5 Water Quality Impact

5.1 Overview

This section presents the assessment of potential water quality impacts arising from the construction and operation of the proposed developments in KTN and FLN NDAs. Mitigation measures such as silt traps and oil interceptors will be implemented on site to control the potential surface runoff during construction/operational phase. Cofferdam/diaphragm wall will be deployed to the bridge pier constructions, riverbank works and diversion works of natural streams to prevent the disturbance to nearby water bodies and minimize the intrusion to groundwater during excavation.

During operational phase, the major water pollution source would be the sewage from the proposed development. The sewage from the proposed developments within the NDAs will be collected to the upgraded/expanded Shek Wu Hui Sewage Treatment Works (SWHSTW) before disposal. The "No Net Increase in Pollution Loading" policy will be complied through the compensation of Deep Bay catchment with the upgraded/expanded SWHSTW.

The water quality impact assessment has been conducted in accordance with the requirements of Annexes 6 and 14 of the TM-EIAO as well as the requirements set out under Clause 3.4.6 of the EIA Study Brief.

5.2 Environmental Legislation, Standards and Guidelines

The relevant legislations, standards and guidelines applicable to the present study for the assessment of water quality impacts include:

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

5.2.1 Water Pollution Control Ordinance, CAP 358

The entire Hong Kong waters are divided into Water Control Zones (WCZs) and supplementary WCZs under the Water Pollution Control Ordinance (WPCO) (CAP 358). Each WCZ has a designated set of statutory Water Quality Objectives (WQOs) designed to protect the inland and/or marine environment and its users. The NDAs are wholly located

within the Deep Bay WCZ. The WQOs for the Deep Bay WCZ, which are presented in **Table 5.1**, are applicable as criteria for assessing compliance of any effects from the construction and operation of the NDAs.

Table 5.1 - Water quality objectives for the Deep Bay WCZ

Parameters	**Objectives**	**Sub-Zone**
Offensive Odour, Tints	Not to be present	Whole zone
Visible foam, oil scum, litter	Not to be present	Whole zone
Dissolved Oxygen (DO) within 2 m of the seabed	Not less than 2.0mg/L for 90% of samples	Outer Marine Subzone excepting Mariculture Subzone
DO within 1 m below surface	Not less than 4.0mg/L for 90% of samples	Inner Marine Subzone excepting Mariculture Subzone
	Not less than 5.0mg/L for 90% of samples	Mariculture Subzone
DO	Not less than 4.0mg/L for 90% of samples	Outer Marine Subzone excepting Mariculture Subzone
	Not less than 4.0mg/L	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone, Water Gathering Ground Subzones and other inland waters of the Zone
5-Day Biochemical Oxygen Demand (BOD_5)	Not to exceed 3mg/L	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	Not to exceed 5mg/L	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
Chemical Oxygen Demand (COD)	Not to exceed 15mg/L	Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	Not to exceed 30mg/L	Yuen Long & Kam Tin (Lower) Subzone and other inland waters
pH	To be in the range of 6.5 – 8.5, change due to waste discharges not to exceed 0.2	Marine waters excepting Yung Long Bathing Beach Subzone
	To be in the range of 6.5 – 8.5	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones
	To be in the range of 6.0 –9.0	Other inland waters
	To be in the range of 6.0 – 9.0 for 95% samples, change due to waste discharges	Yung Long Bathing Beach Subzone

Parameters	Objectives	Sub-Zone
	not to exceed 0.5	
Salinity	Change due to waste discharges not to exceed 10% of ambient	Whole zone
Temperature	Change due to waste discharges not to exceed 2°C	Whole zone
Suspended solids (SS)	Not to raise the ambient level by 30% caused by waste discharges and shall not affect aquatic communities	Marine waters
	Not to cause the annual median to exceed 20mg/L	Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Ganges Subzone, Indus Subzone, Water Gathering Ground Subzones and other inland waters
Unionized Ammonia (UIA)	Annual mean not to exceed 0.021mg/L as unionized form	Whole zone
Nutrients	Shall not cause excessive algal growth	Marine waters
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	Yung Long Bathing Beach Subzone

Parameters	Objectives	Sub-Zone
	in a calendar month at intervals of between 3 and 14days.	
	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
	Not to exceed 50 Hazen units	Yuen Long & KamTin (Lower) Subzone and other inland waters
Turbidity	Shall not reduce light transmission substantially from the normal level	Yuen Long Bathing Beach Subzone
Phenol	Quantities shall not sufficient to produce a specific odour or more than 0.05mg/L as C_6H_5OH	Yuen Long Bathing Beach Subzone
Toxins	Should not cause a risk to any beneficial uses of the aquatic environment	Whole Zone
	Should not attain such levels as to produce toxic carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms.	Whole Zone

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

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

effluent discharge standards are presented in **Tables 5.2** and **5.3** respectively.

Table 5.2 - Standards for effluents discharged into Group B inland waters

Parameter	Flow Rate(m³/day)							
	≤ 200	**>200 and ≤400**	**>400 and ≤600**	**>600 and ≤800**	**>800 and ≤1000**	**>1000 and ≤1500**	**>1500 and ≤2000**	**>2000 and ≤3000**
pH (pH units)	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
Temperature (°C)	35	30	30	30	30	30	30	30
Colour (lovibond units)(25mm cell length)	1	1	1	1	1	1	1	1
Suspended solids (mg/l)	30	30	30	30	30	30	30	30
BOD (mg/l)	20	20	20	20	20	20	20	20
COD (mg/l)	80	80	80	80	80	80	80	80
Oil & Grease (mg/l)	10	10	10	10	10	10	10	10
Iron (mg/l)	10	8	7	5	4	3	2	1
Boron (mg/l)	5	4	3	2.5	2	1.5	1	0.5
Barium (mg/l)	5	4	3	2.5	2	1.5	1	0.5
Mercury (mg/l)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium (mg/l)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Selenium (mg/l)	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1
Other toxic metals individually (mg/l)	0.5	0.5	0.2	0.2	0.2	0.1	0.1	0.1
Total Toxic metals (mg/l)	2	1.5	1	0.5	0.5	0.2	0.2	0.2
Cyanide (mg/l)	0.1	0.1	0.1	0.08	0.08	0.05	0.05	0.03
Phenols (mg/l)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Sulphide (mg/l)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Fluoride (mg/l)	10	10	8	8	8	5	5	3
Sulphate (mg/l)	800	800	600	600	600	400	400	400
Chloride (mg/l)	1000	1000	800	800	800	600	600	400
Total phosphorus (mg/l)	10	10	10	8	8	8	5	5

