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5 WATER QUALITY IMPACT

5.1 Introduction

5.1.1.1 This section presents an assessment of the potential water quality impacts associated with the construction and operation of the Project. Suitable measures have been recommended, where necessary, to avoid, minimize and mitigate the potential impacts.

5.2 Legislation, Standards, Guidelines and Criteria

5.2.1 Environmental Impact Assessment Ordinance

5.2.1.1 The Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) specifies the assessment method and criteria that need to be followed in the EIA. The reference sections in EIAO-TM that are relevant to the water quality impact assessment include:

- Annex 6 Criteria for Evaluating Water Pollution.
- Annex 14 Guidelines for Assessment of Water Pollution.

5.2.2 Water Pollution Control Ordinance

5.2.2.1 The Water Pollution Control Ordinance (WPCO) provides the major statutory framework for the protection and control of water quality in Hong Kong. According to the WPCO and its subsidiary legislation, Hong Kong waters are divided into ten Water Control Zones (WCZ). Corresponding statements of Water Quality Objectives (WQOs) are stipulated for different water regimes (marine waters, inland waters, bathing beaches subzones, secondary contact recreation subzones and fish culture subzones) in the WCZ based on their beneficial uses. The assessment area covers Junk Bay WCZ, Eastern Buffer WCZ and other potentially affected area including part of Victoria Harbour WCZ, Port Shelter WCZ, Mirs Bay WCZ and Southern WCZ. The corresponding WQOs are presented in **Table 5.1** to **Table 5.6**.

Table 5.1 Water Quality Objectives for Junk Bay Water Control Zone

Parameters	Water Quality Objective	Part or Parts of Zone
A. Aesthetic Appearance	(a) Waste discharges shall cause no objectionable odours or discolouration of the water.	Whole zone
	(b) Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole zone
	(c) Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole zone
	(d) There should be no recognisable sewage-derived debris.	Whole zone
	(e) Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole zone
	(f) Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	Whole zone
B. Bacteria	(a) The level of *Escherichia coli* (*E. coli*) should not exceed 610 per 100 millilitre (mL), calculated as the geometric mean of all samples collected in one calendar year.	Secondary Contact Recreation Subzones and Fish Culture Subzones
	(b) The level of *E. coli* should not exceed 1 000 per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Inland waters
C. Colour	Waste discharges shall not cause the colour of water to exceed 50 Hazen units.	Inland waters
D. Dissolved Oxygen (DO)	(a) Waste discharges shall not cause the level of DO to fall below 4 milligram per litre (mg/L) for 90% of the sampling occasions during the year; values should be calculated as water column	Marine waters excepting Fish Culture Subzones

Parameters	Water Quality Objective	Part or Parts of Zone
	average (arithmetic mean of at least 3 measurements at 1 metre (m) below surface, mid-depth and 1 m above seabed). In addition, the concentration of DO should not be less than 2 mg/L within 2 m of the seabed for 90% of the sampling occasions during the year.	
	(b) The DO level should not be less than 5 mg/L for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of DO should not be less than 2 mg/L within 2 m of the seabed for 90% of the sampling occasions during the year.	Fish Culture Subzones
	(c) Waste discharges shall not cause the level of DO to be less than 4 mg/L.	Inland waters
E. pH	(a) The pH of the water should be within the range of 6.5–8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 units.	Marine waters
	(b) The pH of the water should be within the range of 6.0–9.0 units.	Inland waters
F. Temperature	Waste discharges shall not cause the natural daily temperature range to change by more than 2.0 degree Celsius (℃).	Whole zone
G. Salinity	Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole zone
H. Suspended Solids (SS)	(a) Waste discharges shall neither cause the natural ambient level to be raised by 30% nor give rise to accumulation of SS which may adversely affect aquatic communities.	Marine waters
	(b) Waste discharges shall not cause the annual median of SS to exceed 25 mg/L.	Inland waters
I. Ammonia	The ammoniacal nitrogen level should not be more than 0.021 mg/L, calculated as the annual average (arithmetic mean), as unionized form.	Whole zone
J. Nutrients	(a) Nutrients shall not be present in quantities sufficient to cause excessive growth of algae or other aquatic plants.	Marine waters
	(b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.3 mg/L, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed).	Marine waters
K. 5-Day Biochemical Oxygen Demand (BOD_5)	Waste discharges shall not cause the BOD_5 to exceed 5 mg/L	Inland waters
L. Chemical Oxygen Demand (COD)	Waste discharges shall not cause the COD to exceed 30 mg/L	Inland waters
M. Dangerous substances	(a) Waste discharges shall not cause the concentrations of dangerous substances in the water to attain such levels as to produce significant toxic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other.	Whole zone
	(b) Waste discharges of dangerous substances shall not put a risk to any beneficial uses of the aquatic environment.	Whole Zone

Source: Junk Bay Water Control Zone Statement of Water Quality Objectives

Table 5.2 Water Quality Objectives for Eastern Buffer Water Control Zone

Parameters	Water Quality Objective	Part or Parts of Zone
A. Aesthetic	(a) There should be no objectionable odours or discolouration of the water.	Whole zone

Parameters	Water Quality Objective	Part or Parts of Zone
Appearance		
	(b) Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole zone
	(c) Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole zone
	(d) There should be no recognisable sewage-derived debris.	Whole zone
	(e) Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole zone
	(f) The water should not contain substances which settle to form objectionable deposits.	Whole zone
B. Bacteria	(a) The level of *Escherichia coli* (*E. coli*) should not exceed 610 per 100 millilitre (mL), calculated as the geometric mean of all samples collected in a calendar year.	Fish Culture Subzones
	(b) The level of *E. coli* should be less than 1 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Water Gathering Ground Subzones
	(c) The level of *E. coli* should not exceed 1 000 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Other inland waters
C. Colour	(a) Human activity should not cause the colour of water to exceed 30 Hazen units.	Water Gathering Ground Subzones
	(b) Human activity should not cause the colour of water to exceed 50 Hazen units.	Other inland waters
D. Dissolved Oxygen (DO)	(a) The level of DO should not fall below 4 milligrams per litre (mg/L) for 90% of the sampling occasions during the whole year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 metre (m) below surface, mid-depth and 1 m above seabed). In addition, the concentration of DO should not be less than 2 mg/L within 2 m of the seabed for 90% of the sampling occasions during the whole year.	Marine waters excepting Fish Culture Subzones
	(b) The level of DO should not be less than 5 mg/L for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of DO should not be less than 2 mg/L within 2 m of the seabed for 90% of the sampling occasions during the whole year.	Fish Culture Subzones
	(c) The level of DO should not be less than 4 mg/L	Water Gathering Ground Subzones and other inland waters
E. pH	(a) The pH of the water should be within the range of 6.5-8.5 units. In addition, human activity should not cause the natural pH range to be extended by more than 0.2 units.	Marine waters
	(b) Human activity should not cause the pH of the water to exceed the range of 6.5-8.5 units.	Water Gathering Ground Subzones
	(c) Human activity should not cause the pH of the water to exceed the range of 6.0-9.0 units.	Other inland waters
F. Temperature	Human activity should not cause the natural daily temperature range to change by more than 2.0°C.	Whole zone
G. Salinity	Human activity should not cause the natural ambient salinity level to change by more than 10%.	Whole zone
H. Suspended Solids (SS)	(a) Human activity should neither cause the natural ambient level to be raised by more than 30% nor give rise to accumulation of SS which may adversely affect aquatic communities.	Marine waters
	(b) Human activity should not cause the annual median of SS to exceed 20 mg/L.	Water Gathering Ground Subzones

Parameters	Water Quality Objective	Part or Parts of Zone
	(c) Human activity should not cause the annual median of SS to exceed 25 mg/L.	Other inland waters
I. Ammonia	The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg/L, calculated as the annual average (arithmetic mean).	Whole zone
J. Nutrients	(a) Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
	(b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.4 mg/L, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed).	Marine waters
K. 5-Day Biochemical Oxygen Demand (BOD_5)	(a) The BOD_5 should not exceed 3 mg/L.	Water Gathering Ground Subzones
	(b) The BOD_5 should not exceed 5 mg/L	Other inland waters
L. Chemical Oxygen Demand (COD)	(a) The COD should not exceed 15 mg/L.	Water Gathering Ground Subzones
	(b) The COD should not exceed 30 mg/L.	Other inland waters
M. Toxic Substances	(a) Toxic substances in the water should not attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to interactions of toxic substances with each other.	Whole zone
	(b) Human activity should not cause a risk to any beneficial use of the aquatic environment.	Whole zone

Source: Statement of Water Quality Objectives (Eastern Buffer Water Control Zone)

Table 5.3 Water Quality Objectives for Victoria Harbour (Phases One, Phase Two and Phase Three) Water Control Zone

Parameters	Water Quality Objective	Part or Parts of Zone
A. Aesthetic Appearance	(a) There should be no objectionable odours or discolouration of the water.	Whole zone
	(b) Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole zone
	(c) Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole zone
	(d) There should be no recognisable sewage-derived debris.	Whole zone
	(e) Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole Zone
	(f) The water should not contain substances which settle to form objectionable deposits.	Whole zone
B. Bacteria	The level of *Escherichia coli* (*E. coli*) should not exceed 1 000 per 100 millilitre (mL), calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Inland waters
C. Colour	Human activity should not cause the colour of water to exceed 50 Hazen units.	Inland waters
D. Dissolved Oxygen (DO)	(a) The level of DO should not fall below 4 milligrams per litre (mg/L) for 90% of the sampling occasions during the whole year; values should be calculated as water column average (see Note). In addition, the concentration of DO should not be less than 2 mg/L within 2 metre (m) of the seabed for 90% of the sampling occasions during the whole year.	Marine waters
	(b) The level of DO should not be less than 4 mg/L	Inland waters
E. pH	(a) The pH of the water should be within the range of 6.5-8.5 units. In addition, human activity should not cause the natural pH range	Marine waters

Parameters	Water Quality Objective	Part or Parts of Zone
	to be extended by more than 0.2 units.	
	(b) Human activity should not cause the pH of the water to exceed the range of 6.0-9.0 units.	Inland waters
F. Temperature	Human activity should not cause the natural daily temperature range to change by more than 2.0°C.	Whole zone
G. Salinity	Human activity should not cause the salinity level to change by more than 10%.	Whole zone
H. Suspended Solids (SS)	(a) Human activity should neither cause the SS concentration to be raised more than 30% nor give rise to accumulation of SS which may adversely affect aquatic communities.	Marine waters
	(b) Human activity should not cause the annual median of SS to exceed 25 mg/L.	Inland waters
I. Ammonia	The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg/L, calculated as the annual average (arithmetic mean).	Whole zone
J. Nutrients	(a) Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
	(b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.4 mg/L, expressed as annual water column average (see Note).	Marine waters
K. 5-Day Biochemical Oxygen Demand (BOD_5)	The BOD_5 should not exceed 5 mg/L.	Inland waters
L. Chemical Oxygen Demand (COD)	The COD should not exceed 30 mg/L.	Inland waters
M. Toxic Substances	(a) Toxic substances in the water should not attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to interactions of toxic substances with each other.	Whole zone
	(b) Human activity should not cause a risk to any beneficial use of the aquatic environment.	Whole zone

Note: Expressed normally as the arithmetic mean of at least 3 measurements at 1 m below surface, mid depth and 1 m above the seabed. However, in water of a depth of 5 m or less the mean shall be that of 2 measurements (1 m below surface and 1 m above seabed), and in water of less than 3 m the 1 m below surface sample only shall apply.

Source: Statement of Water Quality Objectives (Victoria Harbour (Phase One, Phase Two and Phase Three) Water Control Zone)

Table 5.4 Water Quality Objectives for Port Shelter Water Control Zone

Parameters	Water Quality Objective	Part or Parts of Zone
A. Aesthetic Appearance	(a) Waste discharges shall cause no objectionable odours or discolouration of the water.	Whole zone
	(b) Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole zone
	(c) Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole zone
	(d) There should be no recognisable sewage-derived debris.	Whole zone
	(e) Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole zone
	(f) Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	Whole zone
B. Bacteria	(a) The level of *Escherichia coli* (*E. coli*) should not exceed 610 per 100 millilitre (mL), calculated as the geometric mean of all samples collected in a calendar year.	Secondary Contact Recreation Subzones and Fish Culture Subzones

Parameters	Water Quality Objective	Part or Parts of Zone
	(b) The level of *E. coli* should be less than 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October inclusive in one calendar year. Samples should be taken at least 3 times in a calendar month at intervals of between 3 and 14 days.	Bathing Beach Subzones
C. Colour	Waste discharges shall not cause the colour of water to exceed 50 Hazen units.	Inland waters
D. Dissolved Oxygen (DO)	(a) Waste discharges shall not cause the level of DO to fall below 4 milligrams per litre (mg/L) for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 metre (m) below surface, mid-depth and 1 m above seabed). In addition, the concentration of DO should not be less than 2 mg/L within 2 m of the seabed for 90% of the sampling occasions during the year.	Marine waters excepting Fish Culture Subzones
	(b) The level of DO should not be less than 5 mg/L for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of DO should not be less than 2 mg/L within 2 m of the seabed for 90% of the sampling occasions during the year.	Fish Culture Subzones
	(c) Waste discharges shall not cause the level of DO to be less than 4 mg/L	Inland waters
E. pH	(a) The pH of the water should be within the range of 6.5–8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 units.	Marine waters excepting Bathing Beach Subzones
	(b) The pH of the water should be within the range of 6.0–9.0 units for 95% of samples. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 units.	Bathing Beach Subzones
	(c) Waste discharges shall not cause the pH of the water to exceed the range of 6.5–8.5 units.	Ho Chung (A) Subzone
	(d) The pH of the water should be within the range of 6.0–9.0 units.	Other inland waters
F. Temperature	Waste discharges shall not cause the natural daily temperature range to change by more than 2.0°C.	Whole zone
G. Salinity	Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole zone
H. Suspended Solids (SS)	(a) Waste discharges shall neither cause the natural ambient level to be raised by 30% nor give rise to accumulation of SS which may adversely affect aquatic communities.	Marine waters
	(b) Waste discharges shall not cause the annual median of SS to exceed 25 mg/L.	Inland waters
I. Ammonia	The ammonia nitrogen level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean), as unionised form.	Whole zone
J. Nutrients	(a) Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
	(b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.1 mg/L, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed).	Marine waters
K. 5-Day Biochemical Oxygen Demand (BOD_5)	Waste discharges shall not cause the BOD_5 to exceed 5 mg/L.	Inland waters
L. Chemical Oxygen Demand (COD)	Waste discharges shall not cause the COD to exceed 30 mg/L.	Inland waters

Parameters	Water Quality Objective	Part or Parts of Zone
M. Dangerous substances	(a) Waste discharges shall not cause the concentrations of dangerous substances in the water to attain such levels as to produce significant toxic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other.	Whole zone
	(b) Waste discharges of dangerous substances shall not put a risk to any designated beneficial uses of the aquatic environment.	Whole zone
N. Phenol	Phenols shall not be present in such quantities as to produce a specific odour, or in concentrations greater than 0.05 mg/L as C_6H_5OH.	Bathing Beach Subzones
O. Turbidity	No changes in turbidity or other factors arising from waste discharges shall reduce light transmission substantially from the normal level.	Bathing Beach Subzones

Source: Port Shelter Water Control Zone Statement of Water Quality Objectives

Table 5.5 Water Quality Objectives for Mirs Bay Water Control Zone

Parameters	Water Quality Objective	Part or Parts of Zone
A. Aesthetic Appearance	(a) Waste discharges shall cause no objectionable odours or discolouration of the water.	Whole zone
	(b) Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole zone
	(c) Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole zone
	(d) There should be no recognisable sewage-derived debris.	Whole zone
	(e) Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole zone
	(f) Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	Whole zone
B. Bacteria	(a) The level of *Escherichia coli* (*E. coli*) should not exceed 610 per 100 millilitre (mL), calculated as the geometric mean of all samples collected in a calendar year.	Secondary Contact Recreation Subzones and Fish Culture Subzones
	(b) The level of *E. coli* should be zero per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Water Gathering Ground Subzones
	(c) The level of *E. coli* should not exceed 1 000 per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Other inland waters of the Zone
C. Colour	(a) Waste discharges shall not cause the colour of water to exceed 30 Hazen units.	Water Gathering Ground Subzones
	(b) Waste discharges shall not cause the colour of water to exceed 50 Hazen units.	Other inland waters of the Zone
D. Dissolved Oxygen (DO)	(a) Waste discharges shall not cause the level of DO to fall below 4 milligrams per litre (mg/L) for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 metre (m) below surface, mid-depth and 1 m above seabed). In addition, the concentration of DO should not be less than 2 mg/L within 2 m of the seabed for 90% of the sampling occasions during the year.	Marine waters excepting Fish Culture Subzones
	(b) The DO level should not be less than 5 mg/L for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of DO should not be less than 2 mg/L within 2 m of the seabed for 90% of the sampling occasions during the year.	Fish Culture Subzones

Parameters	Water Quality Objective	Part or Parts of Zone
	(c) Waste discharges shall not cause the level of DO to be less than 4 mg/L	Water Gathering Ground Subzones and Other inland waters
E. pH	(a) The pH of the water should be within the range of 6.5–8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 units.	Marine waters
	(b) Waste discharges shall not cause the pH of the water to exceed the range of 6.5–8.5 units.	Water Gathering Ground Subzones
	(c) The pH of the water should be within the range of 6.0–9.0 units.	Other inland waters of the Zone
F. Temperature	Waste discharges shall not cause the natural daily temperature range to change by more than 2.0 °C.	Whole zone
G. Salinity	Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole zone
H. Suspended Solids (SS)	(a) Waste discharges shall neither cause the natural ambient level to be raised by 30% nor give rise to accumulation of SS which may adversely affect aquatic communities.	Marine waters
	(b) Waste discharges shall not cause the annual median of SS to exceed 20 mg/L.	Water Gathering Ground Subzones and Other inland waters of the Zone
I. Ammonia	The un-ionized ammoniacal nitrogen level should not be more than 0.021 milligram per litre, calculated as the annual average (arithmetic mean).	Whole zone
J. Nutrients	(a) Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
	(b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.3 mg/L, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed).	Marine waters
K. 5-Day Biochemical Oxygen Demand (BOD_5)	(a) Waste discharges shall not cause the BOD_5 to exceed 3 mg/L.	Water Gathering Ground Subzones
	(b) Waste discharges shall not cause the BOD_5 to exceed 5 mg/L.	Other inland waters of the Zone
L. Chemical Oxygen Demand (COD)	(a) Waste discharges shall not cause the COD to exceed 15 mg/L.	Water Gathering Ground Subzones
	(b) Waste discharges shall not cause the COD to exceed 30 mg/L.	Other inland waters of the Zone
M. Toxins	(a) Waste discharges shall not cause the toxins in water to attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans or fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other.	Whole zone
	(b) Waste discharges shall not cause a risk to any beneficial uses of the aquatic environment.	Whole zone

Source: Statement of Water Quality Objectives (Mirs Bay Water Control Zone)

Table 5.6 Water Quality Objectives for Southern Water Control Zone

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

Parameters	Water Quality Objective	Part or Parts of Zone
	(e) Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole zone
	(f) Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	Whole zone
B. Bacteria	(a) The level of *Escherichia coli* (*E. coli*) should not exceed 610 per 100 millilitre (mL), calculated as the geometric mean of all samples collected in a calendar year.	Secondary Contact Recreation Subzones and Fish Culture Subzones
	(b) The level of *E. coli* should be less than 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October inclusive in one calendar year. Samples should be taken at least 3 times in a calendar month at intervals of between 3 and 14 days.	Bathing Beach Subzones
C. Dissolved Oxygen (DO)	(a) Waste discharges shall not cause the level of DO to fall below 4 milligrams per litre (mg/L) for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 metre (m) below surface, mid-depth and 1 m above seabed). In addition, the concentration of DO should not be less than 2 mg/L within 2 m of the seabed for 90% of the sampling occasions during the year.	Marine waters excepting Fish Culture Subzones
	(b) The DO level should not be less than 5 mg/L for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of DO should not be less than 2 mg/L within 2 m of the seabed for 90% of the sampling occasions during the year.	Fish Culture Subzones
	(c) Waste discharges shall not cause the level of DO to be less than 4 mg/L	Inland waters of the Zone
D. pH	(a) The pH of the water should be within the range of 6.5–8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 units.	Marine waters excepting Bathing Beach Subzones; Mui Wo (A), Mui Wo (B), Miu Wo (C), Mui Wo (E) and Mui Wo (F) Subzones.
	(b) The pH of the water should be within the range of 6.0–9.0 units.	Mui Wo (D) Subzone and other inland waters.
	(c) The pH of the water should be within the range of 6.0–9.0 units for 95% of samples. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 units.	Bathing Beach Subzones
E. Temperature	Waste discharges shall not cause the natural daily temperature range to change by more than 2.0 °C.	Whole zone
F. Salinity	Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole zone
G. Suspended Solids (SS)	(a) Waste discharges shall neither cause the natural ambient level to be raised by 30% nor give rise to accumulation of SS which may adversely affect aquatic communities.	Marine waters
	(b) Waste discharges shall not cause the annual median of SS to exceed 20 mg/L.	Mui Wo (A), Mui Wo (B), Mui Wo (C), Mui Wo (E) and Mui Wo (F) Subzones.
	(c) Waste discharges shall not cause the annual median of SS to exceed 25 mg/L	Mui Wo (D) Subzone and other inland waters.
H. Ammonia	The ammonia nitrogen level should not be more than 0.021 mg/L,	Whole zone

Parameters	Water Quality Objective	Part or Parts of Zone
	calculated as the annual average (arithmetic mean), as unionised form.	
I. Nutrients	(a) Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
	(b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.1 mg/L, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed).	Marine waters
J. 5-Day Biochemical Oxygen Demand (BOD_5)	Waste discharges shall not cause the BOD_5 to exceed 5 mg/L.	Inland waters of the Zone
K. Chemical Oxygen Demand (COD)	Waste discharges shall not cause the COD to exceed 30 mg/L.	Inland waters of the Zone
L. Dangerous substances	(a) Waste discharges shall not cause the concentrations of dangerous substances in the water to attain such levels as to produce significant toxic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other.	Whole zone
	(b) Waste discharges of dangerous substances shall not put a risk to any designated beneficial uses of the aquatic environment.	Whole zone

Source: Southern Water Control Zone Statement of Water Quality Objectives

5.2.3 Technical Memorandum on Effluent Discharge Standard

5.2.3.1 Besides setting the WQOs, the WPCO controls effluent discharging into the WCZs through a licensing system. Guidance on the permissible effluent discharges based on the type of receiving waters (foul sewers, stormwater drains, inland and coastal waters) is provided in the Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS). The limits given in the TM-DSS cover the physical, chemical and microbial quality of effluents. Any effluent discharge during the construction and operation stages should comply with the relevant standards as stipulated in the TM-DSS.

5.2.4 Professional Persons Environmental Consultative Committee Practice Notes

5.2.4.1 The Professional Persons Environmental Consultative Committee Practice Note on Drainage Plans subject to Comments by Environmental Protection Department (ProPECC PN 1/23) provides guidelines and practices for handling, treatment and disposal of various effluent discharges to stormwater drains and foul sewers during the operation phase.

5.2.4.2 The Professional Persons Environmental Consultative Committee Practice Note on Construction Site Drainage (ProPECC PN 2/23) provides good practice guidelines for dealing with various types of discharge from a construction site. These include surface runoff, groundwater, boring and drilling water, bentonite slurry, water for testing and sterilisation of water retaining structures and water pipes, wastewater from building construction, acid cleaning, etching and pickling wastewater, and wastewater from site facilities. Practices outlined in the ProPECC PN 2/23 should be followed where applicable during the construction phase to minimize the water quality impact due to construction site drainage.

5.2.4.3 The relevant practices outlined in ProPECC PN 1/23 and ProPECC PN 2/23 should be implemented for the Project as far as practicable to ensure proper handling, treatment and disposal of various discharges from the Project.

5.2.5 Technical Circular

5.2.5.1 Environment, Transport and Works Bureau Technical Circular (ETWB TC) (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 watercourses at or near the Project area during the construction phase.

5.2.6 Water Quality Criteria for Flushing Water Intakes

5.2.6.1 The Water Supplies Department (WSD) has specified a set of target seawater quality objectives for their flushing water intakes. The list is shown in **Table 5.7** below. These target objectives will be adopted for the flushing intakes (namely FW1 to FW6) in **Figure 5.1**. There is no seawater outfall, spent cooling water outfall nor sewage effluent outfall located within 100 m from these flushing water intakes under both the existing scenario and the "with Project" scenarios.

Table 5.7 WSD's Target Seawater Quality Objectives at Flushing Water Intakes

Parameter (in mg/L unless otherwise stated)	WSD's Target Water Quality Limit at Flushing Water Intake
Colour (Hazen Unit)	< 20
Turbidity (NTU)	< 10
Threshold Odour Number (odour unit)	< 100
Ammonia Nitrogen (NH_3-N)	< 1
Suspended Solids (SS)	< 10
Dissolved Oxygen (DO)	> 2
5-Day Biochemical Oxygen Demand (BOD_5)	< 10
Synthetic Detergents	< 5
E. coli (no./100mL)	< 20,000

5.2.7 Water Quality Standards for Rainwater Effluent

5.2.7.1 Effluent from any proposed rainwater harvesting system shall meet the water quality standards specified in the "Technical Specifications on Grey Water Reuse and Rainwater Harvesting" issued by the WSD, as presented in **Table 5.8**.

Table 5.8 Water Quality Standards for Treated Grey Water and Rainwater Effluent

Parameters	Unit	Recommended Water Quality Standards
E. coli	cfu /100 ml	Non detectable
Total residual chlorine	mg/l	≥ 1 exiting treatment system; ≥ 0.2 at user end
DO in reclaimed water	mg/l	≥ 2
Total Suspended Solids (TSS)	mg/l	≤ 5
Colour	Hazen unit	≤ 20
Turbidity	NTU	≤ 5
pH		6 - 9
Threshold Odour Number (TON)		≤ 100
BOD_5	mg/l	≤ 10
NH_3-N	mg/l as N	≤ 1
Synthetic detergents	mg/l	≤ 5

Notes:
1. Apart from total residual chlorine which has been specified, the water quality standards for all parameters shall be applied at the point-of-use of the system.
2. Where recycled water is treated for immediate usage, the level of total residual chlorine may be lower than the one specified in this table.
3. Immediate usage means the collected grey water/ rainwater is drawn into the treatment process immediate before a particular round of usage and the treated water will be depleted after that round of usage is completed.

5.2.8 Water Quality Criteria for Seawater Intake of Desalination Plant

5.2.8.1 There are no available legislative water quality requirements specific to the seawater intake of desalination plant. The statutory WQOs stipulated under the WPCO are used to assess the potential water quality impact on the seawater intake of Tseung Kwan O (TKO) desalination plant (namely SW1 in **Figure 5.1**). The WQOs are summarized in **Table 5.9**. There is no seawater outfall, spent cooling water outfall nor sewage effluent outfall located within 100 m from this seawater intake (SW1) under both the existing scenario and the "with Project" scenarios.

Table 5.9 Water Quality Criteria for Seawater Intake Desalination Plant

Parameter	WQOs for Eastern Buffer WCZ
Bottom DO	≥ 2 mg/L for 90% of samples
Depth-averaged DO	≥ 4 mg/L for 90% of samples
SS	≤ 30% increase
Unionized Ammonia (UIA)	≤ 0.021 mg/L
Total Inorganic Nitrogen (TIN)	≤ 0.4 mg/L

Remark: Full descriptions of the WQOs are provided in **Table 5.2**.

5.2.8.2 The design basis values for seawater quality (see table below) developed for the first stage of the TKO desalination plant provided by WSD are also referenced to assess the potential water quality impact during construction and operation phases.

Table 5.10 Seawater Qualtiy Design Basis Value

Parameter	Design Basis Value
Temperature	15 to 30.1^{o}C
TSS	≤ 40 mg/L
Total Dissolved Solids (TDS)	≤ 39,000 mg/L
Bromide	≤ 80 mg/L
Boron	≤ 5.3 mg/L

5.2.9 Sewerage Manual (Part 2)

5.2.9.1 Part 2 of the Sewerage Manual issued by Drainage Services Department (DSD) offers guidance on the planning, design, construction, operation and maintenance of the sewage pumping stations and rising mains in Hong Kong, which shall be observed and followed under this Project where applicable.

5.2.10 Environmental Guidance Note for Sewage Pumping Stations which is not a Designated Project

5.2.10.1 This guidance note (GN) is intended to provide environmental advice about sewage pumping stations which are not classified as a Designated Project (DP) under the Environmental Impact Assessment Ordinance (EIAO). It provides guidelines for the works departments or agents (usually DSD) to site, plan, design, construct and operate sewage pumping stations that are not DPs.

5.2.11 Water Quality Criteria for Cooling Water Intakes

5.2.11.1 Based on the information provided by the individual cooling water intake operators under other relevant EIA studies such as the approved EIAs for "Tseung Kwan O – Lam Tin Tunnel and Associated Works (AEIAR-173/2013)", "Upgrading of Tai Po Sewage Treatment Works (AEIAR-244/2022)" and "Sha Tin to Central Link - Hung Hom to Admiralty Section (AEIAR-166/2012)", etc., no specific seawater quality requirement is available for the cooling water intakes identified in the assessment area including the cooling water intakes of Kai Tak District Cooling System (DCS), Yau Tong Bay Ice Plant, North Point Government Office, Taikoo Place and Pamela Youde Nethersole Eastern Hospital.

5.2.12 Criteria for Heavy Metals and Micro-pollutants

5.2.12.1 There are no legislative standards in Hong Kong for assessment of acceptable concentrations of heavy metals and micro-pollutants such as total polychlorinated biphenyls (PCBs), total polyaromatic hydrocarbons (PAHs) and tributyltin (TBT) in marine water. Heavy metals and micro-pollutants are potential sediment-bound contaminants which may be released into the marine water due to dredging. It is proposed to adopt the relevant overseas standards as summarized in **Table 5.11** below. The most stringent criteria amongst the four overseas references identified in **Table 5.11** are adopted in this assessment.

Table 5.11 Criteria for Heavy Metals and Micro-pollutants

Parameters	Assessment Criteria (μg/L)		Overseas Reference 1	Overseas Reference 2	Overseas Reference 3	Overseas Reference 4
	Proposed Value	Overseas Reference				
Arsenic (As)	13	1	13 (a)	25 (b)	36	-
Chromium (Cr)	4.4	1	4.4 (a)	15 (b)	50	-
Copper (Cu)	1.3	1	1.3 (a)	5 (b)	3.1	-
Lead (Pb)	4.4	1	4.4 (a)	25 (b)	8.1	-
Silver (Ag)	1.4	1	1.4 (a)	2.3 (b)	-	-
Zinc (Zn)	8	1	8 (a)	40 (b)	81	-
Mercury (Hg)	0.3	2	0.4 (a)	0.3 (b)	0.94	-
Cadmium (Cd)	2.5	2	5.5 (a)	2.5 (b)	7.9	-
Nickel (Ni)	8.2	3	70 (a)	30 (b)	8.2	-
PCBs	0.03	3	-	-	0.03 (a), (b)	-
PAHs	0.2	3	3 (b)	-	0.2 (a)	-
TBT	0.006	3	-	-	0.006 (a)	0.1 (b)

Shaded Cell – Proposed criteria for this EIA

Overseas References:

1. Australian & New Zealand Guidelines for Fresh & Marine Water Quality.
2. European Union Environmental Quality Standard (EQS) Values to Protect Marine Life.
3. U.S. Environmental Protection Agency (USEPA) National Recommended Water Quality Criteria. Criteria Continuous Concentration (CCC).
4. Michael H. Salazar and Sandra M. Salazar (1996). *"Mussels as Bioindicators: Effects of TBT on Survival, Bioaccumulation, and Growth under Natural Conditions"* in Organotin, edited by M. A. Champ and P. F. Seligman. Chapman & Hall, London.

