg/L	-	0.66 (0.32-3.10)	0.72 (0.39 - 2.70)	1.10 (0.16 - 2.00)	0.36 (0.20-1.20)	0.47 (0.18 - 2.00)	0.68 (0.24 - 1.30)
Sulphide	mg/L	-	<0.02 (<0.02-<0.02)	<0.02 (<0.02 - 0.02)	<0.02 (<0.02 - <0.02)	<0.02 (<0.02-<0.02)	<0.02 (<0.02 - 0.02)	<0.02 (<0.02 - <0.02)
Aluminum	µg/L	-	52 (<50-111)	<50 (<50 - 222)	<50 (<50 - 103)	51 (<50-538)	66 (<50 - 222)	<50 (<50 - 125)
Cadmium	µg/L	-	<0.1 (<0.1-<0.1)	<0.1 (<0.1 - 0.1)	<0.1 (<0.1 - 0.1)	<0.1 (<0.1-0.4)	<0.1 (<0.1 - <0.1)	<0.1 (<0.1 - <0.1)
Chromium	µg/L	-	<1 (<1-<1)	<1 (<1 - <1)	<1 (<1 - <1)	<1 (<1-<1)	<1 (<1 - <1)	<1 (<1 - <1)
Copper	µg/L	-	3 (1-13)	7 (2 - 20)	7 (1 - 31)	3 (<1-29)	4 (<1 - 9)	1 (1 - 3)
Lead	µg/L	-	<1 (<1-2)	<1 (<1 - 2)	<1 (<1 - <1)	<1 (<1-20)	1 (<1 - 25)	<1 (<1 - 1)
Zinc	µg/L	-	<10 (<10-24)	15 (<10 - 30)	12 (<10 - 16)	<10 (<10-80)	18 (<10 - 29)	11 (<10 - 37)
Flow rate	m^3/s	-	0.020 (0.005-0.180)	0.067 (0.012 - 0.266)	0.117 (0.020 - 0.422)	0.035 (0.015-0.300)	0.114 (0.020 - 0.289)	0.102 (0.064 - 0.289)

Notes:

- Data presented are in annual medians of monthly samples; except those for faecal coliforms and *E. coli* which are in annual geometric means.
- Figures in brackets are annual ranges.
- Values at or below laboratory reporting limits are presented as laboratory reporting limits.
- Equal values for annual medians (or geometric means) and ranges indicate that all data are the same as or below laboratory reporting limits.
- Shaded values indicate non-compliance of WQO.

* GR1 and GR2 are located within Ganges Subzone of Deep Bay Water Control Zones.

5.3.7 The overall WQO compliance for River Ganges (Ping Yuen River) has been decreased, sharing the compliance rate of 84% ,80% and 79% in 2018, 2019 and 2020 respectively. Level of 5-day Biochemical Oxygen Demand (BOD_5) has shown non-compliances with WQO at GR1 and at GR2 from 2018 to 2020. For Chemical Oxygen Demand (COD), non-compliance with the WQOs was recorded at GR1 in 2018 and 2019 and GR2 in 2019 and 2020. *E. Coli* levels for both stations between

2018 to 2020 has obtained high values up to 14000 cfu/100ml. These parameters indicate that the water in Ping Yuen River is potentially affected by pollution from the livestock farms, unsewered villages and small industrial establishments in the catchment. From 2018 to 2020, GR1 and GR2 maintained "Fair" in the Water Quality Index (WQI).

5.4 Assessment Methodology

5.4.1 The assessment area covers an area within 500 m of the Project site boundary. The assessment has be extended to include other areas such as stream courses and associated water systems, ponds in the vicinity being impacted by the construction and/or operation of the Project which include all water sensitive receivers identified in *Section 5.5*. Potential sources of water quality impact that may arise during the construction and operation of the Project were analysed and discussed. All the identified potential sources of water quality impact and their impact significance was presented in *Section 5.6*. Mitigation measures was then suggested in *Section 5.8* to reduce any identified adverse water quality impact.

5.4.2 The Project is located within the Deep Bay WCZ. Latest Outline Zoning Plan (OZP) including OZP No. S/NE-TKL/14 (Ping Che and Ta Kwu Ling) and No.S/NE-TKLN/2 (Ta Kwu Ling North). The project is mainly improvement works to the tributary sections of Ping Yuen River (River Ganges-TKL04 and TKL05; and drainage improvement works at Ping Yeung Village, constructing of road drainage system at Ping Che Road.

5.4.3 Site Visit has been conducted in March 2021, site photos are recorded in Appendix 5.1.

5.5 Water Sensitive Receivers

5.5.1 The Water Sensitive Receivers (WSRs) that may be affected by changes in water quality arising from the Project are identified in accordance with the EIAO-TM. The water sensitive receivers (WSRs) include a number of fish ponds, water courses, channelised watercourse, conservation area, fishing ground and oyster cultural area. These WSRs (**Figures 5.1**) and their approximate distances are given in **Table 5.3**.