Parameter	Flow Rate(m³/day)							
	≤ 200	>200 and ≤400	>400 and ≤600	>600 and ≤800	>800 and ≤1000	>1000 and ≤1500	>1500 and ≤2000	>2000 and ≤3000
Ammonia nitrogen (mg/l)	5	5	5	5	5	5	5	5
Nitrate + nitrite nitrogen (mg/l)	30	30	30	20	20	20	10	10
Surfactants (total) (mg/l)	5	5	5	5	5	5	5	5
E. coli (count/100ml)	100	100	100	100	100	100	100	100

Notes:

1. All units in mg/L unless otherwise stated

Table 5.3 - Standards for effluents discharged into Group C inland waters

Parameter	Flow Rate (m^3/day)			
	≤ 100	> 100 and ≤500	> 500 and ≤1000	> 1000 and ≤2000
pH (pH units)	6-9	6-9	6-9	6-9
Temperature (˚C)	30	30	30	30
Colour (lovibond units) (25mm cell length)	1	1	1	1
Suspended solids (mg/l)	20	10	10	5
BOD (mg/l)	20	15	10	5
COD (mg/l)	80	60	40	20
Oil & Grease (mg/l)	1	1	1	1
Boron (mg/l)	10	5	4	2
Barium (mg/l)	1	1	1	0.5
Iron (mg/l)	0.5	0.4	0.3	0.2
Mercury (mg/l)	0.001	0.001	0.001	0.001
Cadmium (mg/l)	0.001	0.001	0.001	0.001
Silver (mg/l)	0.1	0.1	0.1	0.1
Copper (mg/l)	0.1	0.1	0.05	0.05
Selenium (mg/l)	0.1	0.1	0.05	0.05
Lead (mg/l)	0.2	0.2	0.2	0.1
Nickel (mg/l)	0.2	0.2	0.2	0.1
Other toxic metals individually (mg/l)	0.5	0.4	0.3	0.2
Total toxic metals (mg/l)	0.5	0.4	0.3	0.2
Cyanide (mg/l)	0.05	0.05	0.05	0.01
Phenols (mg/l)	0.1	0.1	0.1	0.1
Sulphide (mg/l)	0.2	0.2	0.2	0.1
Fluoride (mg/l)	10	7	5	4

Parameter	Flow Rate (m^3/day)			
	≤ 100	> 100 and ≤500	> 500 and ≤1000	> 1000 and ≤2000
Sulphate (mg/l)	800	600	400	200
Chloride (mg/l)	1000	1000	1000	1000
Total phosphorus	10	10	8	8
Ammonia nitrogen (mg/l)	2	2	2	1
Nitrate + nitrite nitrogen (mg/l)	30	30	20	20
Surfactants (total) (mg/l)	2	2	2	1
E. coli (count/100ml)	1000	1000	1000	1000

Notes:

1. All units in mg/L unless otherwise stated

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

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

5.2.4 No Net Increase in Pollution Loads Requirement in Deep Bay

In addition to the provisions of the TM, the 'No Net Increase in Pollution Loads Requirement' aims to provide protection to the inland and marine water quality of the Deep Bay WCZ. The pollutants entering into Deep Bay have exceeded the assimilative capacity of the water body. To increase pollution loads to the water body is environmentally undesirable. In accordance with Clause 3.4.6.5(x) of the EIA Study Brief and Town Planning Board Guideline No.12B, the pollution loads of concern should be offset by equivalent reduction of current loads for new discharge into Deep Bay. The policy ensures that developments within the Deep Bay catchment areas do not result in an increase in pollution loads to the inland and marine waters.

5.2.5 Hong Kong Planning Standards and Guidelines

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

5.2.6 ProPECC PN 1/94 "Construction Site Drainage"

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

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

5.2.7 Waterworks Ordinance Cap 102, Section 30

The Ordinance aims to control solid or liquid matters from falling or being washed or being carried into the waterworks.

5.3 Description of the Environment

5.3.1 Existing Environment

The Study Area falls within the catchment boundary of Ng Tung, and San Tin drainage basins in North District. The Ng Tung and San Tin Basins are sub-basins of the larger Shenzhen Basin. Of these two basins, Ng Tung Basin has an area of approximately 70 km^2, compared to the around 20 km^2 of San Tin Basin (**Figure 5.1**).

In general, these drainage basins are characterized by steep upland catchments with sharp transitions to relatively flat lowland areas, some of which have been already developed or are being planned for future development. The flood plains in the Ng Tung Basins which have primarily agricultural land uses are gradually being replaced by development. San Tin Basin partially included in the Study Area is characterized by fish ponds in the lowland area adjacent to the Shenzhen River. These fish ponds are gradually being filled in to make way for development including open storage areas. There are also some fish ponds in the lower Ng Tung Basin within the sub-catchment boundary of the Sheung Yue River.

There are three reservoirs in the Study Area at Lau Shui Heung on Kwan Tei River, Hok Tau on Tan Shan River, and a small reservoir on a tributary of the Sheung Yue River respectively. There are also water gathering grounds in the upper catchments where water is collected at inlets which are connected to a series of water tunnels conveying water to the reservoirs.

Major developments and industrial land uses are usually not permitted in water gathering grounds, due to concerns about the water quality of stormwater runoff from the site, which may cause deterioration in the quality of water collected from the gathering ground. As the proposed NDAs are outside the water gathering grounds, there should not be any adverse impact on water quality within the water gathering ground.

5.3.1.1 Main Drainage Basin

Ng Tung Basin

The main drainage system in the Ng Tung Basin comprises six main watercourses, i.e., Ng Tung, Sheung Yue, Shek Yeung, Ma Wat, Kwan Tei, and Tan Shan Rivers. The majority of these watercourses passes through the rural areas and includes some AFCD weirs, which are used for irrigation and also for village flood protection schemes which comprise flood storage ponds and pumping stations.

The drainage within the developed areas of Sheung Shui and Fanling mainly comprises a closed drainage system of pipes and culverts which convey runoff to the Ng Tung main drainage channel at the downstream and finally discharging into Shenzhen River.

San Tin Basin

There are five main watercourses in the San Tin Basin which are all outside the Study Area. However, a small portion of the Study Area at northwest falls within the catchment boundary of San Tin drainage system which drain northward and discharge into Shenzhen River. The land uses comprise steep upland sub-catchments and fish ponds in the low-lying area adjacent to the Shenzhen River.