Recent EIA References:

(a) Criteria adopted under the EIA for New Contaminated Sediment Disposal Facility to the West of Lamma Island (AEIAR-241/2022)
(b) Criteria adopted under the EIA for Lei Yue Mun Waterfront Enhancement Project (AEIAR-219/2018).

5.2.13 Water Quality Criteria for Marine Ecological Sensitive Receivers

5.2.13.1 Potential impacts on benthic organisms may arise through excessive sediment deposition. The magnitude of the potential impacts on benthic communities is assessed with reference to the predicted SS and sedimentation rate.

5.2.13.2 The statutory WQO for SS of no more than 30% increase from the ambient level is utilized for determining the acceptability of sediment impacts on important benthic communities (e.g. corals).

5.2.13.3 There is no existing legislative standard on sedimentation rate available. The reference sedimentation rate of no more than 100 g/m^2/day [1] is adopted in this assessment for protecting the benthic ecology, following the approach used in other EIA projects in the central and eastern waters of Hong Kong such as the EIAs for "Tseung Kwan O – Lam Tin Tunnel and Associated Works (AEIAR-173/2013)", "Tseung Kwan O Desalination Plant (AEIAR-192/2015)" and "Sha Tin to Central Link - Hung Hom to Admiralty Section (AEIAR-166/2012)", etc.

5.2.13.4 The statutory WQOs for SS, DO, TIN and UIA as well as the reference criteria for heavy metals and micro-pollutants are also used to assess the potential impact on marine ecological sensitive receivers.

5.2.14 Water Quality Criteria for Fish Culture Zones

5.2.14.1 The statuary WQOs stipulated under the WPCO are adopted as the assessment criteria for Fish Culture Zones (FCZs) as shown in **Table 5.12**.

Table 5.12 Water Quality Criteria for Fish Culture Zones

Parameter	Eastern Buffer WCZ	Port Shelter WCZ
	Tung Lung Chau FCZ	Po Toi O FCZ
Bottom DO	≥ 2 mg/L for 90% of samples	≥ 2 mg/L for 90% of samples
Depth-averaged DO	≥ 5 mg/L for 90% of samples	≥ 5 mg/L for 90% of samples
SS	≤ 30% increase	≤ 30% increase
Annual Geometric Mean *E. coli*	≤ 610 per 100 mL	≤ 610 per 100 mL
UIA	≤ 0.021 mg/L	≤ 0.021 mg/L
TIN	≤ 0.4 mg/L	≤ 0.1 mg/L

Remark: The water quality criteria for FCZs are in accordance with the statutory WQOs. Full descriptions of the WQOs are provided in **Table 5.2** and **Table 5.4**.

5.3 Description of the Environment

5.3.1 Marine Water

5.3.1.1 The EPD water quality monitoring stations in Victoria Harbour East (VM1 and VM2), Eastern Buffer (EM1, EM2 and EM3), Junk Bay (JM3 and JM4) and Mirs Bay (MM19) are the nearest monitoring stations to the Project sites (see **Figure 5.1**). A summary of the relevant monitoring data extracted from the EPD's publication "Marine Water Quality in Hong Kong in 2023" is presented in **Table 5.13** and **Table** 5.14. Full WQO compliances were recorded at all selected stations in 2023.

Table 5.13 Marine Water Quality Monitoring Data Collected by EPD at Victoria Habour East, Chai Wan and Tathong Channel in 2023

Parameter		Victoria Harbour WCZ		Eastern Buffer WCZ			Summary of WPCO WQOs
		Victoria Harbour East		Chai Wan	Tathong Channel		
		VM1	VM2	EM1	EM2	EM3	
Temperature (°C)		23.8 (18.2 - 29.2)	24.1 (18.2 - 29.1)	23.6 (17.9 - 29.4)	23.6 (17.9 - 29.4)	23.6 (18.1 - 29.4)	≤ 2 °C change from natural daily range
Salinity		32.7 (31.8 - 33.6)	32.4 (31.2 - 33.5)	32.7 (31.8 - 33.6)	32.8 (31.9 - 33.7)	33.0 (32.3 - 33.7)	±10% change from natural ambient level
DO (mg/L)	Depth average	5.8 (4.0 – 6.9)	6.5 (4.0 - 8.0)	6.4 (4.7 - 7.9)	6.2 (4.6 - 7.5)	6.3 (5.2 - 7.6)	≥4 mg/L for 90% of the samples during the year
	Bottom	5.9	5.5	5.6	6.0	5.8	≥2 mg/L for 90% of the

[1] This sedimentation criterion is used for protection of important benthic organisms or subtidal habitats (e.g., corals). It is not applicable to other WSRs such as seawater intakes where the main concern would be on the surface or mid-depth water quality.

Parameter		Victoria Harbour WCZ		Eastern Buffer WCZ			Summary of WPCO WQOs
		Victoria Harbour East		Chai Wan	Tathong Channel		
		VM1	VM2	EM1	EM2	EM3	
		(3.5 - 7.4)	(3.7 – 7.2)	(3.5 - 7.9)	(3.7 – 8.0)	(3.8 - 7.7)	samples during the year
DO (% Saturation)	Depth average	82 (60 - 91)	92 (61 - 118)	91 (69 - 115)	88 (66 - 106)	89 (76 - 99)	N/A
	Bottom	83 (51 - 97)	78 (55 - 94)	79 (50 - 102)	84 (53 - 103)	82 (55 - 100)	N/A
pH		7.7 (7.3 - 8.0)	7.7 (7.1 - 8.1)	7.7 (7.1 - 8.2)	7.7 (7.1 - 8.2)	7.7 (7.2 - 8.2)	6.5 - 8.5 (± 0.2 change from natural range)
Secchi disc Depth (m)		2.9 (2.1 – 3.8)	2.8 (2.2 – 4.3)	2.8 (2.0 – 3.6)	2.7 (2.1 – 3.5)	3.2 (2.1 – 5.1)	N/A
Turbidity (NTU)		8.4 (1.6 - 54.7)	10.5 (1.9 - 78.2)	4.4 (1.1 - 13.7)	3.9 (1.2 – 12.1)	3.5 (0.9 – 12.6)	N/A
SS (mg/L)		6.0 (1.4 – 11.7)	5.5 (2.3 – 8.7)	5.0 (1.9 – 9.7)	4.7 (1.4 – 7.8)	4.3 (1.5 – 11.0)	≤ 30% increase from natural ambient level
BOD_5 (mg/L)		0.3 (0.1 – 0.7)	0.4 (<0.1 – 0.7)	0.5 (<0.1 – 1.1)	0.5 (<0.1 - 1.2)	0.4 (0.1 – 0.8)	N/A
NH_3-N (mg/L)		0.060 (0.032 - 0.092)	0.097 (0.041 - 0.180)	0.057 (0.034 - 0.120)	0.049 (0.023 - 0.110)	0.029 (0.008 - 0.067)	N/A
UIA (mg/L)		0.002 (<0.001 - 0.005)	0.003 (<0.001 - 0.007)	0.001 (<0.001 - 0.002)	0.001 (<0.001 - 0.002)	<0.001 (<0.001 - 0.002)	≤0.021 mg/L (annual mean)
Nitrite Nitrogen (NO_2-N) (mg/L)		0.017 (0.004 - 0.032)	0.023 (0.009 - 0.038)	0.018 (0.004 - 0.044)	0.017 (0.004 - 0.043)	0.013 (<0.002 - 0.043)	N/A
Nitrate Nitrogen (NO_3-N) (mg/L)		0.067 (0.029 - 0.127)	0.098 (0.051 - 0.150)	0.087 (0.035 - 0.203)	0.077 (0.021 - 0.193)	0.065 (<0.002 - 0.190)	N/A
TIN (mg/L)		0.14 (0.08 - 0.20)	0.22 (0.13 - 0.34)	0.16 (0.09 - 0.34)	0.14 (0.06 - 0.33)	0.11 (0.03 – 0.26)	≤0.4 mg/L (annual mean)
Total Kjeldahl Nitrogen (TKN) (mg/L)		0.44 (0.18 - 0.92)	0.45 (0.21 - 0.75)	0.37 (0.13 - 0.75)	0.39 (0.12 - 0.83)	0.40 (0.12 - 0.86)	N/A
Total Nitrogen (TN) (mg/L)		0.53 (0.25 - 1.05)	0.57 (0.27 - 0.90)	0.48 (0.20 - 0.99)	0.48 (0.16 – 1.03)	0.47 (0.16 - 1.07)	N/A
Orthophosphate Phosphorus (PO_4-P) (mg/L)		0.009 (<0.002 - 0.018)	0.015 (0.007 - 0.025)	0.012 (<0.002 - 0.020)	0.013 (<0.002 - 0.035)	0.007 (<0.002 - 0.014)	N/A
Total Phosphorus (TP) (mg/L)		0.06 (0.04 - 0.09)	0.06 (0.05 - 0.10)	0.06 (0.03 - 0.08)	0.06 (0.03 - 0.08)	0.06 (0.04 - 0.08)	N/A
Silica (as SiO_2) (mg/L)		0.72 (0.21 - 1.27)	0.77 (0.20 - 1.53)	0.65 (0.19 - 1.43)	0.61 (0.18 - 1.37)	0.59 (0.17 - 1.60)	N/A
Chlorophyll-*a* (µg/L)		1.7 (0.3 - 5.2)	1.8 (0.3 - 5.3)	2.7 (0.3 – 6.9)	2.6 (0.2 – 7.6)	2.2 (0.3 – 7.5)	N/A
E. coli (cfu/100 mL)		150 (40 - 1100)	180 (52 - 1000)	110 (9 - 600)	63 (10 - 320)	7 (<1 - 110)	N/A
Faecal Coliforms (cfu/100 mL)		320 (100 - 3000)	430 (96 - 3500)	240 (10 - 1600)	130 (15 - 1100)	17 (1 - 640)	N/A

Notes:
1. Data source: Marine Water Quality in Hong Kong in 2023
2. Except as specified, data presented are depth-averaged values calculated by taking the means of three depths: Surface, mid-depth, bottom.
3. Data presented are annual arithmetic means of depth-averaged results except for *E. coli* and faecal coliforms that are annual geometric means.
4. Data in brackets indicate the ranges.
5. N/A: Not available.

Table 5.14 Marine Water Quality Monitoring Data Collected by EPD at Junk Bay and

Ninepin Group in 2023

Parameter		Junk Bay WCZ		Mirs Bay WCZ	Summary of WPCO WQOs
		Junk Bay		Ninepin Group	
		JM3	JM4	MM19	
Temperature (ºC)		23.9 (17.7 - 29.8)	23.6 (17.8 - 29.4)	23.5 (17.2 – 27.4)	≤ 2 ºC change from natural daily range
Salinity		32.4 (30.6 - 33.5)	32.8 (32.1 - 33.6)	33.3 (32.1 - 34.1)	±10% change from natural ambient level
DO (mg/L)	Depth average	6.8 (4.9 – 9.8)	6.2 (5.0 - 7.5)	6.3 (4.5 – 7.7)	≥4 mg/L for 90% of the samples during the year
	Bottom	6.3 (4.0 - 11.6)	5.8 (3.5 - 7.9)	6.0 (3.6 - 7.7)	≥2 mg/L for 90% of the samples during the year
DO (% Saturation)	Depth average	97 (78 - 148)	88 (74 - 100)	90 (66 - 99)	N/A
	Bottom	90 (63 - 176)	81 (50 - 101)	83 (50 - 99)	N/A
pH		7.7 (7.1 - 8.1)	7.7 (7.1 - 8.1)	7.7 (7.1 - 8.2)	6.5 - 8.5 (± 0.2 change from natural range)
Secchi disc Depth (m)		2.7 (2.0 - 3.9)	2.8 (1.8 – 3.6)	3.4 (1.8 – 5.4)	N/A
Turbidity (NTU)		6.5 (1.0 - 35.8)	4.1 (1.6 - 13.3)	3.0 (0.9 – 5.7)	N/A
SS (mg/L)		5.0 (1.6 – 9.2)	5.3 (1.9 - 11.3)	4.4 (2.0 - 7.2)	≤ 30% increase from natural ambient level
BOD_5 (mg/L)		0.5 (0.3 - 1.2)	0.4 (0.3 - 0.7)	0.5 (<0.1 – 1.1)	N/A
NH_3-N (mg/L)		0.059 (0.033 - 0.098)	0.056 (0.026 - 0.107)	0.010 (<0.005 - 0.020)	N/A
UIA (mg/L)		0.001 (<0.001 - 0.003)	0.001 (<0.001 - 0.003)	<0.001 (<0.001 – <0.001)	≤0.021 mg/L (annual mean)
NO_2-N (mg/L)		0.018 (0.006 - 0.043)	0.019 (0.003 - 0.046)	0.007 (<0.002 - 0.019)	N/A
NO_3-N (mg/L)		0.083 (0.030 - 0.177)	0.080 (0.013 - 0.210)	0.023 (<0.002 - 0.124)	N/A
TIN (mg/L)		0.16 (0.10 - 0.28)	0.15 (0.06 - 0.35)	0.04 (0.01 - 0.15)	≤0.3 mg/L (annual mean)
TKN (mg/L)		0.45 (0.16 - 0.79)	0.45 (0.15 - 0.74)	0.41 (0.09 - 1.03)	N/A
TN (mg/L)		0.55 (0.24 - 0.88)	0.55 (0.21 - 0.93)	0.44 (0.10 - 1.07)	N/A
PO_4-P (mg/L)		0.010 (<0.002 - 0.019)	0.013 (0.006 - 0.023)	0.008 (<0.002 - 0.042)	N/A
TP (mg/L)		0.06 (0.05 - 0.12)	0.06 (0.04 - 0.08)	0.05 (0.03 - 0.07)	N/A
Silica (as SiO_2) (mg/L)		0.60 (0.19 - 1.23)	0.63 (0.17 - 1.23)	0.40 (0.12 - 0.95)	N/A
Chlorophyll-*a* (µg/L)		3.3 (0.3 - 10.4)	2.7 (0.3 - 9.5)	2.4 (0.6 - 5.1)	N/A
E. coli (cfu/100 mL)		67 (5 - 360)	84 (5 - 360)	1 (<1 - 1)	N/A
Faecal Coliforms (cfu/100 mL)		170 (8 – 850)	190 (10 - 1000)	1 (<1 - 9)	N/A

Notes:
1. Data source: Marine Water Quality in Hong Kong in 2023
2. Except as specified, data presented are depth-averaged values calculated by taking the means of three depths: Surface, mid-depth, bottom.
3. Data presented are annual arithmetic means of depth-averaged results except for *E. coli* and faecal coliforms that are annual geometric means.
4. Data in brackets indicate the ranges.
5. N/A: Not available.

5.3.1.2 The *E. coli* level in the eastern side of Victoria Harbour has decreased markedly since the implementation of HATS Stage 1 in 2001. The annual Cross Harbour Race, suspended since 1979 because of poor water quality, was resumed on the eastern side of the harbour in 2011 after implementation of the Advance Disinfection Facilities (ADF) of HATS. With full commissioning of the HATS Stage 2A, the E. coli level of the central harbour area has been further reduced. Since 2017, the race route of the event has returned to the traditional route in the central harbour.

5.3.1.3 Both the Eastern Buffer WCZ and the Junk Bay WCZ have fully achieved the marine WQOs for the past 24 years. Since the implementation of the HATS Stage 1 in 2001, the water quality of these two WCZs has improved noticeably with significant increase in DO level and decrease in nutrient and bacteria levels.

5.3.1.4 The water quality at Ninepin Group in Mirs Bay WCZ has maintained to be very good in the past decade with high DO, and low nutrient and *E. coli* levels, fitting for various recreational and mariculture uses.

5.3.2 Inland Water

5.3.2.1 The catchment areas of minor watercourses in Fat Tong Chau and Clear Water Bay Country Park (CWBCP) near Tseung Kwan O Area 137 (TKO 137) comprise natural terrains with no significant pollution sources.

5.3.2.2 The catchment areas of minor watercourses at Tseung Kwan O Area 132 (TKO 132) comprises natural topography with some developed areas (cemetery and village houses). Since the catchment areas are rural in nature and sparsely populated and the village houses only occupy a very minor portion of the catchment areas, significant water pollution at these minor stream courses is not expected.

5.4 Concurrent Projects, Assessment Boundary and Water Sensitive Receivers

5.4.1 Concurrent Projects

5.4.1.1 This sub-section describes the concurrent projects in the vicinity of the Project site as presented in **Figure 2.13**. The description and layout of these concurrent projects will be subject to changes and further updates by the respective project proponents.

Construction of Relocated Berthing Facilities and Associated Structures within Tseung Kwan O Area 137 Fill Bank

5.4.1.2 The primary objective of the works is to facilitate the development of TKO 137, and the works involves construction of berthing facilities and associated structures within TKO 137 Fill Bank as a replacement for the existing berthing facilities at the barging basin in TKO 137. The concerned berthing facilities (with berthing length of around 500m) will be located near the southern end of TKO 137 Fill Bank (**Figure 2.13**). The berthing facilities will be in use from Q4 2026 to Q4 2031, subject to the availability of the re-provisioned PFTF in TKO 132. Construction of the berthing facilities would involve modification of the existing sloping seawall as follows.

a) Remove the existing tetrapod (with no fines content) along the existing sloping seawall to form a rock armour platform.

b) Construct the new vertical seawall by placement of precast concrete blocks on the toe block and rock armour platform of the existing seawall.

c) Filling behind the vertical seawall.

5.4.1.3 The seawall modification works are minor in scale. All the filling works would be enclosed by the new vertical seawall. No dredging is proposed under this concurrent project.

Proposed Water Sports Centre in Tseung Kwan O

5.4.1.4 A new water sports centre will be provided along the seafront of Tseung Kwan O (TKO) Area 77 (i.e., TKO Stage 1 Restored Landfill). It would offer water sports activities including sailing, windsurfing, canoeing and dragon boating. The proposed facilities of the water sports centre are as follows:

a) A main service building.

b) Covered storage areas for rescue boats and coaching boats.

c) Boatsheds with racks for dinghies, windsurfing boards, kayaks, dragon boats.

d) Various water sports accessories, buoyancy aids and wetsuits.

e) A workshop for maintenance and repairs.

f) Boat parks for double-handed dinghies.

g) Open space for rigging, derigging, tuning and repairing of water sports accessories.

h) A resting place, covered lecture areas, outdoor showers and a spectator terrace for 200 spectators adjacent to the seawall.

i) Launching facilities/slipways for all boats/crafts (including sailing boats, windsurfing boards, kayaks and dragon boats) as well as rescue boats and coaching boats, with installation of winch system.

j) Coastal facilities (including steps or levels on the seawall to serve as spectator stand for competitions) and a pier with landing steps and mooring points for rescue boats.

k) other ancillary facilities.

5.4.1.5 The water sports centre would mainly involve land-based construction works. Minor marine works including the construction of landing steps are proposed. No implementation programme for the water sports centre is available.

TKO Desalination Plant

5.4.1.6 The desalination plant is proposed for public water supply and is located at TKO 137. It involves 2 stages. Stage 1 of the desalination plant would involve a water production capacity of 135,000 m^3 per day. Stage 2 of the Project involves an additional water production capacity of 135,000 m^3 per day. The ultimate capacity of the plant will be 270,000 m^3 per day. The desalination plant would involve seawater intake and brine discharge in the marine water of Joss House Bay within the Eastern Buffer WCZ.

5.4.1.7 Stage 1 of the desalination plant is currently under the commissioning stage. Majority of land-based construction works for Stage 1 of the desalination plant and all the proposed marine construction works (for laying the seawater intake and submarine brine discharge outfall) are completed. Construction of Stage 2 of the desalination plant is scheduled to commence in 2027 for commissioning in 2030, which would involve land-based construction works only.

South East New Territories Landfill Extension

5.4.1.8 The South East New Territories Landfill Extension (SENTX) is a land-based concurrent project located within 500 m from the Project boundary. The SENTX forms an integral part in the Strategic Plan in maintaining the continuity of landfill capacity in the Hong Kong for disposal of waste. The SENTX has a net void capacity of about 6.5 Mm^3 and receives construction waste only.

5.4.1.9 The construction works and operation of the SENTX commenced in 2019 and 2021, respectively. SENTX is expected to be closed with its restoration works completed prior to the population intake at TKO 137, and the 30-year aftercare period follows afterwards.

Tseung Kwan O Line Southern Extension

5.4.1.10 The programme and details of Tseung Kwan O Line Southern Extension (TKLSE) are yet to be confirmed. The only currently known information is that part of the TKLSE alignment would be located within the development area of TKO 137, while the alignment would be generally located underground.

5.4.2 Assessment Boundary

5.4.2.1 The marine-based assessment area covers Junk Bay WCZ, Eastern Buffer WCZ and other potentially affected area including part of Victoria Harbour WCZ, Port Shelter WCZ, Mirs Bay WCZ and Southern WCZ. The land-based assessment area covers areas within 500 m from the Project boundary. The assessment boundary of cumulative impact is shown in **Figure 5.1**.

5.4.3 Water Sensitive Receivers

5.4.3.1 Key Water Sensitive Receivers (WSRs) that would potentially be affected by the Project are summarized in **Table 5.15** and their locations are shown in **Figure 5.1**.

Table 5.15 Water Sensitive Receivers and Indicator Points

Description	Name / Location	Representative Indicator Point
Marine Receivers		
Flushing Water Intake	TKO	FW1
	Cha Kwo Ling	FW2
	Sai Wan Ho	FW3
	Quarry Bay	FW4
	Heng Fa Chuen	FW5
	Siu Sai Wan	FW6
Seawater Intake	TKO Desalination Plant	SW1
Cooling Water Intake	Kai Tak District Cooling System	CW1
	Yau Tong Bay Ice Plant	CW2
	Tai Koo Place	CW3
	North Point Government Office	CW4
	Pamela Youde Nethersole Eastern Hospital	CW5
Gazetted Bathing Beach	Big Wave Bay	B1
	Rocky Bay	B2
	Shek O	B3
	Clear Water Bay First	B4
	Clear Water Bay Second	B5
Secondary Contact Recreation	Potential Water Sports Area in Junk Bay	WS1
	Secondary contact recreation subzone at TKO 132	C1a, C1b, C1c, C1d, C1f, C1g, CR1
Coral Communities	Junk Bay West	C1a, C1d, C1e, C1f, C1g
	Junk Bay West Note (1)	C1b, C1c
	Junk Bay	C2
	Lohas Park	C3
	Junk Island	C4
	TKO INNOPARK	C5a

Description	Name / Location	Representative Indicator Point
	TKO INNOPARK	C5b
	TKO INNOPARK	C5c
	TKO INNOPARK	C5d
	Fat Tong Chau	C6a
	Fat Tong Chau	C6b
	Tit Cham Chau	C7
	Kwun Tsai	C8
	Tin Ha Au	C9
	Tin Ha Shan	C10
	Tai Miu Wan	C11
	Tung Lung Chau West	C12
	Tung Lung Chau North	C13
	Tung Lung Chau North	C14
	Tung Lung Chau North	C15
	Tung Lung Chau East	C16
	Tung Lung Chau East	C17
	Tung Lung Chau South	C18
	Cape Collinson	C19
	Cape Collinson	C20
	Cape Collinson	C21
	Tai Long Pai	C22
	Shek Mei Tau	C23
	So Shi Tau	C24
	Tai Wan Tau	C25
	Tai Hang Tun North	C26
	Hong Kong Museum of Coastal Defence	C27
	Fat Tong O Note (1)	C28
Coral Recipient Site	Junk Bay West	CR1
	Fat Tong Chau	CR2
Amphioxus	Tit Cham Chau	A1
	Tathong Channel	A2
Site of Special Scientific Interest (SSSI)	Shek O Headland	SS1
Coastal Protection Area	Coastal water around Hong Kong Island, Joss House Bay and Clear Water Bay	C11, C15, C19, C20, C21, C23, C24, C25, SS1, B4
FCZ	Tung Lung Chau	F1
	Po Toi O	F2
Important Spawning Ground of Commercial Fisheries Resources	Eastern Water	SG1, SG2, SG3
Important Nursery Ground of Commercial Fisheries Resources	Port Shelter	NG1
Typhoon Shelter	Sam Ka Tsuen	T1
Terrestrial Receivers		

Description	Name / Location	Representative Indicator Point
Country Park	Clear Water Bay	Note (2)
Key natural watercourses	Clear Water Bay Country Park	W1 to W4
	Existing slope at TKO 132	S1 to S5
Key modified watercourse	TKO 137	M1, M2

Note:
(1) Based on the preliminary Project design information, coral colonies at Junk Bay (C1b and C1c) and Fat Tong O (C28) are located within the direct footprint of the proposed Project and will be subject to direct loss.
(2) The country park area within the assessment area is shown in **Figure 5.1**. No indicator point is defined.

5.4.3.2 Modified watercourses (M1 and M2) are located within the Project development area at TKO 137 as indicated in **Figure 5.1**. All other major works of the Project are located downstream of CWBCP and identified natural watercourses. All major natural watercourses are located upstream and would not be affected. In particular, the alignment of natural watercourse (S3) ends before reaching the rocky shore and is located outside the proposed Project works areas at TKO 132.

5.4.3.3 Baseline ecological and fisheries conditions are separately presented in the Ecological Impact Assessment and Fisheries Impact Assessment of the EIA report.

5.4.3.4 Ecological resources identified as directly lost within from the proposed reclamation works areas of this Project would unavoidably be removed and will not be considered as WSRs.

5.5 Identification of Potential Impacts for Construction Phase

5.5.1 Introduction

5.5.1.1 Potential sources of water quality impacts identified during the construction phase are summarized in the table below and further elaborated in Sections 5.5.2 and 5.5.3.

Table 5.16 Potential Water Quality Impact for Construction Phase

Potential Sources of Impacts	Identification of Impacts	TKO 137	TKO 132
Marine Construction Works			
Deep Cement Mixing (DCM)	Section 5.5.2.2	✓	✓
Seawall construction	Sections 5.5.2.3 to 5.5.2.5	✓	✓
Underwater filling and sand blanket laying	Sections 5.5.2.6 and 5.5.2.8	✓	✓
Dredging	Sections 5.5.2.7 to 5.5.2.8	✓	✓
Construction of marine viaducts	Section 5.5.2.9	NA	✓
Construction of outfall	Section 5.5.2.12	✓	✓
Leakage and spillage from barges	Section 5.5.2.13	✓	✓
Land-based Construction Works			
Construction site runoff and dust suppression sprays	Sections 5.5.3.3 to 5.5.3.6	✓	✓
Wastewater from general construction activities	Section 5.5.3.7	✓	✓
General refuse	Section 5.5.3.8	✓	✓
Accidental chemical spillage	Section 5.5.3.9	✓	✓
Sewage effluent from construction workforce	Section 5.5.3.10	✓	✓
Contaminated site runoff	Section 5.5.3.11	✓	✓
Construction near inland watercourses or seafront	Section 5.5.3.12	✓	✓
Removal or diversion of inland watercourses	Section 5.5.3.13	✓	✓

Remarks:
✓ denotes that the source of impact would be generated from the construction of the development
NA – Not applicable

5.5.2 Marine Construction Works

5.5.2.1 Potential sources of water quality impact associated with the marine construction works include:

- DCM.
- Seawall construction.
- Underwater filling, dredging and sand blanket laying activities.
- Construction of marine viaducts.
- Construction of outfall.
- Leakage and spillage from barges.

DCM

5.5.2.2 The foundations of the reclamations and the seawall will be constructed by non-dredged ground treatment method, i.e. DCM. The DCM involves injecting controlled volumes of cement into the underlying materials whilst simultaneously mixing the cement with the *in-situ* materials to improve their strength. The key water quality concern would be the potential release of fines and cement slurry from the DCM operation as well as the possible thermal impact due to heat dissipation from the exothermic process of DCM.

Seawall Construction

5.5.2.3 Seawall will be built on top of the DCM foundation. Sloping seawall is proposed for the TKO 137 reclamation as well as along the northeast boundary of the TKO 132 reclamation. Rock fill will be used for construction of the sloping seawall with rock armour protection at the top. Typical cross section of non-dredged reclamation for sloping seawall is shown in Exhibit 5-1.

5.5.2.4 Vertical seawall is proposed at the lower portion near Tit Cham Chau at TKO 137. The remaining seawalls of TKO 132 reclamation will be in the form of vertical blockwork seawalls to facilitate vessel berthing. The vertical seawall will be built typically by placing precast blockwork wall on top of the DCM columns. Typical cross section of non-dredged reclamation for vertical seawall is shown in Exhibit 5-2.

5.5.2.5 As there is no or negligible fines content in blockwork wall, rock fill and rock armour, no loss of fines is expected during the seawall construction. No adverse water quality impact would arise from the seawall construction. Further assessment for seawall construction is not required.

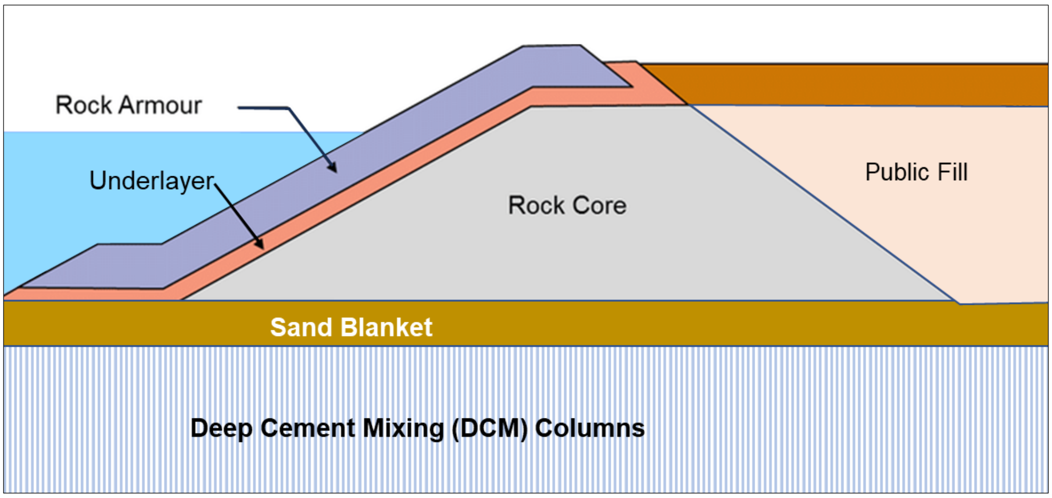

Exhibit 5-1 Typical Cross Section of Non-dredged Reclamation (Sloping Seawall)

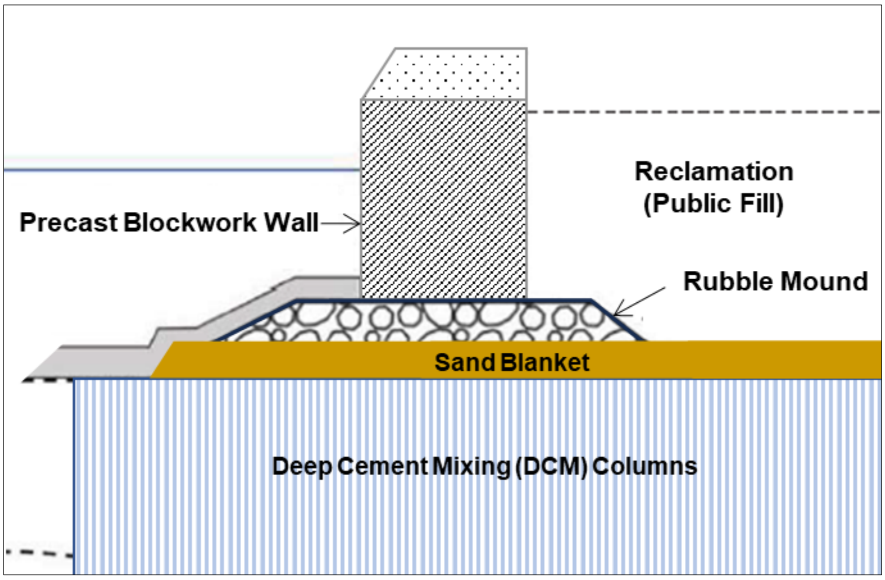

Exhibit 5-2 Typical Cross Section of Non-dredged Reclamation (Vertical Seawall)

Underwater Filling, Dredging and Sand Blanket Laying

5.5.2.6 The proposed reclamation method at TKO 132 and TKO 137 will adopt an approach where seawalls will first be formed (above the high-water mark) to partially enclose the filling activities. Public fill will be used to form the reclamation. Filling will be carried out behind the leading seawall of at least 200m in length. Sand blanket laying would be carried out prior to the DCM operation.

