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PURPOSE OF THIS DOCUMENT

This Project is located close to the HK-Mainland marine border. As a good practice, the potential water quality impacts at the HK-Mainland marine border from Project construction and operation is assessed under this EIA Study. This document presents the assessment criteria, approach and results of modelling assessment conducted under this EIA Study for the Mainland Waters.

The following are discussed in sequence in this document:

- Relevant assessment criteria;
- Assessment approach; and
- Modelling prediction and assessment results.

Other water quality impacts which are addressed qualitatively in the main text is not further consider in this document. It is considered the proposed mitigation and control measures would be sufficient in controlling those potential impacts.

Relevant water quality criteria from the *Sea Water Quality Standard GB 3097-1997* is provided in *Table 2.1* below. It should be highlighted that coastal development on the Mainland side of the Study Area includes only residential and commercial (near the Shataujiao Town) as well as port works (the Yantian Port). Therefore, the waters within the Study Area is considered either category 3 or 4 stipulated under the GB 3097-1997. Assessment criteria for category 3 waters are adopted for conservative assessment.

Table 2.1 *People's Republic of China Sea Water Quality Standard (GB 3097-1997)*

Unit: mg/L	Category 1: Fisheries, Marine Reserve and Conservation Area of rare or Endangered Species	Category 2: Mariculture, Bathing Beach, Secondary Contact Recreation, Industrial Use related to Direct Human Consumption	Category 3: General Industrial Use and General Aesthetic	Category 4: Harbour Area and Marine Development Area
Floating Object	No oil film, floating foam and other debris on water surface	No oil film, floating foam and other debris on water surface	No oil film, floating foam and other debris on water surface	No observable oil film, floating foam and other debris on water surface
Colour / Odour / Taste	No abnormal colour, odour or taste should be presented in sea water	No abnormal colour, odour or taste should be presented in sea water	No abnormal colour, odour or taste should be presented in sea water	No objectionable or unpleasant colour, odour or taste should be presented in sea water
Suspended Solid	Increase from human activities should be less than 10	Increase from human activities should be less than 10	Increase from human activities should be less than 100	Increase from human activities should be less than 150
Coliform (count/L)	10000 700 for mariculture of shellfish for direct human consumption	10000 700 for mariculture of shellfish for direct human consumption	-	-
<i>E.coli</i> (count/L)	2000 140 for mariculture of shellfish for direct human consumption	2000 140 for mariculture of shellfish for direct human consumption	-	-
Pathogen	Not to present for mariculture of shellfish for direct human consumption	Not to present for mariculture of shellfish for direct human consumption	Not to present for mariculture of shellfish for direct human consumption	Not to present for mariculture of shellfish for direct human consumption
Water Temperature (°C)	Change due to human activities should not cause increase for 1°C in summer, 2°C in other seasons	Change due to human activities should not cause increase for 4°C	Change due to human activities should not cause increase for 4°C	Change due to human activities should not cause increase for 4°C
pH	7.8-8.5 Change should not exceed normal range by 0.2 pH unit	6.8-8.8 Change should not exceed normal range by 0.5pH unit	6.8-8.8 Change should not exceed normal range by 0.5pH unit	6.8-8.8 Change should not exceed normal range by 0.5pH unit
Dissolved Oxygen	6	5	4	3
Chemical Oxygen Demand	2	3	4	5

Unit: mg/L	Category 1: Fisheries, Marine Reserve and Conservation Area of rare or Endangered Species	Category 2: Mariculture, Bathing Beach, Secondary Contact Recreation, Industrial Use related to Direct Human Consumption	Category 3: General Industrial Use and General Aesthetic	Category 4: Harbour Area and Marine Development Area
5-day Biochemical Oxygen Demand	1	3	4	5
Inorganic Nitrogen (as N)	0.2	0.3	0.4	0.5
Unionized Ammonia (as N)	0.020	0.020	0.020	0.020
Reactive Phosphate (as P)	0.015	0.030	0.030	0.045
Mercury	0.00005	0.0002	0.0002	0.0005
Cadmium	0.001	0.005	0.010	0.010
Lead	0.001	0.005	0.010	0.050
Hexavalent Chromium	0.005	0.010	0.020	0.050
Total Chromium	0.05	0.10	0.20	0.50
Arsenic	0.020	0.030	0.050	0.050
Copper	0.005	0.010	0.050	0.050
Zinc	0.020	0.050	0.10	0.50
Selenium	0.010	0.020	0.020	0.050
Nickel	0.005	0.010	0.020	0.050
Cyanide	0.005	0.005	0.10	0.20
Sulphide (as S)	0.02	0.05	0.10	0.20
Volatile Phenol	0.005	0.005	0.010	0.050
Petroleum Hydrocarbon	0.05	0.05	0.30	0.50
Hexachlorocyclohexane	0.001	0.002	0.003	0.005
Dichlorodiphenyltrichloroethane	0.00005	0.0001	0.0001	0.0001
Malathion	0.0005	0.001	0.001	0.001
Parathion	0.0005	0.001	0.001	0.001

ASSESSMENT APPROACH

As part of the assessment, the same approach outlined in *Annex 5A* as well as *Section 5.6* of the EIA would be applied. The only major difference would be the adoption of Category 3 Criteria of *Sea Water Quality Standard GB 3097-1997* for assessment instead of WQO for assessment. Further details on assessment approach are therefore not repeated in this annex.

