5 HYDRODYNAMICS AND WATER QUALITY

5.1 Introduction

5.1.1 This section presents the assessment results of the potential hydrodynamic and water quality impact associated with the construction and operation of the proposed Wan Chai Development Phase II (WDII) and Central-Wan Chai Bypass (CWB). Mitigation measures are also recommended to minimise potential adverse impacts and to ensure the acceptability of any residual impact (that is, after mitigation). It should be highlighted that no secondary contact recreation zones and water sports activities will be proposed for the coastal water within the Project site boundary.

5.1.2 Key environmental issues in respect of hydrodynamic and water quality impacts associated with the Project include:

- construction phase water quality impact due to dredging and filling, and construction site runoff and waste water from work force and general site activities
- change of flow regime after completion of the project and the associated water quality impact along the new coastline formed by the proposed reclamation.

5.1.3 Water Quality Impact Assessment: the assessment area should include the areas within and 300m extended beyond the boundary of the Project, plus the Victoria Harbour Water Control Zone (WCZ), the Eastern Buffer WCZ and the Western Buffer WCZ as declared under the Water Pollution Control Ordinance (WPCO).

5.2 Water Sensitive Receivers

5.2.1 In order to evaluate the potential water quality impacts from the Project, water sensitive receivers (WSR) in Victoria Harbour and its adjacent waters were considered. Major water sensitive receivers identified include:

- WSD Flushing Water Intakes;
- Cooling Water Intakes; and
- Corals.

5.2.2 Water sensitive receivers identified outside the Project site boundary in farther field within Victoria Harbour and its adjacent waters are shown in **Figure 5.1**. No sensitive coral sites were identified in the Victoria Harbour. The Green Island and Junk Bay coral communities are located more than 5.5 km west and 6.5 km east of the proposed reclamation site, respectively. These ecological sensitive receivers are included for water quality assessment as they are potentially affected during the construction phase of the Project due to the sedimentation of suspended solids in the water column. Potential adverse impacts on the coral communities, in terms of sedimentation rate, are addressed in Section 5.7. Further discussions are included in the marine ecological impact assessment (Section 9).

5.2.3 A number of cooling water pumping stations and intakes are located within the proposed permanent reclamation limit along the existing waterfront of Wan Chai. These intakes supply cooling water to the air conditioning systems of various commercial buildings in the Wan Chai area including:

- Hong Kong Convention and Exhibition Centre (HKCEC) Phase 1
- Shui On Centre

- Telecom House
- Government Buildings (Wan Chai Tower/Revenue Tower/Immigration Tower)
- China Resources Building
- Hong Kong Exhibition Centre
- Great Eagle Centre
- Sun Hung Kai Centre.

5.2.4 Cooling water intake for Sun Hung Kai Centre will be reprovisioned to the new waterfront of Wan Chai during operational phase of the Project. The rest of the above listed cooling water intakes will be reprovisioned to the intake chambers to the north of HKCEC Extension.

5.2.5 An existing WSD flushing water intake is also located within the proposed reclamation limit at Wan Chai which will be uprated and reprovisioned to Wan Shing Street under this Project.

5.2.6 **Figure 5.2** shows the locations of the existing and reprovisioned seawater intakes within the Project site boundary. Cooling water intakes for some potential future developments are also included in **Figure 5.2** for reference. Further description of these cooling water intakes are provided in Section 5.6.

5.2.7 It should be noted that the MTRC South Intake previously situated at the Wan Chai waterfront between Central Reclamation Phase III (CRIII) and HKCEC Extension has been relocated to the Central waterfront as shown in **Figure 5.1**.

5.3 Environmental Legislation, Policies, Plans, Standards and Criteria

5.3.1 The criteria for evaluating water quality impacts in this EIA Study include:

Environmental Impact Assessment Ordinance (EIAO)

5.3.2 The Technical Memorandum on Environmental Impact Assessment Process (Environmental Impact Assessment Ordinance) (EIAO-TM) was issued by EPD under Section 16 of the EIAO. It specifies the assessment method and criteria that were followed in this Study. Reference sections in the EIAO-TM provide the details of assessment criteria and guidelines that are relevant to the water quality assessment, including:

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

Water Quality Objectives

5.3.3 The Water Pollution Control Ordinance (WPCO) provides the major statutory framework for the protection and control of water quality in Hong Kong. According to the Ordinance and its subsidiary legislation, Hong Kong waters are divided into ten Water Control Zones (WCZs). Corresponding statements of Water Quality Objectives (WQO) 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 proposed Project is located within Victoria Harbour (Phase Three) WCZ and the corresponding WQO are listed in **Table 5.1**.

Table 5.1 Summary of Water Quality Objectives for Victoria Harbour WCZ

Parameters	Objectives	Sub-Zone
Offensive odour, tints	Not to be present	Whole zone
Visible foam, oil scum, litter	Not to be present	Whole zone
Dissolved oxygen (DO) within 2 m of the seabed	Not less than 2.0 mg/l for 90% of samples	Marine waters
Depth-averaged DO	Not less than 4.0 mg/l for 90% of samples	Marine waters
pH	To be in the range of 6.5 - 8.5, change due to human activity not to exceed 0.2	Marine waters
Salinity	Change due to human activity not to exceed 10% of ambient	Whole zone
Temperature	Change due to human activity not to exceed 2 ^{o}C	Whole zone
Suspended solids (SS)	Not to raise the ambient level by 30% caused by human activity	Marine waters
Unionised ammonia (UIA)	Annual mean not to exceed 0.021 mg/l as unionised form	Whole zone
Nutrients	Shall not cause excessive algal growth	Marine waters
Total inorganic nitrogen (TIN)	Annual mean depth-averaged inorganic nitrogen not to exceed 0.4 mg/l	Marine waters
Toxic substances	Should not attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms.	Whole zone
	Human activity should not cause a risk to any beneficial use of the aquatic environment.	Whole zone

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

Water Supplies Department (WSD) Water Quality Criteria

5.3.4 Besides the WQO set under the WPCO, the WSD has specified a set of objectives for water quality at flushing water intakes as listed in **Table 5.2** which shall not be exceeded at all stages of the Project. The target limit for suspended solids (SS) at these intakes is 10 mg/l or less.

Table 5.2 WSD's Water Quality Criteria for Flushing Water at Sea Water Intakes

Parameter (in mg/l unless otherwise stated)	Target Limit
Colour (HU)	< 20
Turbidity (NTU)	< 10
Threshold Odour Number (odour unit)	< 100
Ammoniacal Nitrogen	< 1
Suspended Solids	< 10
Dissolved Oxygen	> 2
Biochemical Oxygen Demand	< 10
Synthetic Detergents	< 5
E. coli (no. per 100 mL)	< 20,000

Cooling Water Intake Standards

5.3.5 Based on a questionnaire survey conducted under the approved Comprehensive Feasibility Study for Wan Chai Development Phase II (WDIICFS) EIA [(1)], a SS limit of 40 mg/L was adopted as the assessment criterion for Admiralty Centre intake and MTRC South intake. No information on the SS limit is available for other cooling water intakes. These findings have been confirmed by a telephone survey conducted under the recent approved EIA for the Hong Kong Convention and Exhibition Centre (HKCEC) Atrium Link Extension (ALE). The locations of the cooling water intakes are shown in **Figure 5.1** and **Figure 5.2**. The SS criterion for cooling water intakes is different from that for the WSD's intakes as their beneficial uses are different (the former is used for cooling water system and the latter for flushing purpose).

Technical Memorandum

5.3.6 Discharges of effluents are subject to control under the WPCO. The Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS) gives guidance on the permissible effluent discharges based on the type of receiving waters (foul sewers, storm water drains, inland and coastal waters). The limits control the physical, chemical and microbial quality of effluents. Any sewage from the proposed construction and operation activities must comply with the standards for effluents discharged into the foul sewers, inshore waters or marine waters of Victoria Harbour WCZ, as given in the TM-DSS.

Practice Note

5.3.7 A Practice Note for Professional Persons (ProPECC) was issued by the EPD to provide guidelines for handling and disposal of construction site discharges. The ProPECC PN 1/94 "Construction Site Drainage" provides good practice guidelines for dealing with ten 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 constructions, acid cleaning, etching and pickling wastewater, and wastewater from site facilities. Practices given in the ProPECC PN 1/94 should be followed as far as possible during construction to minimise the water quality impact due to construction site drainage.

Assessment Criteria for Corals

5.3.8 Potential impacts on benthic organisms, including corals, may arise through excessive sediment deposition. The magnitude of impacts on marine ecological sensitive receivers was assessed based on the predicted elevation of SS and sedimentation rate.

5.3.9 According to the WQO criteria, elevation of SS less than 30% of ambient level, which is set for among other reasons, to offer protection for marine ecological resources, is adopted in this assessment for coral protection. This criterion is more stringent than that previously adopted in other EIA study for assessing SS impact on hard corals in eastern Hong Kong waters (i.e. SS elevation less than 10 mg/L, ERM 2003 [(2)]).

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(1) Territory Development Department (July 2001). Agreement No. CE 74/98, Wan Chai Development Phase II, Comprehensive Feasibility Study, Environmental Impact Assessment Report, Volume I – Text.

(2) ERM (2003). The Proposed Submarine Gas Pipelines from Cheng Tou Jiao Liquefied Natural Gas Receiving Terminal, Shenzhen to Tai Po Gas Production Plant, Hong Kong EIA report.

5.3.10 According to Pastorok and Bilyard [3] and Hawker and Connell [4], a sedimentation rate higher than 0.1 kg/m^2/day would introduce moderate to severe impact upon corals. This criterion has been adopted for protecting the corals in Hong Kong under other approved EIAs such as Tai Po Sewage Treatment Works Stage 5 EIA [5], Further Development of Tseung Kwan O Feasibility Study EIA, Wan Chai Reclamation Phase II EIA, Eastern Waters MBA Study [6], West Po Toi MBA Study [7] and Tai Po Gas Pipeline Study [8]. This sedimentation rate criterion is considered to offer sufficient protection to marine ecological sensitive receivers and is anticipated to guard against unacceptable impacts. This protection has been confirmed by previous EM&A results which have indicated no adverse impacts to corals have occurred when this assessment criterion has been adopted.

5.3.11 The assessment criteria used in this Project for protection of corals identified at Green Island, Junk Bay and Cape Collinson is also based on the WQO for SS established under the WPCO, i.e. the SS elevations should be less than 30% of ambient baseline conditions. The WQO for SS has also been adopted under the approved Tai Po Sewage Treatment Works Stage 5 EIA as one of the assessment criteria for evaluating the water quality impact from the sewage effluent on corals identified at Tolo Harbour, Green Island and Junk Bay.

5.3.12 The above assessment criteria would be used to assess water quality impact to coral habitats (i.e. the far field ecological sensitive receivers) as identified and indicated in **Figure 5.1**.

Potential Water Quality Impacts Related to Cooling Water Discharges

5.3.13 Thermal plumes associated with the reprovisioned outfalls for cooling water discharges will lead to a temperature rise in the receiving water. The WQO for Victoria Harbour WCZ stipulated that the temperature rise in the water column due to human activity should not exceed 2 ^{o}C (**Table 5.1**).

5.3.14 Chlorine, in the form of sodium hypochlorite solution or produced through electrolysis of sea water, is commonly used as an anti-fouling agent or biocide for the treatment of cooling water within the cooling systems. Residual chlorine discharging to the receiving water is potentially harmful to marine organisms. A previous study [9] indicated that a residual chlorine level of 0.02 mg/l would have an adverse impact on marine organisms. EPD had commissioned an ecotoxicity study [10] on TRC using local species. The lowest No Observable Effect Concentration (NOEC) value from that study was 0.02 mg/L. The United States Environmental

(3) Pastorok, R.A. and Bilyard, G.R. (1985). "Effects of sewage pollution on coral-reef communities." *Marine Ecology Progress Series* 21: 175-189.
(4) Hawker, D. W. and Connell, D. W. (1992). "Standards and Criteria for Pollution Control in Coral Reef Areas" in Connell, D. W and Hawker, D. W. (eds.), *Pollution in Tropical Aquatic Systems*, CRC Press, Inc.
(5) Maunsell Consultants Asia Limited (2003). Tai Po Sewage Treatment Works Stage 5, EIA Report, Drainage Services Department, 2003
(6) Hyder (1997). Sand Dredging and Backfilling of Borrow Pits at the Potential Eastern Waters Marine Borrow Area, EIA Report, CED, 1997.
(7) ERM-Hong Kong, Limited (2001). Focused Cumulative Water Quality Impact Assessment of Sand Dredging at the West Po Toi Marine Borrow Area Final Report.
(8) ERM-Hong Kong, Limited (2003). The Proposed Submarine Gas Pipelines from Cheng Tou Jiao Liquefied Natural Gas Receiving Terminal, Shenzhen to Tai Po Gas Production Plant, Hong Kong, EIA Report, The Hong Kong and China Gas Company Limited, 2003
(9) Langford, T. E. (1983). Electricity Generation and the Ecology of Natural Waters.
(10) Tender Ref. WP 98-567 Provision of Service for Ecotoxicity Testing of Marine Antifoulant – Chlorine in Hong Kong Final Report January 2000. Submitted to Environmental Protection Department by the Centre for Coastal Pollution and Conservation, City University of Hong Kong.

Protection Agency (USEPA) has a more stringent limit of 7.5 $\mu g\ L^{-1}$ for residual chlorine that has been adopted as the assessment criterion for this EIA.

5.3.15 C-Treat-6 is the trade name of a commercially available surfactant-based antifouling / anticorrosion chemical agent that is commonly used for the cooling water systems which contains the active ingredient '30% tallow 1,3-propylene diamine' at a typical concentration of 33% (measured as amine content). It is acutely toxic to aquatic life. Ma et al [11] considered an interim maximum permissible concentration (based on an ecotoxicity study on marine brown shrimp) of 0.1 mg C-Treat-6 per litre in the ambient water acceptable from an ecotoxicological standpoint.

5.4 Description of the Environment

Marine Water Quality in Victoria Harbour

5.4.1 The marine water quality monitoring data routinely collected by EPD in Victoria Harbour were used to establish the baseline condition. A summary of water quality data for selected EPD monitoring stations extracted from the EPD's publication "20 years of Marine Water Quality Monitoring in Hong Kong" (which is the latest version available at the time of preparing this report) is presented in **Table 5.3** for Victoria Harbour WCZ (VM1 VM2, VM4-VM8, VM12 and VM15). Locations of the monitoring stations are shown in **Figure 5.1**.

5.4.2 In the past, wastewater from both sides of the Victoria Harbour was discharged into it after just simple screening, leading to marine water low in DO and high in organic nutrients and sewage bacteria. Commissioning of HATS Stage 1 in late 2001 has brought large and sustained improvements to the water quality of the eastern and central Victoria Harbour. However, improvements are less noticeable in the western harbour area which was still subject to the sewage discharges from local PTW (Central, Wan Chai West and Wan Chai East).As the HATS Stage 1 was commissioned in late 2001, the data for 2005 as shown in **Table 5.3** represent the situation after the commissioning of HATS Stage 1.