Table 5.3
Water Sensitive Receivers

ID	WSRs	Status	Potential Impact from the Project
WSR1	Ping Yuen River (River Ganges) near Shenzhen River	Channelized watercourse	Construction works will be undertaken to connections with the proposed improvement works of downstream TKL05
WSR2	Shenzhen River	Natural watercourse	Approx. 500 m away from the Project, no direct impact
WSR3	TKL04 Watercourse	Natural watercourse	To be widened
WSR4	TKL05 Watercourse	Natural watercourse	To be widened

ID	WSRs	Status	Potential Impact from the Project
WSR5	TKL02 Watercourse	Channelized watercourse	Direct upstream of the Project, minor impact may anticipate
WSR6	TKL07 Watercourse	Channelized watercourse	Direct upstream of the Project, minor impact may anticipate
WSR7	Watercourse near Sing Ping Village	Natural watercourse	Minor impact may anticipate at the connection of the WSR 10 and the construction works of TKL04
WSR8	Ping Yuen River	Natural watercourse	Minor construction works will be undertaken to connections between Ping Yuen River (WSR 8) and the improvement works of downstream TKL04
WSR9	Watercourse near Ping Yeung	Natural watercourse	Close proximity to the Project, minor impact may anticipate
WSR10	Area of Fish Pond	Fish Pond	Over 9000m, no direct impact
WSR11	Deep Bay Oyster Culture Area	Oyster Culture Area	Over 16000m, no direct impact
WSR12	Watercourse near Ta Kwu Ling Farm	Natural watercourse	Minor impact may be anticipated at the connection o the WSR 12 and the construction works of TKL05
WSR13	Yuen Leng Chai	Conservation Area	Over 3000m from the Project, no direct impact
WSR14	Hoo Hok Wai	Conservation Area	Over 4000m from the Project, no direct impact
WSR15	Ha Wan Tsuen	Conservation Area	Over 8000m from the Project, no direct impact
WSR16	Sam Po Shue	Conservation Area	Over 9000m from the Project, no direct impact
WSR17	Mai Po Marsh SSSI	SSSI	Over 11000m from the Project, no direct impact
WSR18	Inner Deep Bay Ramsar Site	Ramsar	Over 10000m from the Project, no direct impact

5.5.2 Although waters from the Project Site will eventually be discharged into the Deep Bay through the Shenzhen River, it is considered unlikely that the Project will lead to any adverse water quality impacts to the Conservation Area and ponds along Shenzhen River (Yuen Leng Chai, Hoo Hok Wai, Ha Wan Tsuen and Sam Po Shue), Mai Po Marsh SSSI, Inner Deep Bay Ramsar Site near the Shenzhen River estuary, area of fish pond and oyster culture area in Deep Bay given the large separation distance from the Project Site as presented in Table 5.3 above.

5.6 Potential Sources of Impacts

Construction Phase

5.6.1 The main construction activities associated with the Project that have the potential to cause water quality impacts involve the following:

- Temporary flow diversion and excavation works;
- Sewage discharges from the construction work force;
- Widening of Drainage Channels;
- Construction runoff and drainage; and
- Pollutants entering the receiving waters due to accidental spillage /uncontrolled discharge from the general construction activities.

Operation Phase

5.6.2 During the operation phase of the Project, potential water quality impacts that may arise are identified as follows:

- Maintenance and desilting works within the proposed drainage channel to remove excessive silt, vegetation, debris and obstructions within the drainage channel which may lead to disturbance and re-suspension of river sediments and thereby affecting water quality;
- Changes in hydrodynamic conditions, water quality and local erosion and sedimentation patterns during the operation of the drainage channel; and
- Potential effect of brackish tidal influence from Inner Deep Bay or Lower Ping Yuen River.

5.7 Impact Assessment

Construction Phase

Temporary Flow Diversion and Excavation Works of the Existing Watercourse

5.7.1 The major construction activities will include temporary flow division, sewage discharge from the construction workforce, construction runoff and drainage and widening drainage channel. Temporary flow division will reroute water from the upstream flow to a designed portion of the downstream to allow for construction activities to take place in the channel of TKL04 & TKL05. Temporary flow diversion and excavation works for the Project along the entire TKL04 and TKL05 will be divided by segments in dry condition. It is anticipated that the temporary flow diversion and excavation works will be carried out in each segment of approximate 50m in length. Temporary flow diversion will be undertaken before any excavation works within the existing watercourse to ensure that the flow is not affected and to provide dry condition for excavation. As the temporary flow diversion and excavation works will be undertaken in dry conditions with segment division, it will not lead to disturbance of the river bed material. Unacceptable water quality impacts are thus not anticipated.

5.7.2 Overall, no unacceptable adverse impacts to water quality are anticipated to occur as a result of the temporary flow diversion and excavation works within the existing watercourse TKL04 and TKL05.

Sewage Generated from the Construction Workforce

5.7.3 Sewage will be generated from the construction workforce, site office's sanitary facilities and from portable toilets. If not properly managed, these wastewaters could cause adverse water quality impacts.

5.7.4 It is estimated that about 80 to 100 construction workers will be involved in the construction of the Project during the peak construction period. With a sewage generation rate of 0.15 m^3/worker/day (Table T-2 of EPD's Report No.: EPD/TP 1/05 Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning Version 1.0.), about 15 m^3 of sewage will be generated per day. The sewage is characterised by high levels of Biochemical Oxygen Demand (BOD), ammonia, *E.coli* and oil/grease. An adequate number of portable toilets will be provided at the Project Site to ensure that sewage from site staff is properly collected. No adverse impacts are envisaged provided that the portable toilets are properly maintained by a contractor and the collected sewage is disposed at the designated sewage treatment works.

Construction Runoff and Drainage

5.7.5 Runoff and drainage from construction activities may contain elevated levels of suspended solids and possibly other contaminants (e.g. oil and grease from machinery). Potential sources of water pollution from site runoff include the following:

- Runoff and erosion of exposed bare soil and earth and temporary stockpiles;
- Release of cement materials with rain wash;
- Wash water from dust suppression sprays and vehicle wheel washing facilities; and
- Fuel, oil, and lubricants from maintenance of construction vehicles and mechanical equipment.

5.7.6 Potential adverse water quality impacts may arise if construction site runoff is allowed to spill outside the construction site area and drain into the nearby streams, storm drain or natural drainage without treatment. The Best Management Practices outlined in ProPECC PN 1/94 will be implemented to control site runoff and drainage during construction phase. Precautionary measures relating to rainstorms as stated in Appendix A2 of ProPECC PN 1/94 will also be implemented to avoid water pollution due to site runoff during inclement weather. With the proper implementation of appropriate mitigation measures, good site practices and housekeeping as discussed in *Section 5.7*, unacceptable water quality impacts due to construction runoff and drainage are not expected to occur.