5.5.2.7 Dredging is proposed at the southwestern end of TKO 132 reclamation to provide sufficient depth for vessel berthing. Removal of thin layers of marine deposit involving dredging is also required at the rock outcrops and rocky shorelines, which spread within the footprint of TKO 132 reclamation as well as located near the northern and southern end of TKO 137 reclamation. The vast majority of the marine clay within the reclamation footprint of TKO 132 and TKO 137 is still left in place and is treated by the DCM method.

5.5.2.8 The potential water quality impacts associated with these marine construction works in TKO 132 and TKO 137 include:

- Potential release of fines and increase in SS level in the water column due to the sand blanket laying and marine filling works.
- Potential loss of fines and increase in SS in the water column during dredging, with possible consequence of reducing DO levels due to organic pollution of the disturbed sediment.
- Potential release of sediment-bound constituents such as heavy metals and nutrients into the water column, either via suspension or by disturbance as a result of dredging.

Construction of Marine Viaducts

5.5.2.9 Construction of marine viaducts connecting the TKO 132 development would involve installation of marine piles. There will not be any open sea dredging nor marine filling for construction of marine viaducts. It would involve installation of marine piles. Bored piles or equivalent system would be adopted for the installation works. Precast pile cap shells would then be erected by marine floating crane. The precast pile cap shells would serve as a permanent form for the pile cap and rests directly on the cut-off marine piles. The rest of the pile installation would be conducted in dry environment within the precast shells. The key water quality issue is the seabed disturbance due to the marine piling works and potential release of fines into the water environment.

Construction of Outfall

5.5.2.10 The existing saltwater pumping system in TKO would be upgraded to cater for the new development. The existing 4 pump sets at TKO Salt Water Pumping Station would be replaced by 5 new pump sets with increase total output flow and output head. Associated electrical works, power supply, Supervisory Control and Data Acquisition (SCADA) system and necessary enlargement / replacement of pipeworks and surge vessels will be implemented. No marine construction nor modification works at seawater intake and culvert are proposed. The proposed upgrading works would be land-based and the associated water quality impacts are identified in Section 5.5.3 below.

5.5.2.11 No DCS is proposed under this Project. This Project would not involve any outfall or intake construction for DCS.

5.5.2.12 The proposed Effluent Polishing Plant (EPP) at TKO 137 would involve seawall outfall only. The new EPP outfall as well as other storm outfalls of the Project would be located at the seawall of the proposed reclamation. No submarine intake nor submarine outfall would be constructed under the Project. The effluent of the EPP would be diverted to the seawall via the underground pipe / box culvert. The effluent outfall of the EPP would be submerged at all times under the surface of marine water (see **Appendix 5.3**). The pre-cast outfall structure near seawall will be designed with both ends covered and sealed temporarily, and embedded in parallel with construction of seawall structure. The remaining pre-cast box culvert will be packed with air-inflated packer inside in order to prevent public fill materials being wash out through the box culvert during the reclamation works. Upon completion of the reclamation works and construction of the outfall and box culvert, the seals at the outmost outfall including the packers placed inside will be removed accordingly. Installation of the EPP outfall, underground pipes, box culverts and storm outfalls at TKO 137 and / or TKO 132 would not disturb the seabed or sediments. Based on the proposed outfall construction method, the installation of pre-cast outfall structure and box culvert would not create additional water quality impact. It is not further considered in the assessment.

Leakage and Spillage from Barges

5.5.2.13 Spillage and leakage from construction vessels and marine delivery of construction materials could be the result of poor handling and overflow from barges. Materials to be used for the reclamation works and delivered to and from the reclamation sites by barges are mainly construction and demolition (C&D) materials such as fill materials. Filling materials would be transported by barge to respective barging point located adjacent to the reclamation works area. The major consequences of accidental marine spillage of these materials would be the increase in SS and turbidity in the marine water. In case of spillage from marine delivery of dredged sediment, possible release of sediment-bound contaminants such as heavy metals and nutrients may occur in addition to the loss of fines into the marine water.

5.5.3 Land-based Construction Works

5.5.3.1 Potential sources of water quality impact associated with the land-based construction works include:

- Construction site runoff and dust suppression sprays;
- Wastewater from general construction activities;
- General refuse;
- Accidental chemical spillage;
- Sewage effluent from construction workforce;
- Contaminated site runoff;
- Construction near inland watercourses or seafront; and
- Removal or diversion of inland watercourses.

5.5.3.2 Any discharge of effluent from the Project construction should be pre-treated to comply with the requirements of the WPCO and those specified in the discharge license. All effluent discharges from the construction works should be sited away from any natural watercourses.

Construction Site Runoff and Dust Suppression Sprays

5.5.3.3 Runoff and erosion from exposed soil surfaces, earth working areas and stockpiles of the construction site may contain increased loads of sediments. Water spraying would be an effective measure for dust suppression but the spent water could be high in SS and turbidity.

5.5.3.4 Polluted site runoff may also be generated from the rain washing down of bentonite slurries, cement and other grouting materials. These wash waters are turbid and alkaline materials, which may increase the SS levels and raise the pH level in the nearby water bodies.

5.5.3.5 Accidental spillage of fuel, oil and lubricants from maintenance of construction vehicles and equipment may also contaminate the site runoff and increase the hydrocarbon level in the receiving water.

5.5.3.6 Windblown dust would be generated from exposed soil surfaces in the works areas. It is possible that windblown dust would fall directly onto the nearby water bodies when a strong wind occurs. Dispersion of dust within the works areas may increase the SS levels in surface run-off causing a potential impact to the nearby sensitive receivers.

Wastewater from General Construction Activities

5.5.3.7 Various types of construction activities may generate wastewater. These may include boring and drilling, general cleaning and polishing, wheel washing, dust suppression sprays and utility installation etc. These types of wastewater would contain high concentrations of SS and could affect the water quality if uncontrolled.

General Refuse

5.5.3.8 Construction works would generate debris and rubbish such as packaging, and refuse. Improper rubbish and refuse disposal could lead to degradation of aesthetic appearance and water quality of the receiving waters.

Accidental Chemical Spillage

5.5.3.9 Variety of chemicals would be used for carrying out construction activities. These chemicals may include petroleum products, spent lubrication oil, grease, mineral oil and solvent. Fuel, oil and lubricants may be used for maintenance of construction vehicles, machinery and equipment. Accidental leakage or spillage of these chemicals may infiltrate into the surface soil layer, or runoff into nearby water bodies, increasing their hydrocarbon levels.

Sewage Effluent from Construction Workforce

5.5.3.10 Domestic sewage would be generated from the workforce during the construction phase. Discharge of sewage effluent may increase the organic pollution, ammonia and bacterial levels in the receiving waters. Sufficient chemical toilets should be provided and properly maintained to prevent the water quality impact. According to the Reference Materials on Construction Site Welfare, Health and Safety Measures that issued by the Construction Industry Council (Section 5.6.10), the number of toilet facilities provided on site shall be at a ratio of not less than 1 for every 25 workers. The number of the chemical toilets required for the construction site should be subject to later detailed design, the capacity of the chemical toilets, and contractor's site practices.

Contaminated Site Runoff

5.5.3.11 The presence of any potential contaminated lands and need of land remediation will be subject to the land contamination assessment to be carried out under the EIA study. Any contaminated material disturbed, or material which comes into contact with the contaminated material, has the potential to be washed with site runoff into the nearby drainage system and eventually to the marine environment. As a result, the levels of Chemicals of Concern (CoC) such as petroleum hydrocarbons and metals in the marine water may increase.

Construction near Inland Watercourses or Seafront

5.5.3.12 Two major construction works of the Project would be located close to the natural inland watercourses. These include the possible slope cutting works in TKO 132 and construction of reservoirs and access road in Fat Tong Chau. Construction activities in close proximity of the inland watercourses or seafront may pollute the nearby water bodies due to the potential release of construction wastes as well as the discharges of construction wastewater and site runoff which are generally characterised by high concentration of SS and elevated pH.

Removal or Diversion of Inland Watercourses

5.5.3.13 Removal or diversion of existing modified watercourses would be required within TKO 137 (due to construction of the new development area) as summarized in **Table 5.17**. Water flow in the affected sections of these watercourses would be diverted from their existing routes to the proposed covered drainage system of the new development area. The works could increase the SS levels in the receiving downstream marine water.

Table 5.17 Inland Watercourses to be Removed or Diverted under the Project

ID of Watercourse (Figure 5.1)	Location	Nature	Remarks
M1, M2	TKO 137 development area	Modified watercourse	The watercourses would be removed and diverted

5.6 Identification of Potential Impacts for Operation Phase

5.6.1 Introduction

5.6.1.1 Potential sources of water quality impacts identified during the operation phase are summarized in the table below and further elaborated in Sections 5.6.2 to 5.13.9.

Table 5.18 Potential Water Quality Impact for Operation Phase

Potential Sources of Impacts	Identification of Impacts	TKO 137	TKO 132
Changes of coastline configurations	Section 5.6.2	✓	✓
Creation of embayed water and marine refuse entrapment at TKO 132	Section 5.6.3	NA	✓
Operation of new development at TKO 137 • Sewage / wastewater generation, operation of EPP and advance Sewage Pumping Station (SPS) • Non-point source surface runoff	Sections 5.6.4	✓	NA
Operation of new development at TKO 132 • Sewage / wastewater generation and operation of SPS • Accidental marine spillage from marine delivery, unloading and loading of materials from barges • Non-point source surface runoff and accidental spillage	Sections 5.6.5	NA	✓
Maintenance dredging for proposed berthing facility of TKO 132 development	Section 5.6.6	NA	✓

Remarks:
✓ denotes that the source of impact would be generated from the Project development.
NA – Not applicable

5.6.2 Changes of Coastline Configurations

5.6.2.1 The proposed development area in TKO 137 would be about 103 hectares (ha), including about 20 ha of land to be created through reclamation. The proposed development area in TKO 132 would involve about 20 ha of land to be formed from reclamation off the existing shoreline (about 19 ha) and slope-cutting / site formation (about 1 ha).

5.6.2.2 Changes in coastline configurations due to the proposed reclamations and marine viaducts may change the hydrodynamic regime and water quality patterns in the assessment area and thus, potentially affect the nearby WSRs.

5.6.3 Creation of Embayed Water and Marine Refuse Entrapment at TKO 132

5.6.3.1 Embayed water would be formed near the northern corner of TKO 132 reclamation. The tidal flow velocity or flushing capacity in this new embayment is expected to be reduced. The embayed water is vulnerable to pollution. Key water quality issues of marine embayment would be the potential marine refuse entrapment and accumulation of pollutants. The trapped sediment and pollutants in the embayed water may also increase oxygen demand in the slack water, and chance of DO depletion.

5.6.3.2 Floating refuse and debris may arise from surface runoff, illegal dumping and littering from marine vessels and waterfront and accidental spillage from daily operation of the public facilities at TKO 132. Accumulation and trapping of floating refuse and debris may occur near the TKO 132 development in particular at the northern corner of the site.

5.6.4 Operation of New Development at TKO 137

<u>Sewage / Wastewater Generation, Operation of EPP and Advance SPS</u>

Proposed Sewage Disposal Scheme

5.6.4.1 The first and final population intake of TKO 137 development would occur in 2030 and 2041 respectively. Sewage generated in the proposed TKO 137 development would be mainly domestic in nature. A public sewerage system will be built to collect all the sewage effluents generated from the Project area for proper disposal. An EPP will be built at TKO 137 to receive and treat the collected sewage effluents. The EPP would be developed in 2 phases. Phase 1 and Phase 2 of the EPP would be commissioned by 2034 and 2041 respectively. The design capacity of the EPP would be 39,000 m^3 / day under Phase 1 and ultimately increased to 54,000 m^3 / day under Phase 2.

5.6.4.2 An advance sewerage provision will be implemented to temporarily facilitate the first and second population intake of the TKO 137 development prior to the EPP commissioning. The advance sewerage provision involves screens, equalization tank(s) and an advance SPS within the EPP site and rising main to divert the sewage flow to the existing TKO Preliminary Treatment Works (PTW) and subsequently to the HATS. The design capacity of the advance SPS would be 22,000 m^3 per day.

5.6.4.3 The flow capacity for the advance SPS and Phase 1 of the EPP would be sufficient to cater for all interim Project sewage flow generated prior to commissioning of the Phase 2 EPP. Phase 2 of the EPP has been designed to cater for the full development of TKO 137.

5.6.4.4 The EPP (under both Phase 1 and Phase 2) will treat the collected sewage to the secondary plus level (i.e. secondary treatment with 75% nitrogen removal and disinfection). The design capacity and effluent standards of the proposed EPP are tabulated in **Table 5.19**. The development is located close to the marine water. Seawater flushing is the most effective option and is therefore recommended for the Project. Reuse of treated EPP effluent / use of reclaimed water are not proposed under the Project.

Table 5.19 Design Capacity and Effluent Standards of EPP at TKO 137

Description			Remarks
Treatment Level (Phase 1 and Phase 2)		Secondary Plus	See Note (1)
Treatment Capacity in Average Dry Weather Flow (ADWF)		Phase 1 - 39,000 m^3/d (by 2034) Phase 2 - 54,000 m^3/d (by 2041)	See Note (2)
Effluent Standards (Phase 1 and Phase 2)	BOD_5	20 mg/l	95th percentile
	SS	30 mg/l	95th percentile
	NH_3-N	2 mg/l	Annual average
	TN	10 mg/l	Annual average
	E. coli	1000 no./100ml	Monthly geometric mean

Notes:
(1) Biological treatment process such as moving bed biofilm reactor (MBBR) technology or aerobic granular sludge (AGS) technology would be adopted as the treatment technology subject to the detailed design of the EPP. The MBBR or AGS technology can treat the sewage to the secondary plus level and achieve the target remove rate of 75% for TIN. Ultraviolet (UV) disinfection would be adopted to meet the discharge standards for *E. coli*.
(2) The EPP will be developed by phase with an ultimate design flow of 54,000 m^3 /day.

Effluent Outfall of EPP

5.6.4.5 The outfall of EPP would be in the form of land-based underground box culvert for diverting the treated effluent from the EPP to the new man-made seawall of the TKO 137 development. The outfall would discharge the Project effluent into the receiving marine water at Tathong Channel. The EPP outfall would be commissioned upon the first population intake of TKO 137 development. It would also be adopted for diverting any emergency discharge from the advance SPS prior to the commissioning of the EPP.

Analysis on Operation Arrangement of EPP

5.6.4.6 The maximum effluent flow rate of the EPP at the ultimate stage would be, on average, in the order of less than 1 m^3/s. The effluent would be discharged to the open water of Tathong Channel. The water depth at the proposed outfall and along the Tathong Channel is at least 17 m, which is shown in Exhibit 5-3. The large volume of the receiving marine water and tidal current in Tathong Channel would dilute and disperse the effluent. Provision of the secondary plus treatment level for the EPP would minimize the residual pollutants and further safeguard the water quality.

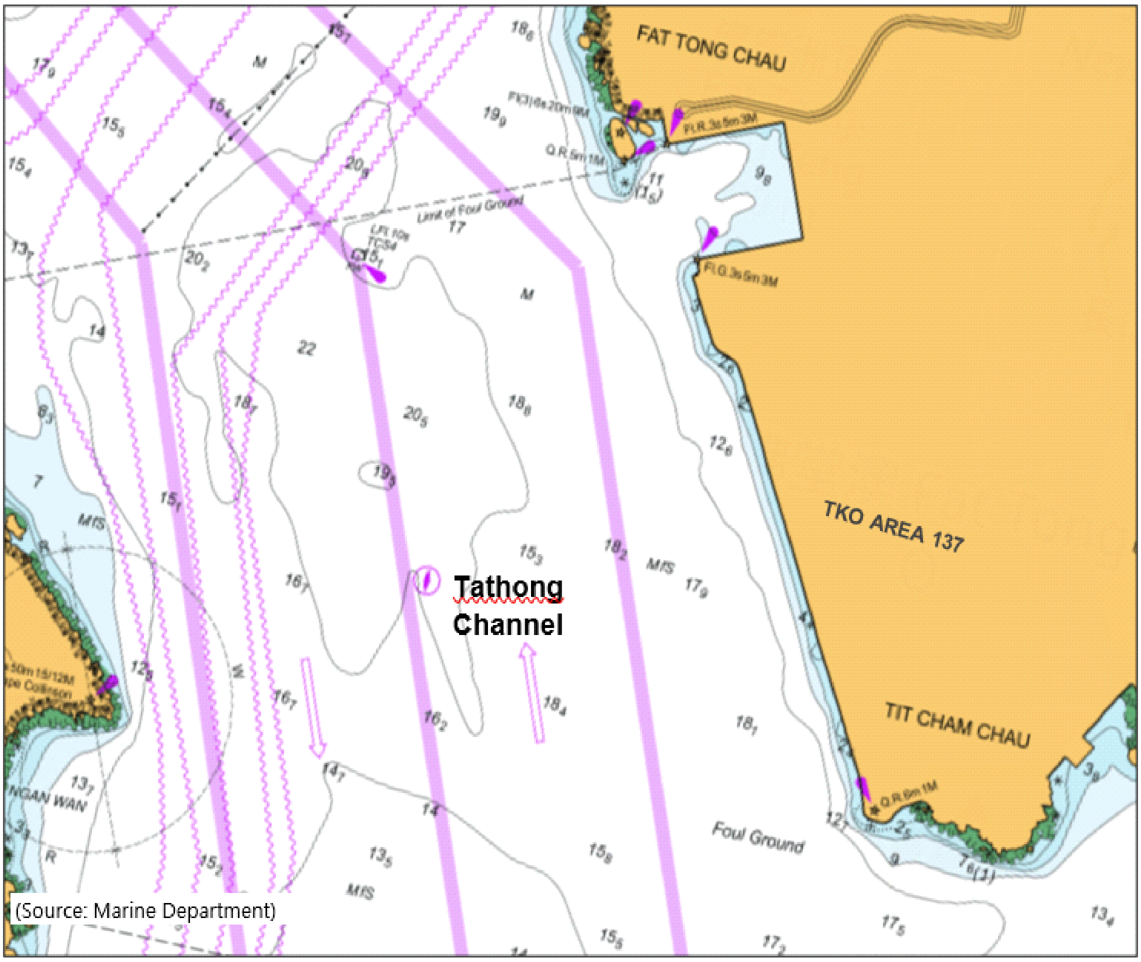

Exhibit 5-3 Water Depths in Metre below Chart Datum (mCD)

5.6.4.7 Emergency discharge from the EPP would be the consequence of pump failure, interruption of the electrical power supply or failure of treatment units. Normally, sewage generated from the new development would be diverted to the inlet system of the EPP (e.g. to the inlet manhole and then to the coarse screen and then to the wet well of the inlet pumping station). If total power failure occurs, raw sewage bypass would occur at the entry point or inlet system of the EPP (i.e. inlet manhole or wet well) and the emergency raw sewage would flow by gravity to the same outfall for discharge of treated EPP effluent at the new seawall of TKO 137. Preventive design measures to avoid such occurrence would be provided for the EPP including dual power supply from CLP, standby facilities for the main treatment units and standby equipment parts / accessories. Furthermore, renewable energy sources would be implemented in the EPP. Renewable energy could be recovered from the biogas generated in anaerobic digestion process and / or solar panels on the building rooftop.

5.6.4.8 The proposed dual power supply would involve two independent power supply sources from CLP to secure electricity supply to the EPP. Based on past records, power failure had not happened in Sewage Treatment Works (STW) with dual power supply from CLP in Hong Kong. As an example, power failure at Tai Po STW has never occurred again after the provision of dual power supply from CLP as recommended in the approved EIA for Tai Po STW Stage V. Best Management Practices (BMP) including proactive maintenance, inspection and housekeeping measures would be adopted in the EPP to prevent operation and maintenance (O&M) problems. The dual power supply from CLP and BMP will ensure the operation reliability of EPP. In the extremely remote event of unstable power or accidental failure of treatment unit, dual power supply from CLP or standby treatment units would serve the process and the treatment system restarting time will be less than 2 hours according to DSD's normal practice [2].

5.6.4.9 Emergency discharge of raw sewage is assumed in this assessment to occur for a period of 2 hours, which would represent the worst possible water quality impact of the EPP. With reference to EPD/TP 1/05 Guidelines for Estimating Sewage Flows for Sewage Infrastructure Planning (Figure VIII-F3 in Appendix VIII), the highest diurnal sewage flow rates would occur between 20:00 and 23:00, which are approximately 1.3 times of the daily average flow rate. Thus, a diurnal peak factor of 1.3 is applied in calculation of the emergency discharge rate and quantity. The corresponding discharge volume would be 5,850 m^3 under Phase 2 of the EPP at the ultimate design stage. The emergency discharge rate would be in the order of about 1 m^3/s. The emergency discharge volume during Phase 1 of the EPP would be smaller and less critical.

5.6.4.10 In case of an extremely remote emergency situation of complete plant failure, raw sewage would flow by gravity into the effluent outfall of the EPP at the new seawall of TKO 137. Any emergency discharge may temporarily degrade the marine water quality.

5.6.4.11 Seawall outfall is assumed in the modelling exercise for discharge of the EPP effluent. Typical arrangement of the seawall outfall is illustrated in **Appendix 5.3**.

Operation of Advance SPS

5.6.4.12 No sewage and wastewater would be discharged from the advance SPS prior to the EPP commissioning. Potential water quality impact may arise from emergency overflow / bypass of sewage due to pump or power supply failure. Under the emergency situation, raw sewage bypass from the advance SPS would flow to the same effluent outfall of the EPP by gravity. Preventive design measures to avoid such occurrence would be provided for the advance SPS such as the provision of dual power supply, standby pump and screen. In case one source of power supply is failed or in the event of pump failure, backup power supply from another source or standby pump would serve the process and the system restarting time would be typically within 2 hours. An emergency discharge of raw sewage for 2 hours would represent a reasonable worst case for the advance SPS. The associated impact would however be less than that resulted from the 2-hour emergency discharge event from the EPP considered in Section 5.6.4.9 above, which involves a larger discharge quantity.

Operation of Refuse Collection Point

5.6.4.13 The potential sources of water pollution to be generated from the refuse collection point would be the accidental spillage of pollutants (rubbish, dirt, debris, etc.) and associated contaminated surface runoff or washed water from any floor cleansing activities. Wastewater generated at the refuse collect point may contain a certain amount of SS, BOD_5, and organic loading and may cause an impact on the water quality if it is uncontrolled. Wastewater generated from the refuse collection point would be connected to the public sewerage system of the new development area for disposal at the EPP.

Operation of Public Transport Interchange, Green Fuel Station and Ambulance Depot

5.6.4.14 The potential sources of water pollution from Public Transport Interchange (PTI), green fuel station and ambulance depot would be the potential fuel spillage from the transports and vehicles and associated contaminated surface runoff or washed water from any floor cleansing activities. Wastewater generated at these facilities may contain a small amount of oil and grease, grit and debris, which could have an impact on the water quality if uncontrolled. Wastewater generated from these facilities would be connected to the public sewerage system of the new development area for disposal at the EPP.

Operation of Service Reservoirs at TKO 137

5.6.4.15 A Fresh Water Service Reservoir (FWSR) and a Salt Water Service Reservoir (SWSR) are proposed at Fat Tong Chau for fresh water supply and toilet flushing respectively. The water stored in the FWSR and SWSR will be distributed to the users and there will not be any

2 Hung Shui Kiu EPP EIA (AEIAR-240/2022) and Yuen Long South EPP EIA (AEIAR-237/2022)

discharge from its normal operation. Cleansing effluent would be generated from the regular cleansing and maintenance of the service reservoirs with water. Chlorine solution would be added as sterilizing agent. The cleansing effluent would contain SS and residual chlorine. Water quality impact may arise if the cleansing effluent is not properly treated before being discharged into storm water drainage system. Treatment and disposal of cleansing water during annual cleansing and maintenance of the service reservoirs would follow the WSD's current practice.

Aging or Damage of the Sewerage Network

5.6.4.16 Ageing or damage of the proposed sewerage system could cause leakage or bursting of the untreated sewage to the nearby receiving waters. Pollutant levels of the receiving watercourses could temporarily increase in case of damage of sewage pipelines. Precautionary measures shall be implemented to avoid such occurrence and the associated water quality impact.

Non-point Source Surface Run-off in TKO 137 Development

5.6.4.17 Surface run-off to be generated from the Project development is known as non-point source pollution.

5.6.4.18 More surface runoff would be generated from the paved area and less from the unpaved area. The existing area in TKO 137 mainly comprises temporary fill bank and unpaved area. The Project development area in TKO 137 is about 103 ha, including about 20 ha of land to be formed through reclamation. The Project would increase the amount of area including paved area at TKO 137 and thus increase the amount of non-point source surface runoff.

5.6.4.19 It is considered that only rainfall events of sufficient intensity and volume would give rise to runoff. The rainfall data obtained from the Hong Kong Observatory (HKO) in the period from 2019 to 2023 were analysed to estimate the runoff percentage and average daily runoff value (mm / day) in each month over the year. Calculations of the runoff values are detailed in **Appendix 5.8**.

5.6.4.20 The new development area is expected to comprise both paved and landscaped areas. It is conservatively assumed that the entire development area would be impermeable with a runoff coefficient of 1.0. The average daily runoff values (mm / day) were then applied to the impermeable area of the new development to give the average daily runoff volumes. The highest daily runoff volume generated from the TKO 137 development would occur in June and September with an average value of approximately 14,000 $m^{3/}$day. The monthly profile of runoff volumes is presented in **Appendix 5.8**.

5.6.4.21 The possible sources of non-point source pollution in TKO 137 development would include a small amount of oil, grease and grit that may be deposited on the surfaces of the road network as well as a small amount of debris, refuse, dust from the roof of buildings and cleaning agents used for washing streets and building façade.

5.6.5 Operation of New Development at TKO 132

Sewage / Wastewater Generation and Operation of SPS

5.6.5.1 The TKO 132 development is proposed to accommodate five public facilities including a public fill transfer facility (PFTF), a concrete batching plant (CBP), an Electricity Facilities (EFs), a construction waste handling facility (CWHF) and a refuse transfer station (RTS). Marine frontage is required for daily operation of most of these public facilities. The wastewater generation from these facilities is preliminarily estimated to be around 360 m^3/day. Details of the wastewater estimation are presented in Section 6.5. It should be noted that there will be separate EIA studies to assess the water quality impacts from the designated projects (i.e. EFs, CWHF and RTS).

5.6.5.2 These five facilities shall be designed with sufficient water pollution control measures to minimise any adverse water quality impact during operation. Pollution sources and operation activities of these facilities are expected to be properly covered or enclosed within buildings to avoid contaminated runoff.

5.6.5.3 A public sewerage system including a SPS and twin rising mains would be built to collect and convey all the sewage and wastewater generated at the proposed TKO 132 development (including those generated at the PFTF, CBP, CWHF, EFs and RTS) to the existing TKO PTW and subsequently to the HATS for proper treatment and disposal. The design capacity of the SPS would be about 400 m^3 per day. The existing TKO PTW and HATS system have been assessed to have sufficient capacity to accommodate the additional sewage / wastewater flow from the new development at TKO 132.

5.6.5.4 No sewage and wastewater discharges are proposed at the TKO 132 development. Potential water quality impact may arise from emergency overflow / bypass of sewage due to pump failure and power supply failure. Design and precautionary measures such as the provision of backup power supply, emergency storage, standby pump and screen are recommended to avoid the occurrence of emergency discharge from the SPS. If power supply is failed or in case of pump failure, backup power or standby pump would serve the process to avoid emergency discharge. In addition, an on-site storage of raw sewage for at least 2 hours will be provided for the SPS. Since the breakdown of SPS could be recovered typically within 2 hours, the chance of emergency discharge from the SPS would be highly unlikely. An emergency discharge for 2 hours would represent a reasonable worst case for the SPS. Emergency bypass culvert will be built to convey any emergency discharge from the SPS to the sea. With reference to Section 5.6.3 above, the emergency discharge point should avoid the embayed water to the north of TKO 132 development at the inner Junk Bay, which has low flushing and effluent dispersion capacity. The emergency discharge point of the SPS is proposed at the southern seawall of TKO 132 development in the outer Junk Bay, which would be nearer to the Victoria Harbour, where the current speed is higher than that of the inner Junk Bay, in order to enhance effluent dispersion. As shown in **Figure 5.1**, the emergency discharge point is selected at the nearshore location of the southern seawall, which is within an open space to allow regular maintenance of the bypass culvert. Marine frontage along the remaining sections of the southern seawall and eastern seawall is required for vessel berthing and daily operation of the public facilities and therefore not suitable for locating the emergency discharge point. Considering the minor scale of the SPS, the emergency discharge volume is considered minor and insignificant.

Operation of PFTF

5.6.5.5 Operation of the PFTF will involve handling and transfer of fill material. No material stockpile is proposed at the PFTF. Public fill material will be imported to the site by trucks and barges. Accidental dropping of material, non-point source surface runoff, dust suppression spays, wheel washing facilities etc. would be the possible sources of water pollution within PFTF. All surface runoff and effluent of the facility mainly containing SS would be collected, settled and recycled within the facility. No industrial wastewater discharge is assumed. Sewage generated from staff and employee would be diverted to the public sewerage system for proper disposal.

Operation of CBP

5.6.5.6 Within the CBP, wastewater may be generated from the concrete batching process, truck cleaning, yard washing and dust suppression spraying etc. The wastewater is typically turbid and contain high level of SS and pH and would be conveyed to the public sewerage system for proper disposal.

Operation of EFs

5.6.5.7 The facilities would be enclosed within building structure. Sewage generated from the workforce at the EFs would be conveyed to the public sewerage system for proper disposal.