5.4.3 In 2005, the marked improvements in eastern Victoria Harbour (VM1 and VM2) and moderate improvements in the mid harbour area (VM4 and VM5) and northern part of Rambler Channel (VM14) since HATS Stage 1 was commissioned were generally sustained. Several monitoring stations in the WCZ are located close to sewage outfalls, including VM5 (Wan Chai East and Wan Chai West PTW outfall), VM6 (Central PTW outfall), VM4 (North Point PTW outfall) and VM8 (SCISTW – HATS Stage 1 outfall). The water quality at these stations was inevitably subject to the direct impact of sewage discharge from these outfalls. The WQO compliance in 2005 was 83%, slightly lower than that in 2004 (87%). Full compliance with the WQO (for DO and UIA) was achieved in 2005 in the Victoria Harbour WCZ. However, the WQO compliance for TIN was only 50% in 2005.

(11) Ma, S. W. Y., Kueh, C. S. W., Chiu, G. W. L., Wild, S. R. and Yip, J. Y. (1998). "Environmental Management of Coastal Cooling Water Discharges in Hong Kong" in *Wat. Sci. Tech.* Vol. 38, No. 8-9, pp. 267 – 274.

Table 5.3 Summary Statistics of 2005 Marine Water Quality in Victoria Harbour

Parameter		Victoria Harbour East		Victoria Harbour Central			Victoria Harbour West		Stonecutters Island	Rambler Channel		WPCO WQO (in marine waters)
		VM1	VM2	VM4	VM5	VM6	VM7	VM8	VM15	VM12	VM14	
Temperature (°C)		22.6 (15.7-27.9)	22.9 (15.8-28.0)	22.9 (15.8-27.8)	23 (15.9-27.9)	23 (15.9-27.8)	23.1 (15.8-27.9)	23.1 (15.6-27.7)	23 (16.0-27.8)	23.1 (15.8-27.7)	23.4 (15.9-27.9)	Not more than 2 °C in daily temperature range
Salinity		32.3 (30.4-33.4)	31.9 (28.5-33.3)	31.8(28.9-33.2)	31.4 (27.3-32.9)	31.3 (26.8-32.8)	30.9 (26.3-32.8)	31.1 (27.4-32.9)	31.3 (26.6-32.9)	31(27.7-33.0)	29.6 (23.0-33.0)	Not to cause more than 10% change
Dissolved Oxygen (DO) (% Saturation)	Depth average	79 (59-94)	78 (66-92)	75 (63-88)	76 (68-99)	77 (68-96)	78 (72-99)	80 (61-108)	77 (64-105)	75 (54-94)	80 (68-105)	Not available
	Bottom	78 (46-93)	77 (54-90)	74 (51-88)	74 (46-99)	73 (45-94)	75 (54-94)	78 (35-108)	74 (43-101)	74 (42-92)	79 (52-103)	Not available
Dissolved Oxygen (DO) (mg/l)	Depth average	5.7 (4.2-6.9)	5.6 (4.4-6.8)	5.4 (4.4-6.6)	5.5 (4.7-6.6)	5.5 (4.8-6.5)	5.6 (4.9-6.6)	5.8 (4.3-7.1)	5.5 (4.5-7.0)	5.4 (3.8-6.4)	5.7 (4.8-6.9)	Not less than 4 mg/l for 90% of the samples
	Bottom	5.6 (3.3-6.9)	5.6 (3.8-6.8)	5.3 (3.6-6.5)	5.3 (3.3-6.6)	5.3 (3.2-6.5)	5.4 (3.8-6.5)	5.6 (2.5-7.1)	5.3 (3.1-6.7)	5.3 (2.9-6.2)	5.6 (3.7-6.9)	Not less than 2 mg/l for 90% of the samples
pH		8.1 (7.8-8.3)	8.1 (7.7-8.3)	8 (7.7-8.3)	8 (7.6-8.3)	8 (7.6-8.2)	8 (7.7-8.2)	8.1 (7.7-8.2)	8 (7.6-8.2)	8 (7.7-8.2)	8.1 (7.7-8.2)	6.5 - 8.5 (± 0.2 from natural range)
Secchi disc Depth (m)		2.3 (1.5-2.8)	2.2 (1.2-3.5)	2.1 (1.5-3.2)	2.1 (1.3-3.1)	2.1 (1.2-3.3)	1.8 (0.9-3.2)	1.9 (1.2-2.5)	1.9 (1.2-2.7)	1.7 (1.2-2.5)	1.8 (1.5-2.3)	Not available
Turbidity (NTU)		10 (5.1-16.2)	9.8 (4.8-15.8)	9.6 (4.5-15.3)	9.8 (4.9-14.5)	9.8 (5.0-14.8)	10.8(5.9-16.1)	11.9 (5.4-22.0)	10.7 (5.8-16.2)	14.4 (6.4-22.1)	11.3 (5.4-17.1)	Not available
Suspended Solids (SS) (mg/l)		4.5 (0.9-10.8)	3.6 (1.3-8.5)	3.6 (1.3-9.8)	3.4 (1.7-5.3)	3.7 (1.3-8.2)	4.1 (2.1-8.7)	5.2 (1.8-16.3)	5.1 (2.1-10.3)	7.2 (3.1-15.7)	4.7 (2.6-10.7)	Not more than 30% increase
5-day Biochemical Oxygen Demand (BOD_5) (mg/l)		0.8 (0.5-1.2)	0.9 (0.4-1.5)	0.9 (0.5-1.1)	1.1 (0.6-1.4)	0.9 (0.4-1.4)	1 (0.6-1.4)	0.8 (0.5-1.4)	0.8 (0.5-1.2)	0.7 (0.4-1.2)	0.8 (0.4-1.6)	Not available
Nitrite Nitrogen (NO_2-N) (mg/l)		0.02 (0.01-0.05)	0.02 (0.01-0.05)	0.03 (0.01-0.05)	0.03 (0.01-0.05)	0.03 (0.01-0.05)	0.03 (0.01-0.06)	0.04 (0.01-0.07)	0.03 (0.02-0.06)	0.04 (0.02-0.07)	0.05 (0.01-0.09)	Not available
Nitrate Nitrogen (NO_3-N) (mg/l)		0.1 (0.04-0.17)	0.12 (0.03-0.23)	0.13 (0.05-0.24)	0.15 (0.05-0.31)	0.16 (0.06-0.34)	0.19 (0.08-0.45)	0.18 (0.08-0.49)	0.16 (0.09-0.31)	0.2 (0.09-0.45)	0.27 (0.09-0.67)	Not available
Ammonia Nitrogen (NH_3-N) (mg/l)		0.09 (0.05-0.16)	0.13 (0.04-0.21)	0.15 (0.06-0.27)	0.19 (0.06-0.29)	0.19 (0.07-0.26)	0.21 (0.12-0.32)	0.18 (0.09-0.30)	0.23 (0.08-0.32)	0.2 (0.14-0.25)	0.17 (0.10-0.25)	Not available
Unionised Ammonia (UIA) (mg/l)		0.004 (0.002-0.010)	0.006 (0.002-0.015)	0.006 (0.003-0.015)	0.007 (0.005-0.015)	0.008 (0.004-0.014)	0.009 (0.004-0.018)	0.009 (0.003-0.022)	0.009 (0.005-0.014)	0.008 (0.005-0.012)	0.008 (0.004-0.013)	Not more than 0.021 mg/l for annual mean
Total Inorganic Nitrogen (TIN) (mg/l)		0.22 (0.11-0.32)	0.28 (0.08-0.46)	0.31 (0.12-0.54)	0.37 (0.12-0.64)	0.38 (0.14-0.65)	0.43 (0.28-0.83)	0.4 (0.22-0.76)	0.42 (0.19-0.63)	0.44 (0.31-0.71)	0.49 (0.29-0.91)	Not more than 0.4 mg/l for annual mean
Total Nitrogen (TN) (mg/l)		0.34 (0.23-0.47)	0.43 (0.22-0.63)	0.47 (0.26-0.69)	0.55 (0.28-0.77)	0.55 (0.29-0.79)	0.58 (0.47-0.93)	0.59 (0.34-1.16)	0.58 (0.36-0.76)	0.63 (0.43-1.31)	0.66 (0.40-1.02)	Not available
Orthophosphate Phosphorus (PO_4) (mg/l)		0.02 (0.01-0.03)	0.03 (<0.01-0.04)	0.03 (0.01-0.04)	0.04 (0.01-0.05)	0.03 (0.01-0.05)	0.04 (0.02-0.05)	0.03 (0.01-0.05)	0.04 (0.02-0.05)	0.03 (0.02-0.04)	0.03 (0.02-0.04)	Not available

Parameter	Victoria Harbour East		Victoria Harbour Central			Victoria Harbour West		Stonecutters Island	Rambler Channel		WPCO WQO (in marine waters)
	VM1	**VM2**	**VM4**	**VM5**	**VM6**	**VM7**	**VM8**	**VM15**	**VM12**	**VM14**	
Total Phosphorus (TP) (mg/l)	0.03 (0.02-0.05)	0.04 (0.02-0.06)	0.05 (0.03-0.06)	0.05 (0.03-0.07)	0.05 (0.03-0.07)	0.05 (0.04-0.06)	0.05 (0.03-0.17)	0.05 (0.03-0.07)	0.06 (0.04-0.17)	0.05 (0.03-0.11)	Not available
Chlorophyll-*a* (μg/L)	2.5 (0.9-6.0)	2.4 (0.8-6.0)	2.4 (0.9-7.2)	2.8 (0.8-9.1)	2.6 (0.8-9.0)	2.2 (0.8-7.6)	2 (0.9-6.4)	3.2 (0.7-12.3)	1.8 (0.9-4.8)	2.8 (0.8-11.8)	Not available
E coli (cfu/100 ml)	640 (88-4500)	1600 (120-31000)	2400 (310-11000)	7700 (2500-23000)	5700 (1200-33000)	9100 (1200-35000)	4900 (790-40000)	5400 (490-22000)	4000 (1200-17000)	2100 (520-8700)	Not available
Faecal Coliforms (cfu/100 ml)	1300 (300-9100)	3600 (340-50000)	5200 (770-33000)	17000 (6800-40000)	12000 (2300-89000)	21000 (2700-130000)	12000 (1500-140000)	13000 (1800-97000)	9700 (2600-35000)	4700 (1500-31000)	Not available

Notes:
1. Except as specified, data presented are depth-averaged values calculated by taking the means of three depths: Surface, mid-depth, bottom.
2. Data presented are annual arithmetic means of depth-averaged results except for *E. coli* and faecal coliforms that are annual geometric means.
3. Data in brackets indicate the ranges.

Marine Water Quality within Causeway Bay Typhoon Shelter

5.4.4 A summary of published EPD monitoring data (in 2005) collected from the monitoring station at the Causeway Bay Typhoon Shelter (VT2) is presented in **Table 5.4**. The data are extracted from the EPD's publication "20 years of Marine Water Quality Monitoring in Hong Kong".

Table 5.4 Summary Statistics of 2005 Marine Water Quality at the Causeway Bay Typhoon Shelter

Parameter		EPD Monitoring Station (Bi-Monthly)	WPCO WQOs (in marine waters)
		VT2	
Temperature (^{o}C)		22.8 (15.9 – 27.3)	Not more than 2 ^{o}C in daily temperature range
Salinity (ppt)		30.2 (25.2 – 32.2)	Not to cause more than 10% change
Dissolved Oxygen (DO) (% saturation)	Depth average	68 (53 – 103)	Not available
	Bottom	68 (53 – 102)	Not available
DO (mg/l)	Depth average	4.9 (3.6 – 7.2)	Not less than 4 mg/L for 90% of the samples
	Bottom	4.9 (3.6 – 7.1)	Not less than 2 mg/L for 90% of the samples
pH value		8.1 (7.9 – 8.3)	6.5 - 8.5 (± 0.2 from natural range)
Secchi disc (m)		1.9 (1.5 – 2.9)	Not available
Turbidity (NTU)		8.8 (5.0 – 9.9)	Not available
Suspended Solids (SS) (mg/l)		5.8 (3.0 – 13.8)	Not more than 30% increase
Silica (as SiO_2)(mg/l)		1.0 (0.5 – 1.4)	Not available
5-day Biochemical Oxygen Demand (BOD_5) (mg/l)		1.6 (1.2 – 2.9)	Not available
Nitrite Nitrogen (NO_2-N) (mg/l)		0.04 (0.02 – 0.05)	Not available
Nitrate Nitrogen (NO_3-N) (mg/l)		0.19 (0.11 – 0.32)	Not available
Ammoniacal Nitrogen (NH_3-N) (mg/l)		0.20 (0.18 – 0.30)	Not available
Unionised Ammonia (UIA) (mg/l)		0.011 (0.005 – 0.021)	Not more than 0.021 mg/L for annual mean
Total Inorganic Nitrogen (TIN) (mg/l)		0.43 (0.35 – 0.55)	Not more than 0.4 mg/L for annual mean
Total Nitrogen (TN) (mg/l)		0.65 (0.56 – 0.80)	Not available
Ortho-Phosphate (OrthoP) (mg/l)		0.04 (0.02 – 0.05)	Not available
Total Phosphorus (TP) (mg/l)		0.06 (0.05 – 0.08)	Not available
Chlorophyll-*a* (µg L^{-1})		4.3 (0.5 – 16.5)	Not available
E. coli (cfu per 100 mL)		5,200 (2,300 – 12,000)	Not available
Faecal Coliform (cfu per 100 mL)		17,000 (5,100 – 61,000)	Not available

Note: 1. Except as specified, data presented are depth-averaged data.
2. Data presented are annual arithmetic means except for *E. coli* and faecal coliforms that are geometric means.
3. Data enclosed in brackets indicate ranges.

5.4.5 Due to the embayment form and reduced flushing capacity of the typhoon shelter, marine water within the typhoon shelter is vulnerable to pollution. In 2005, high levels of *E.coli* were recorded at the Causeway Bay Typhoon Shelter indicating faecal contamination. The water quality level marginally exceeded the WQO for TIN but fully complied with the WQO for DO and UIA. Significant long-term improvements in terms of decreasing trends in TIN, TN, OrthoP and TP were observed in Causeway Bay Typhoon Shelter.

Sediment Quality

5.4.6 The results of marine sediment quality analysis from the marine ground investigation works at the Project site are presented in Section 6. A review of the sediment quality data from the marine ground investigation indicated that the majority of marine sediments to be dredged at the WDII project area were classified as contaminated. Details of the sediment quality criteria and guidelines are given in Section 6.