Widening of Drainage Channels

5.7.7 As indicated in **Section 2**, the area for the proposed widening and deepening of channels will be excavated. Upon completion of excavation, fixing of reinforcement

bars and concreting would be carried out on site for the structures of the proposed channels.

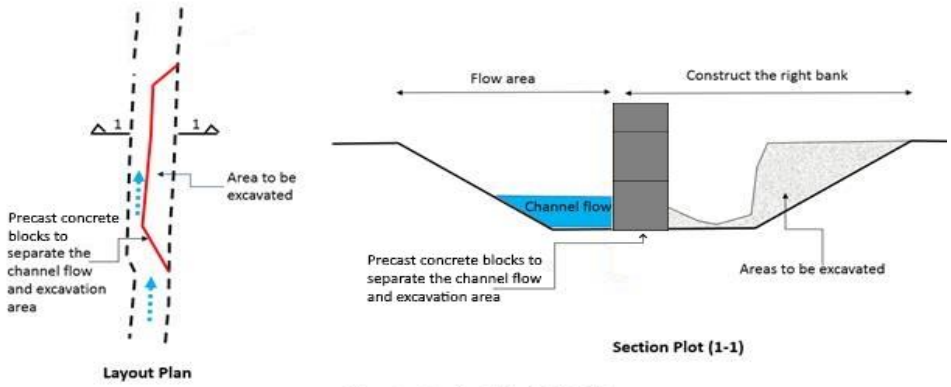
5.7.8 During construction phase, there will be potential water quality impact due to the alternation of watercourses. The existing streams at TKL04 and TKL05 will be upgraded/widened.

5.7.9 The channel widening will involve excavation, formation of embankments and temporary diversion of watercourses, which would probably lead to temporary obstruction of flows. In addition, construction activities being carried out along the channels without adequate mitigation measures may likely cause erosion and lead to suspended solids elevation in the waterbody.

5.7.10 To minimize potential impacts on water quality during the channel works for the proposed drainage improvements, the excavation works would be carried out in dry condition. Construction would be strictly carried out by land-based plant. Potential impacts on water quality would be minimised by restricting the excavation works within an artificially enclosed dry section of the river/stream.

5.7.11 De-watering of streams and sediment removal would be conducted during channel widening works. Temporary access and maintenance access along the proposed drainage channel will be constructed prior to all construction works, and due consideration for the overland flow patterns and the drainage connections will be given if flow diversion is necessary. As the alignment of the proposed channel coincides with the existing stream, channel diversions will be required to divert existing flow, in particular when the construction coincides with the wet season (April to September). Relevant requirements and stipulations from ETWB TCW No.5/2005 "*Protection of Natural Streams/Rivers from Adverse Impacts Arising from Construction Works*" will be complied to better protect the natural watercourses from the impacts of construction works.

5.7.12 Works will commence from downstream and proceed to upstream. Diversion of the channel flow is required before excavation works start. Shallow water levels were noted in the existing channels and dewatering will be required in trenches below channel inverts or after heavy rainstorm. Adequate knowledge of subsurface conditions is required before excavation. All excavated materials will be stockpiled outside the existing stream/channel but within the defined works area, and temporarily stabilized to prevent re-entry into the stream/channel. The stockpile should not create adverse drainage impacts and not impede the overland flow patterns. The area next to the proposed channel works shall be fully utilized as temporary workplace and storage of construction plant. Where possible, the excavated materials will be utilized in any backfilling. On balance, it is anticipated that some fill will need to be imported to form the embankments.

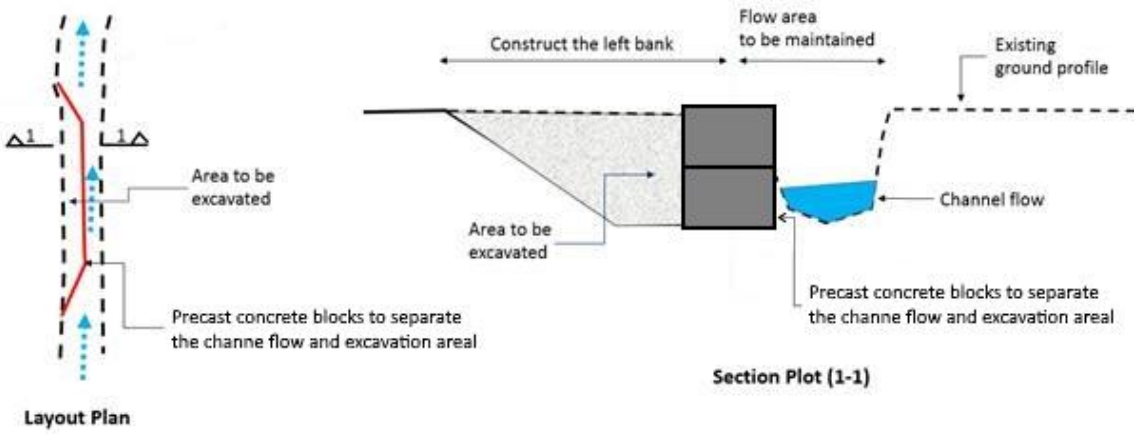


Stage 2 – Construct the Right Bank

5.7.13 The proposed channel will be constructed in segments from downstream to upstream. When the segment under construction requires stream diversion, sheet pile will be installed both upstream and downstream of the existing stream to separate the flow through the bypass channel so that the works area will remain dry for later excavation and widening works. To reduce resumption of private land lots for temporary construction works, where possible, all stream diversion and widening works will be strictly confined within the site boundary.