Operation of CWHF

5.6.5.8 As advised by the operators, CWHF would generate wastewater from machineries and ground washing. This wastewater is expected to contain SS due to possible contamination by construction waste and chemicals (e.g. fuel oil) from machineries. All sewage effluent, wastewater generated from the CWHF would be diverted to the public sewerage system for proper disposal.

Operation of RTS

5.6.5.9 Leachate would be generated from the RTS, which are typically very high in organic and ammonia loading. This wastewater stream may contain SS, BOD_5, COD, ammonia and organic contaminants and would be conveyed to the public sewerage system for proper disposal.

Aging or Damage of the Sewerage Network

5.6.5.10 Ageing or damage of the proposed sewerage system could cause leakage or bursting of the untreated sewage to the nearby receiving waters. Pollutant levels of the receiving watercourses could temporarily increase in case of damage of sewage pipelines. Precautionary measures shall be implemented to avoid such occurrence and the associated water quality impact.

Accidental Marine Spillage from Marine Delivery, Unloading and Loading of Materials from Barges at TKO 132

5.6.5.11 Marine delivery, unloading and loading of fill, aggregate, sand, construction materials and other materials with fines content as well as municipal solid wastes are required for daily operation of the facilities at TKO 132. Accidental spillage of these materials may increase the SS and degrade the aesthetic quality of the marine water. Design measures are required to avoid accidental spillage.

Non-point Source Surface Runoff and Accidental Spillage in TKO 132 Development

5.6.5.12 The Project would involve reclamation at TKO 132 and increase the amount of non-point source surface runoff. The footprint of the TKO 132 development is approximately 20 ha (200,000 m^2). The monthly profile of runoff volumes generated at the TKO 132 development and details of the runoff calculations are presented in **Appendix 5.8**. The highest runoff volumes generated at the TKO 132 development would occur in June and September with an average value of approximately 3,600 m^3/day.

5.6.5.13 All active works areas in the industrial facilities at TKO 132 would be enclosed to contain accidental spillage of material or chemicals. For any unavoidable operations in open areas of TKO 132 development, there would be a potential for generation of contaminated wash-off and the source of contamination could be the result of accidental spillage. If uncontrolled, the wash-off of the accidental spillage may increase the SS content and degrade the aesthetic quality of the receiving marine water. Design measures are required to prevent and control any accidental spillage.

5.6.6 Maintenance Dredging for Proposed Berthing Facility of TKO 132 Development

5.6.6.1 Regular maintenance dredging would be required for safe marine access to the berthing area of TKO 132 development. The potential water quality impacts arising from the maintenance dredging would be similar to that arising from dredging during construction phase described in Section 5.5.2.8 above. The key issues would be the possible loss of fines and sediment-bound contaminants into the marine water.

5.7 Assessment Methodology

5.7.1 Modelling Tools

Modelling Platforms

5.7.1.1 Mathematical modelling is performed using the hydrodynamic and water quality modelling platforms, namely the D-Flow Flexible Mesh and D-Water Quality of Delft3D Flexible Mesh Suite, developed by Deltares.

5.7.1.2 The D-Flow Flexible Mesh is applied to simulate the hydrodynamics effects of the Project. The D-Water Quality module is used to simulate the water quality effect based on the relevant flow fields determined by the D-Flow Flexible Mesh.

Model Selection and Development

5.7.1.3 The Regional Delft3D Flexible Mesh Hong Kong Model (HK-DFM Model) version 202210 provided by Environmental Protection Department (EPD) is employed for this EIA. The HK-DFM Model was developed and verified under the EPD's study "Provision of Consultancy Services for HATS 2A Post Project Monitoring" in 2021. The HK-DFM Model covers the Pearl River Estuary, Macau, Ma Wan Channel, Cheung Chau, East Lamma Channel, Victoria Harbour, Tathong Channel, Nine Pin Islands, Po Toi Island, etc. All major influences on hydrodynamics (including the Pearl River discharges, spatio-temporal variations of meteorological forcing and oceanic current in the South China Sea) are incorporated into the HK-DFM Model.

5.7.1.4 For the purpose of this EIA study, the grid layout of the HK-DFM Model has been refined in the assessment to give better representation of the coastline configuration near the Project sites. **Appendix 5.4** shows the grid layout and properties of the refined HK-DFM Model. The refined model has a grid resolution of no greater than 75 m by 75 m at or in the vicinity of the proposed Project works.

5.7.1.5 The hydrodynamics performance of the refined HK-DFM Model has been verified to be consistent with the performance of the original HK-DFM Model as shown in Plots No. 5 to 22 of **Appendix 5.4**. The main purpose of the model performance verification or comparison is to illustrate that the model settings of the refined model were carried out correctly.

5.7.1.6 The water quality levels predicted by the refined HK-DFM Model are also compared against the field data collected by EPD at four stations (JM3, JM4, EM2 and EM3) and the comparison results are included in Plot No. 23 to 32 of **Appendix 5.4**. The refined model results are considered reasonable and further adjustment of the model parameter is not necessary.

Simulation Periods

5.7.1.7 Each hydrodynamics simulation (using D-Flow Flexible Mesh) and each water quality simulation (using D-Water Quality) for operation stage is conducted for 1 complete calendar year.

5.7.1.8 For studying the construction phase impact and the worst-case impact due to the temporary emergency discharge of raw sewage from the EPP during the operation phase, the simulations cover at least one 15-day full spring-neap cycle (excluding the spin-up period) for each of the dry and wet seasons.

5.7.1.9 A spin-up period of 1 complete calendar year is provided for each hydrodynamic simulation and each water quality simulation for both construction and operation stages.

5.7.1.10 It is expected that a spin-up period for 10 months would be sufficient for the refined HK-DFM Model to produce stable and acceptable results. Spin-up test was conducted by comparing water levels predicted by the refined HK-DFM Model after 10-month spin-up with that of after 12-month spin-up. The model results for Month 10 and Month 12 are compared in **Appendix 5.5** for dry season. The comparison showed that the results for Month 10 and Month 12 are consistent with each other. Therefore, the spin-up period of 1 complete calendar year is considered sufficient.

5.7.1.11 The hydrodynamic results generated from the D-Flow Flexible Mesh simulations are used to drive the D-Water Quality simulations.

General Model Settings

5.7.1.12 The general settings of the refined model such as the approach to the setup of boundary and initial conditions as well as the model coefficients and parameters follow those adopted in the original HK-DFM Model provided by EPD.

5.7.2 Construction Phase

Assessment Criteria

Introduction

5.7.2.1 The ambient values and tolerance limits for various parameters relevant to the construction impact are tabulated for each WSR in **Table 5.20**. The approach to deriving these values is elaborated in Sections 5.7.2.2 to 5.7.2.12.

Table 5.20 Key Assessment Criteria for Construction Phase

WSRs	ID	WCZ	Nearest EPD Station	Assessment Water Depth	SS (mg/L)				DO (mg/L)			TIN (mg/L)			NH_3-N or UIA (mg/L), Note (7)			Sediment Deposition Rate ($g/m^2/day$)	Heavy Metals(ug/L)									Organics (ug/L)		Organo-metallics (ug TBT/L)
					Ambient Notes (3) & (9)		Allowable Increase, Note (3)		Ambient, Notes (4) & (9)	Assessment Criteria, Note (6)	Allowable Depletion	Ambient, Notes (5) & (9)	WQO, Note (8)	Allowable Increase	Ambient, Notes (5) & (9)	Assessment Criteria, Note (8)	Allowable Increase		Ag	As	Cd	Cr	Cu	Ni	Pb	Zn	Hg	PCB	PAHs	TBT
					Dry Season	Wet Season	Dry Season	Wet Season										Upper Limit												
Flushing Water Intake																														
Tseung Kwan O	FW1	JB	JM3	Depth average	10.7	11.2	0.1	0.1	4.73	2	2.73	0.14	-	-	0.08	1	0.92	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Cha Kwo Ling	FW2	VH1	VM1	Depth average	6.9	12.4	3.1	0.1	4.26	2	2.26	0.17	-	-	0.09	1	0.91	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Sai Wan Ho	FW3	VH3	VM1	Depth average	6.9	12.4	3.1	0.1	4.26	2	2.26	0.17	-	-	0.09	1	0.91	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Quarry Bay	FW4	VH3	VM2	Depth average	6.6	11.0	3.4	0.1	4.50	2	2.50	0.22	-	-	0.12	1	0.88	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Heng Fa Chuen	FW5	EB	EM1	Depth average	8.8	11.2	1.2	0.1	4.59	2	2.59	0.15	-	-	0.09	1	0.91	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Siu Sai Wan	FW6	EB	EM1	Depth average	8.8	11.2	1.2	0.1	4.59	2	2.59	0.15	-	-	0.09	1	0.91	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Seawater Intake																														
TKO Desalination Plant	SW1	EB	EM2	Depth average	9.9	11.5	3.0	3.5	4.50	4	0.50	0.13	0.4	0.27	0.002	0.021	0.019	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Cooling Water Intake																														
Kai Tak District Cooling System	CW1	VH2	VM2	Depth average	6.6	11.0	-	-	4.50	-	-	0.22	-	-	0.003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Yau Tong Bay Ice Plant	CW2	VH1	VM1	Depth average	6.9	12.4	-	-	4.26	-	-	0.17	-	-	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tai Koo Place	CW3	VH3	VM2	Depth average	6.6	11.0	-	-	4.50	-	-	0.22	-	-	0.003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
North Point Government Office	CW4	VH3	VM2	Depth average	6.6	11.0	-	-	4.50	-	-	0.22	-	-	0.003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pamela Youde Nethersole Eastern Hospital	CW5	EB	EM1	Depth average	8.8	11.2	-	-	4.59	-	-	0.15	-	-	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gazetted Bathing Beach																														
Big Wave Bay	B1	S	EM3	Depth average	9.9	10.8	3.0	3.2	4.59	4	0.59	0.10	0.1	0.001	0.002	0.021	0.019	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Rocky Bay	B2	S	EM3	Depth average	9.9	10.8	3.0	3.2	4.59	4	0.59	0.10	0.1	0.001	0.002	0.021	0.019	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Shek O	B3	S	EM3	Depth average	9.9	10.8	3.0	3.2	4.59	4	0.59	0.10	0.1	0.001	0.002	0.021	0.019	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Clear Water Bay First	B4	PS	MM19	Depth average	8.8	9.1	2.6	2.7	4.68	4	0.68	0.06	0.1	0.04	0.001	0.021	0.020	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Clear Water Bay Second	B5	PS	MM19	Depth average	8.8	9.1	2.6	2.7	4.68	4	0.68	0.06	0.1	0.04	0.001	0.021	0.020	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Potential Water Sports Area																														
Junk Bay	WS1	JB	JM3	Depth average	10.7	11.2	3.2	3.4	4.73	4	0.73	0.14	0.3	0.16	0.002	0.021	0.019	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Secondary Contact Recreation Subzone																														
Junk Bay West	C1a, C1g	JB	JM3	Depth average	10.7	11.2	3.2	3.4	4.73	4	0.73	0.14	0.3	0.16	0.002	0.021	0.019	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Junk Bay West	C1d, C1f	JB	JM4	Depth average	9.8	11.6	2.9	3.5	4.59	4	0.59	0.14	0.3	0.16	0.002	0.021	0.019	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Junk Bay West	CR1	JB	JM4	Depth average	9.8	11.6	2.9	3.5	4.59	4	0.59	0.14	0.3	0.16	0.002	0.021	0.019	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Coral Communities																														
Junk Bay West	C1a, C1g	JB	JM3	Bottom	14.0	11.8	4.2	3.5	4.33	2	2.33	0.12	0.3	0.18	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Junk Bay West	C1d – C1f	JB	JM4	Bottom	11.0	12.6	3.3	3.8	3.69	2	1.69	0.11	0.3	0.19	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Junk Bay	C2	JB	JM4	Bottom	11.0	12.6	3.3	3.8	3.69	2	1.69	0.11	0.3	0.19	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Lohas Park	C3	JB	JM3	Bottom	14.0	11.8	4.2	3.5	4.33	2	2.33	0.12	0.3	0.18	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Junk Island	C4	JB	JM3	Bottom	14.0	11.8	4.2	3.5	4.33	2	2.33	0.12	0.3	0.18	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
TKO INNOPARK	C5a	JB	JM3	Bottom	14.0	11.8	4.2	3.5	4.33	2	2.33	0.12	0.3	0.18	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
TKO INNOPARK	C5b	JB	JM3	Bottom	14.0	11.8	4.2	3.5	4.33	2	2.33	0.12	0.3	0.18	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
TKO INNOPARK	C5c	JB	JM3	Bottom	14.0	11.8	4.2	3.5	4.33	2	2.33	0.12	0.3	0.18	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
TKO INNOPARK	C5d	JB	JM3	Bottom	14.0	11.8	4.2	3.5	4.33	2	2.33	0.12	0.3	0.18	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Fat Tong Chau	C6a	JB	JM4	Bottom	11.0	12.6	3.3	3.8	3.69	2	1.69	0.11	0.3	0.19	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Fat Tong Chau	C6b	JB	JM4	Bottom	11.0	12.6	3.3	3.8	3.69	2	1.69	0.11	0.3	0.19	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006

WSRs	ID	WCZ	Nearest EPD Station	Assessment Water Depth	SS (mg/L)				DO (mg/L)			TIN (mg/L)			NH_3-N or UIA (mg/L), Note (7)			Sediment Deposition Rate ($g/m^2/day$)	Heavy Metals(ug/L)									Organics (ug/L)		Organo-metallics (ug TBT/L)
					Ambient Notes (3) & (9)		Allowable Increase, Note (3)		Ambient, Notes (4) & (9)	Assessment Criteria, Note (6)	Allowable Depletion	Ambient, Notes (5) & (9)	WQO, Note (8)	Allowable Increase	Ambient, Notes (5) & (9)	Assessment Criteria, Note (8)	Allowable Increase		Ag	As	Cd	Cr	Cu	Ni	Pb	Zn	Hg	PCB	PAHs	TBT
					Dry Season	Wet Season	Dry Season	Wet Season											Upper Limit											
Tit Cham Chau	C7	EB	EM2	Bottom	12.6	13.6	3.8	4.1	3.67	2	1.67	0.10	0.4	0.30	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Kwun Tsai	C8	EB	EM2	Bottom	12.6	13.6	3.8	4.1	3.67	2	1.67	0.10	0.4	0.30	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Tin Ha Au	C9	EB	EM2	Bottom	12.6	13.6	3.8	4.1	3.67	2	1.67	0.10	0.4	0.30	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Tin Ha Shan	C10	EB	EM2	Bottom	12.6	13.6	3.8	4.1	3.67	2	1.67	0.10	0.4	0.30	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Tai Miu Wan	C11	EB	EM2	Bottom	12.6	13.6	3.8	4.1	3.67	2	1.67	0.10	0.4	0.30	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Tung Lung Chau West	C12	EB	EM3	Bottom	12.0	11.0	3.6	3.3	3.60	2	1.60	0.08	0.4	0.32	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Tung Lung Chau North	C13	EB	EM2	Bottom	12.6	13.6	3.8	4.1	3.67	2	1.67	0.10	0.4	0.30	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Tung Lung Chau North	C14	EB	EM2	Bottom	12.6	13.6	3.8	4.1	3.67	2	1.67	0.10	0.4	0.30	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Tung Lung Chau North	C15	MB	MM19	Bottom	9.0	12.0	2.7	3.6	3.50	2	1.50	0.07	0.3	0.23	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Tung Lung Chau East	C16	MB	MM19	Bottom	9.0	12.0	2.7	3.6	3.50	2	1.50	0.07	0.3	0.23	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Tung Lung Chau East	C17	MB	MM19	Bottom	9.0	12.0	2.7	3.6	3.50	2	1.50	0.07	0.3	0.23	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Tung Lung Chau South	C18	EB	EM3	Bottom	12.0	11.0	3.6	3.3	3.60	2	1.60	0.08	0.4	0.32	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Cape Collinson	C19	EB	EM2	Bottom	12.6	13.6	3.8	4.1	3.67	2	1.67	0.10	0.4	0.30	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Cape Collinson	C20	EB	EM2	Bottom	12.6	13.6	3.8	4.1	3.67	2	1.67	0.10	0.4	0.30	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Cape Collinson	C21	EB	EM2	Bottom	12.6	13.6	3.8	4.1	3.67	2	1.67	0.10	0.4	0.30	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Tai Long Pai	C22	EB	EM3	Bottom	12.0	11.0	3.6	3.3	3.60	2	1.60	0.08	0.4	0.32	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Shek Mei Tau	C23	PS	MM19	Bottom	9.0	12.0	2.7	3.6	3.50	2	1.50	0.07	0.1	0.03	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
So Shi Tau	C24	PS	MM19	Bottom	9.0	12.0	2.7	3.6	3.50	2	1.50	0.07	0.1	0.03	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Tai Wan Tau	C25	PS	MM19	Bottom	9.0	12.0	2.7	3.6	3.50	2	1.50	0.07	0.1	0.03	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Tai Hang Tun North	C26	PS	MM19	Bottom	9.0	12.0	2.7	3.6	3.50	2	1.50	0.07	0.1	0.03	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Hong Kong Museum of Coastal Defence	C27	EB	VM1	Bottom	10.4	12.6	3.1	3.8	3.27	2	1.27	0.13	0.4	0.27	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Coral Recipient Site																														
Junk Bay West	CR1	JB	JM4	Bottom	11.0	12.6	3.3	3.8	3.69	2	1.69	0.11	0.3	0.19	0.001	0.021	0.020	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Fat Tong Chau	CR2	JB	EM1	Bottom	11.6	13.2	3.5	4.0	3.66	2	1.66	0.12	0.3	0.18	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Amphioxus																														
Tit Cham Chau	A1	EB	EM2	Bottom	12.6	13.6	3.8	4.1	3.67	2	1.67	0.10	0.4	0.30	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Tathong Channel	A2	EB	EM2	Bottom	12.6	13.6	3.8	4.1	3.67	2	1.67	0.10	0.4	0.30	0.002	0.021	0.019	100	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Site of Special Scientific Interest (SSSI)																														
Shek O Headland	SS1	S	EM3	Depth average	9.9	10.8	3.0	3.2	4.59	4	0.59	0.10	0.1	0.001	0.002	0.021	0.019	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Fisheries Sensitive Receiver																														
Tung Lung Chau FCZ	F1	EB	EM2	Depth average	9.9	11.5	3.0	3.5	4.50	5	0.05	0.13	0.4	0.27	0.002	0.021	0.019	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Po Toi O FCZ	F2	PS	MM19	Depth average	8.8	9.1	2.6	2.7	4.68	5	0.05	0.06	0.1	0.04	0.001	0.021	0.020	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Important Spawning Ground of Commercial Fisheries Resources	SG1	S	EM3	Depth average	9.9	10.8	3.0	3.2	4.59	4	0.59	0.10	0.1	0.001	0.002	0.021	0.019	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
	SG2	EB	EM3	Depth average	9.9	10.8	3.0	3.2	4.59	4	0.59	0.10	0.4	0.3	0.002	0.021	0.019	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
	SG3	MB	MM19	Depth average	8.8	9.1	2.6	2.7	4.68	4	0.68	0.06	0.3	0.24	0.001	0.021	0.020	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Important Nursery Ground of Commercial Fisheries Resources	NG1	PS	PM8	Depth average	9.6	6.7	2.9	2.0	4.23	4	0.23	0.06	0.1	0.04	0.001	0.021	0.020	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006
Typhoon Shelter																														
Sam Ka Tsuen	T1	VH1	VM1	Depth average	6.9	12.4	2.1	3.7	4.26	4	0.26	0.17	0.4	0.23	0.002	0.021	0.019	-	1.4	13	2.5	4.4	1.3	8.2	4.4	8	0.3	0.03	0.2	0.006

Notes:

(1) Details of assessment criteria are also presented in Section 5.2.

(2) Shaded cells represent the proposed assessment criteria for construction phase.

(3) Ambient level for SS is defined as 90th percentile of monitoring data collected by EPD from 2018 to 2022. The ambient data were analysed and derived for both dry season (November to March) and wet season (April to October). Details of the assessment criteria for SS for different WSRs

are presented in Sections 5.7.2.2 to 5.7.2.4.

(4) Ambient level for DO is defined as 10th percentile of monitoring data collected by EPD from 2018 to 2022.

(5) Ambient level for TIN and UIA is defined as average value of monitoring data collected by EPD from 2018 to 2022.

(6) The WQO for DO under the WPCO is a 10th percentile value. Details of the assessment criteria for DO for different WSRs are presented in Sections 5.7.2.5 and 5.7.2.6 below.

(7) The values shown in these columns are NH_3-N concentrations for flushing water intakes and UIA concentrations for other WSRs.

(8) The WQOs for TIN and UIA under the WPCO are annual mean values Details of the assessment criteria for TIN, UIA and NH_3-N for different WSRs are presented in Sections 5.7.2.7 to 5.7.2.10.

(9) Latest monitoring data collected by EPD in 2023 (available after completion of the water quality modelling and impact assessment) have been reviewed to be within the same range of the data collected from 2018 to 2022. Using the 2018 – 2022 data to establish the ambient levels is considered acceptable.

" – " denotes no applicable water quality criteria.

JB – Junk Bay WCZ; EB – Eastern Buffer WCZ; VH1 –Victoria Harbour WCZ (Phase 1); VH2 – Victoria Harbour WCZ (Phase 2); VH3 – Victoria Harbor WCZ (Phase 3); PS – Port Shelter; MB – Mirs Bay; S – Southern

Suspended Solids

5.7.2.2 With reference to the WQO, any sediment plume generated from the Project shall not cause the ambient SS concentrations to be elevated by more than 30% at any time. The allowable SS increase is calculated as 30% of the ambient SS values for all WSRs except for the flushing water intakes where the target absolute SS limit of 10 mg/L as specified by WSD is used. As compared to the design basis values for SS of ≤40 mg/L for the seawater intake of TKO desalination plant, the statutory WQO of no more than 30% increase from the baseline level is considered more stringent and is therefore adopted. The SS criteria is not applicable to cooling water intakes.

5.7.2.3 The ambient SS levels are derived using the concentrations measured by EPD during the period from 2018 to 2022 at the stations nearest to the WSRs. It is proposed to analyse the ambient data for both dry season and wet season and define the ambient values for each season as 90^{th} percentile (90%ile) of the measured SS levels following the approach adopted in other relevant EIA studies.

5.7.2.4 The ambient SS levels at flushing water intakes exceeded the target level of 10 mg/L. The maximum allowable SS increase is proposed to be 1% of the target limit, which is 0.1 mg/L. As compared to the relatively high background SS levels of over 10 mg/L at the flushing water intakes, a transient SS increase of 0.1 mg/L is considered minimal. No adverse effect on the intake operation is anticipated due to the transient SS increase of 0.1 mg/L.

Oxygen Depletion

5.7.2.5 According to the WQOs for DO, the numerical objective value can be exceeded for 10% of samples collected during the whole year. The ambient levels are presented as 10^{th} percentile (10%ile) of the DO concentrations measured by EPD at the closest stations to the WSRs during the period from 2018 to 2022, which is a conservative approach. The allowable DO depletion is calculated by subtracting the WQO from the ambient DO level except for the cooling water intakes and WSD flushing intakes. For cooling water intakes, criteria on DO is not applicable as the use is not sensitive to DO depletion. As for WSD flushing water intake, the allowable DO depletion at the flushing water intakes is calculated by subtracting the target DO level specified by the WSD from the ambient DO level.

5.7.2.6 The ambient DO levels at the FCZs are already below the WQO value of 5 mg/L. The maximum allowable DO depletion for FCZs is thus set at 1% of the WQO value, which is 0.05 mg/L. Since the ambient level is based on the 10%ile value of all data collected over a 5-year period, this would mean that most of the measured values should be above this ambient level and the mean DO level measured at FCZs is in fact over 5.8 mg/L. It is considered that the transient DO decrease of only 0.05 mg/L at FCZs during the construction phase would be acceptable and insignificant.

Nitrogen Parameters

5.7.2.7 The WQOs for TIN and UIA are annual mean values. The average of all monitoring data collected by EPD during the period from 2018 to 2022 is used to represent the ambient level. The allowable TIN and UIA increases are defined by subtracting the ambient level from the respective WQO.

5.7.2.8 The ambient TIN levels at Shek O Headland SSSI, 3 gazetted beaches (Big Wave Bay, Rocky Bay and Shek O) and part of the Important Spawning Ground of Commercial Fisheries Resources (SG1) already reached the WQO value of 0.1 mg/L. It is thus proposed to set the maximum allowable TIN increase at 1 % of the WQO value, which is 0.001 mg/L. As compared to the background TIN levels of 0.2 mg/L at these WSRs, the transient TIN increase of only 0.001 mg/L is considered minimal and would not increase the risk of red tide.

5.7.2.9 The target NH_3-N level of < 1 mg/L as specified by WSD is adopted for the flushing water intakes. The ambient NH_3-N levels for flushing water intakes are calculated as the 90%ile values of all data measured during the period from 2018 to 2022.

5.7.2.10 The cooling water intakes are not sensitive to the nitrogen content and the assessment criteria on UIA, NH_3-N and TIN are not applicable to cooling water intakes.

Sedimentation

5.7.2.11 The absolute sediment deposition criterion of 100 g/m^2/day are only applicable to the benthic communities such as coral colonies (see Section 5.2.13).

Heavy Metals and Micro-pollutants

5.7.2.12 The upper concentration limits for heavy metals and micro-pollutants are based on overseas standards and recommendations of other relevant EIA projects (see Section 5.2.12) and applicable to all WSRs except for cooling water intakes, which are not sensitive to these pollutants.

Elevation of Suspended Solids

Modelling Scenarios

5.7.2.13 Water quality modelling is carried out to simulate the loss of fines and dispersion of sediment load from the marine construction works. Dredging, sand blanket laying and marine filling works are identified as the key sources of sediment release. The indicative sequences and phasing of marine construction are illustrated in **Appendix 5.1** and **Appendix 5.2** Construction of marine viaducts is also considered in the modelling. The key sediment generating activities are summarized in **Table 5.21**.

Table 5.21 Tentative Programme of Key Sediment Generation Activities and Sediment Release Rates

Reclamation activities	No. of Workfront	Production Rate (m^3/day)		Sediment Release Rate (kg/s), See Note (3)						
		Per Workfront	Total	2026 / Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
TKO 137 Phase 1A				Modelling Scenario A1 (Month 7)	Modelling Scenario A2 (Month 12)					
Sand blanket laying	1	1,060	1,060	0.103						
Underwater filling (public fill)	4	530	2,120		1.166					
TKO 137 Phase 1B										
Sand blanket laying	1	1,060	1,060	0.103						
TKO 137 Phase 2A										
Sand blanket laying	1	1,060	1,060				0.103			
Removal of marine deposit	1	700	700				0.324			
TKO 137 Phase 2B										
Sand blanket laying	1	1,060	1,060						0.103	
TKO 137 Phase 2C										
Sand blanket laying	1	1,060	1,060						0.103	
Removal of marine deposit	1	700	700						0.324	
Maximum Sediment Release Rate Over Each Half Year Period (kg/s):				0.103 / 1.269	1.166 / 1.166	1.166 / 0	0 / 0.427	0 / 0	0 / 0.530	-
TKO 132				Modelling Scenario A1 (Month 9)	Modelling Scenario A2 (Month 15)					
Removal of marine deposit	1	2,100	2,100	0.972						
Sand blanket laying (seawall & reclamation)	2	1,060	2,120	0.206						
Sand blanket laying (reclamation)	2	1,060	2,120	0.206						
Underwater filling (public fill) from NE	6	1,060	6,360		3.497					
Dredging for berthing facility	1	700	700			0.324				
Marine viaduct (bore pile)	See Section 5.7.2.21				0.00873					
Maximum Sediment Release Rate Over Each Half Year Period (kg/s):				0.00873 / 1.393	3.712 / 3.506	0.333 / 0.333	0.00873 / -	-	-	-

Notes:
(1) Shaded cell indicates the duration of activity.
(2) Underwater filling for Phase 1B, 2A, 2B and 2C at TKO 137 would be fully contained within completed seawall and is therefore not considered.
(3) Assumptions adopted for calculation of the sediment release rates are described in Sections 5.7.2.19 to 5.7.2.21 and illustrated in **Appendix 5.6**.
(4) No sediment loss is anticipated from the DCM works as the recent full-scale DCM monitoring results showed no SS elevation attributable to the DCM operation (see Sections 5.8.1.4 and 5.8.1.5).

5.7.2.14 Two scenarios are simulated in the sediment plume modelling exercise as follows.

- Scenario A1 assumes that sand blanket laying along the seawall of Phase 1A of TKO 137 reclamation in Month 7 would occur together with dredging and sand blanket laying along the seawall and within the reclamation area of TKO 132 and construction of marine viaduct in Month 9.
- Scenario A2 assumes that underwater filling at Phase 1A and sand blanket laying at Phase 1B of TKO 137 reclamation in Month 12 would be carried out concurrently with sand blanket laying and underwater filling within the reclamation area of TKO 132 and construction of marine viaduct in Month 15.

5.7.2.15 Scenario A1 represents the case with largest overall sediment release in open water before formation of any seawall at TKO 137 and TKO 132 due to dredging and sand blanket laying.

5.7.2.16 Scenario A2 addresses the worst-case impact due to underwater filing behind the leading seawall at both TKO 137 and TKO 132. The worst-case underwater filling work at TKO 137 would occur during Phase 1A of the reclamation. The underwater filling in the remaining phases of TKO 137 reclamation would be fully surrounded by seawall and therefore would not create water quality impact. At TKO 132, the reclamation work would proceed from northeast (NE) to southwest (SW). The seawall construction would take place first to surround the reclamation site as far as practicable to confine the underfilling work. As shown in **Appendix 5.2**, by end of Month 18, the seawall surrounding the reclamation site would be completed except only a 100-m gap for marine access. Scenario A2 considers the worst-case impact of underwater filling at TKO 132 in Month 15 before the SW seawall is constructed.

5.7.2.17 Scenario A1 and Scenario A2 are expected to cover the worst-case water quality impact upon the WSRs. Dredging would be carried out by closed grab dredgers. Sand blanket can be placed by a number of methods including but not limited to hopper barge, pipeline pumping, derrick lighter, flat-top barge with excavators, etc. Sediment release points assumed under Scenario A1 and Scenario A2 are shown in **Appendix 5.6**.

5.7.2.18 No dredging will be required for pier construction along the marine viaducts at TKO 132. Dredging for pier construction is conservative assumed under both Scenario A1 and Scenario A2 for worst-case assessment. No marine filling is required for construction of the marine viaducts. No sediment loss is anticipated from the DCM works as supported by the recent full-scale DCM monitoring results as discussed in Sections 5.8.1.4 and 5.8.1.5 below. Sediment release from DCM is therefore not assumed to avoid significantly overestimating the sediment impact, following the same approach adopted in the approved EIA for Tung Chung New Town Extension (AEIAR-196/2016).

Sediment Loss Rates

5.7.2.19 The EPD's Contaminated Spoil Management Study [3] concluded that sediment loss from closed grab would be 11 kg/m^3, 14 kg/m^3 and 20 kg/m^3 of mud removed for large, medium and small grab size respectively. The grab to be used for this Project could range from 8 m^3 to 16 m^3. A spill rate of 20 kg per m^3 is assumed for the dredging work of this Project. This spill rate is consistent with the value adopted in other approved EIA projects [4, 5, 6, 7, 8].