5.5 Identification of Environmental Impact

Operational Phase

5.5.1 The WDII operation could have potential impact on the flow regime and the associated water quality impact in Victoria Harbour as a result of the change of coastline configurations. The formation of the WDII reclamation may affect the water levels, current velocity, and tidal flushing in the vicinity of the reclaimed land and, potentially, over a larger area. In addition, the changes in the hydrodynamics in Victoria Harbour may affect the pattern of pollutant dispersion patterns from sewage outfalls and stormwater culverts into the surrounding waters.

5.5.2 The future potential for refuse accumulation near the coastal area of HKCEC and Wan Chai areas under the current WDII reclamation layout is expected to be improved as the existing embayment areas to the west and to the east of the HKCEC Extension and the HKCEC water channel will be reclaimed under the Project. The future coastline in the HKCEC and Wan Chai areas will be more streamlined. The existing storm outfalls, which are the key sources of floating refuse and debris, would be diverted to the more open water with larger pollutant dispersion capacity.

5.5.3 On the other hand, the future potential for refuse accumulation in the PCWA area and the Causeway Bay typhoon shelter are expected to be similar to the existing situations, as no change of coastline or storm outfall diversion is currently proposed at these two embayment areas under the current reclamation layout. It is not anticipated that there would be a need to increase the frequency of refuse collection currently adopted at the PCWA area and the Causeway Bay typhoon shelter.

5.5.4 It is considered that impacts resulting from the operation of CWB, in terms of water quality, will be minimal and similar for both the elevated and tunnel sections of the route. Surface runoff from slip-roads and elevated structures may be contaminated by oils leaked from passing vehicles, and tunnel seepage would potentially be contaminated to the same extent. It is considered that impacts upon water quality will be minimal provided that the tunnel and elevated sections of the CWB are designed with adequate drainage systems and appropriate oil interceptors, as required.

Construction Phase

5.5.5 Details of the reclamation and construction methods are given in Section 2. **Figure 2.7** shows the reclamation stages. Key water quality concerns during the WDII and CWB reclamation are identified as follows:

- Dredging and filling works for temporary and permanent reclamations will disturb the marine bottom sediment, causing an increase in SS concentrations in the water column and forming sediment plume along the tidal flows.

- Temporary embayments will be formed between the partially reclaimed land as the WDII and CWB reclamation proceeds in stages. Potential accumulation of pollutants from contaminated stormwater runoff (due to debris and oil / grease left on the ground, and organic matter from expedient connections) into the temporary embayments may increase the dissolved oxygen demand in the slack water, causing dissolved oxygen depletion and, in turn, potential odour impacts on the neighbouring sensitive receivers.

- Construction runoff and drainage, with effluents potentially contaminated with silt, oil and grease.

5.5.6 Dredging of contaminated mud within the CBTS is proposed to mitigate the operational phase odour impacts as detailed in Section 3. The dredging operations within this embayed waters should be carefully planned and controlled and suitable mitigation measures are proposed (refer to Section 5.8) to minimize the potential impacts on the seawater intakes within the typhoon shelter.

5.5.7 Estimated volume of dredged and fill materials is provided in Section 2 and further discussed in Section 6. Potential impacts on water quality from dredging and filling will vary according to the quantities and level of contamination, as well as the nature and locations of the WSR at or near the dredging sites. These impacts are summarised as follows:

- Increased suspension of sediment in the water column during dredging activities, with possible consequence of reducing DO levels and increasing nutrient levels.

- Release of previously bound organic and inorganic constituents such as heavy metals, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and nutrients into the water column, either via suspension or by disturbance as a result of dredging activities, or depositing of fill materials.

- Release of the same contaminants due to leakage and spillage as a result of poor handling and overflow from barges during dredging and transport.

5.5.8 All of the above may result in deterioration of the receiving marine water quality and may have adverse effects on WSR. They are elaborated in the following paragraphs.

<u>Suspended Sediment</u>

5.5.9 As a result of dredging and filling activities during the construction phase, fine sediment (less than 63 μm) will be lost to suspension. The suspended sediment will be transported by currents to form sediment plumes, which will gradually resettle. The impact from sediment plumes is to increase the suspended sediment concentrations, and cause non-compliance in WQO and other criteria.

5.5.10 Any sediment plume will cause the ambient suspended sediment concentrations to be elevated and the extent of elevation will determine whether or not the impact is adverse or not. The determination of the acceptability of any elevation is based on the WQO. The WQO of SS is defined as being an allowable elevation of 30% above the background. EPD maintains a flexible approach to the definition of ambient levels, preferring to allow definition on a case-by-case basis rather than designating a specific statistical parameter as representing ambient. As adopted in the approved WDIICFS EIA for assessing the environmental impacts of released SS, the ambient value is represented by the 90th percentile of baseline (pre-construction) concentrations.

Release of the Contaminants due to Leakage and Spillage

5.5.11 Release of the same contaminants due to leakage and spillage as a result of poor handling and overflow from barges during dredging and transport can be addressed by proper implementation of recommended mitigation measures in Section 5.8.

Stormwater Discharges

5.5.12 Stormwater and drainage discharges from the construction sites may contain considerable loads of SS and contaminants during construction activities. Potential water quality impact includes run-off and erosion of exposed bare soil and earth, drainage channels, earth working area and stockpiles. Minimum distances of 100 m shall be maintained between the existing or planned stormwater discharges and the existing or planned WSD flushing water intakes during construction and operation phases.

5.5.13 Local and coastal water pollution impact may be substantial if the construction site run-off is allowed to discharge into the storm drains or natural drainage without mitigation.

Construction Runoff and Drainage

5.5.14 Surface runoff generated from the construction site may contain increased loads of SS and contaminants. Potential water quality from site run-off may come from:

- contaminated ground water from any dewatering activities as a result of excavation and disturbance of contaminated sediments
- release of any bentonite slurries and other grouting materials with construction run-off, storm water or ground water dewatering process
- wash water from dust suppression sprays and wheel washing facilities
- fuel, oil and lubricants from maintenance of construction vehicles and equipment.

General Construction Activities

5.5.15 The general construction works that will be undertaken for the roads and infrastructure will be primarily land-based and may have the potential to cause water pollution. These could result from the accumulation of solid waste such as packaging and construction materials, and liquid waste such as sewage effluent from the construction work force, discharge of bilge water and spillage of oil, diesel or solvents by vessels and vehicles involved with the construction. If uncontrolled, any of these could lead to deterioration in water quality. Increased nutrient levels result from contaminated discharges and sewage effluent could also lead to a number of secondary water quality impacts including decreases in DO concentrations and localised increase in NH_3-N concentrations which could stimulate algal growth and reduction in oxygen levels.

5.5.16 Sewage will arise from sanitary facilities provided for the on-site construction work force. It is characterised by high level of BOD, NH_3-N and *E.coli* counts. For some of the works areas, there will be no public sewers available for domestic sewage discharge on-site.

Potential Fill Source

5.5.17 While marine sand is proposed to be used generally for filling, detailed investigations have been conducted to explore the possibility of using public fill and surplus rock fill from appropriate sources that may be identified during the detailed implementation stages of the project, where engineering, programme and implementation constraints permit. The investigations indicate that it is possible to use public fill from Penny's Bay Reclamation Stage 2 (PBR2) in the upper formation layers, above +2.5 mPD. For the temporary reclamation where settlement is not a major concern, public fill from PBR2 for the full depth of reclamation is proposed, to maximise the use of public fill materials. Transportation of public fill from PBR2 to the works site will mainly by barges as both the supply and demand locations are at their respective shorelines. Delivery of reused construction and demolition materials within the site and/or surplus materials to the public fill reception facilities will be by barges for large quantities and by truck for local and small quantities. Release of the pollutants due to leakage and spillage as a result of poor handling and overflow from barges during dredging, filling and transport can be addressed by proper implementation of recommended mitigation measures in Section 5.8.

5.6 Assessment Methodology

5.6.1 To assess the potential water quality impacts due to the construction and operation of the Project, the sources and natures of water pollution to be generated during construction and operation phases have been identified and their impacts are quantified where practicable.

Operational Phase Impact

Hydrodynamic and Water Quality

Modelling Scenarios

5.6.2 The presence of the proposed WDII reclamation may change the flushing capacity of Victoria Harbour and thus impact upon the water quality. The proposed permanent reclamation may be divided into 3 main areas, namely:

- the Hong Kong Convention and Exhibition Centre Reclamation (HKCEC);
- the Wan Chai Reclamation (WCR); and
- the North Point Reclamation (NP)

5.6.3 **Figure 1.1** shows the boundaries of the proposed permanent reclamations. The extent of the reclamation has already been minimized to satisfy the Government's requirement and the community's aspiration.

5.6.4 Construction of the Project is scheduled to commence in early 2009 for completion by 2016. Two time horizons (Year 2016 and Ultimate Year respectively) were considered for the operational phase impact. Major factors that would affect the water quality simulated would be (i) the change in background pollution loading discharged from storm and sewage outfalls; and (ii) the change in coastline configurations between the two time horizons.

5.6.5 Sewage effluent discharged from the Harbour Area Treatment Scheme (HATS) would be the key background pollution source affecting the water quality in Victoria Harbour. Stage 1 of HATS, comprising the Stonecutters Island Sewage Treatment Works (SCISTW) and the deep tunnels, was commissioned in late 2001, which collects sewage from Kwai Chung, Tsing Yi, Tseung Kwan O, parts of eastern Hong Kong Island and all of Kowloon and deliver it to SCISTW for chemically enhanced primary treatment (CEPT). Stage 2 of HATS would be implemented in two phases, namely Stage 2A and Stage 2B. Under Stage 2A, deep tunnels would be built to bring sewage from the northern and western areas of Hong Kong Island to SCISTW and the design capacity of the SCISTW would be expanded to meet the future demands. Stage 2A is currently scheduled for implementation by 2014. Stage 2B of HATS involves the provision of biological treatment at the SCISTW to improve the effluent quality. Stage 2B is tentatively scheduled for implementation by 2021. It should however be highlighted that the way forward of the HATS is still being studied and the timing for implementation of Stage 2B is still subject to review.

5.6.6 In 2016 during early commissioning of WDII and CWB, the pollution loading discharged from HATS would be larger than that in the ultimate condition (even though the effluent flow in 2016 would be smaller than the ultimate flow). This is based on an assumption that the treatment process of SCISTW would be upgraded from CEPT to biological treatment under Stage 2B by 2021 (before the ultimate condition).

5.6.7 The pollution loading discharged from the storm water outfalls along the seafront of Victoria Harbour is mainly contributed by polluted stormwater runoff, expedient connections or cross connection between the drainage and sewerage systems in the catchment areas. With the continuous efforts by the government to improve the sewerage system and implement water pollution control measures and enforcement in the catchments on both sides of Victoria Harbour, it is unlikely that the storm pollution problem under the ultimate condition would be worse than the 2016 scenario.

5.6.8 Based on the information on the planned developments from the EIA Reports registered under the EIAO, there would not be any change in the coastline configuration within Victoria Harbour between 2016 and the ultimate year. The reclamations for Kai Tak Development (KTD) and Yau Tong Bay Reclamation (YTBR) are excluded as they are still subject to planning review. It should be noted that the "no reclamation" scenario is being considered for the KTD but the feasibility of such scenario is still subject to detailed investigation.

5.6.9 Three proposed reclamation projects, namely Tuen Mun Siu Lang Shui Reclamation, Hei Ling Chau Reclamation and Tai O Reclamation, would unlikely to be in place before 2016 as no implementation schedule is currently available for these development proposals. These reclamations are thus excluded in the 2016 scenario. All these 3 reclamations are located outside Victoria Harbour in farther field. It is therefore anticipated that the possible change of coastline configuration for these 3 development projects would not affect the outcome of the water quality modelling. Details of the coastline configurations assumed under various construction and operation scenarios are given in **Table 5.13**.

5.6.10 Based on the above considerations, the 2016 development scenario, with completion of WDII reclamation, represents a worst case in terms of both background pollution discharges and impact on tidal flushing within Victoria Harbour. Year 2016 was therefore selected as the time horizon for operational phase hydrodynamic and water quality modelling. Two scenarios were simulated to evaluate the change in the hydrodynamic regime due to the WDII reclamation:

Scenario 1A

- <u>2016 Baseline Scenario</u> without the proposed WDII reclamation

Scenario 1B

- <u>2016 Development Scenario</u> with the proposed WDII reclamation

5.6.11 Additional scenarios for addressing the hydrodynamic and water quality impact during different interim construction stages are considered in Sections 5.6.41 to 5.6.113. A summary of the modelling scenarios is given in **Table 5.13a**.

Hydrodynamic and Water Quality Modelling Tools

5.6.12 Computer modelling was used to assess the potential impacts on water quality in Victoria Harbour associated with the operation of the Project. The hydrodynamic and water quality modelling platforms were developed by Delft Hydraulics, namely the Delft3D-FLOW and Delft3D-WAQ respectively.

5.6.13 Delft3D-FLOW is a 3-dimensional hydrodynamic simulation programme with applications for coastal, river and estuarine areas. This model calculates non-steady flow and transport phenomena that result from tidal and meteorological forcing on a curvilinear, boundary fitted grid. Delft3D-WAQ is a water quality model framework for numerical simulation of various physical, biological and chemical processes in 3 dimensions. It solves the advection-diffusion-reaction equation for a predefined computational grid and for a wide range of model substances.

5.6.14 In the present study, the detailed Victoria Harbour (VH) model developed using Delft3D-FLOW and Delft3D-WAQ was employed for hydrodynamic and water quality impact assessment. This detailed model was originally developed to assess the impacts of the proposed Shatin Sewage Treatment Works Stage III extension on the water quality in Victoria Harbour. The model was extensively calibrated by comparing computational results with measurements of the 1988 Victoria Harbour measurement campaign, and accepted by the EPD.

5.6.15 The model setup of the VH model was further modified under the previous approved Comprehensive Feasibility Study for Wan Chai Development Phase II (WDIICFS) EIA for assessing water quality impacts of the WDII. For example, the grid layout of the original Victoria Harbour model was enhanced in the vicinity of the WDII reclamation resulting in a higher resolution of approximately 50 m by 100 m. Details of the model setup and verification for the WDII Study were described in the "Technical Note on Hydrodynamic Model & Water Quality Model Set-up" prepared under the WDIICFS [(12)].

5.6.16 It was assumed under the approved WDIICFS EIA that all the existing storm and spent cooling water outfalls within the Causeway Bay typhoon shelter would be decommissioned and these outfalls would be diverted outside the typhoon shelter. This is deviated from the present Study that the existing storm and spent cooling water outfalls would remain within the Causeway Bay typhoon shelter. The water quality impacts arising from such deviation from the approved WDIICFS EIA need to be examined. In the present Study, the grid mesh of the detailed VH model was further modified with a higher resolution (approximately 50m x 50m) at Causeway Bay typhoon shelter to address the water quality concern. **Appendix 5.1** shows the grid layout of the refined VH model.