5.3.1.2 Main Drainage Watercourses

The alignment and the engineering details of the major river and drainage channels located within the Study Area are presented in **Figure 5.2** and briefly described as follows:

Ng Tung River (River Indus)

Ng Tung River, also known as River Indus, is a river in the northern New Territories and the major sections of which are located within the FLN NDA. Tributaries of the river include Tan Shan River, Kwan Tei River and Ma Wat River. It passes through and separates the existing area of FLN NDA into two parts. Ma Shi Po, Wu Nga Lok Yeung, Tin Ping Shan Tsuen, Sheung Shui Slaughter House and Shek Wu Hui Sewage Treatment Works are located to the south, while Sheung Shui Wa Shan, Fu Tei Au Tsuen and Sheung Shui Water Treatment Works are located

to the north of Ng Tung River. The river further collects two other major rivers, namely Shek Sheung River and Sheung Yue River and runs parallel with East Rail before it finally discharges into Shenzhen River.

Shek Sheung River (River Sutlej)

Shek Sheung River, also known as River Sutlej, is a river in the northern New Territories near Sheung Shui. It originates from areas near Choi Po Court and Hong Kong Golf Club. The river is running along and parallel to East Rail in a north-south direction and joins with Sheung Yue River before it eventually discharges into Ng Tung River.

Sheung Yue River (River Beas)

Sheung Yue River, also known as River Beas, is a river in the northern New Territories passing through the existing area of Kwu Tung. Its sources are near Kai Kung Leng and Ki Lun Shan, where numerous streams flow into the river. It flows through the existing areas of KTN NDA and runs parallel to the western boundary of Long Valley. It joins up with Shek Sheung River just to the north of Long Valley and eventually discharges into Ng Tung River. There is a small vehicular bridge spanning across Sheung Yue River at the northern end of Long Valley.

5.3.1.3 Historic Flooding

There is a history of flooding in the low-lying areas of Ng Tung and San Tin Basins in both large and small rainstorm events during the past. Major flooding occurred in previous years including Typhoon Dot (26.9.93), Tropical Storm Faye (18.7.92), Typhoon Brenda (19-21.5.89), and Typhoon Warren (21-22.7.88) and during the rainfall event on 24.5.98.

However, flooding conditions have been improved considerably after the implementation of drainage improvement works of main drainage channels in Ng Tung and San Tin Basins. Apart from this, the hydraulic performance of the secondary drainage system has been assessed under Drainage Master Plan Studies which proposed significant drainage improvement works of secondary drainage system with some of them already completed and rest either in implementation or in planning stage. After the implementation of these drainage improvement works, the trained section of drainage system will be able to provide flood protection.

5.3.2 Sewage Treatment System

Existing and planned sewerage system within the Study Area is discussed in **Section 6**. All sewage from the planned developments within the NDAs will be collected to the sewage treatment facilities for necessary treatment before disposal.

5.3.3 Existing Baseline Condition

5.3.3.1 River Water Quality

KTN NDA

KTN NDA falls within the catchment of River Beas (Sheung Yue River). There are three EPD river water quality monitoring stations (RB1, RB2 and RB3) near KTN NDA. The compliance levels of WQO for River Beas were 79% in 2011. The river water quality was subjected to pollution from livestock farms, small industrial establishments and unsewered villages. The River Beas water quality was found to be "**Good**" at both upstream RB1, and "**Fair**" at RB2 and mid-stream downstream RB3 in 2011. The latest five-year environmental monitoring data are presented in **Table 5.4** and the locations of the monitoring stations are presented in **Figure 5.3**. Details of other streams including streams which flow only after rainstorm events are given in **Appendix 5.1**.

Table 5.4 - Summary of the EPD routine river water quality monitoring data for the River Beas between 2007 and 2011[5-1]

Parameter	Monitoring Point	Concentration [1]				
		2007	2008	2009	2010	2011
Dissolved Oxygen (DO) (mg/L)	RB1	8.1	8.3	9.0	9.7	10.2
	RB2	7.7	7.9	7.8	7.7	6.0
	RB3	6.5	6.7	7.8	8.1	8.8
pH	RB1	7.7	7.7	8.0	8.0	8.1
	RB2	7.5	7.4	7.5	7.5	7.4
	RB3	7.3	7.3	7.4	7.6	7.5
Suspended Solid (SS) (mg/L) (mg/L)	RB1	10	13	7	8	8
	RB2	12	24	11	20	11
	RB3	17	17	16	9	13
BOD_5 (mg/L)	RB1	3	4	2	3	3
	RB2	5	4	3	4	5
	RB3	4	5	4	8	6
COD (mg/L)	RB1	12	11	10	8	8
	RB2	14	12	9	10	11
	RB3	19	17	12	14	13

Notes:

1. Data presented are in annual medians of monthly samples

FLN NDA

FLN NDA falls within the catchment of River Indus (Ng Tung River). It is close to the existing new town development at Sheung Shui and Fanling and includes the area immediately south of River Indus. The site comprises of mostly agricultural farmlands and ponds, with scattered temporary structures that have no proper sewer systems.

There are two EPD river water quality monitoring stations (IN1 and IN2) in FLN NDA. The WQO compliance rate of River Indus was 67% in 2011, 82% in 2010 and 46% in 1997. The river water quality in 2011 was "**Good**" at upstream IN2, while "**Bad**" at downstream IN1 due to the

backflow from Shenzhen River. The latest environmental monitoring data are presented in **Table 5.5** and the locations of these monitoring stations are presented in **Figure 5.3**.

Table 5.5 - Summary of the EPD routine river water quality monitoring data for the River Indus between 2007 and 2011[5-1]

Parameter	Monitoring Point	Concentration [1]				
		2007	2008	2009	2010	2011
DO (mg/L)	IN1	5.8	2.9	4.7	5.1	3.7
	IN2	6.9	8.1	6.8	6.6	5.8
pH	IN1	7.2	7.1	7.3	7.4	7.3
	IN2	7.4	7.3	7.3	7.7	7.4
Suspended Solid (SS) (mg/L)	IN1	16	35	24	20	36
	IN2	12	6	6	10	11
BOD_5 (mg/L)	IN1	6	10	6	8	7
	IN2	3	3	3	3	3
COD (mg/L)	IN1	20	25	15	18	15
	IN2	11	9	8	8	9

Notes:

1. Data presented are in annual medians of monthly samples

All the water quality of River Beas, and River Indus showed an improvement tendency in the last decade. However, pollution of the major rivers in the Northwestern New Territories was still serious because of the remaining livestock farms and unsewered villages in the area. With the continued implementation of the Voluntary Surrender of Poultry and Pig Farm License Schemes, livestock waste pollution in the rivers should reduce. The North District Sewerage Master Plan and Yuen Long & Kam Tin Sewerage Master Plan have included plans to provide public sewers to most of the unsewered villages. River water quality in the Northwestern New Territories should gradually improve as these schemes take effect.