5.7.14 Construction of embankment will be undertaken after excavation works. Ramps shall also be required to provide a pathway for machinery to utilize the excavated channel bottom for construction and maintenance of the embankment and channel. Lining of channel bank will be followed and the lining material to be used will be fully agreed with DSD.

5.7.15 With good implementation of appropriate working method controls and good management practices, it is anticipated that unacceptable water quality impacts would not arise at the identified WSRs during construction phase. However, monitoring and audit of water quality during the construction phase is recommended.



Stage 1 – Construct the Left Bank

Accidental Spillage

5.7.16 Accidental spillage of liquid and chemicals stored on-site, such as oil, diesel and solves etc., and illegal disposal of these chemicals would cause soil contamination and adverse impact to the groundwater quality. The Code of Practice on Packaging, Labelling and Storage of Chemical Wastes released by the Waste Disposal Ordinance will be used as a guideline for chemical waste handling. All chemicals disposal should comply with the requirement imposed by the Waste Disposal Ordinance.

5.7.17 With proper measures to prevent accidental spillage, no adverse impacts to water quality are anticipated due to accidental spillage of liquid or chemicals.

Uncontrolled Discharge from General Construction Activities

5.7.18 The following pathways of uncontrolled discharge and spillage of contaminants from general construction activities may lead to adverse water quality impacts to nearby WSRs:

- Uncontrolled discharge of wastewater generated from concrete and vehicle washing;
- Uncontrolled discharge of debris and rubbish such as packaging, construction waste and refuse, etc.; and

5.7.19 Wastewater generated from concrete and vehicle washing may contain elevated levels of suspended solids. Wastewater from concrete washing is also noted with high pH value. Debris and rubbish generated by the construction activities, if allowed to enter nearby streams, storm drain or natural drainage, may cause blockages, water quality impacts and hygiene issues.

5.7.20 The effects on water quality from the construction activities are, however, likely to be minimal, provided that the site is well maintained and that good construction practices and well designed temporary drainage system and mitigation measures, as described in *Section 5.8*, are implemented properly.

Operation Phase

Maintenance Works

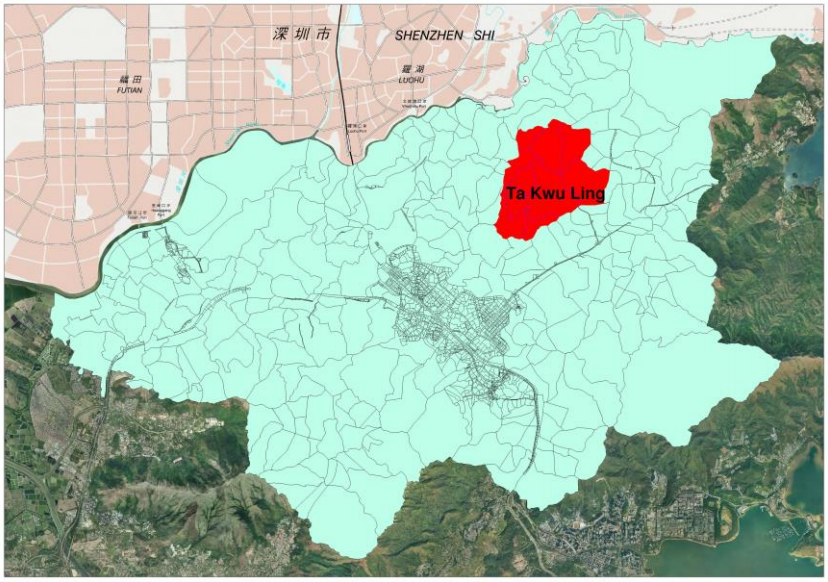
5.7.21 Regular maintenance would be necessary for the proposed drainage channel in order to maintain the flow in the channel and its structural integrity. Siltation will generally be allowed to accumulate and removal of silt, vegetation growth, debris and obstructions would only be carried out at locations where water flow is impeded. Such small scale maintenance would require only light mechanical equipment such

as a small loader and/or a small crane truck. Hand-held equipment will be used for vegetation removal.

5.7.22 Whilst possible changes to water quality may be expected during the removal of silt, vegetation growth, debris and obstruction, such as increases in suspended solids due to disturbance of river bed material and subsequently increased sedimentation onto the river bed, it is expected that these changes will be short term and occur only within the area of maintenance works and for a short distance downstream due to rapid settling out of any disturbed river bed material. Changes in suspended solids concentrations and sedimentation rate would be expected to be similar to ambient conditions following heavy storms and increased sediment run-off. With the implementation of the precautionary measures in *Section 5.8*, no unacceptable water quality impacts are anticipated to occur as a result of the small scale maintenance works. Water quality impacts to the water and ecological sensitive receivers located downstream of the proposed drainage channel (Wetland Conservation Area and Mai Po and Inner Deep Bay Ramsar Site near the Shenzhen River estuary) are also not expected to occur.

Changes in Hydrodynamic Conditions

5.7.23 According to the Drainage Impact Assessment (DIA) of the Project, by achieving the flood protection standard of 1 in 10 years after implementation of the Project, water level within the Project Site will be slightly lower than the water level before implementation in a 1 in 10 years flooding event. It is thus considered that implementation of the Project will be beneficial to the hydrodynamics of the Project Site by improving the flood prevention performance. Water level at the downstream boundary of the proposed Drainage Channel TKL05 will be slightly increased (i.e. 26mm) during the operation phase in a 1 in 10 years flooding event. Therefore, implementation of the Project is not expected to significantly affect the hydrodynamic conditions downstream of the Project Site. As indicated in the DIA report, the associated drainage sub-catchments are highlighted in red in the diagram below. Compared to the total catchment area of the North district catchment, drainage sub-catchments of the Project is relatively small. Therefore, it is considered that the flow discharged from drainage sub-catchments of the Project will have a limited impact to the hydraulic condition. In addition, unacceptable water quality impacts to the downstream WSRs due to the insignificant changes in hydrodynamic conditions caused by the Project are not expected.