(12) Maunsell Consultants Asia Ltd. (May 2000). Agreement No. CE 74/98, Wan Chai Development Phase II, Comprehensive Feasibility Study, Environmental Impact Assessment Study, Technical Note: Hydrodynamic Model & Water Quality Model Set-up.

5.6.17 The performance of the detailed VH model refined under the present Study has been checked against that of the detailed VH model approved under the WDIICFS EIA. The results of water level, depth averaged flow speed and depth averaged flow directions predicted by the two models are compared at three indicator points (namely Stations 3, 6 and 8 respectively as shown in **Figure 5.14a**). The results of momentary flows are compared at two selected cross sections. The eastern cross section is located across the Lei Yue Mun Channel, while the western section is located between Yau Ma Tei and Sheung Wan (**Figure 5.14a**). 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. The comparison plots are given in **Appendix A.5a** and **Appendix A.5b** attached to Annex 15.3 of **Appendix 15.1** (see Volume 6) of this EIA report. The results predicted by both models are in general consistent with each other which implied that the model setting of the refined VH model including the nesting procedure and the derivation of the boundary conditions were carried out correctly.

5.6.18 It is important to realize that the refined VH model has higher resolution than the original approved VH model in the Causeway Bay and nearby areas. The grid cells of the VH model have also been refined under the present Study to improve the orthogonality and smoothness of the grids. The differences in the grid resolution and grid layout between the two models have caused some minor deviations in the simulated flow directions and flow speeds between the two models.

5.6.19 In addition, the surface salinity results produced from the WAQ model of the refined VH model are compared with the surface salinity results produced by the FLOW model of the refined VH model as well as the FLOW model of the original VH model developed under the WDIICFS in **Appendix A.6** (attached to Annex 15.3 of **Appendix 15.1** of this EIA report) to check for the consistency. It can be seen in **Appendix A.6** that the three sets of salinity results are in general consistent with each other. The differences between the data sets are considered acceptable.

5.6.20 The refined VH Model is linked to the regional Update Model, which was constructed, calibrated and verified under the project "CE42/97 Update on Cumulative Water Quality and Hydrological Effect of Coastal Development and Upgrading of Assessment Tool" (Update Study). Computations were first carried out using the Update Model to provide open boundary conditions to the VH Model. The Update model covers the whole Hong Kong and the adjacent Mainland waters including the discharges from Pearl River. The influence on hydrodynamics and water quality in these outer regions would be fully incorporated into the VH Model.

5.6.21 It should be noted that after the water quality modelling for this EIA was completed, the permanent reclamation area in Wan Chai area (WCR) has been slightly reduced in response to public comments. Thus, the final reclamation limit for WDII as shown in **Figure 1.1** is slightly different from the configuration adopted in this modelling exercise. The final WDII reclamation has a curved permanent coastline for the Wan Chai Reclamation Stage 4 (WCR4) as shown in **Figure 2.7**. Under this modelling exercise, a slightly larger reclamation area is adopted for WCR4 with a straight permanent coastline connecting the points between the northeast corner of Wan Chai Reclamation Stage 3 (WCR3) and the northwest corner of the PCWA. The model grid (with a straight permanent coastline at WCR4) adopted under this modelling exercise is compared against the final WDII reclamation limit (with a curved permanent coastline at WCR4) in **Appendix 5.1**. The comparison showed that the deviation of the coastline configuration is small. No significant effect on the water quality modelling results is expected from such deviation considering that there is no existing or planned water sensitive receivers located at the waterfront of WCR4.

Simulation Periods

5.6.22 For each operational phase modelling scenario, the simulation period of the hydrodynamic model covered two 15-day full spring-neap cycles (excluding the spin-up period) for dry and wet seasons respectively. The hydrodynamic results were used repeatedly to drive the water quality simulations for one complete calendar year (excluding the spin-up period) as specified in the EIA Study Brief. It was found that a spin-up period of 8 days and 45 days is required for hydrodynamic simulation and water quality simulation respectively to ensure that initial condition effects can be neglected.

5.6.23 The spin-up (8 days) of hydrodynamic simulation follows that adopted in the approved EPD Update Model and has been tested under the present EIA Study to be sufficient. For water quality simulation, pollution load discharges are included within the embayment areas (e.g. Causeway Bay Typhoon Shelter) and a longer spin-up of 45 days is required for the model to reach an equilibrium status. Spin-up of water quality simulation has also been tested under the present EIA study to be sufficient.

Model Setup for Discharges

5.6.24 The Pearl River estuary flows were incorporated in the hydrodynamic model. Flows from other storm and sewage outfalls within the whole Hong Kong waters are relatively small and would unlikely change the hydrodynamic regime in the area and were therefore excluded in the hydrodynamic model.

5.6.25 Loading from the sewage outfalls was allocated in the bottom water layer. Pollution loads from storm outfalls and other point source discharges such as those from typhoon shelters, marine culture zones, landfills and beaches were specified in the middle layer of the water quality model.

<u>Potential Water Quality Impacts Associated with Cooling Water Discharges</u>

Description of Cooling Water Discharges

5.6.26 The proposed WDII reclamation would require reprovisioning of the existing cooling water intakes and discharges along the Wan Chai waterfront. Computer modelling was employed to assess the potential impact due to the thermal plumes and discharge of residual chlorine associated with the reprovisioned outfalls for cooling water discharges upon full commissioning of the Project. Locations of intakes and discharges for the cooling systems within the study area have been identified in **Figure 5.2** and **Figure 5.3A** respectively. Spent cooling water from these identified cooling water systems will be discharged through culverts / outfalls into the harbour causing a potential increase in water temperature. Information on the cooling water discharges collected under the WDIICFS at the planning stage is given in **Table 5.5**.

5.6.27 It should be noted that the WDIICFS adopted a conservative approach, based on the available information from the planning stage (**Table 5.5**). For most of the spent cooling water discharges, the maximum discharge flow rates of the water cooling systems have been applied to the model continuously (that is, 24 hours daily). In reality, the maximum flow discharge would only occur during the office hours and depends on the outdoor air temperature in different seasons. Latest design flow rates of these cooling water systems provided in the Study "Implementation Study for Water-cooled Air Conditioning System at Wan Chai and Causeway Bay – Investigation (ISWACS-WCCB)" recently completed in 2005 have been reviewed and compared to those adopted under the WDIICFS. The flow rates provided in the ISWACS-WCCB are based on the latest engineering information and a more detailed estimation. It was found that the cooling water discharge rates adopted under the WDIICFS are more conservative as compared to those used under the ISWACS-WCCB and are therefore used for this EIA for worst-case assessment. The proposed discharge rates used under this EIA are provided in **Table 5.6**.

Table 5.5 Summary of Information of Water Cooling Systems

Name of Building	The Hong Kong Academy for Performing Arts	Hong Kong Convention and Exhibition Centre (Phase I)	Hong Kong Convention and Exhibition Centre (New Wing)	China Resources Building	Great Eagle Centre	Sun Hung Kai Centre	Windsor House
Seawater abstraction rate (m^3 per hour)	3312	3033.0 with a range from 1213.2 to 4852.8	126 (maximum =6120)	2160, with a range from 414 to 3312	1400 (summer) 1085 (winter) (maximum=1635)	1308 (maximum = 2616)	1362.4
Discharge frequency and duration	From 0800 to 2400 continuously	24 hours	24 hours with variable flow	24 hours	24 hours	24 hours	-
Cooling water intake temperature (^oC)	30.0	Depends on sea water temperature	26	28 (summer)	24 – 27 (summer) 17 – 19 (winter)	28	26
Cooling water discharge temperature (^oC)	35.4	34	32	35 (summer)	30 – 33 (summer) 21 – 23 (winter)	33 – 35	32
Method of treatment	Electrochlorinator	Chemical additives and electrochlorinator	Electro-chlorinate and Biocide dosing system	Electrochlorinator	Electrochlorinator	Chloropac	Electrochlorinator
Name and dosage of chemicals added	-	C-Treat-6, 6 ppm	Hypochlorite, 3 ppm	-	-	Sodium hypochlorite system	-
Main chemical constituents of the additives	Chlorine	Chlorine, C-Treat-6	Chlorine	Chlorine	Chlorine	-	Chlorine
Effluent quality	-	Chlorine, 0.2 ppm; C-Treat-6, 2 ppm	Residual chlorine level at discharge > 0.3 ppm	-	-	0.3 – 0.5 ppm at outlet	-
Remarks	-	-	The Centre was only 60% occupied during survey.	-	-	-	-

Note: ppm = mg/l

Table 5.6 Flow Rates of Water Cooling Systems for Thermal Plume Modelling.

Outfall ID (Figure 5.3A)	Buildings	Discharge Rate (m^3/s)	
		Adopted in WDIICFS EIA	Adopted in this EIA
10	Proposed HKAPA Extension	1	1 (1)
2a	The Hong Kong Academy for Performing Arts	0.92	0.92 (1)
3	HKCEC (Phase I)	1.35	1.35 (1)
2	Shui On Centre	0.94	0.94 (1)
2	Telecom House	0.84	0.84 (1)
4	Government Buildings	1.2	1.2 (1)
5	China Resources Building and Hong Kong Exhibition Centre	0.92	0.92 (1)
5	Great Eagle Centre	0.45	0.45 (1)
6	Sun Hung Kai Centre	0.72	0.72 (1)
1	HKCEC (New Wing)	1.7	1.7 (1)
7	Proposed Exhibition Station	1.35	1.35 (1)
-	Proposed Hotel / Commercial Development WDII/28	1.4	Not included (2)
-	Proposed Leisure and Entertainment Complex Development WDII/30	1.4	Not included (2)
9	Windsor House	0.38	0.38 (1)
8a	No. 27-63 Paterson Street	0.38	0.38 (1)
8	Excelsior Hotel and World Trade Centre	1.4	1.4 (1)
11	City Garden	-	- (3)
12	Provident Centre	-	- (3)

Notes:

(1) Based on values adopted under the WDIICFS EIA.

(2) Under the WDIICFS EIA, WDII/28 and WDII/30 were proposed to be developed on the new reclamation land within the Causeway Bay Typhoon Shelter. These developments are excluded in this EIA as no such developments / reclamation is currently proposed within the Causeway Bay Typhoon Shelter

(3) No information on flow rate is available for this cooling water intake. The potential short circuit problem of the re-circulation of heated water to the cooling water intake was qualitatively assessed in Section 5.7.

Thermal Plume Modelling Tools

5.6.28 In the present study, the basis for modelling of the harbour waters is the refined Victoria Harbour (VH) Model as discussed in Sections 5.6.12 to 5.6.16.

5.6.29 The Excess Temperature Model within Delft3D-FLOW model was employed to simulate the thermal plume dispersion in Victoria Harbour and to assess the impact on the neighbouring cooling water intakes. The model allows for the excess temperature distribution and decay of the thermal plume, and addresses heat transferred from the water surface to the atmosphere. While the total heat flux is proportional to the excess temperature at the surface, the heat transfer coefficient of the formulation depends mainly on water temperature and wind speed. The parameters adopted for the thermal plume modelling are summarised in **Table 5.7**. It should be noted that Delft3D-PART model was employed for the thermal plume modelling conducted under the WDIICFS EIA which did not take into account the surface heat loss as mentioned above. Thus, the thermal plume impact for the WDIICFS EIA may be overestimated. The thermal plume impact predicted by the Delft3D-FLOW model conducted under this Study is considered more realistic.

Table 5.7 Summary of Parameters for Thermal Plume Model (Delft3D-FLOW)

Delft3D-FLOW Excess Temperature Model Parameters		
Background (Air) Temperature (^{o}C)	18 28	Dry Season Wet Season
Temperature of spent cooling water (^{o}C)	24 32 (1)	Dry Season Wet Season
Wind Speed (m s^{-1})	5	Dry Season and Wet Season
Ambient Water Temperature (^{o}C)	18 To be computed by model (1)	Dry Season Wet Season

(1) The predicted temperature at various intake locations under the baseline scenario (without any cooling water discharges) have been checked and confirmed to be lower than 26°C for the entire simulation period, the discharge temperature of 32°C for wet season should provide a good approximation of the temperature of spent cooling water for thermal plume modelling and assessment.

5.6.30 The simulation periods for the hydrodynamic FLOW model cover a complete spring-neap tidal cycle, preceded by a spin-up period. It was found that the long spin-up period (about 1.5 tidal cycles) is required to establish the quasi-steady thermal pattern within the Study Area. One-minute time step was used in the thermal plume modelling. In order to determine whether the time step of 1 minute is acceptable, a sensitivity hydrodynamic run was conducted using a smaller time step of 30 seconds. Comparison of the flow results for the 1-minute time step and the 30-second time step showed that there is no significant deviation between the 2 sets of results. The time step of 1 minute is therefore considered acceptable.

5.6.31 It is conservatively assumed that all cooling water discharges have an excess temperature of 6 ^{o}C with reference to the background seawater temperature. As adopted in the WDIICFS EIA, results of the predicted temperature elevation at the intakes were factored up by [1(1-E/k)] to take into account the potential short circuit problem of the re-circulation of heated water to the cooling water intake.

Where:

E = maximum of the mean temperature elevations predicted at the intakes

k = excess temperature of the cooling system = 6°C

5.6.32 The derivation of the heat re-circulation factor [1(1-E/k)] is given in **Appendix 5.1a**.

5.6.33 It should be noted that the thermal impact predicted by the temperature model is linearly proportional to the temperature loading of the cooling discharges. A factor of 1.2 has been applied to all the flow rates for model input to allow a safety margin for the discharge rates. Using the safety factor is a conservative approach as most of the concurrent discharges covered in this EIA are already the peak flow rates which were applied to the model constantly throughout the whole simulation period. It should be noted that the discharge rates as shown in **Table 5.6** did not incorporate the safety factor of 1.2.

5.6.34 The purpose of applying the factor of 1.2 is to allow a safety margin for the assumed discharge rates. The factor of 1.2 mentioned in S5.6.33 is different from the factor [1(1-E/k)] mentioned in S5.6.31 for addressing the potential short circuit problem.

Residual Chlorine

5.6.35 The 3-dimensional particle tracking model (Delft3D-PART) developed by Delft Hydraulics was employed to model the residual chlorine discharged from the cooling water. The discharge of residual chlorine was represented by discrete particles released into the surface layer of the model. These discrete particles were transported with flow fields determined from the hydrodynamic simulation using the refined Delft3D-FLOW Victoria Harbour (VH) Model, and turbulent diffusion and dispersion, based on a random walk technique. The residual chlorine elevation over the ambient level was then evaluated from the particle density in each cell of the curvilinear grid of Victoria Harbour model. Due to the high decay rate of chlorine in marine waters, the ambient chlorine level was assumed to be negligible.

5.6.36 The flow data adopted in Delft3D-PART model were obtained from the Delft3D-FLOW hydrodynamic model results. Each Delft3D-FLOW simulation covered a complete spring-neap tidal cycle (about 15 days) for both dry and wet seasons. The actual simulation period for Delft3D-FLOW was preceded by a spin-up period of 8 days.