Details of other streams including streams which flow only after rainstorm events are given in **Appendix 5.1**.

Fanling Bypass

The proposed alignment of the Fanling Bypass runs along northern side of Ng Tung River. It turns south to run along the Ma Wat River before rejoining the Fanling Highway near Wo Hop Shek San Tsuen. There is, however, no water quality monitoring station in Ma Wat River.

5.3.3.2 Marine Water Quality

The NDAs are wholly located within the Deep Bay WCZ and could be referred to EPD's routine marine monitoring data at Inner Deep Bay area (Stations DM1 to DM3 according to EPD's data), which is more than 18km away from the NDAs. According to the Marine Water Quality in Hong Kong 2011, Deep Bay has the poorest water quality in the territory

with high concentrations of organic and inorganic pollutants and low levels of DO.

The compliance level of WQOs at Deep Bay was 40%, same as Year 2010. The total inorganic nitrogen exceeded the WQOs (i.e. 0.7mg/L) at three Stations DM1, DM2 and DM3 by 2.9, 1.98 and 0.93 mg/L, respectively. The inner bay was most affected by the discharges from Shenzhen River as well as Kam Tin River, Yuen Long Creek and Tin Shui Wai Nullah from the Hong Kong side. Details of EPD's marine water quality monitoring at Inner Deep Bay are presented in **Table 5.6** and the locations of monitoring stations are presented in **Figure 5.3.**

Table 5.6 - Marine water quality of Inner Deep Bay between 2007 and 2011[5-2]

Parameter	Monitoring Point	Concentration				
		2007	2008	2009	2010	2011
Dissolved Oxygen (mg/L)	DM1	3.8	5.2	4.1	4.2	4.8
	DM2	5.3	6.7	5.0	4.9	5.4
	DM3	6.4	7.2	6.2	6.2	6.8
Ammonia Nitrogen (mg/L)	DM1	5.62	2.88	4.04	2.830	2.520
	DM2	3.74	2.47	2.63	1.930	1.640
	DM3	0.84	0.55	0.57	0.436	0.438
Unionised Ammonia, mg/L (Annual mean)	DM1	0.057	0.045	0.050	0.025	0.024
	DM2	0.058	0.082	0.046	0.025	0.024
	DM3	0.017	0.014	0.015	0.009	0.009
Nitrite Nitrogen, mg/L	DM1	0.256	0.284	0.254	0.348	0.348
	DM2	0.305	0.291	0.280	0.348	0.308
	DM3	0.21	0.178	0.202	0.218	0.187
Nitrate Nitrogen (mg/L)	DM1	0.259	0.528	0.470	0.628	0.735
	DM2	0.308	0.52	0.505	0.687	0.734
	DM3	0.539	0.673	0.678	0.803	1.010
Total Inorganic Nitrogen, mg/L (Annual mean)	DM1	6.13	3.7	4.77	3.81	3.60
	DM2	4.36	3.28	3.42	2.97	2.68
	DM3	1.59	1.4	1.45	1.46	1.63
Total Kjeldahl Nitrogen (mg/L)	DM1	7.1	3.76	4.86	3.24	3.13
	DM2	4.89	3.34	3.09	2.33	2.14
	DM3	1.28	0.92	0.81	0.65	0.79
Total Nitrogen, mg/L	DM1	7.61	4.57	5.58	4.22	4.22
	DM2	5.51	4.15	3.87	3.36	3.18
	DM3	2.03	1.77	1.69	1.68	1.99
Orthophosphate Phosphorus (mg/L)	DM1	0.549	0.278	0.372	0.301	0.276
	DM2	0.405	0.24	0.283	0.236	0.227
	DM3	0.14	0.081	0.109	0.079	0.080
Total Phosphorous (mg/L)	DM1	0.73	0.41	0.55	0.38	0.38
	DM2	0.55	0.36	0.38	0.30	0.29

Parameter	Monitoring Point	Concentration				
		2007	2008	2009	2010	2011
	DM3	0.20	0.13	0.16	0.11	0.13
E.coli (cfu/100L) (Annual geometric mean)	DM1	5000	1400	1500	1300	1000
	DM2	1200	680	470	480	270
	DM3	38	85	32	26	19
pH	DM1	7.1	7.4	7.4	7.3	7.3
	DM2	7.3	7.6	7.5	7.5	7.5
	DM3	7.5	7.8	7.7	7.7	7.7
Suspended Solids (mg/L)	DM1	20.7	41.5	58.8	34.3	26.7
	DM2	19.7	22.9	38.4	23.8	16.2
	DM3	13.4	11.2	23.2	10.0	10.6
Salinity (psu)	DM1	17.1	17	17.5	17.2	16.9
	DM2	19.1	18.1	19.5	19.0	19.0
	DM3	22.9	21.2	22.9	21.4	23.6

5.4 Water Quality Sensitive Receivers

The water quality sensitive receivers (WSRs) for the whole NDAs include a number of fish ponds, wet agricultural lands, water courses, meander, marshland and water intake. These WSRs (**Figures 5.4 – 5.5**) and their approximate distances are given in **Table 5.7**.

Table 5.7 - Water quality sensitive receivers

ID	WSRs	Status	Location	Approximate Distance from Site
WSR1	Fish ponds and wet agricultural land at Ho Sheung Heung	Abundant or active fishponds/ agricultural land	KTN NDA	-
WSR2	The River Beas	Channelized nullah	KTN NDA	-
WSR3	Ponds and wet agricultural land to the north of the NDA, adjacent to the Shenzhen River	Abundant or active fishponds/ agricultural land	KTN NDA	~360m
WSR4	Long Valley – wet agricultural land, marshland, ponds	Abundant or active fishponds/ agricultural land	KTN NDA	-
WSR5	Ma Tso Lung Stream	Natural stream	KTN NDA	-
WSR6	Ma Tso Lung San Tsuen watercourse and nearby	Natural stream/marsh land	KTN NDA	-