5.7.2.20 It is assumed that 5% of the fine content in the sand fill and public fill would be lost during the sand laying and underwater filling as adopted in all past relevant EIA studies [7, 10, 9, 10]. The typical fine content and dry density of sand fill and public fill is 5% and 25% of the bulk

[3] EPD Contaminated Spoil Management Study, Final Report, Volume 1, October 1991.

[4] EIA for Expansion of Hong Kong International Airport into a Three-Runway System (AEIAR-185/2014)

[5] EIA for Development of Integrated Waste Management Facilities Phase 1 (AEIAR-163-2012)

[6] EIA for Shatin to Central Link - Hung Hom to Admiralty Section (AEIAR-166/2012)

[7] EIA for Tuen Mun - Chek Lap Kok Link (AEIAR-146/2009)

[8] EIA for Dredging Works for Proposed Cruise Terminal at Kai Tak (AEIAR-115/2007)

[9] EIA for Hong Kong - Zhuhai - Macao Bridge Hong Kong Boundary Crossing Facilities (AEIAR-145/2009)

[10] EIA for Further Development of Tseung Kwan O Feasibility Study (AEIAR-092/2005)

respectively, and 1680 kg/m^3 and 1,900 kg/m^3 respectively [7]. All quoted past EIA studies involve either bottom dumping of fill materials or by trailer suction hopper dredger discharging sand at a much higher rate. The sand laying or filling operation of this Project at each work front would be undertaken at a much smaller rate of 1,060 m^3/day. Thus, the proposed spill rate for sand laying and underwater filling is considered appropriate.

5.7.2.21 No dredging is proposed for construction of marine viaduct. As shown in **Appendix 5.9**, each set of piers typically involves 2 precast pile cap shells with 3 piles in each shell. Each marine pile would have a typical diameter of about 2 m. The approved EIA for Airport Tung Chung Link Project (AEIAR-254/2023), which involves similar marine pile size and construction method, concluded that the disturbance of bottom sediment due to the construction of marine viaduct would be limited. Under this EIA, it is conservatively assumed that the first 1 m of the surface sediment would be displaced by the piling work and released to the seabed surface above. Sediment below 1 m of the seabed level is expected to be suppressed by the weight of sediment above and would not be brought up to the surface. The piling work would be conducted within steel casing. The spill rate of 20 kg per m^3 adopted for the open grab dredging method is conservatively assumed to be the rate of sediment release from the steel casing. In actuality the degree of sediment disturbance by the piling work would be much smaller than that caused by grab dredging. Assuming that 6 marine piles would be installed concurrently and the surface sediment displacement by the 6 piles would occur in sequence over the working day, the sediment loss rate would be 0.00872 kg/s = 3.14 m^2 (pile area) x 1 m (depth of surface sediment displaced) x 6 (number of concurrent pile installations) x 20 kg/m^3 (spill rate) ÷ 43,200 s (seconds per 12 working hours per day).

5.7.2.22 Details of the sediment loss rates are presented in **Appendix 5.6**.

Efficiency of Silt Curtain and Silt Screen

5.7.2.23 Silt curtains will be deployed to minimize the potential water quality impacts.

5.7.2.24 A single layer of silt curtain would reduce the dispersion of SS by a factor of 4 (or about 75%). This efficiency value was developed under the EPD's Contaminated Spoil Management Study and has been proven and adopted in all past relevant EIA projects involving a single layer silt curtain system.

5.7.2.25 Where necessary, installation of silt screen at the seawater intakes would also be recommended. Silt screen would reduce the SS level at the intake by a factor of 2.5 (or about 60%), based on the value established under the Pak Shek Kok Reclamation, Public Dump EIA (1997). This SS reduction factor (60%) has been adopted in all past relevant EIA projects involving silt screen deployment at seawater intake.

5.7.2.26 According to a field trial undertaken under the "Central Reclamation Phase III - Water Quality Assessment on the Use of Type A Fill in Final Reclamation Area East (VEP-296/2009)", the efficiency of removing fine particles by applying double layer of floating type silt curtains was found to be 86%.

5.7.2.27 Pilot test was undertaken for the Expansion of Hong Kong Airport into a Three-Runway System Three-Runway System (3RS) to determine the efficiency of a double layer floating type silt curtain system and concluded that the overall SS removal efficiency of the system would be 87.4% [11].

5.7.2.28 The efficiency of floating type silt curtain would be inversely proportional to the magnitude of current velocity. The current velocities are mostly less than 0.5 m/s in Junk Bay and less than 1 m/s along the seafront of TKO 137. Deployment of silt curtain at the proposed marine construction site is considered practical and effective.

5.7.2.29 Double silt curtains are recommended to be deployed at TKO 132 in Junk Bay. Junk Bay is an embayed water with slow current velocity where the silt curtain would be effective in reducing SS release. It is proposed to adopt a SS removal efficiency of 87.4% for the double

[11] Expansion of Hong Kong International Airport into a Three-Runway System. Pilot Test Report on Silt Curtain Efficiency, August 2017.

layer floating type silt curtain system in Junk Bay with reference to the past pilot test results available from the 3RS project.

Modelling Parameters

5.7.2.30 The general parameters adopted for sediment plume modelling are:

- Settling velocity – 0.5 mm/s
- Critical shear stress for deposition – 0.2 N/m^2
- Critical shear stress for erosion – 0.3 N/m^2
- Minimum depth where deposition allowed – 0.1 m
- Resuspension rate – 30 g/m^2/d

5.7.2.31 The above parameters including the settling velocity of 0.5 mm/s have been adopted in numerous past studies in Hong Kong [12, 13, 14, 15, 16, 17, 18] involving similar modelling work. With reference to these past studies, the critical shear stress values for erosion and deposition were determined by laboratory testing of a large sample of marine mud from Hong Kong as part of the WAHMO [19] studies associated with the new airport at Chek Lap Kok.

Release of Sediment-bound Contaminants

5.7.2.32 The likelihood of releasing sediment-bound contaminants such as heavy metals, micro-pollutants and nutrients from dredging is reviewed by using the results of elutriate testing. Details of the sediment and elutriate testing plan are presented in the Sediment Sampling and Testing Plan (SSTP).

5.7.2.33 Sediment samples collected in the proposed Project site are mixed with the ambient seawater collected from the same site and then vigorously agitated during the elutriate tests to simulate the disturbance to the seabed sediment during dredging. Pollutants absorbed onto the sediment particles may be released and increasing the pollutant concentrations in the solution. The laboratory testing is conducted to analyze the contaminants in the solution (elutriate). If the contaminant levels are higher in the elutriates in comparison with the blanks (i.e. marine water from the same site), it can be concluded that the contaminants are likely to be released into the marine waters from dredging.

5.7.2.34 Based on the measured contaminant concentration in the elutriates, the required dilutions to meet the assessment criteria are then calculated. Critical contaminant concentrations that would require significant dilution to meet the criteria are selected for tracer dispersion modelling.

5.7.2.35 Inert tracers (with zero decay) are introduced into the refined HK-DFM Model at the Project site locations to determine the dilution potential achieved at WSRs. The dilution information is then applied to the elutriate test results to estimate the decreases in concentrations of the concerned parameters and water quality compliance at WSRs.

Oxygen Depletion

5.7.2.36 The 20-day sediment oxygen demand (SOD) of the sediment samples collected from marine SI is used to determine the reductions in DO concentrations, based on the predicted increases in SS concentrations at the WSRs in accordance with the following equation:

[12] Environmental Assessment (EA) Study for Backfilling of Marine Borrow Pits at North of the Brothers. EA Report, 2002.
[13] Permanent Aviation Fuel Facility. EIA Report, 2002 (for Environmental Permit EP-139/2002)
[14] EIA for Hong Kong Offshore Wind Farm in Southeastern Water (AEIAR-140/2009)
[15] EIA for Development of a 100MW Offshore Wind Farm in Hong Kong (AEIAR-152/2010)
[16] EIA for Additional Gas-fired Generation Units Project (AEIAR-197/2016)
[17] EIA for Hong Kong Offshore LNG Terminal (AEIAR-218/2018)
[18] EIA for New Contaminated Sediment Disposal Facility to the West of Lamma Island (AEIAR-241/2022)
[19] Water Quality and Hydraulic Mathematical Models (WAHMO) - the first set of comprehensive mathematical models for simulation of hydrodynamics, water quality, waves, and sediment movement in Hong Kong waters.

$$DO_{DEP} = C * SOD * K * 10^{-6}$$

where DO_{DEP} = DO depletion (mg/L)

C = Predicted maximum SS concentration (mg/L)

SOD = SOD (mg/kg) measured in the sediment samples collected from marine SI

K = Daily oxygen uptake factor (set as 1)

5.7.2.37 The calculation is performed using the highest measured SOD level for conservative predictions. The daily oxygen uptake factor, K, is set to be 1, which implies instantaneous oxidation of the SOD. This is a conservative prediction of DO depletion since oxygen depletion is not instantaneous. It is worth noting that the above equation does not account for re-aeration which tends to reduce the SS impacts on the DO concentrations.

5.7.2.38 The calculated DO depletion is subtracted from the ambient DO level presented in **Table 5.20** to determine the resulted DO level in marine water and WSRs.

5.7.3 Operation Phase

<u>Assessment Criteria</u>

5.7.3.1 The assessment criteria for operation phase are based on the statutory WQOs, the flushing water intake concentration limits specified by WSD and the design basis values specified by WSD for the seawater intake of desalination plant. In addition, sedimentation criterion is applied to the sensitive benthic communities (e.g., corals). No water quality requirements are available for the cooling water intakes. The assessment criteria for operation phase are summarized in **Table 5.22.**

Table 5.22 Key Assessment Criteria for Operation Phase

WSRs (Assessment Depth)	ID	WCZ	Annual Minimum DO	Annual Maximum SS	Annual Maximum NH_3-N	Annual Maximum BOD_5	Annual Maximum *E. coli*	Annual 10%ile Bottom DO, Note (2)	Annual 10%ile Depth Average DO, Note (2)	Allowable SS Increase from Ambient Level	Annual Mean TIN	Annual Mean UIA	Geometric Mean *E. coli*	Change of Salinity from Ambient Level	Annual Maximum Sedimentation Rate
			mg/L	mg/L	mg/L	mg/L	no. / 100 mL	mg/L	mg/L	-	mg/L	mg/L	no. / 100 mL	%	g/m^2/day
Flushing Water Intake (Depth average)															
Tseung Kwan	FW1	JB	> 2	< 10	< 1	< 10	<20,000	-	-	-	-	-	-	-	-
Cha Kwo Ling	FW2	VH1	> 2	< 10	< 1	< 10	<20,000	-	-	-	-	-	-	-	-
Sai Wan Ho	FW3	VH3	> 2	< 10	< 1	< 10	<20,000	-	-	-	-	-	-	-	-
Quarry Bay	FW4	VH3	> 2	< 10	< 1	< 10	<20,000	-	-	-	-	-	-	-	-
Heng Fa Chuen	FW5	EB	> 2	< 10	< 1	< 10	<20,000	-	-	-	-	-	-	-	-
Siu Sai Wan	FW6	EB	> 2	< 10	< 1	< 10	<20,000	-	-	-	-	-	-	-	-
Seawater Intake (Depth average)															
TKO Desalination Plant	SW1	EB	-	≤ 40	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	-
Cooling Water Intake (Depth average)															
Kai Tak District Cooling System	CW1	VH2	-	-	-	-	-	-	-	-	-	-	-	-	-
Yau Tong Bay Ice Plant	CW2	VH1	-	-	-	-	-	-	-	-	-	-	-	-	-
Tai Koo Place	CW3	VH3	-	-	-	-	-	-	-	-	-	-	-	-	-
North Point Government Office	CW4	VH3	-	-	-	-	-	-	-	-	-	-	-	-	-
Pamela Youde Nethersole Eastern Hospital	CW5	EB	-	-	-	-	-	-	-	-	-	-	-	-	-
Gazetted Bathing Beach (Depth average)															
Big Wave Bay	B1	S	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.1	≤0.021	≤180 (March to October)	±10	-
Rocky Bay	B2	S	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.1	≤0.021		±10	-
Shek O	B3	S	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.1	≤0.021		±10	-
Clear Water Bay First	B4	PS	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.1	≤0.021		±10	-
Clear Water Bay Second	B5	PS	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.1	≤0.021		±10	-
Potential Water Sports Area (Depth average)															
Junk Bay	WS1	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	-
Secondary Contact Recreation Subzone (Depth average)															
Junk Bay West	C1a, C1g	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	≤610 (Annual)	±10	-
Junk Bay West	C1d, C1f	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021		±10	-
Junk Bay West	CR1	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021		±10	-
Coral Communities (Bottom)															
Junk Bay West	C1a, C1g	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
Junk Bay West	C1d – C1f	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
Junk Bay	C2	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
Lohas Park	C3	JB						≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
Junk Island	C4	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
TKO INNOPARK	C5a	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
TKO INNOPARK	C5b	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
TKO INNOPARK	C5c	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
TKO INNOPARK	C5d	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
Fat Tong Chau	C6a	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
Fat Tong Chau	C6b	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
Tit Cham Chau	C7	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Kwun Tsai	C8	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Tin Ha Au	C9	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Tin Ha Shan	C10	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Tai Miu Wan	C11	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Tung Lung Chau West	C12	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Tung Lung Chau North	C13	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Tung Lung Chau North	C14	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Tung Lung Chau North	C15	MB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
Tung Lung Chau East	C16	MB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
Tung Lung Chau East	C17	MB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
Tung Lung Chau South	C18	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Cape Collinson	C19	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Cape Collinson	C20	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Cape Collinson	C21	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Tai Long Pai	C22	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Shek Mei Tau	C23	PS	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.1	≤0.021	-	±10	≤100
So Shi Tau	C24	PS	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.1	≤0.021	-	±10	≤100
Tai Wan Tau	C25	PS	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.1	≤0.021	-	±10	≤100

WSRs (Assessment Depth)	ID	WCZ	Annual Minimum DO	Annual Maximum SS	Annual Maximum NH_3-N	Annual Maximum BOD_5	Annual Maximum *E. coli*	Annual 10%ile Bottom DO, Note (2)	Annual 10%ile Depth Average DO, Note (2)	Allowable SS Increase from Ambient Level	Annual Mean TIN	Annual Mean UIA	Geometric Mean *E. coli*	Change of Salinity from Ambient Level	Annual Maximum Sedimentation Rate
			mg/L	mg/L	mg/L	mg/L	no. / 100 mL	mg/L	mg/L	-	mg/L	mg/L	no. / 100 mL	%	$g/m^2/day$
Tai Hang Tun North	C26	PS	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.1	≤0.021	-	±10	≤100
Hong Kong Museum of Coastal Defence	C27	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Coral Recipient Site															
Junk Bay West	CR1	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
Fat Tong Chau	CR2	JB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	≤100
Amphioxus (Bottom)															
Tit Cham Chau	A1	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Tathong Channel	A2	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	≤100
Site of Special Scientific Interest (Depth average)															
Shek O Headland	SS1	S	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.1	≤0.021	-	±10	-
Fisheries Sensitive Receiver (Depth average unless otherwise specified)															
Tung Lung Chau	F1	EB	-	-	-	-	-	≥ 2	≥ 5	≤30%	≤0.4	≤0.021	≤ 610 (Annual)	±10	-
Po Toi O	F2	PS	-	-	-	-	-	≥ 2	≥ 5	≤30%	≤0.1	≤0.021		±10	-
Important Spawning Ground of Commercial Fisheries Resources	SG1	S	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.1	≤0.021	-	±10	-
	SG2	EB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	
	SG3	MB	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.3	≤0.021	-	±10	-
Important Nursery Ground of Commercial Fisheries Resources	NG1	PS	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.1	≤0.021	-	±10	-
Typhoon Shelter (Depth average)															
Sam Ka Tsuen	T1	VH1	-	-	-	-	-	≥ 2	≥ 4	≤30%	≤0.4	≤0.021	-	±10	-

Notes:
(1) Details of assessment criteria are also presented in Section 5.2.
(2) The WQOs for DO allow exceedance of the objective values for no more than 10% of the samples.
"– " denotes no applicable water quality criteria.

JB – Junk Bay WCZ; EB – Eastern Buffer WCZ; VH1 – Victoria Harbour WCZ (Phase 1); VH2 – Victoria Harbour WCZ (Phase 2); VH3 – Victoria Harbor WCZ (Phase 3); PS – Port Shelter; MB – Mirs Bay; S – Southern

Modelling Scenarios

Changes of Coastline Configurations and Discharges from EPP

5.7.3.2 Three modelling scenarios are simulated to predict the changes of hydrodynamics and water quality as follows.

- Scenario B1: Baseline scenario without the Project in 2041
- Scenario B2: Impact scenario with the Project (Normal EPP Operation) in 2041
- Scenario B3: Impact scenario with the Project (Emergency Discharge from EPP) in 2041

5.7.3.3 All the three modelling scenarios are assumed to occur at the same time horizon for comparison. Scenario B1 represents the baseline "do-nothing" scenario without the Project. Scenario B2 represents an impact scenario upon completion of the entire Project with full population intake. The EPP flow is assumed to reach its design capacity under normal operation. The model results are compared between Scenario B1 and Scenario B2 to predict the changes of hydrodynamics and water quality due to the Project.

5.7.3.4 Scenario B3 represents a very remote event of emergency discharge of raw sewage from the EPP for 2 hours for conservative assessment. The emergency discharge near slack water of neap tide is simulated as worst-case scenario in both dry and wet seasons. The rest of the model setting for Scenario B3 is the same as that of Scenario B2.

5.7.3.5 Changes of flow regime is assessed by comparing the model results between Scenario B1 and Scenario B2 in terms of the predicted flow rates across Lei Yue Mun, Joss House Bay and Tung Lung Chau West in **Appendix 5.7**. Maps of flow vectors and current velocities comparing Scenario B1 and Scenario B2 in the assessment area are prepared.

Pollution Loading

Background Pollution Loading

5.7.3.6 The background pollution loading inventory for major storm and sewage effluent outfalls in Hong Kong compiled by the EPD for 2041 is used for model input under Scenario B1, Scenario B2 and Scenario B3. This background pollution loading inventory also covers major discharges from Mainland including the Pearl River. In addition, the pollution loading from the TKO Desalination Plant, as shown in **Table 5.23** is also incorporated into all the three modelling scenarios.

Table 5.23 Brine Discharge from TKO Desalination Plant

Description	Upper Discharge Limit
Discharge Flow Rate	464,000 m^3 / day
TP	1 mg/L
TIN	2 mg/L
Salinity	71,347 mg/L
SS	13 mg/L

Source: TKO Desalination Plant (TKODP) EIA (AEIAR-192/2015) (for discharge flow rate) and existing WPCO discharge license of TKODP (for TP, TIN, Salinity and SS).

EPP Effluent

5.7.3.7 The effluent flow and quality of the EPP assumed under Scenarios B2 and B3 are presented in **Table 5.24**.

Table 5.24 Effluent Discharge from EPP

Description		Scenario B2 (Normal Operation)	Scenario B3 (Emergency Situation)
Treatment Level		Secondary plus	Raw sewage
Effluent quantity, see Note (1)		54,000 m^3 per day	5,850 m^3 per 2-hour event
BOD_5	mg/L	20	210
SS	mg/L	30	320
NH_3-N	mg/L	2	30
TN	mg/L	10	50
TP	mg/L	2.26	7
E. coli	no./100mL	1,000	4.0 x 10^7
Salinity	ppt	11	11

Note (1): The design flow of EPP is under review and subject to further updating during the course of this EIA.

5.7.3.8 The TKO 137 development would use seawater for toilet flushing, which would contribute about 30% of the total EPP flow. The maximum salinity level recorded in the closest EPD monitoring station (JM3) to the TKO flushing water intake is 33.7 ppt in 2022. Assuming that the salinity level of the flushing water is 33.7 ppt and the freshwater would typically have a salinity level of 0.5 ppt, the overall salinity level of the EPP effluent would be about 10.1 ppt. The modelling assumption of using an effluent salinity level of 11 ppt is considered reasonable.

5.7.3.9 The WSD requires an assessment of potential impact on TDS, boron and bromide levels at the seawater intake of desalination plant. These parameters are not considered in the HK-DFM Model. They are also not measured in the sewage effluent of major STW in Hong Kong. The TDS levels in seawater would mainly comprise salinity but can also include other organic solutes. The model prediction for salinity and other key parameters such as BOD_5, TIN and DO will be reviewed to provide an indication of the degree of water quality influence from the EPP discharges at the seawater intake. If the degree of water quality influence due to this Project is insignificant, the increase in TDS, boron and bromide at the intake of TKO desalination plant due to this Project is also expected to be insignificant.

5.7.3.10 No heated effluent discharge is proposed under this Project. Discharges from the proposed EPP would not have any thermal impact. Impact on water temperature is therefore not considered in the assessment.

Non-point Source Surface Runoff

5.7.3.11 Pollution loading due to non-point source surface runoff is also incorporated into the water quality modelling. The loading was estimated with reference to the urban runoff pollutant concentrations provided under the EPD Pilot Study of Storm Pollution. Details of non-point source pollution loading adopted in the modelling are presented in **Appendix 5.8**.

5.7.4 Coastline Configurations for Modelling

5.7.4.1 The existing coastline configurations, which have incorporated all completed or on-going coastal projects such as the Tseung Kwan O – Lam Tin Tunnel and Associated Works, Cross Bay Link, Expansion of Hong Kong International Airport into a Three-Runway System and Tung Chung New Town Extension, are adopted under Scenario A1 and Scenario A2 (Construction Phase Impact Scenarios).

5.7.4.2 In addition to the completed and on-going coastal projects, other planned projects as summarized in **Table 5.25** are also incorporated under the operation phase scenarios, namely Scenario B1 (Baseline "do-nothing" Scenario in 2041) and Scenarios B2 and B3 (Operation Phase Impact Scenarios in 2041).

Table 5.25 Other Planned Projects Included under Scenarios B1, B2 and B3

Planned Projects Affecting the Coastline	Layout Reference
Reclamation for Kau Yi Chau Artificial Islands	LC Paper No. CB(1)930/2022(01)
Reclamation for Road P1	EIA study brief No. ESB-337/2020
Reclamation for Route 11	EIA Study Brief No. ESB-352/2022
Lung Kwu Tan Reclamation	LC Paper No. CB(1)141/2023(03)
Tsing Yi - Lantau Link	EIA Study Brief No. ESB-359/2023

5.7.4.3 Scenario A2 also incorporates part of the permanent / temporary seawalls as indicated in **Appendix 5.6**, whilst full completion of the Project development is assumed under Scenarios B2 and B3.

5.7.4.4 Besides, the TKO 132 and TKO 137 reclamations, the piers of the proposed marine viaducts at TKO 132 are also incorporated into Scenarios B2 and B3. The marine viaducts would typically involve the installation of 1 pair of pile cap (each with a dimension of 16 m x 4 m) at a spacing of 40 m as indicated in **Appendix 5.9**.

5.7.4.5 Any reclamation proposals in Deep Bay are over 40 km away from the Project site and their effect on the hydrodynamics in the assessment area would be negligible and are not considered.

5.7.5 Model Bathymetry

5.7.5.1 The model bathymetry schematization developed by EPD for use in the HK-DFM Model is adopted for modelling. Scenarios B2 and B3 (Operation Phase Impact Scenarios in 2041) also incorporate the design depth of 8 m below CD in the berthing area of TKO 132. The model bathymetry is shown in Plot No. 33 of **Appendix 5.4**.

5.7.6 Assessment Approach for Other Potential Impacts

5.7.6.1 The remaining water quality impacts identified during the construction and operation phases are assessed using qualitative approach. Potential sources of water quality impact that may arise are described. All the identified sources of potential water quality impact are then evaluated, and their impact significance determined. Mitigation measures to reduce any identified impacts on water quality are also recommended.

5.8 Evaluation of Potential Impacts – Marine Construction

5.8.1 DCM

5.8.1.1 The DCM method enables *in-situ* stabilisation of the underlaying marine mud within the proposed reclamation and seawall areas. It is capable to treat sediment in deep layer without excavation, dredging, shoring or dewatering, and thus there is less exposure of wastes to the water environment.

5.8.1.2 By deployment of silt curtain and placing the sand blanket layer on top of the DCM works areas before the DCM treatment, release of fines and cement slurry from the DCM operation would be negligible.

5.8.1.3 The piling pipe of the DCM equipment would contact the longitudinal surface of the materials to be treated. Any heat dissipation from the exothermic process of DCM would largely occur within the materials immediately surrounding the DCM column, which is beneath the seabed. Any minor heat dissipation from the top of DCM columns will be absorbed by the sand blanket laid above the DCM columns. Thermal impact due to DCM would be negligible.

5.8.1.4 The DCM method has been proven and adopted in Hong Kong. Recent DCM applications include the foundation of breakwater and seawall around the artificial island for development of Integrated Waste Management Facilities Phase 1 (I■PARK1) at Shek Kwu Chau. Marine water quality monitoring was conducted under the I■PARK1 during the DCM trials held in July, September, October and December 2018 and the full-scale DCM conducted within the period from February 2019 to October 2020 [20]. Salinity, pH, DO, turbidity, temperature, SS and total alkalinity were monitored in locations close to the artificial island, at representative WSRs and control stations further away. The monitoring has demonstrated that there were no adverse water quality impacts associated with the DCM. Elevated pollution levels due to the DCM works were not recorded. Based on the past monitoring results, no adverse water quality impact is expected from the DCM works of this Project.

5.8.1.5 According to approved EIA for 3RS (AEIAR-185/2014), overseas application and the local site trial of DCM held in February 2012 has demonstrated that there is no adverse water quality impact associated with the DCM installation works. This was further confirmed after the approval of the EIA for 3RS under both the intensive DCM water quality monitoring and regular DCM monitoring for full-scale DCM applications in 3RS between 2017 and 2019 [21]. These recent monitoring results concluded that the DCM works would not result in sediment loss and no SS elevation was attributable to the DCM installation work.

5.8.2 Underwater Filling, Dredging and Sand Blanket Laying

Elevation of Suspended Solids and Sediment Deposition

Model Results for Unmitigated Scenarios

5.8.2.1 Loss of fines could arise from the proposed marine construction works and the associated SS elevations and sediment depositions are predicted by means of mathematical modelling.

5.8.2.2 Two sediment dispersion modelling scenarios, namely Scenarios A1 and A2, were simulated as defined in **Appendix 5.6** and Section 5.7.2.14. The model results for maximum SS elevations and maximum sedimentation rates under the unmitigated scenarios are tabulated for each WSR in **Appendix 5.10a**. Contour plots of mean SS elevations and mean sedimentation rates under the unmitigated scenarios are given in **Appendix 5.10b**.

5.8.2.3 As illustrated in **Table 5.21**, the overall amount of sediment release from TKO 132 is larger than that from TKO 137. The flushing capacity at TKO 132 in Junk Bay is also poorer than that at TKO 137 in Tathong Channel. Furthermore, TKO 132 is located in close proximity to WSRs. The SS elevations and sedimentation rates are predicted to be above the corresponding assessment criteria at six coral sites (C1a, C1d, C1e, C1f, C1g, C2) and one coral recipient site (CR1) in Junk Bay under Scenario A1 and / or Scenario A2 as shown in **Table 5.26**.

Table 5.26 Predicted SS Elevations and Sedimentation Rates at Representative WSRs – Unmitigated Scenarios

WSRs	ID	Assessment Depth	Maximum SS Elevation (mg/L)				Maximum Sediment Deposition (g/m²/day)		
			Dry Season		Wet Season		Assessment Criteria	Dry Season	Wet Season
			Assessment Criteria	Predicted Level	Assessment Criteria	Predicted Level			
Scenario A1									
Coral Communities									
Junk Bay West	C1a	Bottom	4.2	1.0	3.5	**7.3**	100	48	**307**
Junk Bay West	C1d	Bottom	3.3	**3.9**	3.8	**4.3**	100	**161**	**186**
Junk Bay West	C1e	Bottom	3.3	**11.9**	3.8	**8.8**	100	**503**	**374**
Junk Bay West	C1f	Bottom	3.3	**5.1**	3.8	**7.6**	100	**201**	**335**
Junk Bay West	C1g	Bottom	4.2	**4.8**	3.5	**6.9**	100	**209**	**283**
Junk Bay	C2	Bottom	3.3	**11.1**	3.8	**8.9**	100	**526**	**378**
Coral Recipient Site									
Junk Bay West	CR1	Bottom	3.3	3.3	3.8	3.4	100	**135**	**132**
Fat Tong Chau	CR2	Bottom	3.5	0.8	4.0	0.4	100	32	16

[20] Website of EM&A data for FEP-01/429/2012/A / EP-429/2012/A - Development of the Integrated Waste Management Facilities Phase 1 (https://www.epd.gov.hk/eia/english/register/index7/fep1772017_content.html)

[21] https://env.threerunwaysystem.com/en/em&a-reports.html

WSRs	ID	Assessment Depth	Maximum SS Elevation (mg/L)				Maximum Sediment Deposition ($g/m^2/day$)		
			Dry Season		Wet Season		Assessment Criteria	Dry Season	Wet Season
			Assessment Criteria	Predicted Level	Assessment Criteria	Predicted Level			
Seawater Intake									
TKO Desalination Plant	SW 1	Depth average	3.0	<0.1	3.5	<0.1	-	-	-
Scenario A2									
Coral Communities									
Junk Bay West	C1a	Bottom	4.2	<0.1	3.5	0.1	100	2	6
Junk Bay West	C1d	Bottom	3.3	0.5	3.8	2.2	100	17	41
Junk Bay West	C1e	Bottom	3.3	**5.6**	3.8	**15.8**	100	**267**	**650**
Junk Bay West	C1f	Bottom	3.3	**4.5**	3.8	**6.1**	100	**187**	**259**
Junk Bay West	C1g	Bottom	4.2	1.5	3.5	2.4	100	61	**111**
Junk Bay	C2	Bottom	3.3	**3.9**	3.8	**3.9**	100	**172**	**149**
Coral Recipient Site									
Junk Bay West	CR1	Bottom	3.3	2.6	3.8	**4.0**	100	**116**	**174**
Fat Tong Chau	CR2	Bottom	3.5	1.6	4.0	1.3	100	62	56
Seawater Intake									
TKO Desalination Plant	SW1	Depth average	3.0	<0.1	3.5	<0.1	-	-	-

Notes:
1. Shaded and bolded value – Predicted level is above the corresponding assessment criteria.
2. Model results for a full list of WSRs are presented in **Appendix 5.10a**.

5.8.2.4 As shown in **Appendix 5.10a**, non-compliances with the assessment criteria for depth-averaged SS elevations are also predicted at the secondary contact recreation subzone (C1a, C1d, C1f, C1g, CR1) at TKO 132 under the unmitigated scenarios. Compliances with the corresponding assessment criteria for SS elevation and sedimentation are predicted at all remaining WSRs including all the WSD's flushing water intakes and the seawater intake of TKO desalination plant.

Model Results for Mitigated Scenarios

5.8.2.5 To mitigate potential impacts on the WSRs, mitigation measure in form of double silt curtain around the marine construction works is recommended at the TKO 132 development area. Silt curtains are highly effective in areas where current speeds are low. Junk Bay is an embayed water with reduced current velocity. Deployment of the double silt curtain system in Junk Bay is considered an effective mitigation measure. A SS removal efficiency of 87.4% is assumed for the double silt curtain system with reference to the past silt curtain efficiency test results. The indicative arrangement of the double silt curtain at TKO 132 is provided in **Appendix 5.10j**.