Changes in Water Quality

5.7.24 The operation of the proposed Drainage Channel TKL04 and 05 will not generate any new pollution load to the catchment. Instead, vegetation re-established/planted along the gabion mattress at river bed will help to remove dissolved and particulate contaminants through absorptive, filtration and biological mechanisms. The water quality pollutants (e.g. SS, BOD and COD) are expected to be reduced. In addition, it is expected that foul odour of polluted water and river bed material during low flow periods would be alleviated with the improved flow conditions and removal of river bed material during channel construction and operation. Since the Project will not induce additional discharge or pollutants from the Project, there will not be changes on downstream salinity profile nor effect on aquatic organisms. It is thus anticipated that the Project will not cause any significant adverse changes to water quality thus impacts are not expected during the operation phase.

5.7.25 Long term reduction of pollution load into the channels is necessary to improve the water quality in the proposed Drainage Channel TKL04 and TKL05. It is expected that the water quality of the drainage channel can be improved by the continuous enforcement of Livestock Waste Control Scheme which will regulate discharge of livestock waste into the drainage channel. In addition, the existing watercourse TKL05 is currently receiving some domestic waste discharge. Provision of sewers connecting the village households to treatment works will thus lead to improvement of water quality of the proposed Drainage Channel TKL05. Such provision of public sewers to the unsewered villages is being implemented under the North District Sewerage Master Plan.

Change in Sediment Deposition and Erosion Pattern

5.7.26 The improved flow condition (i.e. higher flow rate of runoff) in the proposed Drainage Channel TKL04 and TKL05 may alter the pattern of sediment deposition

and erosion within the drainage channel and along the downstream section of Ping Yuen River and Shenzhen River. However, as regular maintenance works will be undertaken within the proposed drainage channel and at the downstream sections to remove excessive sediments (regular maintenance works will be undertaken by DSD at these downstream sections with some hand-held tools which are not within the scope of the Project), it is not anticipated that the Project will lead to any adverse water quality impacts within the Project Site and along the downstream section of Ping Yuen River and Shenzhen River by altering sediment deposition and erosion patterns. It is also not expected that the Project will lead to any unacceptable water quality impacts at the Wetland Conservation Area and Mai Po and Inner Deep Bay Ramsar Site since these areas which are susceptible to changes in sediment deposition and erosion pattern are in considerable distance from the proposed Drainage Channel TKL04 and TKL05 (i.e. >4, >11 and >10 km, respectively). Therefore, we expect same/similar scale of upstream water volume (i.e. in the unit of "m^3") discharging into the channel. After improvement works, the cross-section is expected to be larger, hence the water flow (i.e. in the unit of "m^3/s") shall be decreased. The drainage velocity will be slightly decreased with implementation of drainage improvement works due to wider cross-sections.

5.7.27 Bottom sediment re-suspension will be alleviated because of the decreased flow. Sediment erosion would be substantially reduced, which lead to reduction of drainage maintenance desilting frequency and minimize the potential water quality impacts which may arise from maintenance desilting activities. Sedimentation rate is a function associated with densities of the particle and water, effective particle diameter and dynamic viscosity (Stokes Law). Thus, the change of flow regime will not change the sedimentation rate significantly.

Potential effect of brackish tidal influence

5.7.28 As the invert level of the proposed channels are over 3.5m, which is higher than the highest predicted tide level at Tsim Bei Tsui (<3.5m) and thedownstream Invert level is +4.8mPD. Therefore, the effect of brackish tidal influence from Inner Deep Bay or Lower Ping Yuen River is not expected. Mitigation measures such as tidal barriers / flow management devices are therefore considered not necessary.

5.8 Mitigation Measures

Construction Phase

5.8.1 Potential impacts on water quality as a result of construction activities of the Project, including temporary flow diversion, excavation works within the existing watercourse, sewage generation from workforce, construction runoff and drainage, unplanned accidental spillage and uncontrolled release of pollutants have been assessed in *Section 5.7* above. The following section describes the mitigation

measures proposed to alleviate water quality impacts during construction of the Project.

5.8.2 The contractor should comply with the *Water Pollution Control Ordinance (WPCO)* and its subsidiary regulations. The contractor should carry out works in such a manner as to minimise adverse impacts on the water quality during execution of the works. In particular, the contractor should arrange his method of working to minimise the effects on the water quality within and outside the site and on the transport routes.

5.8.3 Best Management Practices should be implemented in controlling water pollution during the construction phase. The contractor should follow the practices, and be responsible for the design, construction, operation and maintenance of all the mitigation measures below and as specified in *ProPECC PN 1/94 – Construction Site Drainage*. In particular, the contractor should submit and implement an *Water Pollution Control Plan* (as part of the *Environmental Management Plan* [(4)], thereafter called "the Plan") which should incorporate details of the mitigation measures recommended below to reduce water quality impacts arising from construction works. There is also need to apply to the EPD for a discharge licence for discharge of effluent from the construction site under the WPCO. All discharges during the construction phase of the Project should comply with the *Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-ICW)* issued under the *WPCO*.

5.8.4 For construction works in the vicinity of natural rivers and streams, the contractor should follow the recommendations given in *ETWB TC (Works) No. 5/2005- Protection of Natural Streams/Rivers from Adverse Impact Arising from Construction Works*, including but not limited to:

- The use of less or smaller construction plants may be specified in areas close to the water courses to reduce the disturbance to the surface water.
- Temporary storage of materials (e.g. equipment, chemicals and fuel) and temporary stockpile of construction materials should be located well away from any water courses when carrying out of the construction works.
- Stockpiling of construction materials and dusty materials should be covered and located away from any water courses.
- Construction debris and spoil should be covered up and / or disposed of as soon as possible to avoid being washed into the nearby water receivers.