ID	WSRs	Status	Location	Approximate Distance from Site
	marshland			
WSR7	Ngam Pin watercourse	Natural stream	KTN NDA	~120m
WSR8	Tsung Yuen watercourse, wet agricultural land and marshland	Natural stream/agricultural land/ marsh land	KTN NDA	-
WSR9	Shek Sheung River	Channelised nullah	KTN NDA	-
WSR10	Ho Sheung Heung watercourse	Channelised nullah	KTN NDA	-
WSR11	Fung Kong watercourse	Channelised nullah	KTN NDA	-
WSR12	Kwu Tung watercourse	Channelised nullah	KTN NDA	-
WSR13	Tung Fong/Shek Tsai Ling watercourse	Largely channelized nullah	KTN NDA	-
WSR14	Pak Shek Au watercourse	Channelised nullah	KTN NDA	-
WSR15	Lo Wu Correctional Institution watercourse and marshland nearby	Channelised nullah/marsh land	KTN NDA	-
WSR16	The River Indus	Channelized nullah	FLN NDA	-
WSR17	Fish ponds next to the River Indus/mitigation wetland	Abundant or active fishponds/wetland	FLN NDA	-
WSR18	Siu Hang San Tsuen watercourse	Natural stream	FLN NDA	-
WSR19	Cheung Po Tau watercourse	Natural stream	FLN NDA	~170m
WSR20	Tin Ping Shan Tsuen watercourse	Natural stream (part channelised)	FLN NDA	-
WSR21	Fu Tei Au watercourse	Channelised nullah	FLN NDA	-
WSR22	Sheung Shui Wa Shan watercourse	Channelised nullah	FLN NDA	-
WSR23	Ma Shi Po	Channelised	FLN	-

ID	WSRs	Status	Location	Approximate Distance from Site
	watercourse	nullah	NDA	
WSR24	Ma Wat River	Channelised nullah	FLN NDA	-
WSR25	All WSR for KTN and FLN NDAs	-	Fanling Bypass	-
WSR26	Nam Wa Po watercourse	Channelised nullah	Fanling Bypass	~50m
WSR27	Kau Lung Hang Lo Wai watercourse	Channelised but with natural bottom	Fanling Bypass	~100m to Fanling Bypass
WSR28	Kau Lung Hang San Wai watercourse	Channelization work in progress	Fanling Bypass	~100m to Fanling Bypass
WSR29	Yuen Leng watercourse	Natural stream	Fanling Bypass	~100m to Fanling Bypass
WSR 30	Kwan Tei River	Channelised	FLN NDA	~1500m

5.5 Assessment Methodology

In accordance with Clause 3.4.6 of the EIA Study Brief, the area for water quality impact assessment shall cover the Deep Bay WCZ. The study area would be extended to include other areas such as stream courses and associated water systems, fish ponds in the vicinity being impacts by the Project if found justifiable.

The major concerned areas during construction and operation of the NDAs development including Fanling Bypass are the works associated with residential and commercial development, internal and external roadworks, utility infrastructures, works associated with upgrading of sewerage system including Shek Wu Hui Sewage Treatment Works (SWHSTW) sewer mains and pumping stations. The provision and adequacy of the existing, committed and planned future facilities to reduce pollution arising from the storm water drainage system and surface water runoff during construction and operation of the Project was analyzed and proposed in subsequent sections.

There will be no dredging and reclamation works. Minor modification of natural streams and excavation works for bridge pier construction will be conducted within cofferdam or diaphragm walls which would have no contact with water bodies. Thus, the quantification of impacts is not required. Recommendations on good site practices have been proposed in order to minimize/avoid the water quality impact. The assessment approach is referred to Annex 6 – Criteria for Evaluating Water Pollution and Annex 14 – Guidelines for Assessment of Water Pollution under the TM-EIAO.

5.6 Identification and Evaluation of Environmental Impacts

5.6.1 Construction Phase

The following Designated Projects (DPs) have been included in the water impact assessment during construction phase:

KTN NDA

- San Tin Highway and Fanling Highway Kwu Tung Section Widening (between San Tin Interchange and Po Shek Wu Interchange) (Major Improvement) (DP1)
- Castle Peak Road Diversion (Major Improvement) (DP2)
- KTN NDA Road P1 and P2 (New Road), and associated new Kwu Tung Interchange (New Road) and Pak Shek Au Interchange Improvement (Major Improvement) (DP 3)
- KTN NDA Road D1 to D5 (New Road) (DP 4)
- New Sewage Pumping Stations (SPSs) in KTN (DP5)
- Utilization of Treated Sewage Effluent from Shek Wu Hui Sewage Treatment Works (SWHSTW) (DP 7)

FLN NDA

- Utilization of Treated Sewage Effluent from Shek Wu Hui Sewage Treatment Works (SWHSTW) (DP 7)
- Po Shek Wu Interchange Improvement (Major Improvement) (DP 8)
- Fanling Bypass Western Section (New Road) (DP 9)
- Fanling Bypass Eastern Section (New Road) (DP10)
- Shek Wu Hui Sewage Treatment Works - Further Expansion at FLN NDA (DP 11)
- Reprovision of temporary wholesale market in FLN NDA (DP12)
- New Sewage Pumping Stations (SPSs) in FLN NDA (DP13)

5.6.1.1 Construction Site Runoff

Construction site runoff would come from all over the works site during site formation for the development areas (KTN: ~450ha and FLN: ~164, all with 30% active area). According to DSD Stormwater Drainage Manual, the total peak runoff generated from these two areas would be about 6100m^3/hour and 3100m^3/hour respectively under 10-year-return-period rainstorm. The surface runoff might be polluted by:

- Runoff and erosion from site surfaces, drainage channels, earth working areas and stockpiles;
- Bentonite slurries and other grouting and cement materials;
- Wash water from dust suppression sprays and wheel washing facilities; and

- Fuel, oil, solvents and lubricants from maintenance of construction machinery and equipment.

In addition, water quality impact could also arise from the demolition of existing buildings and temporary structures, which would result in volumes of construction debris. Unless carefully controlled, this construction waste could enter any nearby pond, stream and river and lead to adverse impacts upon water quality.

Bentonite, grouting and cement materials may be used during the construction of residential buildings, roads and other infrastructural facilities. They may be delivered to the site by trunks. It is considered that the water pollution will only occur if the materials enter into water bodies as surface runoff or underground storm water / drainage discharge.

5.6.1.2 Alternation of Natural Streams

During construction, there will be potential water quality impact due to alternation of natural streams. According to the Ecological Impact Assessment (**Section 13**), the ecological importance of the natural streams in each NDA is summarized in **Table 5.8**. Other streams to be channelized are considered not significant ecological importance.