5.6.37 For Delft3D-PART, each simulation covered a complete spring-neap tidal cycle (about 15 days), preceded by a spin-up period of 15 days. The 15-day Delft3D-FLOW simulation results were used repeated for the 30-day simulation period for Delft3D-PART with due consideration on the continuity of the tidal level between successive 15-day periods. In order to determine whether the spin-up period for Delft3D-PART is adequate, the time series plot of predicted residual chlorine have been compared between the spin-up period and the actual simulation period at two locations (one at the Wan Chai waterfront and the other at the Causeway Bay typhoon shelter) as shown in Annex II attached to Annex 15.3 of **Appendix 15.1** of this EIA report (see Volume 6). It was found that there is no significant difference in the model results for the 2 successive periods. Therefore, it is considered that the simulation period is acceptable.

5.6.38 Delft3D-PART makes use of the information on water flow derived from the Delft3D-FLOW model. The time step applied in the Delft3D-FLOW model is one-minute (for numerical simulation) and six-minute (for saving model outputs). As the number of particles that can be used in the Delft3D-PART is limited, six-minute time step was used for numerical simulation in particle tracking. The parameters adopted for the Delft3D-PART model for modelling residual chlorine are summarised in **Table 5.8**. For cooling water discharge, the flow rate as shown in **Table 5.6** was factored up by 1.2 and was input into the model as a constant rate throughout both dry and wet seasons simulations. It is also conservatively assumed that all cooling water discharges have a residual chlorine concentration of 0.5 mg/l, which was assumed to be discharged continuously 24 hours a day at the corresponding factored discharge rates.

Table 5.8 Summary of Parameters for Modelling of Residual Chorine (Delft3D-PART)

Partical Track Model Parameters		
Ambient Water Temperature (^oC)	18 28	Dry Season Wet Season
Ambient Salinity (ppt)	31 30	Dry Season Wet Season
Ambient Water Density (kg m^{-3})	1024 1016	Dry Season Wet Season
Horizontal Dispersion Coefficient D_H ($m^2 s^{-1}$)	A = 0.003 B = 0.4	$D_H = a\ t^b$, where t is the age of particle from the instant discharge in seconds
Vertical Dispersion Coefficient D_V ($m^2 s^{-1}$)	5 x 10^{-3} 1 x 10^{-5}	Dry Season Wet Season
Residual Chlorine (mg/l)	0.5	-
Decay Factor for Residual Chlorine, T_{90} (s)	8289 (2)	-
Excess Temperature at Intake	From model	-
Flow Rate ($m^3 s^{-1}$)	Equivalent for Intake and Discharge	No loss of water in the cooling system.
Particle Settling Velocity (m s^{-1})	-0.005 (Constant)	Heated discharge is slightly less dense than ambient water
Critical Shear Stress(1)	N/A	No sedimentation or erosion

(1) Sedimentation and erosion are irrelevant for thermal plume modelling
(2) Reference: Approved EIA for Tai Po Sewage Treatment Works Stage V.

5.6.39 It should be noted that the residual chlorine concentration represents total residual chlorine as there is no mechanism in the Delft model to partition the chlorine into free chlorine or various compound species. As compared to the decay factor for residual chlorine (T_{90} = 1800s) adopted under the WDIICFS EIA, a more conservative value (T_{90} = 8289s) was used under this EIA. The T_{90} factor adopted in this EIA is based on the assumption used under the approved EIA for Tai Po Sewage Treatment Works Stage V. Upon our review of relevant past EIA studies, this T_{90} factor is the most conservative value and was therefore applied to the model for conservative assessment.

5.6.40 As chlorination is being considered as the disinfection method for the HATS, the discharge of residual chlorine from HATS was included in the model for cumulative assessment assuming that the HATS is reaching an extreme flow rate of 2,800,000 m^3 per day with a residual chlorine content of 0.02 mg/l. The design capacity of HATS is only about 2,450,000 m^3 per day based on the latest flow projections conducted under the on-going EIA Study for HATS Stage 2A.

Construction Phase Impact

General Description of Marine Construction Works

5.6.41 The proposed marine construction works will involve:

- Permanent reclamation at Hong Kong Convention and Exhibition Centre (HKCEC)
- Permanent reclamation at Wan Chai (WCR)
- Permanent reclamation at North Point (NPR)
- Temporary reclamation at Public Cargo Working Area (TPCWA) and Causeway Bay (TCBR) for construction of the CWB tunnel
- Construction of Temporary Typhoon Shelter (TBW)
- Construction of new cross-harbour water mains from Wan Chai to Tsim Sha Tsui
- Construction of Wan Chai East submarine sewage outfall.
- Temporary reclamation at Wan Chai (TWCR4) (Please see Section 5.6.53)

5.6.42 The proposed construction method adopts an approach where permanent and temporary seawalls will first be formed to enclose each phase of the reclamation. Bulk filling will be carried out behind the completed seawall. Demolition of temporary reclamation will involve excavation of bulk fills and dredging to the existing seabed level which will be carried out behind the temporary seawall. Temporary seawall will be removed after completion of all excavation and dredging works for demolition of the temporary reclamation. Therefore, the sediment plume can be effectively contained within the permanent and temporary reclamation area. Demolition of temporary seawall will involve removal of rock fill and seawall blocks only, which would not create significant SS impact. Fines content in the filling materials for seawall construction would be negligible and loss of fill material during seawall construction is therefore not expected. Thus, potential water quality impact of SS will only arise during the dredging for seawall foundation.

5.6.43 There will be a total of five main reclamation areas, namely HKCEC, WCR, NPR, TPCWA and TCBR respectively. Each of these five reclamation areas is subdivided into different stages for different engineering and environmental constraints as shown in **Figure 2.7**. Within the same reclamation area, seawall dredging will be performed in sequence instead of operating concurrently. Thus, dredging along the seawall will be undertaken for only one stage at a time to minimize the potential water quality impacts. The sequencing of the reclamation stages are presented in the construction programme in **Appendix 2.1** (as discussed in Section 2).

5.6.44 Temporary reclamation of Causeway Bay will be divided into four stages (**Figure 2.7**). Construction of TCBR1W and TCBR1E will be undertaken at the first stage with seawall foundation to be constructed in sequence. Thus, dredging along the seawall of TCBR1W will not be carried out simultaneously with the dredging along the seawall of TCBR1E to minimize the dredging impact. At Stage 2, dredging at seawall of TCBR2 will take place when TCBR1W and TCBR1E are in place. Demolition of TCBR1E will then proceed and the whole TCBR1E will be removed before the commencement of TCBR3. Thus, during the third stage, dredging for seawall foundation and seawall trench filling at TCBR3 will take place when both TCBR1W and TCBR2 are in place at the same time. Subsequently, TCBR1W will be removed before the TCBR4 commences. Therefore, water body behind temporary reclamation area will not be fully enclosed, which minimise water quality impacts (also refer to **Figure 2.10** to **Figure 2.14**).

5.6.45 After the construction of the western seawall of HKCEC Reclamation Stage 1 (HKCEC1) is completed in early 2009, a temporary embayment will be formed between the existing eastern seawall of CRIII and the HKCEC Extension. This embayment will be a particular cause of concern as a storm outfall (Culvert L) is currently discharging pollutants into this area. Locations of existing storm outfalls within the Project site are shown in **Figure 5.3B**. The potential water quality impact within this embayment will last for more than 2 years until the reclamation of HKCEC Stage 2 where the new Culvert L extension can be constructed via a new land formed under HKCEC2W (**Figure 2.18**). The delay in filling of this embayment arises due to the restriction of piling, dredging and reclamation works in the vicinity of the existing cross harbour water mains, which must be diverted first before any disturbance of the seabed in this area can take place.

5.6.46 As a mitigation measure, to avoid the accumulation of water borne pollutants within this embayment, an impermeable barrier, suspended from a floating boom on the water surface and extending down to the seabed, will be erected by the contractor before the HKCEC1 commences. The barrier will channel the stormwater discharge flows from Culvert L to the outside of the embayment. The contractor will maintain this barrier until the reclamation works in HKCEC2W are carried out and the new Culvert L extension is constructed.

5.6.47 Other storm outfalls, located at the reclamation area, will be temporarily diverted to the adjacent reclamation site before completion of seawall construction, in order to prevent discharging into temporary embayment and this minimise potential water quality impacts. In addition, storm outfalls will be diverted into the area with no nearby seawater intakes to avoid adverse impacts. In case storm outfalls and cooling water intakes are at the same area, water quality impacts have to be modelled to assess whether the impacts would be acceptable. The sequences of temporary diversion of storm outfalls are shown in **Figure 2.8** to **Figure 2.19**.

5.6.48 Diversion of seawater intakes will be undertaken at an early stage of WCR. The existing cooling water intake of Sun Hung Kai Centre (namely 6) and the WSD flushing water intake (namely a) at the Wan Chai seafront will be reprovisioned to the new waterfront (**Figure 5.2**). These two seawater intakes will be diverted across the new land formed under Wan Chai Reclamation Stage 1 (WCR1) before commencement of Wan Chai Reclamation Stages 2 to 4 (WCR2, WCR3 and WCR4).

5.6.49 The existing cooling water intakes (namely 2, 3, 4 and 5) along the HKCEC water channel will be reprovisioned to the intake chambers to the north of the HKCEC Extension (as shown in **Figure 5.2**). These intakes will be diverted via the new land formed under HKCEC Reclamation Stage 1 (HKCEC1). According to the construction programme, these existing intake points will remain in operation during the seawall construction in HKCEC1 and therefore would be potentially affected by the dredging operations. The potential impact during the dredging works at HKCEC2E is considered less critical as these intakes would be diverted to the north of the HKCEC Extension before commencement of this reclamation stage.

5.6.50 There are two cooling water intakes (namely 8 and 9 respectively) in Causeway Bay Typhoon Shelter for Windsor House, Excelsior Hotel and World Trade Centre (as shown in **Figure 5.2**). Intake 9 is located within the reclamation site of TCB4 and thus will be temporarily diverted, in order to ensure continuous operation during the construction (**Figure 2.13**). No temporary diversion will be implemented for Intake 8. Construction of new cross-harbour water mains from Wan Chai to Tsim Sha Tsui and submarine wastewater outfall will also be included in this Project, which will require dredging along the proposed pipelines.

5.6.51 Since the construction of the CWB tunnel will involve temporary reclamation works in the Causeway Bay Typhoon Shelter, it will be necessary to temporarily relocate the existing moorings for those private and operational vessels during construction period for these works. The proposed temporary moorings will require construction of a 400 m long rubble mound breakwater some 180 m offshore and parallel to the existing Causeway Bay Typhoon Shelter breakwater, together with 120 m and 130 m lengths of piled wave walls at the eastern and western ends of the sheltered mooring area respectively. The layout of the proposed temporary typhoon shelter is shown in **Figure 5.5**.

5.6.52 The primary wave and physical protection will be provided by the conventional rubble mound breakwater, which will be of similar construction to the existing breakwater. The piled wave walls will comprise vertical concrete downstands, supported on tubular steel piles at 8 to 10 m spacing. The down stands will extend down below the surface of the water to reduce wave transmission through the typhoon shelter entrances from the north-easterly and north-westerly direction. Typical details of the breakwater and the piled wave walls are shown in **Figure 5.6**.

5.6.53 As previously mentioned, after the modelling exercise for this EIA was completed, the permanent reclamation area in Wan Chai area (WCR) has been slightly reduced after detailed assessment. The final WDII reclamation has a curved permanent coastline for the Wan Chai Reclamation Stage 4 (WCR4) as shown in **Figure 2.7**. The area to the north of WCR4 (namely TWCR4) is required to be temporarily reclaimed for construction of the CBW tunnel based on the final WDII reclamation layout. Under this water quality impact assessment, a slightly larger reclamation area is however assumed for WCR4 with a straight permanent coastline connecting the points between the northeast corner of Wan Chai Reclamation Stage 3 (WCR3) and the northwest corner of the PCWA without any temporary reclamation in the Wan Chai area. However, the latest change of the reclamation method for WCR4 has not caused any change to the programme and locations of seawall construction assumed in this water quality impact assessment, considering that the impacts arising from the dredging for seawall foundation would be a key water quality concern. In addition, excavation of fill material and dredging activities for demolition of TWCR4 will be carried out behind the completed seawall. As a result, no significant change in the construction phase water quality impact is therefore expected due to the deviation of reclamation method for WCR4.

<u>Dredging Scenarios</u>

5.6.54 With reference to the construction programme, three worst-case construction phase scenarios were selected for modelling. The proposed scenarios represent the realistic worst cases, including all the potentially concurrent dredging activities, envisaged during the WDII construction. For reclamation activities, impact from the seawall dredging is considered to be the most critical. A summary of the modelling scenarios is given in **Table 5.13a**.

Scenario 2A

5.6.55 Scenario 2A assumes that the following marine works will take place concurrently in early 2009.

a. Dredging for seawall foundation at HKCEC Stage 1 (HKCEC1)
b. Dredging for seawall foundation at WCR Stage 1 (WCR1)
c. Dredging for seawall foundation at PCWA East (TPCWAE)
d. Dredging for seawall foundation at NP Stage 1 (NPR1)
e. Dredging at temporary breakwater (TBW)
f. Dredging along the proposed alignment of the WSD cross harbour water mains from Wan Chai to Tsim Sha Tsui.

5.6.56 Five reclamation areas within the WDII are to be dredged at the same time under this scenario. To compare with other construction periods, no more than five reclamation areas will be dredged or constructed simultaneously. Thus, this scenario is considered the worst case during early stage of construction phase before any new land is formed within the WDII site. The coastline configuration for Scenario 2A is the same as the existing baseline condition. The dredging locations assumed under this scenario are given in **Figure 5.7**.

5.6.57 The existing cooling water intakes will have to be reprovisioned to the new water front during the WDII construction. As previously pointed out, diversion of the existing cooling water intakes along the HKCEC water channel has to be conducted through the new land formed under the HKCEC1. Thus, these cooling water intakes cannot be diverted until the reclamation works of HKCEC1 has been completed as the first stage. Based on the findings of the recent marine site investigation works conducted in 2006, dredging is required for the construction of the temporary seawalls at either side of the HKCEC water channel. Therefore, SS generated from the seawall dredging phase of HKCEC1 may affect the nearby cooling water intakes, which is taken into account in Scenario 2A. These cooling water intakes will be diverted to the intake chambers to the north of the HKCEC Extension before the seawall of HKCEC2W and HKCEC3 is completely constructed. In addition, HKCEC2E will not be carried out before the diversion of these cooling water intakes. Dredging at HKCEC1 will not be carried out concurrently with dredging at HKCEC3. Impact on the cooling water intake between CRIII and HKCEC1 due to the seawall dredging at HKCEC2W is assessed under Scenario 2C.