(4) As required under ETWB TCW No. 19/2005 – Environmental Management on Construction Sites.

- Adequate lateral support may need to be erected in order to prevent soil or mud from slipping into the watercourses.

Temporary Flow Diversion and Excavation Works of the Existing Watercourse

5.8.5 The following good practices should apply at all times during excavation works:

- Excavation within the existing watercourse TKL04 and TKL05 should be carried out in dry conditions. The dry excavation condition could be created with temporary flow diversions as described in detail in *Section 5.7*.

- The excavated material, especially river bed material, should be temporary stored in the stockpile areas for dewatering by natural ventilation. Runoff from these stockpile areas should be collected for treatment by sedimentation with the addition of coagulant. The treated water should be reused on site for water spraying or wheel washing.

- The dried/dewatered excavated material should be reused on-site as backfilling material, as far as practicable.

Sewage Generated from the Construction Workforce

5.8.6 Domestic sewage/wastewater generated by workforce on-site should be collected in a suitable storage facility such as portable chemical toilets. An adequate number of portable toilets should be provided during the construction phase. These toilets should be maintained in a state that will not deter the workers from using them. The collected sewage/wastewater should be discharged into the foul sewer or transferred to the Government sewage treatment works by a licensed collector. Other measures, such as providing notices at conspicuous locations, regular site audit etc., would be conducted.

Widening of Drainage Channels

5.8.7 Due to the characteristics of narrow width and small water flow of the existing channel, the excavation should be carried out in dry condition (even in wet season) by diverting the stream flow from upstream by a temporary drainage channel with a temporary sheetpiles, earth bund or barrier; so that the works area will remain dry for later excavation and widening works.

5.8.8 The temporary drainage channel would be removed when the construction works are completed or the temporary diversion is no longer required. Although flooding of the proposed contaminant section seldom occurs in dry season, the excavation would be considered to suspend when flood water enters the containment and causes leakage of runoffs to stream water.

5.8.9 After dewatering of the streams, the sediments should be allowed to dry before excavation (yet still maintain a moist state to avoid dust nuisance). This will facilitate excavation of the sediments and also minimize the risk of drained water flowing back into watercourses or diversion channels as the sediment is handled. Where time or weather constraints require handling of wet sediment, care should be taken in the removal of sediment and the storage area should be bunded to prevent silty runoff entering watercourses. Given its small quantity, all excavated sediment should be reused on-site as backfilling material.

5.8.10 To further minimize the leakage and loss of sediments during excavation, tightly sealed closed grab excavators should be employed in river sections where material to be handled is wet. Where material is dry and in non-river sections, conventional excavations can be used.

5.8.11 Excavated sediment will likely be temporarily stored on-site for reuse as backfilling material. This should be stored in a bunded area and covered at any time to avoid inadvertent release of silts and suspended solids to nearby water bodies.

5.8.12 Regular monitoring of suspended solids, pH and turbidity should be conducted during excavation works. Any exceedance of water quality in the nearby water bodies caused by inadvertent release of site runoff should be rectified in accordance with EM&A programme for this Project.

Construction Runoff and Drainage

5.8.13 Good construction site practices outlined in *ProPECC PN 1/94 "Construction Site Drainage"* should be followed as far as practicable in order to minimise surface runoff and the chance of erosion, and also to retain and reduce any suspended solids in surface runoff prior to discharge. These practices include the following:

- Prior to discharge of site runoff into the nearby water bodies, site runoff should be treated via sand/silt removal facilities such as sand/silt traps or sedimentation facilities on-site to remove sand/silt particles and to meet the discharge standards of the *TM-ICW* under the *WPCO*. The design of sand/silt removal facilities should be based on the guidelines provided in *ProPECC PN 1/94*. All drainage facilities and erosion and sediment control structures should be inspected regularly and maintained to confirm proper and efficient operation at all times during construction phase and particularly before and after rainstorms. Deposited silt and grit should be removed regularly.

- Appropriate surface drainage should be designed and provided, where necessary. In particular, surface runoff should be collected along the river banks and be diverted to sedimentation tank/pond before discharge into the river.

- The precautions to be taken at any time of year when rainstorms are likely together with the actions to be taken when a rainstorm is imminent or forecasted and actions to be taken during or after rainstorms are summarised in *Appendix A2* of *ProPECC PN 1/94* and should be followed.

- Oil interceptors should be provided in the drainage system where necessary and regularly emptied to prevent the release of oil and grease into the stormwater drainage system after accidental spillages.

- Temporary and permanent drainage pipes and culverts provided to facilitate runoff discharge should be adequately designed for the controlled release of storm flows. The design of permanent drainage pipes should follow the guidelines provided in *ProPECC PN 5/93 Drainage plan subject to comment by the Environmental Protection Department*.

- The temporary diverted drainage should be reinstated to the original condition when the construction work has finished or when the temporary diversion is no longer required.

- Construction materials stored on-site should be covered with tarpaulin sheets to prevent from being washed away. Other measures such as containment bunds, sand bags and temporary drainage should also be considered, especially during wet season or heavy rainstorm events. Such runoff could be minimized through reduction of flat exposed open area, and through diversion and collection via temporary drainage system on the periphery of the Project site.

5.8.14 Site runoff during concrete curing period should be carefully contained and diverted to treatment facilities on-site to prevent it from entering existing watercourses directly. Adjustment of pH should be carried out by adding a suitable neutralising reagent to the wastewater collected.

5.8.15 Any exceedance of pH level against acceptable range in WQO in the nearby watercourse should be closely monitored during the construction phase. Such situation should be rectified in accordance with the EM&A programme for this Project. Adoption of lesser or smaller construction plants would be proposed to reduce disturbance to the channel bed and to the nearby sensitive receivers; and the use of concrete or the like should be avoided or minimized.