Table 5.8 - Ecological importance of the natural streams

NDA	Significance of Impact
Kwu Tung North	Impacts from channelization of Ma Tso Lung stream would be of **Moderate to High Ecological Importance** due to the important fauna present in the stream. Impacts on other streams considered to be of **Low Ecological Importance.**
Fanling North	Impacts from channelization of Siu Hang San Tsuen stream would be of **Moderate Ecological Importance** due to the presence of stream fauna. Loss of other streams would be of **Low to moderate Ecological Importance.**

The potential water quality impact associated with the alteration of natural streams will be from the runoff and erosion from site surfaces and earth working areas. River diversions may be required during the disconnection of the original natural streams. Cofferdam or diaphragm walls will be deployed for protecting river waters during excavation activities such that the construction works will have no contact with the original natural streams before diversion, except during sheetpile installation, as shown in **Figure 5.6**. Silt screen or similar devices will be deployed as far as possible during sheetpile installation. In order to provide an effective cut-off to ground water flow, the walls will need to be toe grouted. Once the primary panels are set, secondary panels will be constructed between the primary panels and the process then repeats to create a continuous wall. It should be noted that this slurry trench method will reduce the gap between the panels to the practicable minimum. After this, soil excavation will be commenced without contacting water. The intrusion of groundwater through cofferdams or diaphragm walls during soil excavation is therefore considered insignificant. To protect water quality from impacts due to the construction of bridge pier/box culvert,

cofferdam or diaphragm walls should also be deployed during their construction.

5.6.1.3 Groundwater from Contaminated Area

Groundwater sample was taken from 3 boreholes (i.e. 2 in KTN and 1 in FLN). No groundwater contamination was detected according to the testing results.

Moreover, all other potentially contaminated sites identified in NDAs were inaccessible and no groundwater sample has been collected. Detailed SI works for these sites are recommended to be conducted when they are resumed and handed over to the Project Proponent (PP) in accordance with **Chapter 8**.

5.6.1.4 Sewage from Workforce

Sewage arising from the on-site construction work force and wastewater from any canteen facilities are likely to cause water pollution without proper management. According to Table T-2 of Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning, the unit flow is $0.15m^3$/day/employed populations. The sewage is characterized by high levels of biochemical oxygen demand (BOD), ammonia, *E. coli* and oil / grease.

Sewage arising from the construction works on site should be collected by temporary sanitary facilities e.g. portable chemical toilets. Hence, no adverse water quality impact is anticipated.

5.6.2 Operational Phase

The following Designated Projects (DPs) have been included in the water impact assessment during operational phase:

KTN NDA

- San Tin Highway and Fanling Highway Kwu Tung Section Widening (between San Tin Interchange and Po Shek Wu Interchange) (Major Improvement) (DP1)
- Castle Peak Road Diversion (Major Improvement) (DP2)
- KTN NDA Road P1 and P2 (New Road), and associated new Kwu Tung Interchange (New Road) and Pak Shek Au Interchange Improvement (Major Improvement) (DP 3)
- KTN NDA Road D1 to D5 (New Road) (DP 4)
- New Sewage Pumping Stations (SPSs) in KTN (DP5)
- Utilization of Treated Sewage Effluent from Shek Wu Hui Sewage Treatment Works (SWHSTW) (DP 7)

FLN NDA

- Utilization of Treated Sewage Effluent from Shek Wu Hui Sewage Treatment Works (SWHSTW) (DP 7)
- Po Shek Wu Interchange Improvement (Major Improvement) (DP 8)

- Fanling Bypass Western Section (New Road) (DP 9)
- Fanling Bypass Eastern Section (New Road) (DP10)
- Shek Wu Hui Sewage Treatment Works - Further Expansion at FLN NDA (DP 11)
- New Sewage Pumping Stations (SPSs) in FLN NDA (DP13)

5.6.2.1 Sewage and Sewerage System

It is anticipated that domestic and commercial effluents including sewage effluents, local restaurant wastewaters and food markets will be the main types of sewage effluents from the developments.

A sewerage network will be built to collect the sewage generated from the NDAs. The collected sewage from NDAs will be diverted to the expanded SWHSTW (upgrading from 93,000m^3/d to 190,000m^3/d) for treatment before discharge. It will be necessary to ensure that the treated effluent is of appropriate quality and to ensure that the “No Net Increase in Pollution Loads Requirement” for Deep Bay could be satisfied. For cumulative impact consideration, there would be additional discharge from Lok Ma Chau Loop Sewage Treatment Works (LMCLSTW) (around 18,000m^3/day) to Deep Bay, as shown in **Section 6**. The ultimate load from the proposed upgraded SWHSTW together with concurrent projects to Deep Bay is summarized in **Table 5.9** below. Details of compensation are given in **Section 6**.

Table 5.9- Pollutant emission inventory subject to ‘no net increase in pollution loads’

Parameter	Unit	SWHSTW (Base Case)	SWHSTW (including NDA)	Cumulative (NDA SWHSTW+ LMCSTW)
Flow	m^3/day	113,000	190,000	208,000
BOD	kg/day	2260	1900	1990
TN	kg/day	1695	1520	1664
TP	kg/day	565	190	208

Whereas, the sewage flow from proposed development between San Uk Ling and Ng Tung River are recommended to be conveyed to SWHSTW. The expansion/upgrading of SWHSTW shall make provision for additional sewage flows from these developments.

Emergency discharge might be required if the on-site STW or sewage pumping stations failed. Adverse water quality impact to surrounded water bodies would be anticipated and impact minimization would therefore be required.

5.6.2.2 Discharge from District Cooling System

Water circulation for the operation of district cooling system (DCS) will be in closed circuit. During emergency or maintenance condition, wastewater will be discharged to the sewerage system. Adverse water quality impact is therefore not anticipated.

5.6.2.3 Runoff from Roads / Open Areas

The area covered by KTN NDA is around 450 ha and is generally bounded by the Frontier Closed Area to the north, Shek Sheung River to the east, Fanling Highway and Castle Peak Road to the south, Pak Shek Au and Tit Hang villages to the west. The majority of KTN NDA lies on a relatively flat area within the central and southern parts where the main developed areas are located.