5.6.58 Scenario 2A also covers the impact during seawall dredging at WCR1 which could potentially affect the existing cooling water intake of Sun Hung Kai Centre and the WSD Wan Chai flushing water intake. As pointed out before, these two intakes are located within the site boundary of WCR2 and cannot be diverted before the reclamation works at WCR1 have been completed.

5.6.59 Dredging for the temporary seawall in PCWA will be performed within the existing breakwater. Therefore, lesser impacts are expected from this area. Nevertheless, this potential impact is also covered under Scenario 2A for cumulative assessment.

5.6.60 In addition, two alternative sediment release locations were considered in the water quality modelling for dredging at the cross harbour water mains between Wan Chai to Tsim Sha Tsui (**Figure 5.7**) to account for the potential impact upon the exiting seawater intakes on both sides of Victoria Harbour. Details of sediment loss rates assumed in the modelling assessment for Scenario 2A are summarized in **Table 5.10** below.

Scenario 2B

5.6.61 Scenario 2B assumes that the following marine works will take place concurrently.

a. Dredging for seawall foundation at TCBR Stage 1 West (TCBR1W)
b. Dredging along the proposed alignment of the submarine sewage pipeline of the Wan Chai East Sewage Treatment Works.

5.6.62 This scenario is assumed to take place in late 2009 to 2010 where the seawall for HKCEC1, WCR1, NPR1 and NPR2W would be completely constructed and the temporary breakwater at TBW and the temporary reclamation at TPCWAE would be in place. **Figure 5.8** shows the Wan Chai coastline configuration and sediment source locations assumed for Scenario 2B. This scenario covers the impact due to the seawall dredging at TCBR1W which could affect the nearby existing cooling water intakes together with the potential cumulative impact caused by the pollutants discharged from the existing storm outfalls (Culvert P and Q) at the western part of the typhoon shelter. The potential effect on the water circulation within the Causeway Bay typhoon shelter due to the placement of the temporary breakwater (TBW) will also be taken into account under this scenario.

5.6.63 Dredging for the proposed submarine sewage pipeline is also included under this scenario to assess the potential cumulative impact. Details of sediment loss rates assumed in the modelling assessment for Scenario 2B are summarized in **Table 5.11** below.

Scenario 2C

5.6.64 Scenario 2C covers the following marine works that will take place concurrently in 2011.

a. Dredging for seawall foundation at HKECE Stage 2 West (HKCEC2W)
b. Dredging for seawall foundation at WCR Stage 3 (WCR3)
c. Dredging for seawall foundation at CBR Stage 3 (TCBR3).

5.6.65 Under this scenario, temporary reclamation at TCBR1W and TCBR2 together with the temporary breakwater (TBW) will be in place at the same time. This is a very adverse scenario in terms of the water circulation inside Causeway Bay typhoon shelter. The potential impact from the seawall dredging at TCBR3 together with the potential cumulative impact due to the pollutants discharged from the storm outfalls (Culvert P and Culvert Q) is assessed in this scenario.

5.6.66 Two more reclamation areas at HKCEC2W and WCR2 respectively are to be dredged at the same time under this scenario. The dredging at HKCEC2W is included to assess the potential impacts on the existing cooling water intakes along the coastline between the eastern seawall of CRIII and the western seawall of the proposed HKCEC1 site. This scenario has also taken account of the potential impacts on the existing cooling water intakes located inside the HKCEC water channel due to the seawall dredging at WCR3. According to the construction programme, WCR2 should be in progress in 2011. However, dredging is assumed to be carried out at WCR3 in 2011 for worst-case assessment, because the WCR3 is closer to the seawater intakes inside the HKCEC channel.

5.6.67 It should be noted that, except Scenario 2A, no more than three reclamation areas will be dredged simultaneously according to the construction programme.

5.6.68 Scenario 2C includes an additional piece of permanent reclamation (WCR2) when compared to Scenario 2B. **Figure 5.9** shows the Wan Chai coastline configuration and dredging locations assumed under Scenario 2C. Details of sediment loss rates assumed in the modelling assessment for Scenario 2C are summarized in **Table 5.12** below.

Other Concurrent Projects

5.6.69 Dredging for the proposed Kai Tak Development, Western Cross Harbour Main, Submarine Gas main relocation at Kowloon Bay and Tseung Kwan O reclamation are also considered in the sediment plume modelling.

KTD - Proposed Dredging Works for Cruise Terminal

5.6.70 Development of the proposed cruise terminal at Kai Tak would require dredging at the existing seawall at the southern tip of the former Kai Tak Airport runway for construction of a berth structure for two berths, and dredging the seabed fronting the new berth structure to provide necessary manoeuvring basin. It is planned to implement the cruise terminal in two phases. Phase I Berth for the initial phase is scheduled for operation by 2012. Phase II Berth for the longer term is currently scheduled for operation after 2015. Dredging required for operation of the Phase I Berth is currently scheduled to be carried out during the period from later half of 2008 to 2011 as Stage 1 dredging. The programme for Stage 2 dredging is unconfirmed at this stage but its completion can be extended up to 2020 and the earliest possible time for the Stage 2 dredging would be 2013 to 2014 after the Stage 1 dredging and decommissioning and removal of the existing submarine gas pipelines currently located to the west of the former Kai Tak Airport runway within the required manoeuvring space and the dredging zone of the Phase II Berth.

5.6.71 The WDII and CWB reclamation is currently scheduled to commence in 2009 for completion by 2016. Dredging for three WDII and CWB activities would be conducted in the open harbour including:

- construction of the water main between Wan Chai and Tsim Sha Tsui
- construction of the Wan Chai sewage submarine outfall
- construction of the temporary Causeway Bay typhoon shelter

5.6.72 Dredging for the above three WDII and CWB activities is considered critical as they will be conducted at or near the main harbour channel with high current speeds where deployment of silt curtain is not practical and may contribute cumulative impacts with the cruise terminal dredging which is also being conducted in the open harbour.

5.6.73 The remaining WDII and CWB dredging activities would be confined within the embayed areas or near shore regions for seawall construction along the coastlines where the water currents would be relatively small and, with the implementation of mitigation measures such as deployment of silt curtains around the dredging operations, the impacts from these remaining WDII and CWB dredging activities are expected to be localized.

5.6.74 It is assumed that the critical scenario for WDII and CWB (with dredging in the open harbour), namely Scenario 2A, will be undertaken concurrently with the Stage 1 dredging for construction of the manoeuvring basin (also in the open harbour) to investigate the cumulative impact. The rate of Stage 1 dredging from existing seabed within the proposed manoeuvring area is assumed to be 4,000m^3 per day (by two closed grab dredgers). The dredging at or near the seawall for berth construction is also assumed to be conducted at a maximum rate of 4,000m^3 per day (by another two closed grab dredgers) concurrently with the Stage 1 dredging.

5.6.75 As the majority of the dredging activities for WDII and CWB would be completed before 2012, the cumulative impact from WDII and CWB was only assessed for the Stage 1 cruise terminal dredging.

KTD - Public Landing Steps cum Fireboat Berth

5.6.76 A section of the existing seawall at the former Kai Tak Airport runway will need to be re-constructed for the proposed public landing steps cum fireboat berth (**Figure 5.7a**) under the Kai Tak Development. Seawall reconstruction would involve excavation and dredging at and near the existing seawall of the runway. It is assumed that the dredging at and near the seawall area will be carried out at a maximum dredging rate of 1,000m^3 per day concurrently with the cruise terminal dredging and the WDII dredging for cumulative assessment.

Submarine Gas Main Relocation

5.6.77 Twin 400mm diameter steel submarine gas pipelines are currently aligned 235m west of and parallel to the former Kai Tak Airport runway. The pipelines serve as a strategic gas supply to Hong Kong Island and is covered under an existing wayleave agreement. They run between a gas offtake and pigging station at Ma Tau Kok (MTK) and a gas pigging station at Quarry Bay. As mentioned before, the existing pipeline is located within the manoeuvring space and the dredging zone of the Phase II Berth for the cruise terminal. Hence, the pipeline would need to be reprovisioned before dredging can commence for the Phase II cruise berth.

5.6.78 The possible alignment for the new gas main crossing of 2.8km in a straight line from Ma Tau Kok to North Point is assumed as indicated in **Figure 5.7a**. The alignment is indicative only and will be subject to detailed design being conducted by the Hong Kong and China Gas Company Limited (HKCGCL).

5.6.79 The dredging associated with removal of the existing submarine gas mains will be incorporated into the Stage 2 dredging works for cruise terminal construction after the majority of the dredging activities for WDII and CWB are completed. Construction of the new gas main may involve dredging and backfilling activities. Backfilling of rock and armour would not be a water quality issue of concern. Only the dredging and sand filling, if any, would cause potential water quality impact. It is expected that backfilling would be carried out after the dredging and laying of the new gas mains is completed. As the possible dredging and backfilling activities would be conducted in sequence rather than concurrently, the worst-case impacts would be during the dredging of seabed as the dredged sediment might be contaminated. Furthermore, the rate of dredging would be larger than the rate of sand filling.

5.6.80 It is assumed that dredging of seabed for construction of the new gas main would be conducted concurrently with the WDII and CWB dredging under Scenario 2A to investigate the worst-case cumulative impact. It is also assumed under the base case scenario that the dredging for gas main construction would be conducted at a maximum rate of 1,000m^3 per day, using small trailer hopper dredger in the fairway and grab dredger at the remaining areas. The trailer hopper dredger is required in the fairway as it is more manoeuvrable and self-powered. Grab dredgers are assumed elsewhere as a worst case for water quality impact. It should be noted that construction of the new gas main is a designated project and will be subject to detailed assessment under separate EIA study.

5.6.81 The dredging rate of 1,000m^3 per day was calculated based on the best available information obtained at the time when the sediment plume model for this EIA was being set up. According to HKCGCL, the dredge volume will be approximately 54 m^3/m run. Assuming 2.8 km of gas mains will give a total dredge volume of approximately 150,000 m^3. It is further assumed that the dredging rate will be relatively slow due to: the need for tight control on the grab to create the relatively narrow trench; the need for accurate alignment; and limited access/working hours when crossing the fairway in the Victoria Harbour. Allowing approximately 6 months to complete this dredging and working 6 days per week gives the assumed dredging rate of approximately 1,000m^3 per day.

5.6.82 However, after the sediment plume modelling exercise for the base case scenarios was completed for this EIA, latest construction information for the new gas main was available from the Project Profile submitted by the HKCGCL in September 2007 under the EIAO for application of EIA study brief. Based on the Project Profile for the new gas main, the alignment option (from Ma Tau Kok to North Point) would be adopted but the latest alignment will be laid within a 500m corridor in Victoria Harbour and the exact alignment of the new gas main will be determined during the feasibility study and detail design stage. Under this EIA, the sediment spill location for the gas main construction is assumed at a point close to the WSD flushing intake at Tai Wan as shown in **Figure 5.7a** (Source ID: A7) which represents a worst case cumulative impact for the Tai Wan intake. Based on the latest alignment corridor provided in the Project Profile for the new gas main, the shortest distance between the new gas pipeline and the Tai Wan WSD intake is similar to that assumed under this EIA. Therefore, the dredging location (Source ID: A7) assumed in this EIA is still considered representative, considering that the Tai Wan intake was also identified in the Project Profile for the new gas main as one of the nearest water sensitive receivers. Besides, a sensitivity test was also conducted under this EIA using a higher dredging rate of 5,000 m^3 per day to address the possible change of dredging rate for the gas main construction.

5.6.83 To investigate the worst-case impact on the WSD flushing intake at Quarry Bay, another sensitivity test was conducted using an alternative source point for the new gas main near the pipeline landing point at North Point with a dredging rate of 5,000 m^3 per day based on the latest information provided by the HKCGCL and the indicative alignment provided in the Project Profile for the new gas main. As the landing point of the new gas main at North Point would be located in close proximity of the Quarry Bay intake, it was predicted that the SS limit for the WSD flushing intake would be exceeded at the Quarry Bay. Sensitivity analysis indicated that, under the case when dredging is conducted near the gas main landing point at North Point, the change of WDII activities would have minimal effect on the SS compliance level at the Quarry Bay intake. As indicated by the sensitivity modelling conducted under this EIA, feasible mitigation measures such as installation of silt curtains around the gas main dredging work near the North Point or reduction of the dredging rate for gas main construction for the dredging activities near the landing point at North Point would effectively eliminate the SS exceedance and achieve full compliance at all the WSD flushing water intakes. Under the base case scenario assuming that dredging for the new gas main would be located away from North Point, the SS levels predicted at the Quarry Bay intake were well below the SS limit. The Project Profile for the new gas main has only indicated an envelope alignment of about 500 metres wide across the Victoria Harbour and the exact alignment had to be determined after a feasibility study and an EIA study. In the EIA Study Brief issued to HKCGCL, the project proponent of the new gas main was requested to consider other feasible alternatives/options for the pipeline alignment. For the purpose of this EIA, full assessment results for this sensitivity analysis (assuming a source point near the pipeline landing point at North Point) are therefore not presented. However, a summary of the results for this sensitivity analysis and an additional assessment to distinguish the impacts due to the WDII activities and those due to the gas main relocation and other sediment sources are given in Section 5.8 for reference.

Western Cross Harbour Main

5.6.84 A new cross-harbour water main would be constructed to provide security of water supply from West Kowloon to Sai Ying Pun. According to the EIA report "Laying of Western Cross Harbour Main and Associated Land Mains (Western Cross Harbour Main)" (EIAO Register No.: AEIAR-109/2007), construction of the water main is currently scheduled for completion in 2009 and the dredging works would be conducted at a maximum dredging rate of 4,000m^3 per day, using one grab dredger.

Further Development of Tseung Kwan O

5.6.85 Based on the approved EIA for Further Development of Tseung Kwan O Feasibility Study (TKOFS), the worst-case construction impacts would occur during the seawall construction for Phase I reclamation when dredging and filling operations are carried out concurrently at the southern area of the TKO reclamation site. According to the reclamation programme given in the approved EIA, these dredging and filling operations would commence in 2010. Based on the latest information obtained from CEDD, the Phase 1 seawall construction would likely to commence in early 2012, and *in-situ* soil improvement measures would be explored under the detailed design to avoid dredging. Therefore, it is possible that no dredging would be carried out for the TKO reclamation works.

5.6.86 Nevertheless, the cumulative effects of the possible dredging and filling works for TKO reclamation have been considered in this modelling exercise. The modelling works aimed to investigate whether the WDII and CWB works would contribute any cumulative water quality impacts with the TKO reclamation works. As the dredging rates for the WDII and CWB activities in the open harbour would be largest under Scenario 2A, the TKO works have been included in Scenario 2A for worst case cumulative assessment. It is assumed that one close grab dredger would be used for dredging and one pelican barge would be used for sand filling under the TKO works. The production rates for dredging and filling would be $1400m^3$ per day and $3000m^3$ per day respectively according to the approved EIA for TKOFS.