Accidental Spillage / Uncontrolled Discharge from General Construction Activities

General Construction Activities

5.8.16 The following good site measures should be implemented to prevent uncontrolled discharge or spillage from the general construction activities:

- Site office, workshop and depot should be located on hard standing grounds with provision of temporary drainage channel and sedimentation tanks with oil interceptor if required. The oil interceptor should be inspected regularly to prevent blockage and oil overflow during storm events.

- Debris and refuse generated on-site should be collected, handled and disposed of properly to avoid entering the existing Ping Yuen River and Shenzhen River downstream of the Project site. Stockpiles of cement and other construction materials should be kept covered when not being used.

- Good site practices described in *ProPECC PN 1/94*, such as avoidance of excavation works in rainy / wet season should be complied.

Storage and Handling of Oil, Other Petroleum Products and Chemicals

5.8.17 The following mitigation measures should be implemented for the storage and handling of oil, other petroleum products and chemicals:

- Waste streams classifiable as chemical wastes should be properly stored, collected and treated for compliance with *Waste Disposal Ordinance* or *Waste Disposal (Chemical Waste) (General) Regulation* requirements.

- All fuel tanks and chemical storage areas should be provided with locks and be sited on paved areas.

- The storage areas should be surrounded by bunds with a capacity equal to 110% of the storage capacity of the largest tank to prevent spilled oil, fuel and chemicals from reaching the receiving waters. The storage areas should be located away from water bodies as far as possible.

- Waste oil should be collected and stored for recycling or disposal, in accordance with the *Waste Disposal Ordinance*.

- Vehicle and plant servicing areas, vehicle wash bays and lubrication bays should, as far as possible, be located within roofed areas. The drainage in these covered areas should be connected to foul sewers via a petrol interceptor.

Handling of Spillage / Leakage

5.8.18 In the event that accidental spillage or leakage of hazardous substances / chemical wastes occur, the response procedures as listed below should be followed. It should be noted that the procedures below are not exhaustive and the contractor should propose other response procedures in the Emergency Contingency Plan based on the particular types and quantities of chemicals or hazardous substances used, handled and stored on-site.

- Oil leakage or spillage should be contained and cleaned up immediately. Waste oil should be collected and stored for recycling or disposal in accordance with the *Waste Disposal Ordinance*.

- Instruct untrained personnel to keep at a safe distance well away from the spillage area.

- If the spillage / leakage involves highly toxic, volatile or hazardous waste, initiate emergency evacuation and call the emergency service.

- Only trained persons equipped with suitable protective clothing and equipment should be allowed to enter and clean up the waste spillage / leakage area.

- Where the spillage/ leakage is contained in the enclosed storage area, the waste can be transferred back into suitable containers by suitable handheld equipment, such as hand operated pumps, scoops or shovels. If the spillage / leakage quantity is small, it can be covered and mixed with suitable absorbing materials such as tissue paper, dry soft sand or vermiculite. The resultant slurry should be treated as chemical waste and transferred to suitable containers for disposal.

- For spillage / leakage in other areas, immediate action is required to contain the spillage / leakage. Suitable liquid absorbing materials such as tissue paper, dry soft sand or vermiculite should be used to cover the spill. The resultant slurry should be treated as chemical waste and transferred to suitable containers for disposal.

- Areas that have been contaminated by chemical waste spillage / leakage should be cleaned. While water is a soluble solvent for aqueous chemical wastes and water soluble organic waste, kerosene or turpentine should be used for organic chemical wastes that are not soluble in water. The waste from the cleanup operation should be treated and disposed of as chemical waste.

- In incidents where the spillage / leakage may result in significant contamination of an area or risk of pollution, the EPD should be informed immediately.

- The Code of Practice on Packaging, Labelling and Storage of Chemical Wastes published under the WDO should be used as a guideline for handing chemical wastes.

Operation Phase

Maintenance Works

5.8.19 Maintenance would be necessary for the proposed drainage channel at regular intervals to remove excessive silts, vegetation, debris and obstruction.

5.8.20 Before proceeding with any maintenance works, except for emergency works, the maintenance engineer should check to ascertain if any of the proposed works should be located in or near an environmentally sensitive and/or ecologically important areas. In case of doubt, advice from EPD and AFCD or other relevant departments should be sought.

5.8.21 If the proposed works should be located inside or near one of the environmentally sensitive and/or ecologically important areas, careful consideration should be given to the proposed method of implementation so as to minimise any adverse environmental impact. Depending on the extent of the maintenance works, EPD and AFCD should be notified and/or consulted as appropriate on the proposed method and mitigation measures for executing the works. Their comments on necessary mitigation measures should be considered and incorporated.

5.8.22 The following precautionary measures should be included in planning for the maintenance works for the proposed channels:

(a) Maintenance of the channels should be restricted to annual silt removal when the accumulated silt should adversely affect the hydraulic capacity of the channel, except during emergency situations where flooding risk is imminent. Desilting should be carried out by hand or light machinery during the dry season (October to March) when water flow is low.

(b) Vegetation removal should be limited to manual cutting to be carried out during dry season and only when growth of vegetation is very likely to impede channel flow.

(c) Phasing of the works should be considered to better control and reduce any impacts caused. Where possible, works should be carried out along half width of the drainage channel in short sections. A free passage along the drainage channel is necessary to avoid forming stagnant water in any phase of the works.

(d) Containment structures (such as sand bags barrier) should be provided for the desilting works area to facilitate a dry or at least confined working area within the drainage channel.

(e) Where no maintenance access is available for the channel, temporary access to the works site should be carefully planned and located to reduce disturbance caused to the drainage channel, adjacent vegetation and nearby sensitive receivers by construction plants.