The area covered by FLN NDA is around 164ha and is generally bounded by Fu Tei Au Road to the north, hills of Ma Tau Leng and Wa Shan to the north-east, Ma Wat River to the east, Sha Tau Kok Road to the south, Ma Sik Road, Tin Ping Road, Jockey Club Road and Po Wan Road to the south-west and a section of MTRC (formerly KCRC) East Rail to the west. FLN NDA is located immediately to the north-east of the developed area of Fanling and Sheung Shui New Towns. The majority of FLN NDA lies on a relatively flat area with mixed land uses which comprise agricultural and rural areas with scattered villages, some small isolated buildings and residential developments.

Potential water quality impact would be the surface runoff from the road surfaces (including the Fanling Bypass and local distributor roads), open spaces, etc during rainfall events which is known as non-point source pollutions during operational phase. Substances such as dust and lubricant oil deposited and accumulated on the road surfaces will be washed into the drainage system, fish ponds or streams during rainfall. A particular concern with surface run-off will be the ‘first flush’ of the system during the early phase of storm. The largest quantities of contaminants will be contained within the ‘first flush’ and the high degree of turbulence in the drains may erode material deposited within the drains. Floating debris and rubbish may also be carried by the surface runoff and may enter and block the stormwater drains. Improper control of the surface runoff may also increase the risk of flooding. The performance of the permanent drainage system will be designed to comply with the relevant regulations. Thus, the potential flood risk is considered as minimal.

However, in terms of the water quality impact, under existing scenario, the area has been partially developed and stormwater discharges would be eventually discharged to Deep Bay. Changes in loading could result due to increased runoff caused by reduced infiltration rate for paved areas resulting from the development on the one hand but the discharge might be less polluting than those from existing land use on the other. Worst scenario will be due to the first flush under heavy rainstorm events. Typical runoff concentrations were measured under the study of Update on Cumulative Water Quality and Hydrological Effect of Coastal Developments and Upgrading of Assessment Tool - Pollution Loading Inventory Report [5-4]. Under normal condition, runoff will not be generated in low rainfall intensity. Moreover, the possible additional pollution load could be minimized by proper design and good management practice for a specific site.

The estimate of non-point loading which is a minor source is presented in **Appendix 5.2**. The estimate takes into account the proposed land use, previous local and oversea studies and prevailing road and open space management practice with enhancement where beneficial.

5.6.2.4 Drainage System

There will be some alterations including channelization and diversion of small natural streams. The change in hydrology regime due to the project involves the additional paved area and the realignment of the small natural stream. The increased paved area may affect the infiltration rate of the catchment and increasing risk as a result of extra stormwater runoff may occur. Nevertheless, the performance of the current drainage system with the rehabilitated Ping Yuen River will comply with the relevant regulations. In addition, the proposed change will be localized compared with the big stormwater catchments. Thus, the potential flood risk is considered as minimal. [5-3]

There would be neither deep tunnel nor deep foundation due to the Project. The change of groundwater table is therefore not anticipated.

Given that insignificant impact of hydrological regime is anticipated, impacts on water quality regime are considered minimal.

5.6.2.5 Reuse of Treated Sewage Effluent

Reuse of treated sewage effluent (TSE) from the on-site STW will be served for flushing, DCS operation and landscape area irrigation. With the reuse, the discharge of sewage to Shenzhen River would be reduced. Furthermore, as the discharged TSE would comply with the criteria given in Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems Inland and Coastal Waters (TM-DSS), adverse impacts from reuse of TSE would not be anticipated. The relevant sewage impact assessment is given in **Chapter 6**.

5.7 Mitigation Measures

5.7.1 Construction Phase

5.7.1.1 Construction Site Runoff and Drainage

In accordance with the Practice Note for Professional Persons on Construction Site Drainage, Environmental Protection Department, 1994 (ProPECC PN 1/94), construction phase mitigation measures should be provided and the Storm Water Pollution Control Plan is given below.

Storm Water Pollution Control Plan

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

temporary on-site drainage system will be undertaken by the contractor prior to the commencement of construction.

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

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

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

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

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

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

- All open stockpiles of construction materials (for example, aggregates, sand and fill material) of more than 50m^3 should be covered with tarpaulin or similar fabric during rainstorms. Measures should be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system.

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

By adopting the above mitigation measures with best management practices, it is anticipated that the impacts of construction site runoff from the construction site will be reduced to satisfactory levels before discharges. Subject to detail design and contractor's site practice, the Storm Water Pollution Control Plan should be reviewed and enhanced, if necessary, to ensure that the loading are minimized and contained as estimated. The requirement of Storm Water Pollution Plan will be incorporated in the project contract documents.

5.7.1.2 Alternation of Natural Steams

Natural streams present at all two NDAs, supporting a variety of stream-associated fauna including certain threatened species. Most significance among these is the presence of Three-banded Box Terrapin in the stream at Ma Tso Lung in KTN NDA. The natural streams would be impacted if channelization resulted in the loss of natural stream beds, banks and/or riparian vegetation. It is recommended, however, that channelization of streams should be avoided as far as possible to minimize potential cumulative impacts to stream fauna resulting from continued channelization of lowland streams in Hong Kong. Where channelization of streams is required, this should follow the recommendations given in DSD PN No. 1/2005 and ETWB TCW No. 5/2005. Particular measures for the ecological importance streams in the NDAs shall refer to **Chapter 13** of Ecological Impact Assessment in this report.

In order to prevent sediment transport during riverbank works, deployment of silt screen or similar devices should be implemented, especially when construction works encroach or occur in close distance to water body. It is recommended to carry out all the riverbank works and diversion works within a cofferdam or diaphragm wall and the work areas on riverbed should be kept in dry condition. Cofferdam or diaphragm walls should also be deployed for protecting nearby water courses/streams during bridge pier/box culvert constructions. Locations of temporary cofferdams to protect streams during construction phase are presented in **Figures 5.7** and **5.8**.

5.7.1.3 Groundwater from Contaminated Area

The anomalistic high arsenic was detected in KTN and a health risk assessment was recommended in accordance with **Chapter 8**. The treatment methods for the high arsenic background will also be included in **Chapter 8**.

For other inaccessible sites, site investigation is required when they are resumed and handed over to the Project Proponent to identify if contaminated groundwater is found.

If the investigation results indicated that the groundwater to be generated from construction works would be contaminated, the contaminated groundwater should be either discharged into recharged wells, or properly treated in compliance with the requirements of Technical Memorandum on Standards for Effluents Discharged into Drainage on Sewerage Systems, Inland and Coastal Waters.

If recharged well method were used, the groundwater quality in the recharged well should not be affected by recharging operation, i.e. the pollution levels of the recharged groundwater should not be higher than that in the recharging wells.