Other Concurrent Projects

5.6.87 It should be noted that no dredging activity is anticipated for the HATS Stage 2A and HKCEC Atrium Link Extension. All the marine activities for CRIII will be completed before the construction of WDII and CWB.

Suspended Solids

Sediment Plume Modelling

5.6.88 Sediment plumes arising from the mud dredging activities during the reclamation works will be simulated using Delft3D-PART. This model has been used for sediment plume modelling in a number of previous reclamation studies in Hong Kong including the approved WDIICFS EIA, Northshore Lantau Development Feasibility Study (13) and the Theme Park Development at Penny's Bay EIA Study (14).

5.6.89 The loss of fines to the water column during dredging operations is represented by discrete particles in the model. These discrete particles are transported by advection, due to the tidal flows determined from hydrodynamic simulation, and turbulent diffusion and dispersion, based on a random walk technique. The detailed Victoria Harbour (VH) Model adopted under the approved WDIICFS EIA was used to provide the hydrodynamic information for particle tracking. The VH model developed under the approved WDIICFS EIA is considered acceptable for modelling of the construction phase impacts where the effect would be temporary only.

5.6.90 The Delft3D-PART model takes into account the sedimentation process by means of a settling velocity, while erosion of bed sediment, causing resuspension of sediment, is governed by a function of the bed shear stress. The SS elevation caused by the proposed dredging activities is predicted by the Delft3D-PART. The model results will also be presented in terms of the sedimentation rate which represents the net effect from both sediment erosion and deposition. The parameters adopted in the present study are summarised in **Table 5.9**. Each construction scenario was simulated with three typical spring-neap tidal cycles for spin-up and one cycle for actual simulation in both dry and wet seasons following the approach adopted under the WDIICFS EIA.

(13) Scott Wilson (Hong Kong) Ltd. (February 2000). Northshore Lantau Development Feasibility Study (Agreement No. CE 60/96), Final Environmental Impact Assessment Report.

(14) Scott Wilson (Hong Kong) Ltd. (February 2000). Construction of an International Theme Park in Penny's Bay of North Lantau and its Essential Associated Infrastructures, Final Environmental Impact Assessment Report.

Table 5.9 Summary of Parameters for Sediment Plume Model (Delft3D-PART)

Sediment Plume Model Parameters		
Horizontal Dispersion Coefficient D_H ($m^2 s^{-1}$)	a = 0.003 b = 0.4	$D_H = a\ t^{\ b}$, Where t is the age of particle from the instant of discharge in seconds
Vertical Dispersion Coefficient D_V ($m^2 s^{-1}$)	$5x10^{-3}$ $1x10^{-5}$	Dry Season Wet Season
Particle Settling Velocity	0.0001 m s^{-1} (Constant)	Grain size diameter of 10 µm
Critical Shear Stress	0.05 Pa 0.15 Pa	Sedimentation Erosion

Sediment Loss Rates

5.6.91 Assumptions made in the sediment plume modelling simulations for calculating the sediment loss rates for WDII and CWB activities are as follows:

- The dry density of harbour mud is 1,370 kg/m^3, based on the geotechnical site investigation for the WDII and CWB marine ground investigation works conducted under this Study.

- Spill loss during mud dredging by closed grab dredger will be continuous, 16 hours a day, 7 days per week. The grab dredger is assumed to work over 16 hours per day in order to maintain the required works rates to meet the tight construction programme.

- With respect to rate of sediment loss during dredging, the Contaminated Spoil Management Study [(15)] (Mott MacDonald, 1991, **Table 6.12**) reviewed relevant literature and concluded that losses from closed grab dredgers were estimated at 11 – 20 kg/m^3 of mud removed. Taking the upper figure of 20 kg/m^3 to be conservative, the loss rate in kg/s was calculated based on the daily volume rate of dredging. (Assuming a dry density for marine mud of 1,370 kg/m^3, the sediment loss during dredging is equivalent to a spill amount of approximately 1.5%).

- Spillage of mud dredged by closed grab dredgers is assumed to take place uniformly over the water column.

- Dredging of contaminated and uncontaminated mud will be carried out at the same rate.

5.6.92 The calculated sediment loss rates for Scenario 2A, Scenario 2B and Scenario 2C are shown in **Table 5.10** to **Table 5.12** respectively. The dredging rates for different construction phases were identified. The corresponding source locations are given in **Figure 5.7** to **Figure 5.9**. The loss rates shown in **Table 5.10** for KTD and TKO reclamations are the reduced loss rates under the mitigated scenarios which have considered the effect of silt curtains. On the other hand, deployment of silt curtains have not been considered in calculating the sediment loss rates from WDII and CWB dredging works and the remaining concurrent activities. These sediment loss rates represent the worst case under the unmitigated scenario. It is assumed that silt curtains will only be deployed if the water quality impacts are found to be unacceptable. Deployment of silt curtains have been considered under the mitigated scenario discussed in Section 5.8.

(15) Mott MacDonald (1991). Contaminated Spoil Management Study, Final Report, Volume 1, for EPD, October 1991.

Table 5.10 Maximum Dredging Rates of WDII and CWB - Scenario 2A (early 2009)

Source ID	Activity	Approx. Duration (1) (days)	Work Hours per day	Dredging Rate		Sediment Loss Rate (kg s^{-1})
				m^3 per day	m^3 per hour	
WDII and CWB Dredging Activities:						
HKCEC1 (**Figure 5.7**)						
A1	Dredging (1 closed grab dredger of 8 m^3 capacity)	14	16	6000	375	2.08
WCR1 (**Figure 5.7**)						
A2	Dredging (1 closed grab dredger of 8 m^3 capacity)	29	16	6000	375	2.08
TPCWAE (**Figure 5.7**)						
A3	Dredging (1 closed grab dredger of 8 m^3 capacity)	16	16	6000	375	2.08
NPR1 (**Figure 5.7**)						
A4	Dredging (1 closed grab dredger of 8 m^3 capacity)	31	16	6000	375	2.08
Water Mains from Wan Chai to Tsim Sha Tsui (**Figure 5.7**)						
Alternative dredging locations: either A5 or A5a (2)	Dredging (1 closed grab dredger of 8 m^3 capacity)	16	16	6000	375	2.08 (for A5 or A5a)
TBW (**Figure 5.7**)						
A6	Dredging (1 closed grab dredger of 8 m^3 capacity)	54	16	6000	375	2.08
External Concurrent Dredging Activity in Victoria Harbour and Junk Bay:						
Submarine Gas Main Relocation (**Figure 5.7a**)						
A7	Dredging (1 closed grab dredger of 8 m^3 capacity)	12	12	1000 (or 5000**)	83 (or 417**)	0.46 (or 2.31**)
KTD – Cruise Terminal – Dredging at or near the seawall for Berth Construction (**Figure 5.7a**)						
A8	Based on the latest information from the Kai Tak Development Engineering Study					0.23
A9						0.23
KTD – Cruise Terminal - Dredging from the seabed for Construction of the Manoeuvring Basin (**Figure 5.7a**)						
Alternative dredging locations: either A10 and A11 or A10a and A11a	Based on the latest information from the Kai Tak Development Engineering Study					0.93 (for A10 or A10a)
						0.93 (for A11 or A11a)
KTD – Public Landing Steps cum Fireboat Berth (**Figure 5.7a**)						
A12	Based on the latest information from the Kai Tak Development Engineering Study					0.12
Western Cross Harbour Main between West Kowloon to Sai Ying Pun						
A13	Based on the EIA report for Western Cross Harbour Main					0.93

Source ID	Activity	Approx. Duration (1) (days)	Work Hours per day	Dredging Rate		Sediment Loss Rate (kg s^{-1})
				m^3 per day	m^3 per hour	
Further Development of Tseung Kwan O						
D1	Based on the approved EIA for TKOFS EIA					0.44
F1						0.15

(1) The duration of each operation is based on the construction programme presented in **Appendix 2.1**.
(2) For the purpose of modelling, two alternative dredging locations are considered with A5 close to Hong Kong Island and A5a close to Tsim Sha Tsui. However, it should be noted that the dredging will be performed by 1 close grab dredger during the construction of the cross harbour water mains. Thus, only one dredger will operate at one location at a time.
** Values in bracket are used for sensitivity test (refer to Section 5.6.82).

Table 5.11 Maximum Dredging Rates of WDII and CWB - Scenario 2B (late 2009 to 2010)

Source ID	Activity	Approx. Duration (1) (days)	Work Hours per day	Dredging Rate		Sediment Loss Rate (kg s^{-1})
				m^3 per day	m^3 per hour	
WDII and CWB Dredging Activities:						
TCBR1W (**Figure 5.8**)						
B1	Dredging (1 closed grab dredger of 8 m^3 capacity)	30	16	6000	375	2.08
Submarine Sewage Pipeline of the Wan Chai East Sewage Treatment Works (**Figure 5.8**)						
B2	Dredging (1 closed grab dredger of 8 m^3 capacity)	13	16	6000	375	2.08
External Dredging Activity in Victoria Harbour:						
Western Cross Harbour Main between West Kowloon to Sai Ying Pun						
B3	Based on the EIA report for Western Cross Harbour Main					0.93

(1) The duration of each operation is based on the construction programme presented in **Appendix 2.1**.

Table 5.12 Maximum Dredging Rates of WDII and CWB - Scenario 2C (2011)

Source ID	Activity	Approx. Duration (1) (days)	Work Hours per day	Dredging Rate		Sediment Loss Rate (kg s^{-1})
				m^3 per day	m^3 per hour	
WDII and CWB Dredging Activities:						
HKCEC2W (**Figure 5.9**)						
C1	Dredging (1 closed grab dredger of 8 m^3 capacity)	44	16	6000	375	2.08
WCR3 (**Figure 5.9**)						
C2	Dredging (1 closed grab dredger of 8 m^3 capacity)	32	16	6000	375	2.08
TCBR3 (**Figure 5.9**)						
C3	Dredging (1 closed grab dredger of 8 m^3 capacity)	41	16	6000	375	2.08
External Dredging Activity in Victoria Harbour:						
Western Cross Harbour Main between West Kowloon to Sai Ying Pun						
C4	Based on the EIA report for Western Cross Harbour Main					0.93

(1) The duration of each operation is based on the construction programme presented in **Appendix 2.1**.

Contaminant Release during Dredging

5.6.93 The loss of sediment to suspension during dredging may have chemical effects on the receiving waters. This is because the sediment may contain organic and chemical pollutants. As part of the marine site investigation works for this Project, laboratory testing of sediment samples was undertaken. A full description of the sediment quality testing and the classification of the sediment according to levels of contaminants is contained in Section 6. Oxygen depletion (due to sediment plume) was calculated using the highest level of 5-day SOD [(16)] measured in the sediment samples collected during the marine site investigation (SI), based on the predicted increases in suspended sediment concentrations for the construction phase scenarios. The reductions were then compared with the baseline levels to determine the relative effects of the increases in SS concentrations on DO. Based on the SI results, the highest SOD was measured at the surface sub-sample of a station located within the HKCEC water channel.

5.6.94 The nutrient impacts from increased SS concentrations were assessed from the sediment quality data for TIN and NH_3-N. An inactive tracer was defined in the model at the dredging locations to determine the dilution in the vicinity of the dredging site. The dilution information was then used to determine the concentrations of the concerned parameters at receiving waters and to evaluate the potential impacts to the marine environment.

5.6.95 An indication of the likelihood of release of contaminants (including heavy metals, PCBs, PAHs and TBT) from the sediment during dredging is given by the results of the elutriation tests from the site investigation works. If the contaminant levels are higher in the elutriates in comparison with the blanks (marine water from the same site), it can be concluded that the contaminants are likely to be released into the marine waters during dredging activities. As there is no existing legislative standard or guideline for individual heavy metal contents in marine waters, the UK Water Quality Standards for Coastal Surface Water [(17)] were adopted as the assessment criteria.

Water Quality in Temporary Embayments

5.6.96 Temporary embayments will be formed between reclaimed areas of land in different stages of the proposed reclamation. Potential water quality impact associated with the accumulation of pollutants discharged from the existing and temporarily diverted storm culverts into the slack water during this period may result in dissolved oxygen depletion and in turn causing odour impact. Water quality modelling was carried out using Delft3D-WAQ for the interim construction scenarios. The detailed Victoria Harbour (VH) Model adopted under the approved WDIICFS EIA was used for construction phase water quality modelling. Each construction scenario was simulated with three typical spring-neap tidal cycles for spin-up and one cycle for actual simulation in both dry and wet seasons following the approach adopted under the WDIICFS EIA. The grid layout along the Wan Chai coastline has been adjusted to fit the construction interim coastline configurations under each construction scenario. Potential embayments at the interim construction scenarios are shown in **Figure 5.10** and **Figure 5.11**.

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(16) The rate of oxygen consumption exerted by the sediment on the overlying water at 20^{o}C for a period of five days.

(17) Environmental Quality Standards and Assessment Levels for Coastal Surface Water (from HMIP (1994) Environmental Economic and BPEO Assessment Principals for Integrated Pollution Control). *(Source: Environmental Impact Assessment Study for Disposal of Contaminated Mud in the East Sha Chau Marine Borrow Pit, by ERM, January 1997).*

Permanent Reclamation at HKCEC and Wan Chai

5.6.97 After the construction of the western seawall in HKCEC1 is completed in early 2009, a temporary embayment will be formed between the existing eastern seawall of CRIII and the HKCEC Extension. This embayment will be a particular cause of concern as a storm outfall (Culvert L) is currently discharging pollutants into this area. The potential water quality impact on the cooling water intakes within this embayment will last for more than 2 years until the HKCEC Reclamation Stage 2 proceeds where the new Culvert L extension can be constructed via a new land formed under the HKCEC2W. In 2010, the MTRC tunnel crossing will be placed inside this embayment as illustrated in **Figure 2.18**. It should be noted that the diversion of cooling water intakes will be completed before the MTRC tunnel crossing is fully constructed.

5.6.98 As a mitigation measure, an impermeable barrier, suspended from a floating boom on the water surface and extending down to the seabed, will be erected by the contractor before the HKCEC1 commences. The barrier will channel the stormwater discharge flows from Culvert L to the outside of the embayment. The contractor will maintain this barrier until the reclamation works in HKCEC2W are carried out and the new Culvert L extension can be constructed.

5.6.99 In the area of WCR, an embayment will be created at the proposed WCR2 site after the seawall in Wan Chai Reclamation Stage 1 (WCR1) is constructed as shown in **Figure 5.10**. A cooling water intake and a flushing water intake located within this embayment would be potentially affected. The storm outfall (Culvert N) will be temporarily diverted to the open water at the adjacent WCR4 site before seawall construction in WCR1 is completed to avoid the accumulation of pollutants at this embayment and thus minimize the potential impact to the seawater intakes. According to the construction programme, these two intakes will be permanently diverted to the open water via WCR1 before commencement of WCR2. Thus, the potential water quality impacts at these two intakes would be limited during the remaining reclamation stages in WCR (WCR2, WCR3 and WCR4).