(f) The locations for the disposal of the removed materials should be identified and agreement sought with the relevant departments before commencement of the maintenance works. Temporary stockpile of waste materials should be located away from the channel and properly covered. These waste materials should be disposed of in a timely and appropriate manner.

(g) The use of lesser or smaller construction plants should be considered to reduce disturbance to the channel bed where fish habitats are located and to the nearby sensitive receivers;and

(h) The use of concrete or the like should be avoided or minimzed.

5.9 Residual Impacts

5.9.1 With the proper implementation of the recommended mitigation measures described in *Section 5.8* above, it is expected that unacceptable residual water quality impacts would not arise from the construction and operation of the Project.

5.10 Cumulative Impacts

5.10.1 The potential for cumulative water quality impact during the construction phase has been checked against the following known committed/existing projects at the time the EIA is prepared, and the project proponents of these projects have been approached and will be closely consulted throughout this Project:

- Implementation of Water Intelligent Network (WIN), Remaining District Metering Areas and Pressure Management Areas in Yuen Long and Sheung Shui & Fanling Major Supply Zones;

- Widening of the Western Section and Eastern Section of Lin Ma Hang Road (Ping Yuen River to Ping Che Road / Tsung Yuen Ha to Lin Ma Hang).

5.10.2 Implementation of WIN will fall within the Study Area while the works will be confined into localised works area with little potential to generate water quality impacts. In addition, the widening of the Western Section and Eastern Section of Lin Ma Hang Road (Ping Yuen River to Ping Che Road / Tsung Yuen Ha to Lin Ma Hang) is not substantial and is over 500m of this Project. Therefore, the potential of causing unacceptable cumulative water quality impacts from these projects is considered low.

5.10.3 In addition to the above projects, there are also three planning studies with study areas within and in the vicinity of the Project Site, which included the following:

- Preliminary Feasibility Study on Developing the New Territories North (NTN);
- Drainage Improvement Works in Hang Tau, Kong Ha and Sha Tau Kok Town, and Lower Ping Yuen River; and
- North East New Territories Sewerage System Upgrade.

5.10.4 The cumulative impacts with the above concurrent projects are mostly related to the water quality impacts caused by excavation works, construction site runoff and sewage discharge during the construction phase. It is expected that the cumulative impacts from the construction and operation of the proposed Drainage Channel TKL04 and TKL05 and other concurrent projects will not lead to exceedance of any relevant water quality criteria, provided that the recommended mitigation measures as stated in the referenced EIA studies are implemented properly. As such, no adverse cumulative environmental impacts are envisaged during both construction and operation of the Project.

5.11 Monitoring and Audit Requirement

Construction Phase

5.11.1 With proper implementation of the recommended mitigation measures, adverse water quality impacts at the identified WSRs are not expected to occur. However, a water quality monitoring programme is recommended to verify the predictions of the EIA and ensure compliance with the assessment criteria.

5.11.2 Detailed approach and methodology of the water quality monitoring programme are presented in the Environmental Monitoring and Audit Manual (EM&A Manual) under a separate cover and are briefly described below.

5.11.3 Baseline monitoring should be undertaken for three times per week for a period of four weeks before commencement of the construction works to establish baseline water quality conditions of the area. Impact monitoring should be undertaken for three times per week during the construction period to obtain updated water quality data of the area for comparison with the baseline water quality data and hence determine any water quality impacts from the construction activities.

5.11.4 Monitoring should be undertaken at stations located upstream and downstream of the Project Site. The upstream station should serve as control station at which the water quality is unlikely to be affected by the Project's activities while the downstream station will serve as impact station. Data will be compared between the upstream

and downstream station to determine any adverse water quality impacts as a result of the construction works of the Project. Locations of the monitoring station are recommended in the EM&A Manual.

5.11.5 The following parameters will be monitored under the water quality monitoring programme:

- Dissolved Oxygen (mg/L) (*in situ measurement*);
- Temperature (*in situ measurement*);
- pH (*in situ measurement*);
- Turbidity (NTU) (*in situ measurement*);
- Suspended Solids (mg/L) (laboratory analysis);
- Salinity (*in situ measurement*);
- Water depth (*in situ measurement*)

5.11.6 Weekly site inspections and monthly site audits will be conducted to ensure that the recommended mitigation measures are properly implemented during the construction stage.

Operation Phase

5.11.7 Adverse water quality impact is not expected during operation phase of the Project and hence monitoring is considered not necessary.

5.12 Conclusion

5.12.1 The potential sources of water quality impacts associated with the construction and operation of the Project have been identified and the potential impacts were evaluated.

5.12.2 Potential impacts arising from the proposed construction works are predicted to be largely confined to the specific works areas. With proper implementation of the recommended mitigation measures, in particular the establishment of dry conditions for excavation works within the existing watercourse and good construction site practices as recommended in relevant regulatory guidelines, adverse water quality impacts are not expected at the identified WSRs.

5.12.3 During the operation phase, changes to hydrodynamic regime within the Project Site are predicted to have no adverse impacts. Adverse water quality impacts are not expected at any identified WSRs during the operation phase as the Project will not

generate any new pollution loads and the maintenance works to remove excessive silt, vegetation, debris and obstructions are small scale in nature. The improved flow condition in the proposed Drainage Channel TKL04 and 05 may alter the pattern of sediment deposition and erosion along the downstream section of Ping Yuen River and Shenzhen River. With regular maintenance works at these downstream sections to remove excessive sediments, it is not anticipated that the Project will lead to any unacceptable adverse water quality impacts by altering their sediment deposition and erosion pattern.

5.12.4 With the implementation of the recommended mitigation measures, it is expected that unacceptable residual water quality impacts would not arise from the construction and operation of the Project. Nevertheless, a monitoring programme is recommended during construction phase to verify the predictions of the EIA and ensure compliance with the assessment criteria.

END OF TEXT