4.1

CONSTRUCTION PHASE

Suspended Solids Dispersion

Predicted extent of sediment plume from the marine construction (installation and removal of sheetpiles for cofferdam) under dry and wet seasons are presented in *Annex 5D*. As shown, the sediment plume is highly localized near the proposed diffuser. The level of SS elevation is also limited. It is predicted that SS elevation due to the sheetpile removal operation would be reduced to below 0.1 mg/L at location over 50 m away from the HK-Mainland marine boundary. As shown in *Table 2.1*, the allowable SS elevation for category 3 and 4 marine waters under the National Sea Water Quality Standard GB3097-1997 is 100 mg/L and 150 mg/L. The predicted SS elevation from the sheetpile removal operation would be well below the relevant SS criterion in marine waters of Mainland. In view of the above, no adverse sediment impact on marine waters of Mainland China would be expected from the proposed sheetpile removal operation.

DO Depletion

As shown in *Annex 5D*, the extent of sediment plume would be larger in the wet season. The predicted maximum level of SS elevation in wet season would be below 0.05 mg/L at the HK-Mainland marine border. To calculate the potential depletion of dissolved oxygen at the HK-Mainland marine border, fraction of organic matter in sediment (Chemical oxygen demand in *Table 5.4* of the main text) was taken as 17,000 mg/kg based on maximum data from EPD Sediment Monitoring Stations MS1 located near the Project Site from 2009-2013.. The corresponding maximum DO depletion can be calculated as follow:

$$\begin{aligned} DO (mg O_2/L) &= SS(gDW/m^3) \times sediment\ oxygen\ demand(gO_2/gDW) \\ &= 0.05(gDW/m^3) \times 0.017(gO_2/gDW) = 0.0009gO_2/m^3 \\ &= 0.0009mgO_2/L \end{aligned}$$

As shown in the calculation above, the maximum DO depletion due to the proposed sheetpile removal operation for the submarine outfall would be about 0.0009 mg/L at the HK-Mainland marine border. The baseline DO level provided in *Table 5.9* of the main text shows that ambient DO would be in general higher than 4 mg/L. The resultant DO level would still be above 4 mg/L and complies with the relevant DO criterion in marine waters of Mainland. The DO criterion stipulated in *National Sea Water Quality Standard GB3097-1997* provided in *Table 2.1* above are 4 mg/L and 3 mg/L for category 3 and category 4 waters respectively. In view of the above, no adverse DO depletion impact on marine waters of the Mainland China would be expected from the proposed sheetpile removal operation.

Elevation of Nutrients

As shown in *Table 2.1*, the water quality criterion for TIN is 0.3 and 0.4 mg/L respectively for Category 3 and 4 marine waters in Mainland. The water quality criterion for UIA is 0.020 mg/L for all marine water. As discussed in the previous section, the predicted maximum level of SS elevation in wet season would be below 0.05 mg/L at the HK-Mainland marine border. The corresponding maximum TIN and UIA elevation can be calculated as follow based on the methodology stated under *Section 5.6* of the EIA:

$$\begin{aligned} \text{Max TIN (mg/L)} &= \text{Max SS (mg DW/m}^3\text{)} \times \text{Max TKN (mgN/kgDW)} \times 10^{-6} \\ &= 0.05(\text{mg DW/m}^3\text{)} \times 620(\text{mgN/kgDW)} \times 10^{-6} \\ &= 0.000031(\text{mg N/L}) = 0.031 (\mu\text{g N/L}) \end{aligned}$$

$$\begin{aligned} \text{Max UIA (mg/L)} &= \text{Max SS (mg DW/m}^3\text{)} \times \text{Max TKN (mgN/kgDW)} \times 10^{-6} \\ &\quad \times 7.8\% \\ &= 0.05(\text{mg DW/m}^3\text{)} \times 620(\text{mgN/kgDW)} \times 10^{-6} \times 7.8\% \\ &= 0.000002425(\text{mg N/L}) = 0.002425 (\mu\text{g N/L}) \end{aligned}$$

As shown in the calculation above, the maximum TIN and UIA elevation due to the proposed sheetpile removal operation for the submarine outfall would be low at the HK-Mainland marine border. The baseline TIN and UIA level provided in *Table 5.16* of *Section 5* of the EIA shows that ambient level would be in general low in Mirs Bay and slight increase in TIN and UIA level would not results in exceedance of the relevant criteria stipulated in *National Sea Water Quality Standard GB3097-1997* for category 3 and category 4 waters. In view of the above, no adverse impact of TIN and UIA elevation on marine waters of the Mainland China would be expected from the proposed sheetpile removal operation.