If treatment and discharge method were used, the design of wastewater treatment facilities, such as active carbon and petrol interceptor, should

be submitted to the EPD and a discharge license should be obtained under the WPCO through the Regional Offices of EPD.

5.7.1.4 Sewage from Workforce

Portable chemical toilets and sewage holding tanks should be provided for handling the construction sewage generated by the workforce. A licensed contractor should be employed to provide appropriate and adequate portable toilets to cater 0.15m^3/day/employed populations and be responsible for appropriate disposal and maintenance.

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

5.7.2 Operational Phase

5.7.2.1 Sewage and Sewerage System

Sewage arising from all the proposed developments within the NDAs and closed area will be collected by sewer to the upgraded/ expanded SWHSTW before disposal. The no-net increase in pollution loading policy will be complied by compensating the existing pollution loading in Deep Bay catchment through diversion into the upgraded/expanded SWHSTW. The detailed sewerage and sewage impact assessment are given in **Chapter 6**.

Emergency discharge may be required if the failure of on-site STW or sewage pumping stations occurred. In order to prevent and minimize the impact due to the emergency discharge, the following precautionary measures shall be included in the STW design:

- To facilitate maintenance and repairing of equipment, standby unit should be provided;
- Dual power supply, or back-up power, should be provided, perfectly in the format of ring main or automatic-operated emergency generator with sufficient capacity to cope with the demand loading of the essential plant equipment;
- Telemetry system should be provided to the closet manned plant for unmanned facilities, such that swift actions could be taken in case of malfunction of unmanned facilities; and
- To prevent the discharge of floating solids, manually cleaned screens should be provided at the overflow bypass.

The occurrence of emergency discharge is remote according to local experience. In accordance with the approved EIA report of Tai Po STW (EIA-097/2004), emergency discharge of untreated effluent was occurred

once due to power failure at Year 1995. The duration of the emergency discharge was less than 3 hours with a total discharge volume of less than 9,000 m^3, compared to their design flow of 88,000 m^3/day at that time. With the implementation of dual power and the abovementioned precaution measures, the occurrence of emergency discharge of STW or sewage pumping station is unlikely.

5.7.2.2 Discharge from District Cooling System

As discussed in **Section 5.6.2.2**, effluent discharge from district cooling system would only occur during emergency or maintenance condition. All the effluent will be discharged to the proposed STW for treatment and adverse water quality impact is not anticipated. No mitigation measure is therefore required.

5.7.2.3 Runoff from Roads / Open Areas

During operational phase, vehicle dust, tyre scraps and oils might be washed away from the road surface / open areas to the nearby water courses by surface runoff or road surface cleaning. Subject to detail design and requirement of relevant government departments, the capacities of road drainage system shall cater the runoff from 50 year-return-period rainstorm. Proper drainage systems with silt traps and oil interceptors should be installed. The design of road gullies with silt traps and oil interceptors should be incorporated in later detailed design.

Runoff will be by controlled by good design practice and site management means. Runoff will be intercepted by properly designed and managed silt traps at appropriate spacings so that common roadside debris, refuse and fallen leaves etc can be captured before allowing the runoff to drain into streamcourses or rivers such as Ma Tso Lung stream. At the outlets to streamcourses or rivers,, the Project Proponent or the delegated operation parties should manage the road/open area cleaning prior to the occurrence of a storm. The operator should undertake the cleaning at an interval of twice a week and the frequency should be increased to suit actual site conditions. Moreover, it is recommended each of the cleaning events should not be separated by more than four days and should be carried out during low traffic flow period, preferably using either manual methods or mechanical means such as vacuum sweeper/truck equipped with side broom, which is to sweep road sludge and debris into the suction nozzle to increase the removal efficiency of pollutants. The collected pollutants would be tankered away for off-site disposal at landfill sites. After removal of the pollutants, the pollution levels from stormwater would be much reduced.

Given the stochastic nature of non-point source pollution and adopting flexible management to suit site conditions, the impact to the receiving water body is insignificant. The estimate of non-point loading which is a minor source is presented in **Appendix 5.2**.

During the EM&A programme, the project proponent should verify the efficiency of silt traps and cleaning frequencies by water quality monitoring during typical rainstorm events.

5.7.2.4 Drainage System

Compared to the whole stormwater catchments, the overall hydrology regime will not be significantly changed with the implementation of proper drainage system. Thus, the associated impact to water quality regime is anticipated to be minimal and no specific mitigation measures are required.

5.8 Cumulative Impacts

5.8.1 Construction Phase

The construction of the following projects might be carried out concurrently with the construction works for the NDAs and Fanling Bypass.

- Planning and engineering study on development of Lok Ma Chau (LMC) Loop
- Regulation of Shenzhen River Stage IV

The cumulative water quality impact of the proposed works, the identified concurrent projects, building construction works to be undertaken by future site developers and other small-scale local construction activities within the Study Area may introduce pollution loadings to the local drainage systems. However, such impacts may be readily controlled by implementation of adequate mitigation measures, good site practices and effective site management under individual projects. Cumulative water quality impacts are not anticipated.

5.8.2 Operational Phase

In addition to the sewage generated from the NDAs, cumulative impact on the sewage implication would be caused from other catchments such as from nearby developments such as LMC Loop. The compensation requirement for cumulative impact from LMC Loop has been included in the design of SWHSTW. The details of sewage impact assessment are discussed in **Chapter 6** in this report. Minor pollution sources including non-point source pollution of surface runoff from LMC Loop have also been taken into account and presented in **Appendix 5.2**.

5.9 Residual Environmental Impacts

No residual impact is anticipated during the construction and operation of the Project with the implementation of mitigation measures.

5.10 Summary

With full implementation of the mitigation measures, no adverse impact is anticipated. No residual impact and cumulative impact is anticipated during both the construction and operational phase of the Project.

5.11 Reference

[5-1] EPD, 2006-2011, River Water Quality Report

[5-2] EPD, 2006-2011, Marine Water Quality

[5-3] Agreement No. CE61/2007 (CE) North East New Territories New Development Areas Planning and Engineering Study - Investigation, Final Technical Report No.6D on Drainage and Sewerage Impact Assessments (Apart A - Drainage Impact Assessment)

[5-4] EPD (1999) Update on Cumulative Water Quality and Hydrological Effect of Coastal Developments and Upgrading of Assessment Tool – Pollution Loading Inventory Report

[5-5] Agreement No. CE 39/2001Shenzhen Western Corridor - Investigation and Planning, Environmental Impact Assessment Report