5.8.2.6 Under the unmitigated scenarios, compliances with the assessment criteria are predicted at WSRs close to the TKO 137 development area. Construction of marine viaducts in Junk Bay is minor in scale as compared to the reclamation works. Potential water quality impact contributed from the reclamation works at TKO 137 and construction of marine viaducts in Junk Bay is considered minor. As a precautionary measure and to minimize the cumulative impact upon the WSRs, a single layer of silt curtain should be deployed around the marine works at TKO 137 and marine viaducts in Junk Bay.

5.8.2.7 The predicted SS elevations and sediment deposition with implementation of the proposed silt curtains are presented in **Table 5.27** for representative WSRs. The full model results tabulated for each WSR under the mitigated scenarios are presented in **Appendix 5.10c**. Full compliances with the corresponding assessment criteria for SS elevation and sedimentation flux are predicted at all WSRs. The contour plots for SS elevations and sedimentation rates under the mitigated scenarios are given in **Appendix 5.10d**, which showed that the extent of sediment plumes would be significantly reduced and minimized with implementation of the recommended mitigation measures.

Table 5.27 Predicted SS Elevations and Sedimentation Rates at Representative WSRs – Mitigated Scenarios

WSRs	ID	Assessment Depth	Maximum SS Elevation (mg/L)				Maximum Sediment Deposition ($g/m^2/day$)		
			Dry Season		Wet Season				
			Assessment Criteria	Predicted Level	Assessment Criteria	Predicted Level	Assessment Criteria	Dry Season	Wet Season
Scenario A1									
Coral Communities									
Junk Bay West	C1a	Bottom	4.2	0.1	3.5	1.0	100	6	40
Junk Bay West	C1d	Bottom	3.3	0.5	3.8	0.6	100	21	24
Junk Bay West	C1e	Bottom	3.3	1.5	3.8	1.1	100	65	49
Junk Bay West	C1f	Bottom	3.3	0.6	3.8	0.9	100	26	38
Junk Bay West	C1g	Bottom	4.2	0.6	3.5	0.9	100	26	38
Junk Bay	C2	Bottom	3.3	1.4	3.8	1.6	100	68	73
Coral Recipient Site									
Junk Bay West	CR1	Bottom	3.3	0.4	3.8	0.4	100	17	17
Fat Tong Chau	CR2	Bottom	3.5	0.2	4.0	<0.1	100	8	4
Seawater Intake									
TKO Desalination Plant	SW1	Depth average	3.0	<0.1	3.5	<0.1	-	-	-
Scenario A2									
Coral Communities									
Junk Bay West	C1a	Bottom	4.2	<0.1	3.5	<0.1	100	<1	<1
Junk Bay West	C1d	Bottom	3.3	<0.1	3.8	0.3	100	2	5
Junk Bay West	C1e	Bottom	3.3	0.7	3.8	2.0	100	34	82
Junk Bay West	C1f	Bottom	3.3	0.6	3.8	0.8	100	24	33
Junk Bay West	C1g	Bottom	4.2	0.4	3.5	0.6	100	15	28
Junk Bay	C2	Bottom	3.3	0.5	3.8	0.5	100	22	19
Coral Recipient Site									
Junk Bay West	CR1	Bottom	3.3	0.3	3.8	0.5	100	15	22
Fat Tong Chau	CR2	Bottom	3.5	0.4	4.0	0.3	100	16	14
Seawater Intake									
TKO Desalination Plant	SW1	Depth average	3.0	<0.1	3.5	<0.1	-	-	-

Notes:

1. Shaded and bolded value – Predicted level is above the corresponding assessment criteria.
2. The model results for a full list of WSRs are presented in **Appendix 5.10c**.

Consideration of Alternative Modelling Scenarios for TKO 137

5.8.2.8 The seawater intake of TKO desalination plant is located in Joss House Bay, which is sheltered from the direct tidal current from the marine construction works and would unlikely be significantly affected by the sediment plumes generated from the Project. As shown in **Table 5.26** and **Table 5.27**, the predicted SS elevations at the seawater intake of TKO desalination plant are negligible under the two worst-case scenarios (A1 and A2). The unmitigated and mitigated SS elevations at the seawater intake are no more than 0.1 mg/L with a great safety margin of at least 97% from the criteria values of 3.7 mg/L and 4.0 mg/L for dry and wet seasons.

5.8.2.9 As indicated in **Table 5.20,** the 90%ile ambient SS level at the seawater intake is 12.2 mg/L and 13.4 mg/L for dry and wet season respectively. The Project would cause a further SS increase at the seawater intake of no more than 0.1 mg/L, which is negligible as compared to the ambient levels. The resulted SS level is significantly (at least 26 mg/L) below the design limit set out by the WSD of ≤ 40 mg/L.

5.8.2.10 Removal of a thin layer of marine deposit is proposed near the southern end of TKO 137 reclamation during Phase 2C of TKO 137 reclamation. As shown in **Table 5.22**, Phase 2C of TKO 137 reclamation would contribute relatively small amount of sediment release. It is not identified as a worst-case scenario in terms of water quality impact and therefore not included in the modelling. As mentioned above, the predicted SS levels under the worst-case modelling scenarios would have minimal impact upon the seawater intake of TKO desalination plant. It is considered that additional modelling scenarios to address the removal of marine deposit during Phase 2C of TKO 137 reclamation or further adjusting the modelling scenario by assuming a closer sediment release point to the seawater intake would not affect the SS compliance and conclusion of this modelling exercise. Additional modelling scenario for TKO 137 is not necessary.

Oxygen Depletion and Contaminant Release

Sediment Quality

5.8.2.11 Sediment sampling and testing was conducted under this EIA to identify the level of sediment contamination within the marine construction works area. The sediment sampling and testing programme are presented in the approved SSTP and in Section 7. Detailed evaluation of the sediment quality for metals, metalloid and organic contaminants including PAHs, PCBs, TBT is provided in Section 7.4 and not presented in this section

5.8.2.12 Sediment quality data for additional parameters including nutrients and 20-day SOD collected under this EIA are tabulated in **Appendix 5.10e** and **Appendix 5.10f**. Relevant sediment quality data are also extracted from the *Marine Water Quality in Hong Kong 2023* at the closest sampling stations and included in **Appendix 5.10e** and **Appendix 5.10f** for comparison. The NH_3-N, TKN and TP contents in sediments recorded under this EIA were <10– 44 mg/kg, 70 – 1730 mg/kg and 71 – 795 mg/kg in TKO 137 and <10 – 27 mg/kg, 70 – 1540 mg/kg and 57 – 3620 mg/kg in TKO 132. The nutrient contents recorded at the EPD's monitoring stations are within the ranges of nutrient contents recorded at TKO 137 and TKO 132 under this EIA.

Oxygen Depletion

5.8.3 The degree of DO depletion exerted by a sediment plume is a function of the SOD of the sediment, sediment concentration in the water column and the rate of oxygen replenishment. The impact of the SOD on DO concentrations has been calculated based on the methodology described in Sections 5.7.2.36 to 5.7.2.38.

5.8.4 The proposed methodology assumed that all SOD reaching the WSRs would be instantaneously oxidated, which would overestimate the DO impact since oxygen depletion is not instantaneous. The methodology does not consider the effect of re-aeration and DO replenishment in the tidal water. In actuality, it will take time for the SS to exert any oxygen demand in the water column and, at the same time, the sediment will be transported and mixed or dispersed with oxygenated water, which are not considered in this assessment. Furthermore, the highest SOD level of 2,470 mg/kg measured amongst all the sediment samples collected at TKO 137 and TKO 132 was adopted in the calculations. The average SOD level recorded at the Project sites would be much lower (**Appendix 5.10e** and **Appendix 5.10f**). Thus, this assessment will provide a highly conservative prediction of DO depletions.

5.8.5 The resulted maximum DO depletions at all WSRs are tabulated in **Appendix 5.10a** and **Appendix 5.10c** for mitigated and unmitigated scenarios. The predicted maximum DO depletions at all WSRs are below 0.1 mg/L under the unmitigated scenarios and below 0.01 mg/L under the mitigated scenarios. The degree of DO depletion arising from this Project is considered minimal. Full DO compliances are predicted during the construction phase.

Release of Nutrients, Metals and Micro-pollutants

5.8.6 Sediment elutriate test was conducted using sediment samples collected at the Project sites to identify the potential release of sediment-bound contaminants due to disturbance from marine works under this Project as described in Sections 5.7.2.32 to 5.7.2.35. The elutriate samples were analysed for nutrients, heavy metals, trace organic pollutants and chlorinated pesticides. The elutriate test locations are presented in **Appendix 5.10e** and **Appendix 5.10f**. The elutriate testing results are enclosed in **Appendix 5.10g** and **Appendix 5.10h**.

5.8.6.1 The elutriate test results showed that the contents of nitrogen and phosphorous nutrients, As, Cu, Pb, Ni and Zn in the sediment would tend to be released into the marine water as a result of seabed disturbances. The concentrations of TIN, UIA, As, Cu and Zn in the elutriate samples exceeded their respective assessment criteria. The measured NH_3-N in the elutriate samples also exceeded the relevant target objective set out by the WSD for flushing water intakes. Full compliances with the assessment criteria are observed for the remaining tested parameters.

5.8.6.2 Based on the elutriate test results, the initial concentrations of nitrogen nutrients, As, Cu and Zn at source (i.e., grab dredger) would potentially exceed the assessment criteria. The concentrations at WSRs were determined based on the dilution potential derived from tracer modelling. Continuous releases of inert and non-settling tracer were introduced in the refined HK-DFM Model to represent contaminant releases at source. Based on the tentative construction programme, no more than 1 grab dredger would be working at each of the TKO 137 and TKO 132 sites. No dredging / sediment removal would be carried out for construction of marine viaducts in Junk Bay. It is assumed in the tracer modelling that two grab dredgers would be working concurrently at TKO 137 and TKO 132 respectively and each grab dredger would represent a contaminant release source. Subsequent comparison between the release rate at the source and the resultant concentration at the model grid cell representing each WSR enables a dilution potential to be determined. The dilution potential for each WSR is then applied to the elutriate data to estimate the contaminant concentration at each WSR.

5.8.6.3 Locations of the two contaminant release sources assumed in the tracer modelling, predicted dilution potential for each source, initial contaminant concentrations at source (i.e. elutriate data used in the estimation) and the cumulative contaminant concentrations predicted at each WSR due to the two sources are presented in **Appendix 5.10i**. As the tracer modelling was performed for calculation of the dilution potential rather than for simulation of the actual contaminant release, no contour plots of contaminants are prepared, following the assessment approach adopted in the approved EIA for Expansion of Hong Kong Airport into a Three-Runway System (AEIAR-185/2014).

5.8.6.4 Based on the estimated dilution rates, full compliances with the assessment criteria are predicted at all WSRs.

5.8.7 Construction of Marine Viaducts

5.8.7.1 Construction of marine viaducts would involve installation of marine piers or piles. Bored piles or equivalent system would be adopted for the installation works. There will not be any open sea dredging for construction of marine viaducts. All marine piers or piles would be bored inside a steel casing or other equivalent systems that can effectively contain wastewater and spoil generated from the pilling process. The steel casing would be inserted into the seabed by vibratory action (e.g. using vibratory hammer). Such operation is expected to result in limited level of localized disturbance to bottom sediment. The sediment would only be laterally displaced during the steel casing insertion process.

5.8.7.2 After the installation of bored piles, the rest of the pile installation would be conducted in dry environment within precast pier shell, and thus would not result in any direct water quality impact.

5.8.7.3 Given the small scale of works (with no open dredging) and together with the use of silt curtain and other mitigation measures for sediment control as recommended in Section 5.11.3, the potential release of fines and contaminants is expected to be limited. The SS release from the construction of marine viaducts has been assumed in the modelling exercise for conservative assessment. The associated modelling results are presented in **Table 5.27**. Full water quality compliances are predicted under the mitigated modelling scenarios with deployment of a single layer silt curtains around the construction of marine viaducts. No adverse water quality impact would arise from construction of the marine viaducts.

5.8.8 Leakage and Spillage from Barges

5.8.8.1 The Contractor shall follow the good practices and mitigation measures as recommended in Section 5.11.5 to prevent marine spillage from barges. Any proposed barging point would be equipped with conveyor belt, which would be fully enclosed to prevent marine spillage. No adverse water quality impact is expected with proper implementation of the recommended mitigation measures.

5.9 Evaluation of Potential Impacts – Land-based Construction

5.9.1 Construction Site Runoff and Dust Suppression Sprays

5.9.1.1 Relevant mitigation measures outlined in ProPECC PN 2/23 would be implemented to control construction site runoff, contaminated surface runoff and drainage from the works areas, and to prevent runoff and drainage water with high levels of SS from entering the nearby water bodies. The construction site runoff and spent dust suppression sprays would be collected by the temporary drainage system installed by the Contractor and then treated on-site before discharging into the storm drains via silt removal facilities. The treated discharges shall meet the respective effluent standards applicable to the receiving waters as set out in the TM-DSS.

5.9.1.2 With the implementation of appropriate measures to control run-off and drainage from the construction site in Sections 5.12.1 and 5.12.4, disturbance of water bodies would be avoided and impact on water quality would be minimal and acceptable.

5.9.2 Wastewater from General Construction Activities

5.9.2.1 Wastewater from general construction activities are likely to be minimal, provided that good construction practices and proper site management would be observed and implemented. Effluent discharged from various construction site facilities would be controlled to prevent direct discharge to the neighbouring inland waters and storm drains. No adverse water quality impact would arise from the wastewater generation with proper implementation of the recommended mitigation measures in Sections 5.12.2 and 5.12.4.

5.9.3 General Refuse

5.9.3.1 Good housekeeping measures and regular refuse collection programme should be adopted to mitigate the potential water quality impact associated with the refuse generation in construction site. With proper implementation of the recommended mitigation measures and good site practices in Section 5.12.3, there would be no adverse water quality impacts due to refuse generation.

5.9.4 Accidental Chemical Spillage

5.9.4.1 All chemicals should be handled, stored and disposed properly to avoid and contain spillage. Good construction practices should be implemented to prevent accidental spillage from maintenance activities. With proper implementation of all recommended mitigation measures in Section 5.12.5, no adverse water quality impacts would arise.

5.9.5 Sewage Effluent from Construction Workforce

5.9.5.1 Provided that sewage is not discharged directly into storm drains or inland/marine waters adjacent to the construction site, and sufficient chemical toilets are serviced and properly maintained by a licensed waste collector, sewage generated from the site would not cause any adverse water quality impact.

5.9.6 Contaminated Site Runoff

5.9.6.1 With proper implementation of the recommended mitigation measures and good site practices to avoid, control or properly treat any contaminated site runoff in Sections 5.12.4 and 5.12.7, the potential water quality impacts arising from contaminated site run-off would be minimized and acceptable.

5.9.7 Construction near Inland Watercourses or Seafront

5.9.7.1 The possible slope cutting works at TKO 132 would affect the most downstream sections of the watercourses. The watercourses immediately next to the slope cutting are located upstream and would unlikely be affected by the Project. The watercourses near the Project works in Fat Tong Chau are very minor and their immediate downstream is the man-made drainage system in TKO 137. Water quality impact due to construction near these inland watercourses would be minor. With proper implementation of the recommended mitigation measures in Sections 5.12.4 and 5.12.8, no adverse water quality impact would arise.

5.9.8 Removal or Diversion of Inland Watercourses

5.9.8.1 The removal of inland modified watercourses at TKO 137 would involve diverting the water flow from their existing routes to the new routes through the proposed covered drainage system of the new development area. Flow diversion would be conducted prior to construction at the existing watercourses. Construction would be undertaken in a dry condition to avoid contaminated runoff. No blockage nor reduction of the water flow of the inland watercourses would occur based on the proposed construction method. Changes of flow regime and hydrodynamics of natural streams / watercourses outside the construction sites are not expected. Proper construction site drainage would be implemented to protect the downstream water quality. No adverse water quality impact upon the downstream water quality is anticipated with proper implementation of the mitigation measures recommended in Sections 5.12.4 and 5.12.9.

5.10 Evaluation of Potential Impacts - Operation Phase

5.10.1 Hydrodynamics Modelling Results

5.10.1.1 The simulated surface flow vectors and depth-averaged flow speeds in the assessment area are compared between Scenario B1 (baseline condition without the Project) and Scenario B2 (with the Project under normal EPP operation) in **Appendix 5.11a**. These plots show the instantaneous water movements at mid-ebb and mid-flood tides during both dry and wet seasons. The momentary flow and accumulated flow predicted at three cross sections (Lei Yue Mun, Joss House Bay and Tung Lung Chau West) during both dry and wet seasons are compared between Scenario B1 and Scenario B2 in **Appendix 5.11b**. Locations of the cross sections are shown in **Appendix 5.7**. Momentary flow represents the instantaneous flow rate at a specific time in m^3/s whereas accumulated flow represents the total flow accumulated at a specific time in m^3. Emergency discharge from the EPP would not have further effect on the flow regime and therefore the hydrodynamics model results for Scenario B3 are not presented.

5.10.1.2 As shown in the flow vector plots in **Appendix 5.11a**, some deviations of flow directions are observed near the proposed reclamation sites at TKO 132 and TKO 137 under the impact "with Project" scenario as compared to the baseline "without Project" scenario. The tidal waters in the remaining areas in Junk Bay, Joss House Bay and along Victoria Harbour and Tathong Channel are generally flowing in the same directions between the "with Project" and "without Project" scenarios. The patterns and ranges of flow speeds within the assessment area are similar between the "with Project" and "without Project" scenarios.

5.10.1.3 The TKO 132 reclamation would block part of tidal flow across inner Junk Bay. Without the Project, the baseline flow speeds at inner Junk Bay are relatively slow (<0.1 m/s). As indicated in **Appendix 5.11b**, the Project would reduce the root-mean-square (RMS) averaged flow speeds of inner Junk Bay (JM3) by about 19% and about 15% in dry and wet seasons respectively. The resulted flow speeds at inner Junk Bay under the "with Project" scenario would still be within the same order of magnitude as compared to the baseline without Project" scenario. The changes of RMS averaged flow speeds (caused by this Project) are small of about 0.3% and about 1% at outer Junk Bay (JM4) in dry and wet seasons respectively. On the other hand, the Project would cause an increase in the RMS averaged flow speeds at Tathong Channel (EM2) by up to about 9% due to the TKO 137 reclamation in both dry and wet seasons.

5.10.1.4 As shown in the timeseries plots, changes of momentary flow across the key tidal channels (caused by this Project) are considered negligible. With this Project, the TKO 137 reclamation would divert some tidal flow away from Joss House Bay, resulting a reduction of accumulated flow through Joss House Bay as compared to the baseline "without Project" scenario. The maximum changes in the accumulated flow rates due to this Project are about 11.6% across Joss House Bay. The maximum changes of accumulated flow across Lei Yue Mun and Tung Lung Chau West (caused by this Project) are significantly smaller of less than 1%.

5.10.1.5 No statutory requirements or guidelines available for the % change of flow speed and tidal flow. The changes of water quality and the predicted water quality compliances as a result of the Project and the associated changes of hydrodynamics are evaluated in the sections below.

5.10.2 Water Quality Modelling Results

Predicted Water Quality Compliances at WSRs

5.10.2.1 The water quality levels predicted at WSRs under all the three modelling scenarios (B1, B2 and B3) are tabulated in **Appendix 5.11c** for DO, BOD_5, NH_3-N, TIN, UIA, *E.coli*, SS, sedimentation rates and salinity for comparison with the relevant assessment criteria. All the predicted values are in annual basis, except only for the bathing beaches where the predicted geometric mean *E. coli* levels are calculated over the bathing season. Description of the three modelling scenarios (B1, B2 and B3) are presented in Section 5.7.3.2.

DO

5.10.2.2 The minimum DO levels predicted at all the flushing water intakes complied with the target DO objective of > 2 mg/L under all the three modelling scenarios (with and without this Project).

5.10.2.3 The predicted 10%ile bottom DO and 10%ile depth-averaged DO at FCZs complied with the WQO of ≥ 5 mg/L for depth-averaged value and ≥ 2 mg/L for bottom layer (with and without this Project) The predicted 10%ile bottom DO and 10%ile depth-averaged DO at other relevant WSRs (including gazette beaches, water sports area at Junk Bay, secondary contact recreation subzone, seawater intake of desalination plant, typhoon shelter, coral communities, coral recipient sites, amphioxus, SSSI, important spawning ground of commercial fisheries resources and important nursery ground of commercial fisheries resources) also complied with the WQO of ≥ 4 mg/L for depth-averaged value and ≥ 2 mg/L for bottom layer (with and without this Project).

5.10.2.4 DO criteria is not applicable to cooling water intakes.

5.10.2.5 Full DO compliances at all WSRs are predicted under all the modelling scenarios (with and without this Project). The Project would not cause any adverse DO impact at all WSRs.

NH_3-N

5.10.2.6 The maximum NH_3-N levels predicted at all the flushing water intakes complied with the target objective of < 1 mg/L under all the modelling scenarios (with and without this Project).

5.10.2.7 NH_3-N criteria is not applicable to the remaining WSRs.

5.10.2.8 No adverse NH_3-N impact at WSRs is predicted from this Project.

TIN

5.10.2.9 TIN criteria is not applicable to flushing water intakes and cooling water intakes.

5.10.2.10 Non-compliances with the WQOs for annual mean TIN are predicted at several WSRs under all the modelling scenarios (with and without this Project). The annual mean TIN levels predicted at 10 WSRs in Southern and Port Shelter WCZs are 0.2 mg/L, which exceeded the respective WQO of ≤ 0.1 mg/L. These 10 WSRs include 3 bathing beaches (B1, B2 and B3), 4 coral sites (C23, C24, C25 and C26), Shek O Headland SSSI (SS1), important spawning ground of commercial fisheries resources (SG1) and important nursery ground of commercial fisheries resources (NG1).

5.10.2.11 There is no noticeable difference in the levels of TIN at these 10 WSRs between all the modelling scenarios (i.e., with or without the Project). These non-compliances are not induced by this Project. They are due to the stringent WQO adopted for the WCZs. These 10 WSRs are distant from the Project area and no adverse water quality impact to these WSRs would be resulted.

5.10.2.12 The predicted annual mean TIN levels at all the remaining WSRs complied with the WQOs under all the modeling scenarios (with and without the Project).

5.10.2.13 The Project would not cause any adverse TIN level at WSRs.

UIA

5.10.2.14 UIA criteria is not applicable to flushing water intakes and cooling water intakes.

5.10.2.15 Full WQO compliances for UIA are predicted at all the remaining WSRs. The predicted annual mean depth averaged UIA levels at all WSRs is <0.01 mg/L under all the three modelling scenarios (with and without this Project) as compared to the WQO of ≤0.021 mg/L.

5.10.2.16 No adverse UIA impact upon the WSRs is predicted from this Project.

E. coli

5.10.2.17 Full *E. coli* compliances with the target limit of 20,000 no./100 mL are predicted at all the flushing water intakes. The maximum *E. coli* levels predicted at the flushing water intakes are within the same order of magnitude between the modelling scenarios (i.e. with or without this Project).

5.10.2.18 The geometric mean *E.coli* levels for bathing season predicted at all gazetted beaches fully complied with the WQO of ≤180 no. / 100 mL under all the modelling scenarios (with and without the Project). The annual geometric mean *E.coli* levels predicted at the secondary contact recreation subzone (C1a, C1d, C1f, C1g and CR1) and the Tung Lung Chau FCZ (F1) fully complied with the WQO of ≤ 610 no. / 100 mL under all the modelling scenarios (with and without the Project).

5.10.2.19 The annual geometric mean *E.coli* levels predicted at a distant WSR, namely Po Toi O FCZ (F2), exceeded the WQO of ≤ 610 no. / 100 mL under all the modelling scenarios (with and without the Project). The exceedance was contributed by the background pollution loading at Po Toi O assumed in the modelling exercise and not caused by this Project. There is no noticeable difference in the *E.coli* levels predicted at F2 between all the modelling scenarios (with and without this Project). Po Toi O FCZ is distant from the Project area and no adverse water quality impact to the FCZ would arise from this Project.

5.10.2.20 The predicted *E.coli* levels at some WSRs are slightly lower under the “with Project” scenarios as compared to the baseline “without Project” scenarios, which could be due to the changes of hydrodynamics as discussed in Section 5.10.1. *E. coli* criteria is not applicable to cooling water intakes, seawater intake of desalination plant, potential water sports area at Junk Bay. typhoon shelter, coral communities, coral recipient sites, amphioxus, SSSI, important spawning ground of commercial fisheries resources and important nursery ground of commercial fisheries resources.

5.10.2.21 No adverse *E. coli* impact upon the WSRs is predicted from this Project.

SS

5.10.2.22 The maximum SS level predicted at the flushing water intakes fully complied with the target limit of 10 mg/L under all the three modelling scenarios (i.e. with or without this Project). No adverse SS impact upon the flushing water intakes would be caused by this Project.

5.10.2.23 The maximum SS levels predicted at the seawater intake of TKO desalination plant under various modelling scenarios are below 2 mg/L, which complied very well with the raw water design basis value set out by the WSD of ≤ 40 mg/L.

5.10.2.24 The % increases in the maximum and mean SS levels caused by this Project are tabulated for all relevant WSRs on page 5 and page 6 of **Appendix 5.11c**. All the predicted % increases (due to this Project) are below the WQO of ≤ 30%.

5.10.2.25 SS criteria is not applicable to cooling water intakes.

5.10.2.26 No adverse SS impact upon the WSR is predicted from the Project.

BOD_5

5.10.2.27 The maximum BOD_5 levels predicted at all the flushing water intakes are well below the target objective of < 10 mg/L under all the modelling scenarios (with and without the Project).

5.10.2.28 BOD_5 criteria is not applicable to all remaining WSRs.

5.10.2.29 No adverse BOD_5 impact upon the WSRs is predicted from the Project.

Sedimentation Rate

5.10.2.30 The maximum sedimentation rates predicted at all identified important benthic communities (corals and amphioxus) are < 20 g/m^2/day, which fully complied with the criteria value of 100 g/m^2/day under all the modelling scenarios (with and without the Project). Sedimentation criteria is not applicable to remaining WSRs. No adverse sedimentation impact would be caused by this Project.

Salinity

5.10.2.31 There is no absolute limit for salinity. The annual maximum salinity levels predicted at the WSRs ranged from 33.8 to 35.6 ppt under all the modelling scenarios (with and without the Project). The % changes in the maximum and mean salinity levels caused by this Project are tabulated for all relevant WSRs on page 7 and page 8 of **Appendix 5.11c**. The changes in the predicted salinity values caused by the Project are no more than 0.23%, which complied well with the WQO of ±10%.

Changes of Water Quality Patterns

5.10.2.32 The water quality modelling results are presented as contour plots in **Appendix 5.11d** for bottom DO and depth-averaged DO, depth-averaged BOD_5, depth-averaged TIN, depth-averaged UIA, depth-averaged *E.coli*, depth-averaged SS, sedimentation rates and depth-averaged salinity. Each figure attached in **Appendix 5.11d** contains three contour plots for comparison. The upper plot shows the model output for baseline scenario without the Project (Scenario B1). The middle plot shows the model output for impact scenario with the Project under normal EPP operation (Scenario B2). The lowest plot shows the model output for Project operation with a 2-hour emergency discharge of raw sewage from the EPP in both dry and wet seasons (Scenario B3). All contour plots are presented as annual arithmetic averages except for the *E.coli* levels which are annual geometric mean values and the DO levels, which include both annual mean and annual 10%ile values.

DO

5.10.2.33 As shown in the contour plots, the mean and 10%ile DO patterns between all the modelling scenarios (with and without the Project) are similar. The predicted annual mean depth-averaged DO levels are in general above 6 mg/L. The predicted 10%ile bottom and depth-averaged DO levels in the assessment area are generally above 2 mg/L and 4 mg/L respectively. The Project would not cause any significant effect on the DO patterns.

TIN

5.10.2.34 As shown in the model contour plots, the annual mean TIN patterns between all the modelling scenarios (with and without the Project) are similar. The annual mean TIN levels are generally below the WQO of 0.4 mg/L in Victoria Harbour and Eastern Buffer WCZs and below the WQO of 0.3 mg/L in Junk Bay and Mirs Bay WCZ. The annual mean TIN levels are between 0.1 mg/L and 0.2 mg/L in Southern and Port Shelter WCZs, which exceed the WQO of 0.1 mg/L due to the stringent WQO adopted for the WCZs.

UIA

5.10.2.35 The Project is predicted to cause no UIA exceedance in the assessment area. The annual mean UIA levels in the assessment area are generally below 0.01 mg/L, which complied with the WQO of 0.021 mg/L under all the modelling scenarios (with and without the Project). The predicted UIA patterns are similar between all the modelling scenarios.

E. coli

5.10.2.36 The predicted depth-averaged geometric mean *E.coli* levels are in general < 180 no. / 100 mL in open waters of the assessment area under all the three modelling scenarios (with and without the Project). *E. coli* plumes of > 180 no. / 100 mL are predicted in embayed waters or near the storm or river outlets such as Kai Tak Approach Channel (KTAC), Eastern Channel in Junk Bay, typhoon shelters and Po Toi O under all the modelling scenarios (with and without the Project). These *E. coli* plumes were contributed from the background polluted storm discharges assumed in this modelling exercise and not related to this Project. The Project including the EPP discharges would not change the *E.coli* pattern.

SS

5.10.2.37 The predicted mean SS levels are generally < 1 mg/L in the eastern Victoria Harbour, Junk Bay, Eastern Buffer, Mirs Bay and Port Shelter under all the modelling scenarios (with and without the Project). SS levels of > 1 mg/L are predicted in central Victoria Harbour as well as in the embayed waters or near the storm or river outlets such as KTAC, Eastern Channel in Junk Bay, typhoon shelters and Po Toi O under all the modelling scenarios (with and without the Project). These SS plumes were contributed from the background polluted storm discharges assumed in this modelling exercise and not related to this Project. Changes of the SS pattern in the assessment area caused by the Project including the EPP effluent discharges are considered minimal.

BOD_5

5.10.2.38 The predicted mean BOD_5 levels in the assessment area are generally below 0.5 mg/L under all the modelling scenarios (with and without the Project). Higher BOD_5 levels are predicted near the storm or river outlets such as the KTAC and Eastern Channel under all the modelling scenarios (with and without the Project). No adverse BOD_5 impact due to the Project is predicted The predicted BOD_5 patterns are similar between all the modelling scenarios.

Sedimentation Rate

5.10.2.39 The predicted mean sedimentation rates range from 1 - 5 g/m^2/day in the embayed waters with reduced current velocity and < 1 g/m^2/day in open waters with better tidal flushing capacity under all the modelling scenarios (with and without the Project). The predicted maximum sedimentation rates are generally below 10 g/m^2/day in the assessment area except in the embayed waters or near the storm and river outlets where the sedimentation rates would be higher under all the modelling scenarios (with and without the Project). The sedimentation plumes of > 10 g/m^2/day were contributed by the background discharges and not caused by this Project. The Project including the EPP discharge would not affect the sedimentation patterns in the assessment area.

Salinity

5.10.2.40 The salinity patterns are similar under all the modelling scenarios (with and without the Project). There is an increasing trend of salinity from west to east. The predicted mean salinity ranged from < 30.5 ppt near the storm outfalls to > 33.5 ppt in the eastern side of the assessment area. The Project including the EPP discharges would not change the salinity patterns.