Table 4.1 *Predicted Worst Case Elevation of TIN and UIA and its comparison with the corresponding WQO Criteria*

Unit: mg/L	TIN	UIA
At the HK-Mainland marine border	0.0031	0.0002425

Elevation of Heavy Metals and Micro-organic Pollutants

The levels of pollutants elevation at the HK-Mainland marine border are provided below in *Table 4.2*. As shown, the predicted maximum elevation of pollutants is less than 1% of the corresponding assessment criteria. No adverse water quality impact on marine water of Mainland China from the

release of pollutants due to marine sheetpile removal at submarine outfall is anticipated.

Table 4.2 *Predicted Maximum Elevation of Pollutants at HK-Mainland Border and its comparison with the corresponding Assessment Criteria*

Parameter	Assessment Criteria ($\mu\text{g/L}$)	Maximum Contaminant Level (mg/kg)	Predicted Maximum Pollutant Elevation in Wet Season ($\mu\text{g/L}$)	Predicted Maximum Pollutant Elevation in Dry Season ($\mu\text{g/L}$)
Arsenic	50	16	1.54×10^{-2}	2.87×10^{-2}
Total PCBs	0.03	0.018	1.73×10^{-5}	3.22×10^{-5}
Total PAHs	3	2.25	2.17×10^{-3}	4.03×10^{-3}

Note: The water quality criteria from *National Sea Water Quality Standard GB3097-1997* for category 3 and category 4 waters (given in *Table 2.1* above) are adopted for assessment at the HK-Mainland Border for available parameters. If no assessment criteria for the relevant parameters are given in *GB3097-1997*, the assessment criteria proposed under this Study (provided in *Table 5.10* of the main text) would be used.

As shown in *Table 4.2* above, no exceedance of assessment criteria is predicted. As such, no adverse impact from the release of contaminants on Mainland waters would be expected.

4.2 OPERATION PHASE

The potential change in water quality at the HK-Mainland marine border is modelled for the 2030 Baseline and Operation Scenario. Assessment for the 2020 Operation Scenario for the TSTP is considered not necessary because there will not be a change in overall pollution loading.

The water quality criteria for marine water of Mainland China are provided in *Table 2.1* above. As discussed in *section 2*, assessment criteria for category 3 waters are adopted for conservative assessment. Relevant WQ criteria stipulated in *Table 2.1* include:

- Dissolved Oxygen: 4 mg/L
- (Total) Inorganic Nitrogen: 0.4 mg/L
- Unionized Ammonia: 0.020 mg/L
- Suspended Solids: Increase < 100 mg/L
- *E.coli*: No relevant requirement

As shown in *Annex 5I-3, 4, 15* and *16*, the predicted 10th-percentile DO level is generally above 4 mg/L in surface and middle layer in the Mainland waters, with a small patch of water below 4 mg/L level at the bottom layer of Mainland Waters north to Ap Chau. The 10th-percentile DO level throughout the whole water column is expected to be above the 4 mg/L criterion in both seasons in the baseline and operation scenarios. As shown in *Annex 5I-1, 2, 13* and *14*, the predicted mean DO level would be much higher. No exceedance of the 4 mg/L DO criterion is predicted in Mainland waters.

The contour plots for predicted mean TIN are provided in *Annex 5I-5, 6, 17 and 18*. The contour plots for predicted mean UIA are provided in *Annex 5I-7, 8, 19 and 20*. As shown in *Annex 5I-5 and 6*, a small increase in plume size of TIN for local discharge at the opening of Starling Inlet is predicted in the dry season. The increase is highly localized and is not observed in wet season. Similar change in UIA is also predicted in dry season for the local discharge near the opening of Starling Inlet. The small and localized increase in plume size is not expected to affect the beneficial use and integrity of the marine waters of the Mainland China. No adverse water quality impact from TIN and UIA is expected from the operation of the expanded STKSTW.

As shown in *Annex 5I-9, 10, 21 and 22*, predicted SS level would be below 100 mg/L in marine waters of the Mainland China. Therefore, no exceedance of the corresponding SS criterion is predicted.

CONCLUSION

A brief summary on the assessment criteria, approach and results of water quality modelling assessment is provided in this document for the potential change in water quality resulted by the construction and operation of this Project. Relevant water quality criteria from the *Sea Water Quality Standard GB 3097-1997* is adopted for the assessment while the same approach for modelling / quantitative assessment is adopted as well. Similar to what has been done for the assessment in the Hong Kong waters, this document covers all potential water quality impacts from the construction and operation of the Project which are assessed quantitative in *Section 5* of the EIA. The modelling assessment and quantitative assessment conducted indicated that there will not be significant change in water quality in Mainland Water as a result of the Project and no exceedance to the water quality *Sea Water Quality Standard GB 3097-1997* is expected.