<u>Changes of Water Quality Before, During and After Emergency Discharges from EPP</u>

5.10.2.41 Emergency situations are the results of loss of power supply or failures of treatment units at the EPP. It is assumed that emergency discharge of raw sewage from the EPP would occur for a period of 2 hours via the proposed seawall outfall. The total emergency discharge volume would be 5,850 m^3, which has taken into consideration of the diurnal peak flow.

5.10.2.42 The time-series model results showing the changes of water quality levels before, during and after the emergency discharge in dry season and wet season (Scenario B3) are presented in **Appendix 5.11f** to **Appendix 5.11k** for DO, TIN, SS. *E.coli*, UIA and salinity.

5.10.2.43 The time-series plots all parameters are prepared for selected WSRs including the coral communities at Fat Tong Chau (C6b), coral recipient site at Fat Tong Chau (CR2), coral communities at Tit Cham Chau (C7), coral communities at Kwun Tsai (C8), coral communities at Cape Collinson (C19 and C20), Tung Lung Chau FCZ (F1), seawater intake of TKO desalination plant (SW1), cooling water intake at Pamela Youde Nethersole Eastern Hospital (CW5), Bathing Beach at Big Wave Bay (B1) and flushing water intake at Siu Sai Wan (FW6). The timeseries plots for *E. coli* are also prepared for one additional WSR, namely flushing water intake at Heng Fa Chuen (FW5). Each figure attached in **Appendix 5.11f** to **Appendix 5.11k** contains a comparison of the model results between normal operation of EPP (Scenario B2) and emergency situation (Scenario B3).

DO

5.10.2.44 As shown in **Appendix 5.11f**. the emergency discharge would not cause any effect on the DO levels in both dry and wet seasons at all selected WSRs. There is no noticeable difference in the DO levels between the emergency discharge scenario (Scenario B3) and the normal EPP operation scenario (Scenario B2).

TIN

5.10.2.45 The predicted changes in TIN levels between Scenarios B2 and B3 during and after the emergency discharge of this Project are minimal or negligible at all selected WSRs (**Appendix 5.11g**). The emergency discharge is predicted to cause no adverse TIN impacts.

SS

5.10.2.46 Water quality deterioration in terms of SS elevations during and after the emergency discharge are considered minimal or negligible at all selected WSRs as shown in **Appendix 5.11h**. The predicted SS levels in the assessment area are in general not sensitive to the emergency discharge. No adverse SS impact is predicted due to the emergency discharge.

E. coli

5.10.2.47 A very high *E.coli* concentration of $4x10^7$ no./100mL is assumed in the emergency discharges, which would inevitably cause some increases in the numerical *E.coli* values at the WSRs. The highest *E.coli* elevations caused by the emergency discharge occurred at the closest WSR i.e., the coral recipient site at Fat Tong Chau (CR2). The *E.coli* elevations at CR2 occurred after the emergency discharge with a peak level of 50,592 no./100 mL. The maximum magnitude of *E. coli* elevations are same as those predicted under other approved EIAs such as the EIA for Yuen Long EPP.

5.10.2.48 The *E.coli* increases predicted at other selected WSRs are substantially smaller. The predicted peak *E coli* levels (caused by the emergency discharge) are 1,946 no. / 100 mL at coral communities at Fat Tong Chau (C6b), 3,995 no./100 mL at flushing water intake at Heng Fa Chuen (FW5), 657 no./100 mL at Tung Lung Chau FCZ (F1), 67 no./100 mL at coral communities at Tit Cham Chau (C7), 52 no./100mL at coral communities at Cape Collinson (C20), 39 no./100mL at the seawater intake of TKO Desalination Plant (SW1), 24 no./100 mL at coral communities at Cape Collinson (C19) and 16 no. /100 mL at coral communities at Kwun Tsai (C8). The predicted *E.coli* elevations are negligible at bathing beach at Big Wave Bay (B1), flushing water intake at Siu Sai Wan (FW6) and cooling water intake at Pamela Youde Nethersole Eastern Hospital (CW5).

5.10.2.49 The *E. coli* increases at all the WSRs are transient. The normal water quality condition would be restored within 2 days after termination of the emergency discharge. The maximum *E. coli* levels predicted during or after the emergency discharge are also tabulated in **Appendix 5.11i** for all WSRs in both dry and wet seasons.

UIA

5.10.2.50 Deterioration in the predicted UIA levels during and after the emergency discharge is considered minimal or negligible at all selected WSRs as shown in **Appendix 5.11j**. The emergency discharge is predicted to cause no adverse UIA impact.

Salinity

5.10.2.51 No salinity elevations are observed during and after the emergency discharge at all selected WSRs as shown in **Appendix 5.11k**. The predicted salinity levels are not sensitive to the emergency discharge at all selected WSRs. No adverse salinity impact is predicted from the emergency discharge.

5.10.3 Changes of Configurations

5.10.3.1 With reference to the hydrodynamic modelling results presented in Section 5.10.1, the proposed reclamations at TKO 137 and TKO 132 would not diminish the tidal flow flushing through the key marine channels in the assessment areas. Based on the water quality modelling results presented in Section 5.10.2, the levels of water quality compliances are the same with or without this Project. No adverse water quality impact is predicted due to the changes of coastline configurations.

5.10.4 Creation of Embayed Water and Marine Refuse Entrapment at TKO 132

5.10.4.1 As shown in **Appendix 5.11d**, the annual 10%ile bottom DO and annual 10%ile depth-averaged DO predicted at the embayed water formed near the northern corner of TKO 132 reclamation are > 4 mg/L and > 5 mg/L respectively, which complied well with the WQOs of ≥ 2 mg/L and ≥ 4 mg/L under Scenarios B2 and B3 (with this Project). Although the water circulation at the northern corner of TKO 132 reclamation would be limited, there is no major pollution sources in the surrounding area. No effluent / sewage / wastewater discharge is proposed along the northeastern boundary of TKO 132 reclamation to minimize accumulation of pollutants. Design and mitigation measures as presented in Section 5.13.6 are also proposed to prevent accidental marine spillage. No hypoxia condition and thus no odour impact would be expected according to the modelling results.

5.10.4.2 The potential impacts from floating refuse accumulation could be mitigated by regular refuse scavenging. Maintenance and clean-up should be conducted regularly by the operators to remove floating refuse along the seafront. Provided with a regular refuse collection programme, accumulation of pollutant and floating refuse is not anticipated.

5.10.5 Sewage / Wastewater Generation and Operation of EPP and Advance SPS at TKO 137

<u>Evaluation of Effluent Outfall Options</u>

5.10.5.1 The model results indicated that the marine water quality effects caused by the seawall discharges from the EPP are insignificant. The EPP discharges would not cause any water quality non-compliances under both normal operation and emergency situation. The levels of water quality compliances are the same with or without the EPP discharges. Since the predicted water quality changes induced by the seawall discharges are already insignificant, use of the alternative submarine effluent outfall option would not induce substantial differences in the water quality impact. Additional water quality benefit due to the use of submarine effluent outfall would be insignificant. The proposed seawall discharge location would be the most effective option for the EPP in minimizing the water quality impact. Submarine effluent outfall is not recommended for the EPP.

Implications on Eutrophication and Risk of Algal Bloom

5.10.5.2 The effluent discharges from the EPP are mainly domestic in nature, which would contain a certain amount of nutrients including nitrogen. Nitrogen nutrient (i.e. TIN) is in theory not harmful to marine life. Nitrogen is however an essential nutrient for the growth of algae or phytoplankton. The key purpose of setting out the WQO for TIN under the WPCO is to control or minimize the risk of algal bloom and eutrophication. With reference to the modelling results, the Project including the effluent discharges from the EPP under normal operation and emergency situation would cause no changes to the TIN compliances within the assessment area. The EPP discharges would not cause any adverse implications on eutrophication and would not increase the risk of algal bloom.

Water Quality Impact on Seawater Intake of Desalination Plant

5.10.5.3 Full compliances with the WQOs are predicted at the intake point of desalination plant for salinity, DO, TIN, UIA and SS under normal EPP operation and emergency situations.

5.10.5.4 As shown in **Appendix 5.11c**, the maximum SS levels predicted at the seawater intake are below 2mg/L under both normal operation and emergency situations of the EPP, which are well below the raw water design basis value of ≤ 40 mg/L.

5.10.5.5 A water temperature range is specified under the design basis values of the desalination plant. Sewage effluent discharge would not release any heat energy to the marine water and would not induce any thermal impact upon the seawater intake.

5.10.5.6 Other design parameters of the desalination plant include TDS, boron and bromide. In pure or clean ocean water, the level of TDS is approximately equal to the level of salinity. Boron and bromide are also naturally present in the ambient seawater. In wastewater or polluted areas, TDS can include organic solutes (such as hydrocarbons and urea) in addition to the salt ions. The seawater intake location in Joss House Bay is sheltered from the direct tidal flow passing through Victoria Harbour and the Project site. It is predicted that the Project including the EPP discharges would not change the salinity and other parameters such as DO, SS, TIN and UIA at the intake point. These model results imply that the influences of the EPP discharges on the water quality at the seawater intake point would be minimal. There are no major existing and future pollution sources of organic solutes in Joss House Bay. Majority of the TDS levels at the seawater intake location is therefore expected to be contributed from the salt ions. As shown in **Appendix 5.11c**, the predicted maximum salinity level at the seawater intake of desalination plant is about 34 ppt as compared to the design basis value for TDS of 39 ppt. Based on the model results and the analysis above, the TDS level at seawater intake is expected to comply the respective design basis value. No exceedance of the design basis values for TDS, boron and bromide would be caused by this Project.

Water Quality Impact on Other WSRs

5.10.5.7 As discussed in Section 5.10.2.10 and 5.10.2.11, the TIN levels predicted at 10 WSRs exceeded the WQO. There is no noticeable difference in the predicted TIN levels at these 10 WSRs between all the modelling scenarios (with and without this Project). As discussed in Section 5.10.2.19, the *E.coli* levels predicted at 1 WSR exceeded the WQO. There is also no noticeable difference in the predicted *E.coli* levels at this WSR between all the modelling scenarios (with and without this Project). These WQO exceedances were not induced by this Project. Full compliances with assessment criteria were predicted at other WSRs. The EPP discharges would not cause any adverse water quality impacts at the WSRs.

Operation of Advance SPS

5.10.5.8 No discharge would arise from normal operation of the advance SPS. The quantity of emergency discharge from the advance SPS would be smaller than that resulted from the EPP and the location of emergency discharge from the advance SPS and the EPP would be the same. The water quality impact due to emergency discharge from EPP has been evaluated to be acceptable. Therefore, any emergency discharge from the advance SPS would not cause adverse water quality impact.

Operation of Refuse Collection Point, PTI, Green Fuel Station, Ambulance Depot and Service Reservoirs

5.10.5.9 Provided the effluent and wastewater generated from these facilities are proper treated and disposed in accordance with the WPCO requirements and the design measures as recommended in Section 5.13.3 are properly implemented, no adverse water quality impact would arise from the operation of refuse collection point, PTI, green fuel station, ambulance depot and service reservoirs at TKO 137.

Aging or Damage of Sewerage Network

5.10.5.10 In order to prevent the uncontrolled discharge of untreated sewage effluent to water environment, there will be a need to minimise the risk of failure of the sewerage system. Precautionary measures are recommended in Sections 5.13.3.14 and 5.13.5.14 to minimise the risk of failure of the proposed sewerage system. With proper implementation of the recommended precautionary measures, no adverse water quality impact arising from damage on sewerage system is anticipated.

5.10.6 Non-point Source Surface Run-off in TKO 137 Development

5.10.6.1 It is expected that with proper implementation of the stormwater control measures including BMP and blue-green infrastructure as presented in Section 5.13.4, the water quality impact due to the non-point source surface runoff would be minimised and insignificant. No adverse water quality impact would arise from the non-point source surface runoff generated at TKO 137 Development.

5.10.7 Sewage / Wastewater Generation and Operation of SPS at TKO 132

5.10.7.1 All wastewater and sewage generated at the PFTF, CBP, CWHF, EFs and RTS during the operation of the TKO 132 development would be diverted to the public sewerage system and then conveyed to the existing TKO PTW for subsequent disposal at the existing HATS. No treated or untreated wastewater / sewage would be discharged at TKO 132. Thus, sewage and wastewater generation at TKO 132 would not cause any adverse water quality impact. It should be noted that there will be separate EIA studies to assess the water quality impacts from the designated projects (i.e. CWHF, EFs and RTS).

5.10.7.2 A new SPS is proposed at the open space of the TKO 132 development with a design capacity of only 400 m^3 per day to convey the sewage and wastewater to TKO PTW. Potential water quality impact may arise from emergency overflow / bypass of sewage due to pump failure, power supply failure and damage to pressure main or flooding. Emergency bypass culverts will be built to convey any emergency overflow to the southern development boundary in the outer Junk Bay, which would be more connected the open channel of Victoria Harbour to enhance dispersion.

5.10.7.3 Backup power supply together with an additional 2-hour on-site emergency storage capacity as well as standby pump would be provided for the SPS to prevent emergency discharge. Breakdown of SPS could be recovered typically within 2 hours. With the proposed design measures for the SPS, the change of emergency discharge would be highly unlikely. Since the capacity of the proposed SPS is minor, the quantity of any emergency discharge would be small with a discharge rate of < 0.005 m^3/s. The discharge would be immediately and continuously diluted by the marine water. The water quality impact, if any, would be transient and reversible. Details of the proposed precautionary and design measures for the SPS are further elaborated in Section 5.13.5. No long-term insurmountable water quality impact would arise.

5.10.8 Accidental Marine Spillage from Marine Delivery, Unloading and Loading of Materials from Barges at TKO 132

5.10.8.1 Enclosed conveyor system or sealed containers would be implemented to fully enclose the materials (e.g. fill, aggregate, sand, construction materials and refuse) during the transfer of these material to and from the barges. Sufficient free board and covering of the materials would be implemented on the barges to avoid overflow of the materials. Since there would be no lifting of these materials in open air during the loading and unloading operations, accidental spillage of these materials would not occur. With proper implementation of the recommended mitigation measures in Section 5.13.6 and Environmental Management Plan (EMP) in Section 5.13.8, accidental material spillable would be avoided.

5.10.9 Non-point Source Surface Runoff and Accidental Spillage in TKO 132 Development

5.10.9.1 The pollution sources or operation activities (e.g. material stockpile) at the TKO 132 development that may contribute to storm pollution will be either fully enclosed or covered within buildings to avoid contaminated runoff. For any uncovered areas or open space within the development area, perimeter drainage and runoff treatment devices would be provided to intercept and convey the first flush of potentially contaminated surface runoff as well as any dry weather flow to the public sewerage system. Containment measures such as stop-logs would be considered and installed at suitable location(s) in the perimeter drainage system of the development sites to contain any accidental spillage in open area.

5.10.9.2 It is anticipated that with proper implementation of the storm water control measures and BMP for stormwater management as recommended in Section 5.13.7 and the EMP proposed in Section 5.13.8, there would be no adverse water quality impact arising from the non-point source surface runoff.

5.10.10 Maintenance Dredging for Proposed Berthing Facility of TKO 132 Development

5.10.10.1 Dredging is proposed during the construction phase to provide sufficient depth for vessel berthing at the TKO 132 development. A sediment layer of about 5 m thick would be removed at a rate of 700 m^3 per day during the construction phase (to the deign depth of about 8 m below CD).

5.10.10.2 The average siltation rates in central Victoria Harbour are expected to be in the range of 50 mm to 60 mm per year [22]. The TKO 132 area is located away from the old urbanized areas and subject to less influences from polluted urban runoff. BMP for storm water management is also recommended to minimize non-point source surface runoff from the Project area. The siltation rate at TKO 132 is not expected to be significantly greater than that previously recorded in the central Victoria Harbour. Assuming that up to 500 mm of sediment will need to be dredged every 5 to 10 years, the sediment volume to be removed under each maintenance dredging event is expected to 10 times smaller than that generated during the construction phase. The maintenance dredging rate can be capped at the dredging rate of 700 m^3/day. The sediment release rate due to the maintenance dredging of 700 m^3/day under the unmitigated scenario would be smaller than the mitigated sediment release rate resulted from the reclamation works at TKO 132 under Scenario A2. The construction phase water quality impacts predicted under Scenarios A1 and A2 would represent the worst case in terms of the sediment releases at TKO 132. No further assessment of the maintenance dredging impact is required. Mitigation measures including the deployment of double silt curtains should be implemented for the maintenance dredging works, in view of its close proximity to the coral sites. No adverse water quality impact would be anticipated.

5.11 Mitigation Measures – Marine Construction

5.11.1 DCM

5.11.1.1 The following design and mitigation measures should be adopted for the DCM treatment.

- Place sand blanket of at least 1 m thick on top of the sediments prior to DCM treatment to avoid seabed sediment disturbance and release of fines.
- Carefully control the cement slurry injection pressure to prevent leaching out of cement

[22] EIA for Dredging Works for Proposed Cruise Terminal at Kai Tak (AEIAR-115/2007)

slurry during the DCM operation.

- Single layer silt curtain shall be deployed during the DCM operation.

5.11.2 Underwater Filling, Dredging and Sand Blanket Laying

5.11.2.1 The following design and mitigation measures should be adopted for the underwater filling, dredging and sand blanket laying works where appropriate.

- Underwater filling for the reclamation works should be carried out behind a leading seawall. The extent and location of underwater filling with respect to the extent of leading seawall shall be designed with reference to the construction sequence in **Appendix 5.1** and **Appendix 5.2**. If there are any proposed changes of the marine construction design / sequence, the associated water quality impact should be reviewed and where necessary additional mitigation measures should be proposed prior to the implementation of the proposed changes.
- A "controlled bottom placement" method should be adopted for the sand blanket laying work as far as practicable by releasing the sand material at a point near the seabed and at a controlled sand filling rate to prevent localized overloading of the seabed and potential instability, and to minimize loss of fines when placing the sand blanket in marine water.
- The reclamation sequence and production rates for underwater filling, dredging and sand blanket laying should follow those presented in **Table 5.21**. If there are any proposed changes of the reclamation sequence and production rates of the marine works, the associated water quality impact should be reviewed and where necessary additional mitigation measures should be proposed prior to the implementation of the proposed changes.
- TKO 132 development is located inside Junk Bay with relatively poor water circulation. It is also in close vicinity of coral communities. Double silt curtain should be deployed to surround the underwater filling, dredging and sand blanket laying works of TKO 132 development to minimize water quality impact at the coral sites. A silt curtain deployment plan should be submitted to EPD prior to the commencement of the corresponding marine construction works. Detailed silt curtain deployment arrangement should be proposed under the silt curtain deployment plan.
- TKO 137 is located along Tathong Channel with high tidal flushing and pollutant dispersion capacity. Full water quality compliances are predicted at WSRs (including the seawater intake of TKO Desalination Plant) under the unmitigated scenarios. A single layer silt curtain should be deployed to surround the underwater filling, dredging and sand blanket laying works of TKO 137 development as a precautionary measure. A silt curtain deployment plan should be submitted to EPD prior to the commencement of the corresponding marine construction works. Detailed silt curtain deployment arrangement should be proposed under the silt curtain deployment plan.

5.11.3 Construction of Marine Viaducts

5.11.3.1 The following standard measures and good site practices are recommended to be implemented for construction of marine viaducts:

- Bored piling and any excavation for construction of the marine viaducts should be enclosed and carried out within steel casings or cofferdams or other equivalent systems that can effectively contain the material, debris and wastewater generated from the process.
- Single layer silt curtain should be set up to enclose the entire active work area before commencement of the marine works such as the installation of steel casing and any piling works for temporary marine facilities and marine viaduct to control sediment dispersion. A silt curtain deployment plan should be submitted to EPD prior to the commencement of the corresponding marine construction works. Detailed silt curtain deployment

arrangement should be proposed under the silt curtain deployment plan.

- All wastewater generated from the process should be fully contained and collected by a derrick lighter or other equivalent collection system and be treated before controlled disposal.
- Any spoil generated from the construction process should be fully contained and collected by sealed hopper barges or other equivalent systems for proper disposal.

5.11.4 Construction of Outfall

5.11.4.1 The proposed seawall outfall should be constructed using the following method or other equivalent methods to avoid disturbance of the seabed and prevent the release of construction or fill materials into the marine water. The pre-cast outfall structure to be installed at the seawall should be designed with both ends covered and sealed temporarily, and embedded in parallel with construction of seawall structure. The remaining pre-cast box culvert should be packed with air-inflated packer inside to prevent construction or fill materials being wash out through the box culvert during the reclamation works. Upon completion of the reclamation works and construction of the outfall and box culvert, the seals at the outmost outfall including the packers placed inside can be removed accordingly.

5.11.5 Good Site Practices for Construction Vessels

5.11.5.1 The following good site practices should be implemented to minimize water pollution from construction vessels and marine transportation of construction materials.

- All barging points to be operated during the construction phase should be equipped with conveyor belt, which should be fully enclosed to prevent marine spillage.
- Barges or hoppers shall not be filled to a level which will cause overflow of materials or pollution of water during loading or transportation.
- Excess materials shall be cleaned from the decks and exposed fittings of barges before the vessels are moved.
- Plants should not be operated with leaking pipes and any pipe leakages shall be repaired quickly.
- Adequate freeboard shall be maintained on barges to reduce the likelihood of decks being washed by wave action.
- All vessels should be sized so that adequate clearance is maintained between vessels and the seabed in all tide conditions, to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash.
- The works shall not cause foam, oil, grease, litter or other objectionable matter to be present in the water within and adjacent to the works site.
- Regular maintenance and checking of all construction vessels should be undertaken to maintain a good operation condition and prevent leakage and spillage.
- A Spill Response Plan (SRP) detailing the actions to be taken in the event of accidental spillage of oil or other hazardous chemicals during construction of the Project should be prepared by the contractor and submitted to WSD for approval before the commencement of marine works of the Project. The content of the SRP should contain but not limited to chemical / material storage, transfer and transport precautions, a notification system (including a contact list of relevant parties) in case of accidental spillage, spill response procedures including necessary actions to protect WSRs, spillage control equipment and material, health and safety equipment, roles and responsibilities of relevant parties and inventory of hazardous chemicals / compounds.

5.12 Mitigation Measures – Land-based Construction

5.12.1 Construction Site Runoff and Dust Suppression Sprays

5.12.1.1 The site practices outlined in ProPECC PN 2/23 "Construction Site Drainage" should be followed where applicable to minimize surface runoff and the chance of erosion. Surface runoff including the spent effluent from dust suppression from construction sites should be discharged into storm drains via adequately designed sand/silt removal facilities such as sand traps, silt traps and sedimentation basins. Channels or earth bunds or sandbag barriers should be provided on site to properly direct stormwater to such silt removal facilities. Perimeter channels at site boundaries should be provided on site boundaries where necessary to intercept storm runoff from outside the site so that it will not wash across the site. Catchpits and perimeter channels should be constructed in advance of construction and earthworks.

5.12.1.2 Silt removal facilities, channels and manholes should be maintained and the deposited silt and grit should be removed regularly, at the onset of and after each rainstorm to prevent local flooding. Before disposal at the public fill reception facilities, the deposited silt and grit should be solicited in such a way that it can be contained and delivered by dump truck instead of tanker truck. Any practical options for the diversion and re-alignment of drainage should comply with both engineering and environmental requirements in order to provide adequate hydraulic capacity of all drains. Minimum distance of 100m should be maintained between the discharge points of construction site runoff and any seawater intakes. All effluent discharges from the construction works should be sited away from any natural watercourses.

5.12.1.3 Construction works should be programmed to minimize soil excavation works in rainy seasons (April to September). If excavation in soil cannot be avoided in these months or at any time of year when rainstorms are likely, for the purpose of preventing soil erosion, temporary exposed slope surfaces should be covered e.g. by tarpaulin, and temporary access roads should be protected by crushed stone or gravel, as excavation proceeds. Intercepting channels should be provided (e.g. along the crest / edge of excavation) to prevent storm runoff from washing across exposed soil surfaces. Arrangements should always be in place in such a way that adequate surface protection measures can be safely carried out well before the arrival of a rainstorm.

5.12.1.4 Earthworks final surfaces should be well compacted and the subsequent permanent work or surface protection should be carried out immediately after the final surfaces are formed to prevent erosion caused by rainstorms. Appropriate drainage like intercepting channels should be provided where necessary.

5.12.1.5 Measures should be taken to minimize the ingress of rainwater into trenches. If excavation of trenches in wet seasons is necessary, they should be dug and backfilled in short sections. Rainwater pumped out from trenches or foundation excavations should be discharged into storm drains via silt removal facilities.

5.12.1.6 Construction materials (e.g. aggregates, sand and fill material) on sites should be covered with tarpaulin or similar fabric during rainstorms. Measures should be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system or nearby water environment. The excavated materials should be backfilled as soon as possible, and stockpiles of the excavated materials shall be covered with tarpaulin or similar fabric during rainstorms.

5.12.1.7 Construction site drainage should be designed and implemented to segregate general construction site runoff from the concrete casting areas and other pollutant generating activities to avoid contamination of site runoff. Surface runoff contaminated with bentonite slurry and concrete washing should be collected and should be regarded as wastewater and adequately treated to the respective effluent standards before disposal into the foul sewers or storm water systems or other receiving water as set out in the TM-DSS.

5.12.1.8 Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris from getting into the drainage system.

5.12.2 Wastewater from General Land-based Construction Activities

5.12.2.1 The mitigation measures as outlined in ProPECC PN 2/23 "Construction Site Drainage" for control of groundwater, boring and drilling water, wastewater from concrete batching and / or precast concrete casting, wheel washing water, bentonite slurries, water for testing and /or sterilization of water retaining structure and water pipes, wastewater from building construction, acid cleaning, etching and picking wastewater and wastewater from toilets generated in the construction site should be observed and adopted where applicable.

5.12.3 General Refuse

5.12.3.1 It is recommended to clean the construction sites on a regular basis. Good site practices should be adopted to remove rubbish, debris and litter from construction sites so as to prevent the rubbish and litter from spreading from the site area. All general refuse generated on-site should be stored in enclosed bins or compaction units separately from C&D material. A reputable waste collector should be employed to remove general refuse from the site, separately from C&D material, on a regular basis to an approved landfill. An enclosed and covered area should be provided to reduce the occurrence of "windblown" light material.

5.12.4 Licensing of Construction Site Discharge

5.12.4.1 There is a need to apply to EPD for a discharge license for discharge of effluent from the construction site under the WPCO. The discharge quality must meet the requirements specified in the discharge license. All the runoff and wastewater generated from the works areas should be treated so that it satisfies all the standards listed in the TM-DSS. The beneficial uses of the treated effluent for other on-site activities such as dust suppression, wheel washing and general cleaning etc., can minimize water consumption and reduce the effluent discharge volume. If monitoring of the treated effluent quality from the works areas is required during the construction phase of the Project, the monitoring should be carried out in accordance with the relevant WPCO license.

5.12.5 Accidental Chemical Spillage

5.12.5.1 Contractor must register as a chemical waste producer if chemical wastes would be produced from the construction activities. The Waste Disposal Ordinance (Cap 354) and its subsidiary regulations in particular the Waste Disposal (Chemical Waste) (General) Regulation, should be observed and complied with for control of chemical wastes.

5.12.5.2 Any service shop and maintenance facilities should be located on hard standings within a bunded area, and sumps and oil interceptors should be provided. Maintenance of vehicles and equipment involving activities with potential for leakage and spillage should only be undertaken within the areas appropriately equipped to control these discharges.

5.12.5.3 Disposal of chemical wastes should be carried out in compliance with the Waste Disposal Ordinance. The Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes published under the Waste Disposal Ordinance details the requirements to deal with chemical wastes. General requirements are given as follows:

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

5.12.6 Sewage Effluent from Construction Workforce

5.12.6.1 It is recommended to provide sufficient chemical toilets in the construction works areas. A licensed waste collector should be deployed to maintain the chemical toilets on a regular basis.

5.12.6.2 Notices should be posted at conspicuous locations to remind the workers not to discharge any sewage or wastewater into the surrounding environment. Regular environmental audit of the construction site should be undertaken to provide an effective control of any malpractices and to encourage continual improvement of environmental performance on site.

5.12.7 Contaminated Site Runoff

5.12.7.1 Any excavated contaminated material and exposed contaminated surface should be properly housed and covered to avoid generation of contaminated runoff. Open stockpiling of contaminated materials should not be allowed. Any contaminated run-off should be properly collected and treated to reduce the pollution level to an acceptable standard and remove any prohibited substances (such as total petroleum hydrocarbon) to an undetectable range. All treated effluent from the wastewater treatment units shall meet the conditions of the discharge license and the requirements as stated in the TM-DSS.

5.12.8 Construction near Inland Watercourses or Seafront

5.12.8.1 The mitigation measures specified in the ProPECC PN 2/23 "Construction Site Drainage" shall be implemented properly to minimise the water quality impacts due to the construction works in close proximity of inland watercourses. The practices outlined in ETWB TC(W) No. 5/2005 "Protection of natural streams/rivers from adverse impacts arising from construction works" shall also be adopted where applicable to minimise the water quality impacts upon any natural streams and inland watercourses. Any discharge of effluent from the Project construction should be pre-treated to comply with the requirements of the WPCO and those specified in the discharge license. All effluent discharges from the construction works should be sited away from any natural watercourses

5.12.8.2 Specific mitigation measures recommended for construction near inland watercourses or seafront are listed below:

- The use of less or smaller construction plants may be specified in areas close to the water bodies to reduce the disturbance to the surface water.
- Temporary storage of materials (e.g. equipment, chemicals and fuel) and temporary stockpile of construction debris and spoil should be located well away from any watercourses or seafront.
- Stockpiling of construction materials and dusty materials should be covered and located away from any watercourses or seafront.
- Construction debris and spoil should be covered up and/or disposed of as soon as possible to avoid being washed into the nearby water bodies.
- Adequate lateral support may need to be erected in order to prevent soil/mud from slipping into the watercourses or the sea.
- Construction works close to the inland watercourses should be carried out in dry season as far as practicable where the flow in the surface channel or stream is low.

5.12.9 Removal / Diversion of Inland Watercourses

5.12.9.1 The construction works for removal and diversion of watercourses should be undertaken within a dry zone. Flow diversion and dewatering should be carried out prior to the construction to avoid water inflow into the construction sites and avoid polluted runoff and impact on the downstream water quality.

5.12.9.2 Dewatering of watercourse should be performed by diverting the water flow using temporary channels, piping, sandbags, steel arrays in concrete case or similar proven methods to suit the works condition. Construction of all the proposed permanent and temporary drainage should be undertaken in a dry zone prior to receiving any water flow.

5.12.9.3 The flow diversion works should be conducted in dry season, where possible, when the flow in the watercourse is low. The wastewater and ingress water from the site should be properly treated to comply with the WPCO and the TM-DSS before discharge.

5.12.9.4 The site practices outlined in the ProPECC PN 2/23 "Construction Site Drainage" and ETWB TC (Works) No. 5/2005 "Protection of natural streams/rivers from adverse impacts arising from construction works" should also be adopted where applicable.

5.13 Mitigation Measures – Operation Phase

5.13.1 Changes of Coastline Configurations

5.13.1.1 No mitigation measures that are specific to the changes of coastline configurations are proposed.

5.13.2 Creation of Embayed Water and Marine Refuse Entrapment at TKO 132

5.13.2.1 Collection and removal of floating refuse should be performed along the waterfront of TKO 132 development at regular intervals e.g. on a daily basis for proper disposal. The operators of the public facilities in TKO 132 should be responsible for keeping the water around their sites and in the neighbouring water free from rubbish.

5.13.3 Sewage / Wastewater Generation, Operation of EPP and Advance SPS at TKO 137

General

5.13.3.1 Sewage and wastewater generated from the TKO 137 development should be diverted to the new public sewerage system at TKO 137 and then conveyed to the existing public sewerage system at TKO or to the proposed EPP for proper treatment and disposal.

Operation of EPP

5.13.3.2 The location of discharge point of emergency overflow or bypass of EPP shall be planned as per the Sewerage Manual (Part 2) to avoid overflow or bypass of untreated sewage into beneficial uses (i.e. WSRs) and shall preferably maintain a buffer distance of at least 150 metres from the nearest WSRs. The tentative location of emergency discharge point of EPP is proposed at the future seawall of TKO 137 development, which has a buffer distance of over 150 m from nearby WSRs (**Figure 5.1**). To avoid the occurrence for emergency discharge, the design and operation of the EPP should incorporate the following provisions:

- Peaking factors should be applied for all major treatment units and electrical and mechanical equipment to avoid equipment failure.
- By-pass mechanism should be provided for both coarse screens and fine screens in the inlet to avoid/minimize failure in coarse/fine screens.
- Interim by-pass should be provided after the primary treatment and settlement of the sewage to avoid raw sewage by-pass as much as possible.
- Regular maintenance and checking of all plant equipment / facilities, treatment units, penstocks should be undertaken to maintain a good operation condition in the EPP and prevent equipment failure.
- Standby unit for all major equipment should be provided in case of unexpected breakdown of pumping and treatment facilities such that the standby pumps and treatment facilities could take over and function to replace the broken units.
- Dual power supply from CLP plus additional backup power supply should be provided in case of power failure.

5.13.3.3 To provide a mechanism to minimize the impact of emergency discharges of raw sewage or partially treated sewage and facilitate subsequent management of any emergency, an Emergency Contingency Plan (ECP) should be formulated prior to commissioning of the EPP. The ECP shall clearly state the emergency response procedures and actions to be followed in case of equipment or sewage treatment failure. The plant operators should carry out necessary follow-up actions according to the procedures of the ECP to minimize any water quality impact. Details of the ECP should be developed at the detailed design stage of the EPP.

5.13.3.4 The ECP shall be circulated to relevant parties including the operators of the TKO desalination plant and WSD to solicit their comments prior to commissioning of the EPP. The plant operators of the EPP should closely communicate with the operators of TKO desalination plant in order to minimize any impact on the seawater intake due to emergency discharge. In the extremely remote event of emergency discharge, the operators of the desalination plant and WSD shall be informed for site inspection and agreement on the follow up and remedial action if required.

Operation of Advance SPS

5.13.3.5 Prior to the EPP commissioning, an advance SPS should be provided to divert the sewage and wastewater generated from the TKO 137 development to the existing TKO PTW and HATS for proper treatment and disposal.

5.13.3.6 Precautionary and design measures as listed below should be incorporated into the advance SPS design to prevent the emergency situation.

- A standby pump and screen should be provided to cater for breakdown and maintenance of the duty pump in order to avoid emergency discharge.
- Dual power supply should be provided to secure electricity supply.
- Temporary equalization tank(s) should be provided for the proposed advance SPS to cater for peak flow.
- An alarm should be installed to signal emergency high water level in the equalization tank / wet well.
- Regular maintenance and checking of plant equipment should be undertaken to prevent equipment failure.
- A telemetry system to the nearest regional control center should be provided so that swift action can be undertaken in case of malfunction of the unmanned facilities.
- Automatic screen (with clear spacing of no less than 25 mm) should be provided to prevent clogging of the downstream pumping system.

5.13.3.7 The relevant conditions in DSD's "Sewerage Manual (Part 2) Pumping Stations and Rising Mains" should be adopted and followed during the design and operation of the advance SPS where applicable. In particular, an overflow or emergency bypass arrangement should be provided at or near the SPS as a good practice. The bypass arrangements should allow sewage to flow to the proposed EPP outfall when the sewage level inside the equalization tank / wet well rises to a predetermined level beyond which pollution may result from the occurrence of sewage overflow at manholes of the upstream sewers or flooding of the pumping station. The opening of the overflow should not be obstructed by any form of screens with bar spacing less than 25 mm as the screen will be easily blocked by screenings, thus resulting in flooding of the pumping station and the upstream catchment. The location of discharge point of emergency overflow or bypass of advance SPS shall be planned as per the Sewerage Manual (Part 2) to avoid overflow or bypass of untreated sewage into beneficial uses (i.e. WSRs) and shall preferably maintain a buffer distance of at least 150 metres from the nearest WSRs. The tentative location of emergency discharge point of advance SPS is proposed at the future seawall of TKO 137 development, which has a buffer distance of over 150 m from nearby WSRs (**Figure 5.1**).

5.13.3.8 An ECP to deal with the emergency raw sewage discharges should be developed in the detailed design stage.

Operation of Refuse Collection Point

5.13.3.9 Refuse collection facilities should be housed and covered to prevent generation of contaminated rainwater runoff. Refuse should be stored in covered containers, which should be securely placed within the refuse collection point. All surface runoff or washed water should be contained inside the refuse collection point for proper disposal and shall not be discharged to the storm system or to the marine water. Wastewater generated from the refuse collection point shall be connected to the public sewerage system of the new development area for disposal at the EPP. No wastewater discharge into the environment should be allowed.

Operation of Public Transport Interchange, Green Fuel Station and Ambulance Depot

5.13.3.10 The PTI, green fuel station and ambulance depot should be covered to prevent generation of contaminated rainwater runoff. All contaminated surface runoff or washed water generated at these facilities should be collected and diverted to oil interceptor or other appropriate treatment facilities with sufficient design capacities for proper treatment before discharge to the foul sewers of the new development area.

5.13.3.11 Fuel spillages should be collected and handled in compliance with the Waste Disposal (Chemical Waste) (General) Regulation and the Waste Disposal Ordinance. Site drainage should be well maintained and good management practices should be observed to ensure that oils and chemicals are managed, stored and handled properly and do not enter the nearby storm or marine water.

Operation of Service Reservoirs at TKO 137

5.13.3.12 Treatment and disposal of cleansing water during annual cleaning and maintenance of the service reservoirs shall follow the WSD's current normal practice with reference to Sections 23.24 – 23.25 of the General Specification for Civil Engineering Works. Portable water incorporated with a mixture of sterilizing chemicals shall be used for washing water retaining structures. The cleansing effluent shall be settled out through the sedimentation tank and dechlorinated by a dechlorination unit before being discharged to drainage system. Discharge license from EPD shall be obtained before commencing any discharges during operation phase. Agreement with DSD shall also be sought before commencing any discharges into the drainage system.

Control of Operation Site Effluents

5.13.3.13 The practices outlined in ProPECC PN 1/23 should be adopted where applicable for handling, treatment and disposal of operation stage effluent. In particular, drainage serving any covered PTI, covered green fuel station, covered ambulance depot and covered refuse collection point in TKO 137 should be connected to public sewers. Sedimentation facilities, petrol interceptors or other appropriate wastewater treatment system should be provided to treat the wastewater or surface run-off generated in these facilities as necessary to meet the discharge standards as stipulated in the TM-DSS prior to the discharge to the public sewers.

Aging or Damage of the Sewerage Network

5.13.3.14 The following precautionary measures are recommended to minimise the risk of failure of the proposed sewerage system:

- Regular inspection, checking and maintenance of the sewerage system.
- Provisions of leakage collection systems linking to the nearest chamber at its downstream to the rising main for collection of sewage leakage from the damaged sewage pipeline.
- Use tankers to store emergency discharge and transport to the STW for disposal in case of both twin rising mains failure.

5.13.4 Non-point Source Surface Run-off

BMP for Storm Water Management

5.13.4.1 The following BMP should be implemented in the new development areas of this Project to reduce stormwater pollution are as follows.

Design Measures to Control Erosion and Run-off Quantity

5.13.4.2 Exposed surface shall be avoided within the development site to minimise soil erosion. The development site shall be either hard paved or covered by landscaping area and plantation where appropriate.

5.13.4.3 The drainage system should be designed to avoid flooding.

5.13.4.4 Green areas / tree / shrub planting etc. should be introduced within the development site as far as possible including open space and along roadside amenity strips and central dividers, which can help to reduce soil erosion.

Devices and Facilities to Control Sedimentation and Run-off Quality

5.13.4.5 Screening facilities such as standard gully grating and trash grille, with spacing which is capable of screening large substances such as fallen leaves and rubbish should be provided at the inlet of drainage system.

5.13.4.6 Road gullies with standard design and silt traps and oil interceptors should be incorporated during the detailed design to remove particles present in stormwater run-off, where appropriate.

5.13.4.7 Evergreen tree species, which in general generate relatively smaller amount of fallen leaves, should be selected where possible.

Administrative Measures to Control Sedimentation and Run-off Quality

5.13.4.8 Good management measures such as regular cleaning and sweeping of road surface / open areas are suggested. The road surface / open area cleaning should also be carried out prior to occurrence of rainstorm.

5.13.4.9 Manholes, as well as stormwater gullies, ditches provided at the development sites should be regularly inspected and cleaned (e.g. monthly). Additional inspection and cleansing should be carried out before forecast heavy rainfall.

Blue-green Infrastructure to Control Sedimentation and Run-off Quantity

5.13.4.10 Blue-green infrastructure should be implemented under this Project where practicable to reduce the storm loading to the drainage system as follows.

5.13.4.11 Provision of bioswales, where practicable at roadside, to convey stormwater and provide removal of coarse and medium sediments. As the water is transported along the bioswales, it is treated to remove pollutants and the cleaned water can then be discharged into the receiving water bodies or retained for non-potable reuse, e.g. irrigation.

5.13.4.12 Rainwater harvesting should be implemented within the development site, where possible, to collect rainwater from uncontaminated areas such as building roofs, podiums, walkway canopies and other built structures for reuse as an alternative water source e.g. irrigation. The system should meet the prevailing WSD guidelines. Treatment of harvested rainwater should consist of pre-treatment, filtration and disinfection system. Treatment process shall be in compliance with the requirements in "Technical Specifications on Grey Water Reuse and Rainwater Harvesting" issued by WSD.

5.13.4.13 Porous paving material should be used, where practicable, to increase stormwater infiltration and improve groundwater recharge and reducing flooding from surface run-off.

Locations of Storm Outfalls at TKO 137

5.13.4.14 The storm outfalls for the future development at TKO 137 shall be located away from the seawater intake location of TKO desalination plant as far as practicable to minimize any potential water quality impact upon the intake. The recommended location of the stormwater outfalls at TKO 137 are presented in **Appendix 5.8** (subject to detailed design).

5.13.5 Sewage / Wastewater Generation and Operation of SPS at TKO 132

5.13.5.1 Sewage and wastewater generated from the TKO 132 development should be diverted to the new public sewerage system at TKO 132 and subsequently to the existing TKO PTW and HATS for proper treatment and disposal. The practices outlined in ProPECC PN 1/23 should be adopted where applicable for handling, treatment and disposal of operation stage effluent.

5.13.5.2 Precautionary and design measures as listed below should be incorporated into the SPS design to prevent the emergency situation.

- A standby pump and screen should be provided to cater for breakdown and maintenance of the duty pump in order to avoid emergency discharge.
- Backup power supply should be provided.
- An alarm should be installed to signal emergency high water level in the wet well.
- An on-site emergency storage tank with capacity to store 2 hours of peak sewage flows should be provided for the proposed SPS to cater for breakdown and maintenance of duty pump.
- Regular maintenance and checking of plant equipment should be undertaken to prevent equipment failure.
- Twin rising mains system should be provided to facilitate maintenance works and to avoid emergency discharge of sewage.
- A telemetry system to the nearest manned station / plant should be provided so that swift action can be undertaken in case of malfunction of the unmanned facilities.
- A bar screen (with clear spacing of no less than 25 mm) should be provided to cover the opening of any emergency sewage bypass which can prevent the discharge of floating solids into receiving waters as far as practicable while ensuring flooding at the facilities would not occur.

5.13.5.3 The relevant conditions in DSD's "Sewerage Manual (Part 2) Pumping Stations and Rising Mains" should be adopted and followed during the design and operation of the SPS where applicable. In particular, an overflow or emergency bypass arrangement should be provided at or near the SPS as a good practice. The bypass arrangements should allow sewage to flow to the most suitable discharge points when the sewage level inside the wet well rises to a predetermined level beyond which pollution may result from the occurrence of sewage overflow at manholes of the upstream sewers or flooding of the pumping station. The acceptability and the location of discharge should be carefully assessed in the detailed design stage. The opening of the overflow should not be obstructed by any form of screens with bar spacing less than 25 mm as the screen will be easily blocked by screenings, thus resulting in flooding of the pumping station and the upstream catchment. As per the Sewerage Manual (Part 2), the location of discharge point of emergency overflow or bypass of SPS shall be planned to avoid overflow or bypass of untreated sewage into beneficial uses (i.e. WSRs) and shall preferably maintain a buffer distance of at least 150 metres from the nearest WSRs. The emergency discharge point of SPS is proposed at the nearshore region of the southern seawall of TKO 132 development as indicatively shown in **Figure 5.1**. Locating the emergency discharge point more offshore (further away from the WSRs) is not feasible due to the Project constraints as presented in Section 5.6.5.4. Nevertheless, the precautionary design measures recommended above would prevent the occurrence of emergency discharge from the SPS into the WSRs. The chance of emergency discharge from the SPS would be extremely remote. In case of emergency situation, the emergency discharge volume would be small and the associated water quality impact (if any) would be highly transient and reversible as discussed in Section 5.10.7.3.

5.13.5.4 An ECP to deal with the emergency raw sewage discharges should be developed in the detailed design stage.

Operation of PFTF

5.13.5.5 Material stockpiles should be enclosed within building structure or properly covered with impermeable sheeting as soon as possible and surrounded by silt fence and runoff intercepting channels or protected by other methods approved by CEDD and EPD to prevent wind and water erosion. Final slope surfaces shall be treated by compaction, followed by hydroseeding, vegetation planting or sealing with shotconcrete, latex, vinyl, bitumen, or other suitable surface stabiliser approved by CEDD to prevent the washing away of stockpiled material. Any material sorting activities shall be enclosed in building structure to avoid contaminated runoff.

5.13.5.6 Appropriate drainage system shall be provided to intercept surface runoff generated in works areas of the facility from direct discharge to the sea. All surface runoff and wastewater (e.g. from wheel washing) generated from the facility should be diverted to silt removal / sedimentation facilities for recycling or reuse within the facility after proper settlement. The BMP to reduce stormwater and non-point source pollution recommended under ProPECC PN 1/23 should be properly followed.

5.13.5.7 Sufficient buffer distance shall be given between the public fill stockpiling area and the seafront. No fill material shall be stockpiled at or near the seafront / berthing area.

5.13.5.8 Sewage generated at PFTF should be properly diverted and conveyed to the public sewerage system.

Operation of CBP

5.13.5.9 All the works areas including wastewater generating processes and dusty operations of the concrete batching plants should be enclosed to avoid loss of dusty materials and generation of contaminated rainwater runoff.

5.13.5.10 All wastewater generated from the concrete batching plants should be collected, treated, stored and recycled to reduce resource consumption. This includes water used in the concrete batching process, yard washing etc. All spent effluents from the works processes should be collected and diverted to the sedimentation basins with sufficient treatment capacity. The overlying water from the sedimentation basin should be recycled for reuse within the plants. All residual wastewater discharge, if any, should be conveyed to the public sewerage system. No wastewater should be discharged from the plant into the water environment.

Operation of EFs

5.13.5.11 All sewage generated from the EFs should be conveyed to the public sewerage system for proper disposal.

Operation of CWHF

5.13.5.12 Handling of construction waste materials in CWHF should be enclosed within building to avoid contaminated rainwater runoff. All sewage effluent, wastewater from machineries and washed water generated from the facility should be properly collected and conveyed to the public sewerage system. Wastewater discharge into the environment from the facility should not be allowed.

Operation of RTS

5.13.5.13 All active works areas and facilities of the Refuse Transfer Station (RTS) should be enclosed within building structure to avoid contaminated runoff. Leachate generated from the station shall be collected and pre-treated to meet the requirements of the TM-DSS and the WPCO discharge license prior to the discharge into the public sewerage system. No wastewater discharge from the RTS into the environment should be allowed.

Aging or Damage of the Sewerage Network

5.13.5.14 The following precautionary measures are recommended to minimise the risk of failure of the proposed sewerage system:

- Regular inspection, checking and maintenance of the sewerage system.
- Provisions of leakage collection systems linking to the nearest chamber at its downstream to the rising main for collection of sewage leakage from the damaged sewage pipeline.
- Use tankers to store emergency discharge and transport to the STW for disposal in case of both twin rising mains failure.

5.13.6 Accidental Marine Spillage from Marine Delivery, Unloading and Loading of Materials from Barges at TKO 132

5.13.6.1 The use of conveyor barge is proposed instead of derrick barge for storage and transfer of fill, aggregate, sand, construction materials and other materials with fines content. Transfer of these materials from barge to site should be through a conveyor system (with no lifting of material involved) and the conveyors should be fully enclosed to prevent any loss of material and refuse to sea.

5.13.6.2 Municipal solid wastes and marine refuse shall be placed in containers that are sealed to prevent spillage of the contents during transportation and unloading operation.

5.13.6.3 Regular inspection and maintenance on the conveyor systems and refuse containers should be carried out by the operators to ensure that they are in good condition and free from damage or any other defects.

5.13.6.4 Should other alternative material transfer and containment methods to prevent marine spillage be proposed by the future operators, these methods shall be subject to approval of EPD. Besides, barges should not be filled to a level which may cause the overflow of material during loading or transportation. Barge effluents (e.g. muddy water) should be properly collected and treated prior to disposal.

5.13.7 Non-point Source Surface Runoff and Accidental Spillage in TKO 132 Development

5.13.7.1 It is recommended that all active works areas in the industrial facilities at TKO 132 should be enclosed to contain accidental spillage of material or chemicals. The stormwater control measures including BMP and blue-green infrastructure recommended in Section 5.13.4 should be implemented for the TKO 132 Development where appropriate.

5.13.7.2 Perimeter drainage systems should be provided in the open areas of these industrial facilities to collect stormwater runoff. Under normal operation, rainwater runoff collected in the perimeter drainage system should be diverted to suitable pollutant removal devices (i.e. sedimentation basins and oil interceptors) for treatment. The treated effluent from the pollutant removal devices should be discharged into the public sewerage system. The pollutant removal devices of the perimeter drainage system should be designed with sufficient capacity for the “first flush” flow, which would carry most of the pollutants. The subsequent overland flow generated from rainstorms after the “first flush” flow should be bypassing the pollutant removal facilities for discharge to the stormwater system. Prevention of “first flush” pollution in stormwater runoff should be incorporated into the drainage design of the facilities to control pollution at source and to abate pollutants under normal situations. This first-flush diversion system would also divert any dry weather flow to the sewerage system and therefore can also act as a dry weather interception system.

5.13.7.3 To address the potential water quality concerns under emergency situations, stop-logs should be considered and installed at suitable location(s) in the perimeter drainage system of the industrial facilities so that contaminants can be contained in the event of accidental spillage.

In the emergency case, stop-logs should be closed to isolate the lot with accidental spillage to facilitate the cleaning up of the spill. Contaminated surface water, if any, generated in the lot should be contained by the stop-logs under the emergency situation. The collected contaminated surface water should be pre-treated as necessary to meet the requirements of the TM-DSS prior to the disposal at the public sewerage system. To ensure that there is no chance of contaminated runoff leaving the site untreated during rainfall, the perimeter drainage system should have sufficient capacity (within the channels or at a designated sump) to store any contaminated runoff (spillage plus collected rainwater) from the area isolated by the stop-logs. If there is any chemical waste collected, the handling and disposal should comply with the Waste Disposal (Chemical Waste) (General) Regulation and Waste Disposal Ordinance.

5.13.7.4 An Emergency Response Plan (ERP) should be developed by the future operators of the industrial facilities where necessary to provide contingency procedures to ensure containment and safe disposal of any accidental spillage or contaminants leaking from the industrial processes. Suitable spill control materials and equipment shall be kept on site to deal with accidental spillages. An outline of the ERP is provided in Section 5.13.8.3.

5.13.8 EMP

5.13.8.1 Prior to the commissioning of each industrial facility proposed at TKO 132, an EMP shall be prepared for the facility to detail the site-specific measures and procedures (including the specific operation plan, wastewater recycling facilities, Storm Pollution Control Plan (SPCP), ERP, pollution and erosion control measures and devices, good site practices, housekeeping measures, implementation frequency, environmental monitoring and audit procedures, maintenance schedules, etc. where appropriate) to prevent environmental nuisance, marine spillage, accidental dropping of materials and water pollution. The EMP shall be prepared by the future operators of the relevant public facilities on a good management practice basis.

5.13.8.2 The SPCP shall be prepared for potential polluting facilities in open areas (if any) and shall incorporate details such as locations, sizes and types of measures / installations and the BMP to control erosion, minimize runoff quantity and to prevent or minimise the potential of pollutants coming into contact with rainwater or runoff. The SPCP shall also provide details, locations and design of the site drainage systems including perimeter drainage systems, storm pollutant removal devices (e.g. sedimentation basins and oil interceptors) and stop-logs etc. where appropriate to prevent “first flush” pollution and release of accidental spillage.

5.13.8.3 The EMP shall also include an ERP where appropriate to deal with emergency situations of accidental spillage on-site or in marine water. The ERP should cover the following:

- Contact personnel and the means to contact.
- Procedures to contain contaminants, prevent their escape and/or dispersion and cleanup the spillage.
- Procedures to divert / transport the contaminated materials to a designated temporary storage area or appropriate treatment facility.
- Procedures to clear up the lot and/or perimeter drainage system prior to opening the stop-logs.

5.13.8.4 Regular and independent environmental audits and inspections should be conducted to check the environmental performance of the operations in TKO 132. These audits and inspections shall aim to ensure proper installation, implementation and maintenance of measures and BMP specified in the EMP.

5.13.9 Maintenance Dredging for Proposed Berthing Facility at TKO 132 Development

5.13.9.1 The following mitigation measures are recommended for the maintenance dredging works for the proposed berthing facility at TKO 132 Development.

- Maintenance dredging should be carried out by closed grab dredger.

- The maximum dredging rate should be controlled at or below 700 m^3 per day.
- Double silt curtains should be deployed around dredging works in view of their close proximity to the coral sites.

5.13.9.2 Details of any future maintenance dredging would be subject to the actual siltation rate and operational need. The future party responsible for carrying out the maintenance dredging works should implement the recommended mitigation measures and propose details of the associated water quality monitoring programme prior to the commencement of the maintenance dredging work.

5.14 Evaluation of Cumulative Impact

5.14.1 Construction Phase

Land-based Construction

5.14.1.1 It is expected that water quality impacts due to the land-based works for SENTX, TKSLE, Stage 2 of TKO desalination plant and construction of relocated berthing facilities and associated structures within TKO 137 Fill Bank as well as those proposed under this Project would be minimized by proper implementation of suitable mitigation measures and good site practices. The associated water quality impacts are expected to be localized. Therefore, no adverse cumulative water quality impact is anticipated due to this Project and other concurrent works.

5.14.1.2 Land-based construction of the proposed water sports centre at TKO Area 77 is located over 500 m from the Project boundary and would not contribute any cumulative water quality impact with this Project.

Marine Construction

5.14.1.3 Construction programme and details of the proposed water sports centre at TKO Area 77 and TKLSE are not available. The possible marine works (such as the construction of landing steps) for the proposed water sports centre at TKO Area 77 would be minimal in scale. The water quality impacts due to marine construction of TKLSE (if any) will be assessed under a separate EIA study, which will take into account other relevant concurrent projects and, where necessary, recommend mitigation measures to minimize its potential water quality impacts. Construction of relocated berthing facilities and associated structures within TKO Area 137 Fill Bank is minor in scale with no dredging nor underwater filling activities. Appropriate mitigation measures will also be implemented under this Project to minimize the water quality impact. As a result, no adverse cumulative marine water quality impact would be expected.

5.14.2 Operation Phase

5.14.2.1 The SENTX, TKO desalination plant, etc. would operate concurrently with this Project in TKO 137 and TKO 132. All sewage and wastewater generated from these concurrent projects would be properly collected and treated prior to discharging to the existing public sewerage system. No discharge of wastewater into the water environment would arise from these concurrent projects. Thus, these concurrent projects would not contribute any cumulative water quality impact.

5.14.2.2 The brine discharge from TKO desalination plant has also been included in the modelling exercise for cumulative assessment. Since the model results indicated that the water quality influences of this Project during the operation phase would be minor, this Project would not cause any adverse cumulative water quality impact with the operation of TKO desalination plant.

5.14.2.3 The programme and details of TKLSE are currently not available. The water quality impacts due to operation of the TKLSE will be assessed under a separate EIA study, which will take into account other relevant concurrent projects and, where necessary, recommend mitigation measures to minimize its potential water quality impacts. Operation of this Project is predicted to cause no significant changes to the hydrodynamics and water quality conditions in the assessment area and therefore would not contribute adverse cumulative water quality impact with TKLSE.

5.15 Residual Impact

5.15.1.1 With proper implementation of all the recommended mitigation measures, no residual water quality impact is expected to be resulted from the Project during the construction and operation phases.

5.16 Environmental Monitoring and Audit (EM&A) Requirements

5.16.1 Construction Phase

5.16.1.1 Marine water quality monitoring at selected WSRs and control stations is recommended for the marine construction of the Project. Site audit would be conducted throughout the marine and land-based construction under this Project to ensure that the recommended mitigation measures are properly implemented. Discharge license(s) should be obtained under the WPCO for any construction site discharges. Monitoring of the construction site effluent shall be carried out in accordance with requirements stipulated in the WPCO discharge licenses.

5.16.1.2 Details of the construction phase monitoring and audit requirements are provided in the standalone EM&A Manual.

5.16.2 Operation Phase

5.16.2.1 Marine water quality monitoring at selected WSRs and control stations should be carried out during the first year operation of the EPP. Marine water quality monitoring should also be conducted in case of emergency discharge from the EPP.

5.16.2.2 Marine water quality monitoring at selected WSRs and control stations should also be carried out during the first year operation of the non-designated projects at TKO 132 (i.e. PFTF and CBP) and in case of accidental spillage from these facilities. Water quality monitoring requirements for operation of the proposed designated projects at TKO 132 (i.e. CWHF, EFs and RTS) will be reviewed under separate EIA studies to be conducted by their respective project proponents.

5.16.2.3 Details of the operation phase monitoring and audit requirements for EPP, PFTF and CBP are provided in the standalone EM&A Manual.

5.17 Environmental Acceptability of Schedule 2 Designated Projects

5.17.1.1 An application for EP would be submitted under this EIA for DP1, DP2, and DP3.

5.17.2 Construction of Carriageway Bridge at TKO 132 (DP1)

5.17.2.1 With the proper implementation of water quality mitigation measures for construction activities (as detailed in Section 5.11), no adverse impact would be resulted from the proposed roads during the constructional stage. There is no adverse operation water quality impact due to DP1 with proper implementation of the BMP for storm water management in Section 5.13.

5.17.3 Reclamation Works at TKO 137 and off TKO 132 (DP2)

5.17.3.1 With the proper implementation of water quality mitigation measures for construction activities, reclamation and maintenance dredging works (as detailed in Sections 5.11 and 5.13.9), no adverse water quality impact would be resulted from reclamation works at TKO 137 and TKO132 during the constructional stage. No adverse hydrodynamics and water quality impact due to the reclamation works is predicted during the operation phase

5.17.4 Construction and Operation of Effluent Polishing Plant (EPP) (DP3)

5.17.4.1 With the proper implementation of water quality mitigation measures for construction activities (as detailed in Section 5.12), no adverse water quality impact would arise from the construction of the EPP. Design measures and ECP are recommended in Section 5.13 to deal with any emergency discharge from the EPP. No adverse water quality impact is predicted during the operation stage of the EPP.

5.17.5 Other DPs

5.17.5.1 There will be separate EIA studies to assess the following Schedule 2 DPs. The water quality impact of these Schedule 2 DPs during construction and operation phases will be further investigated in their own EIA studies under the EIAO. The relevant EM&A requirements for these Schedule 2 DPs will also be provided under their own EIA studies.

- Construction and Operation of Refuse Transfer Station (RTS) (DP4);
- Construction and Operation of Construction Waste Handling Facility (DP5);
- Construction and Operation of Electricity Facilities (DP6).

5.18 Conclusions

5.18.1 Construction Phase

Land-based Construction

5.18.1.1 The key sources of water quality impact arising during the land-based construction of the Project include the construction site runoff, wastewater generated from general construction activities, accidental spillage, general refuse and sewerage from the workforce. The impacts could be mitigated and controlled by implementing the recommended mitigation measures. No adverse water quality impact is expected. Regular site inspections should be undertaken to inspect the construction activities and works area to ensure the recommended mitigation measures are proper implemented.

Marine-based Impact

5.18.1.2 Marine-based water quality impact would arise from the reclamation works at TKO 137 and TKO 132. Non-dredged DCM treatment method is proposed for construction of the foundation of the reclamation. The DCM method enables *in-situ* stabilisation of the underlaying sediments without excavation, dredging, shoring or dewatering, and thus there is less exposure of wastes to the water environment. By placing the sand blanket layer on top of the DCM works areas before the DCM treatment, release of fines and cement slurry from the DCM operation is expected to be negligible.

5.18.1.3 The water quality impacts due to the underwater filling, dredging and sand blanket laying work have been quantitatively assessed by mathematical modelling. Suspended solids and sediment depositions are identified as the key parameters of concern. Specific mitigation measures including the provision of leading seawall to confine underwater filling, deployment of silt curtains and control of production rates for relevant marine construction activities are proposed to mitigate the potential water quality impacts. Under the mitigated scenarios, full compliances with the assessment criteria for SS elevations and sedimentation are predicted at all identified WSRs. A water quality monitoring and audit programme will be implemented for the marine construction work.

5.18.2 Operation Phase

5.18.2.1 During operation phase, no significant changes in the hydrodynamics regime would be caused by the proposed reclamations at TKO 137 and TKO 132 with reference the mathematical modelling results.

5.18.2.2 Wastewater and sewage generated from the TKO 137 development would be diverted to an advance SPS for discharge to the existing public sewerage system in TKO during the early commissioning stage. After commissioning of the proposed EPP by 2034, the wastewater and sewage generated from TKO 137 development would be conveyed to the proposed EPP for proper treatment and disposal. Wastewater and sewage generated from the proposed public facilities at the TKO 132 development would be conveyed to the existing public sewerage system in TKO. The proposed reclamations at TKO 137 and TKO 132 together with the EPP discharges at TKO 137 are predicted to cause no significant change in the water quality regime in the assessment area.

5.18.2.3 Emergency discharges from the EPP are predicted to cause no significant water quality effect except only for the *E.coli* levels at the closest WSR, which would be temporarily elevated. The *E.coli* elevations are however predicted to be transient and reversible. Various design measures and an ECP as well as a water quality and audit programme would be implemented to avoid / deal with the emergency discharge from the EPP and accidental marine spillage from operation of the public facilities at TKO 132 development. Storm pollution control measures and BMP for storm water management should be implemented and followed to minimize the water quality impact due to non-point source surface runoff.

5.18.2.4 With proper implementation of all the recommended water quality mitigation measures, no adverse water quality impact would arise from the Project operation.