5.6.100 After the temporary seawall in the area of WCR is constructed in 2009, a narrow embayment will be created between the HKCEC1 and WCR as illustrated in **Figure 5.10**. As previously pointed out, the storm outfall (Culvert N) will be temporarily diverted at an early stage of WCR before the seawall in WCR1 is constructed. As a result, the water quality inside this temporary embayment would be influenced by the pollutants discharged from the storm outfall (Culvert M) only. The cooling water intakes along the HKCEC water channel would be potentially affected by the water quality within this embayment for a period of about 2 years. According to the construction programme, these cooling water intakes will be diverted to the intake chambers to the north of HKCEC Extension in 2011 before the seawall of HKCEC2W is completely constructed.

5.6.101 The temporary embayment formed between the eastern seawall of HKCEC3W and the western seawall of WCR2 at a later reclamation stage is considered less critical, as no cooling water intake is located within this embayment. The cooling water intakes originally located inside the HKCEC water channel will be permanently diverted to the open water at the north of HKCEC Extension before the completion of seawall in HKCEC3W.

5.6.102 Temporary embayment would be formed between the eastern seawall of HKCEC3E and the western seawall of WCR2 at a later stage (**Figure 2.18**). Before the seawall of HKCEC3E is completely constructed, the outfall of Culvert M would be temporarily diverted to the adjacent area between HKCEC3E and WCR2. According to the construction programme, the temporary embayment formed between HKCEC3E and WCR2 is potentially affected by the discharge from the outfall of Culvert M for a period of about 6 months. The potential water quality impact inside this embayment will however be limited as there would be no water sensitive receiver (i.e. seawater intake) within this temporary embayment. Before the reclamation at WCR3 commences, the storm outfall (Culvert M) will be permanently diverted to the new water front of HKCEC3E. Thus, the local water quality impact within this embayment is considered temporary and insignificant.

Temporary Reclamation at PCWA

5.6.103 Temporary embayment will also be formed within the existing breakwater of PCWA. In accordance with the construction programme, temporary reclamation at the eastern site (TPCWAE) will be carried out as the first stage. Reclamation works in the western site (PCWAW) will not be conducted until demolition of the temporary reclamation in PCWAE is completed. After the reclamation in PCWAW is completed, the storm outfall (Culvert O) will be temporarily diverted into the embayment at the eastern side of the PCWA for a period of about 2 years. This storm outfall must be diverted for construction of the CWB tunnel. As there is no sensitive use located within this temporary embayment area, the potential water quality impact would be limited. The outfall will be diverted back to the open water at the Wan Chai seafront after the CWB tunnel is completed.

Temporary Reclamation at Causeway Bay Typhoon Shelter

5.6.104 The proposed construction method for temporary reclamation in Causeway Bay typhoon shelter adopts an approach where temporary seawalls will first be formed to enclose each phase of the temporary reclamation. Installation of diaphragm wall on temporary reclamation will proceed behind the completed seawall. Demolition of temporary reclamation including the demolition of the diaphragm wall will also be carried out behind the temporary seawall. Description of the construction and demolition of temporary reclamation is also provided in Section 5.6.44.

5.6.105 The potential water quality impact within the temporary embayments inside the Causeway Bay typhoon shelter created by the temporary reclamation (TCBR) and temporary typhoon shelter (TBW) is considered most critical. During the construction period in 2011, TBW, TCBR1W, TCBR3 and TCBR2 will be in place at the same time which is the most adverse scenario in terms of the water circulation and dispersion of pollutants within the Causeway Bay typhoon shelter, considering that there will be several cooling water intakes and storm outfalls located within the temporary embayments (**Figure 2.12**). The pollution loading from Outfall Q is significantly larger than that from the other storm outfalls within the typhoon shelter. Therefore, the impact during the early construction phase when TCBR1W, TCBR1E and TCBR2 are in place together (**Figure 2.11**) is considered less critical as a relatively large opening would be kept near Storm Outfall Q which would provide better dispersion for the pollution loading discharged from Outfall Q as compared to the scenario with TCBR1W, TCBR3 and TCBR2 in place together.

5.6.106 During the construction period from 2012 to 2014, TCBR4 and TCBR3 together with the TBW will be in place at the same time whilst TCBR1W, TCBR2 and TCBR1E will be completely removed (**Figure 2.13**). This scenario is however considered less critical as the storm outfall (Culvert Q) will be diverted to the north of TCBR4 before the seawall construction for TCBR4 is completed. Thus, less pollutant will be discharged into the embayments where the seawater intakes are located. In addition, this temporary land configuration would create two openings close to the storm outfalls (Culverts P, R and S). Thus, more water circulation at the storm outfalls would be expected under this scenario when compared to the period in 2011 when TCBR1W, TCBR3 and TCBR2 are in place.

5.6.107 The storm outfall (Culvert Q) and the cooling water intake for Windsor House are located in the area of TCBR4. Before the seawall construction at TCBR4 is completed, the intake will be diverted into the adjacent area to the south of TCBR3 to ensure continuous operation of the intake during the construction period. Furthermore, the storm outfall (Culvert Q) will be temporarily diverted to the north of TCBR4 before the seawall of TCBR4 is completely constructed. Therefore, no significant water quality impact will be created at the TCBR4.

Water Quality Modelling Scenarios

5.6.108 Based on the considerations above, three modelling scenarios have been set up to evaluate the water quality impact in temporary embayments as described below. A summary of the modelling scenarios is given in **Table 5.13a**.

<u>Scenario 3A</u>

5.6.109 This scenario represents the baseline condition without any reclamation at the Project site to simulate the pre-construction conditions of flow and water quality in Victoria Harbour.

<u>Scenario 3B</u>

5.6.110 This scenario (**Figure 5.10**) is the same as Scenario 3A with modified coastline in Wan Chai, Causeway Bay and North Point assuming that only HKCEC1, WCR1, TPCWAE, TBW, NPR1 and NPR2W will be in place. The aim of this scenario is to assess the potential impacts resulting from:

- temporary embayment formed between CRIII and HKCEC1 where a storm outfall (namely Culvert L) and a cooling water intake (namely 2) will be located
- temporary embayment surrounded by the new land formed under WCR1 where the WSD Wan Chai flushing water intake and the cooling water intake for Sun Hung Kai Centre will be located
- temporary embayment formed between HKCEC1 and WCR2

5.6.111 It should be noted that potential impacts within the temporary embayment between CRIII and HKCEC1 would be eliminated with the proposed mitigation measure of channeling the flows from Culvert L into the open water at an early reclamation stage as mentioned before. This scenario assumes that Culvert L would remain inside the embayment for worst case assessment.

<u>Scenario 3C</u>

5.6.112 This scenario (**Figure 5.11**) assumes that only HKCEC, WCR2, WCR1, TPCWAE, TCBR1W, TCBR3, TCBR2, TBW, NPR1, NPR2W and NP2E will be in place. The aim of this scenario is to assess the potential impacts resulting from:

- temporary embayment within the Causeway Bay typhoon shelter due to the placement of TBW, TCBR1W, TCBR2 and TCBR3

Impact from TBW and New WCEPTW Outfall

5.6.113 Water quality impact due to the operation of TBW and the new Wan Chai East preliminary treatment works (WCEPTW) outfall was also assessed under Scenario 3B and Scenario 3C together with the model results available from the approved EIA for WDIICFS (details refer to Section 5.7).

Time Horizon for Construction Phase Modelling

5.6.114 Based on the construction programme, the worst-case construction impact would occur at early stages of the construction period between early 2009 and 2011. It is anticipated that there would not be any significant change in the background pollution loading and coastline configurations between early 2009 and 2011. The 2011 pollution loading was adopted for modelling of the interim construction phase impacts. For areas outside the Project site boundary, the 2011 coastline configurations were assumed under all the construction phase modelling scenarios.

Pile Friction

5.6.115 Existing structures including the piers of East Bridge, West Bridge and Seafront Promenade within the proposed reclamation sites at the HKCEC water channel have been considered in the construction phase assessment. The pile layouts are shown in **Appendix 5.1b**.

5.6.116 East Bridge consists of 11 rows of marine steel tubular piles across the waterway from south to north with a spacing of about 7 m in between the piles. Each row consists of 4 piles from east to west with a spacing of 9 m between the piles. The diameter of each pile is 914 mm.

5.6.117 The pile arrangement for West Bridge is the same as that for East Bridge except that the spacing between the piles in the east to west direction is only 7 m.

5.6.118 The Seafront Promenade is supported by 31 marine piles. The diameter of each pile is 1 m. The spacing between the piles is different in different areas of the Seafront Promenade site. The spacing varies from 3.3 m to 9 m.

5.6.119 The presence of these marine piles may affect the flushing and dispersion of sediment and pollutants in the HKCEC water channel and were therefore incorporated in all the construction phase scenarios as appropriate. The marine piles have variable separation distance. As the dimensions of the marine piles are much smaller than the grid size, the exact pier configurations cannot be adopted in the model simulation. Instead, only the overall influence of the piles on the flow was taken account. This overall influence was modelled by a special feature of the Delft3D-FLOW model, namely “Porous Plate”. “Porous Plate” represents transparent structures in the model and is placed along the model gridline where momentum can still be exchanged across the plates. The porosity of the plates is controlled by a quadratic friction term in the momentum to simulate the energy losses due to the presence of the piles. The forces on the flow due to a vertical pile or series of piles are used to determine the magnitude of the energy loss terms. The mathematical expressions for representation of piles friction were based on the Cross Border Link Study [18] and the Delft 3D-FLOW module developed by Delft Hydraulics.

(18) Planning Department Agreement No. CE48/97 Feasibility Study for Additional Cross-border Links Stage 2: Investigations on Environment, Ecology, Land Use Planning, Land Acquisition, Economic/Financial Viability and Preliminary Project Feasibility/Preliminary Design Final Water Quality Impact Assessment Working Paper WP2 Volume 1 1999.

5.6.120 For each grid cell where the piles will be located, two loss coefficients have been specified in the model for two different flow directions respectively (i.e. the two directions perpendicular to the model gridline, namely u-direction and v-direction respectively). Details of the equations used in the modelling are contained in **Appendix 5.2**.

Piled Wave Walls of the Temporary Typhoon Shelter

5.6.121 The proposed temporary moorings will require construction of piled wave walls at the eastern and western ends of the sheltered mooring area respectively as shown in **Figure 5.5** and **Figure 5.6**. The overall influence of the piled wave walls on the flow was modelled by a special feature of the Delft3D-FLOW model, namely "Current Deflection Wall (CDW)". The CDW is represented by an impermeable sheet with supporting piles at the bottom and is placed along the model gridline where there will be no flow exchange across the sheet at the upper vertical water layers. The dimension of the impermeable sheet in the vertical direction was defined in the model with reference to the dimension of the proposed waved walls at the temporary sheltered mooring area. Flow exchange across the supportive piles of the CDW in the lower water layers is controlled by the same quadratic friction and mathematical expressions for representation of pile friction as discussed above.

Coastline Configurations

5.6.122 For the hydrodynamic and water quality modelling of this EIA, a Regional Model has been setup to cover the whole of Hong Kong and the Pearl Estuary. The Regional Model, based on the previous Update Model for EPD, is used to provide the boundary inputs to the local Victoria Harbour (VH) Model for the present study. The VH Model covers the neighbouring waters of Hong Kong Island, including Victoria Harbour. The construction and the operation phases were simulated using the VH Model.

5.6.123 Two sets of boundary conditions for the detailed VH Model were generated for 2011 (construction phase modelling) and 2016 (operational phase modelling) respectively using the Update Model. For the purpose of setting up the Update Model properly, the coastline configuration was updated to mimic the envisaged conditions for the modelling scenarios. The details of the coastal developments incorporated in the construction phase (2011) and operation phase (2016) coastline configurations, the source of information and the current status of the planned developments are summarised in **Table 5.13**. With reference to the latest information from Planning Department, the Sunny Bay reclamation would not be completed in or before 2011 and the Sham Tseng reclamation has been withdrawn. The modelling assessment was however conducted assuming that these reclamations would be in place in 2011 as shown in **Table 5.13**. It should be noted that reclamation in North Lantau and Sham Tseng are outside the boundary of the detailed VH model in the far field. Possible change of coastline at these areas would unlikely affect the outcome of the water quality modelling.

Table 5.13 Coastal Developments Incorporated in the Construction and Operational Phase Coastline Configurations

Coastal Development	Information Source	Included in 2011 Construction Scenario (Figure 5.12)	Included in 2016 Operation Scenario (Figure 5.13)
Sunny Bay Reclamation	EIA Report for "Northshore Lantau Development Feasibility Study" (EIAO Register No.: AEIAR-031/2000).	Yes	Yes
Logistic Park Reclamation	EIA Report for "Northshore Lantau Development Feasibility Study" (EIAO Register No.: AEIAR-031/2000).	No	Yes
Penny's Bay Reclamation	EIA Report for "Construction of an International Theme Park in Penny's Bay of North Lantau together with its Essential Associated Infrastructures" (EIAO Register No.: AEIAR-032/2000).	Yes	Yes
Sham Tseng Further Reclamation	EIA Report for "Planning and Engineering Feasibility Study for Sham Tseng Development" (EIAO Register No.: AEIAR-057/2002).	Yes	Yes
Lamma Power Station Extension	EIA Report for "1,800 MW Gas-fired Power Station at Lamma Extension" (EIAO Register No.: AEIAR-010/1999).	Yes	Yes
Further Development of Tseung Kwan O	EIA Report for "Further Development of Tseung Kwan O Feasibility Study" (EIAO Register No.: AEIAR-092/2005).	No	Yes

5.6.124 The baseline coastline configurations (without the Project) assumed for 2011 and 2016, highlighting the incorporated coastal developments, are shown in **Figure 5.12** and **Figure 5.13** respectively. The proposed reclamation limit of the present Project is shown in **Figure 1.1**.

5.6.125 The reclamations for Kai Tak Development (KTD) and Yau Tong Bay Reclamation (YTBR) were excluded as they were still subject to planning review when this EIA report was prepared. It should be noted that the reclamation for Central Reclamation Phase III (CRIII) has been incorporated into the existing coastline as shown in **Figure 5.12** and **Figure 5.13**.

5.6.126 The hydrodynamic and water quality simulation results generated from the Update Model under the 2011 baseline scenario (without any reclamation at the Project site) as shown **Figure 5.12** have been used to provide boundary conditions to the VH Model for all the interim construction phase scenarios (namely Scenario 2A, Scenario 2B, Scenario 2C, Scenario 3A, Scenario 3B and Scenario 3C). Although the interim construction scenario would involve some reclaimed land as the reclamation proceeds, this partially reclaimed land is relatively small and is unlikely to have a major effect on the flow through Victoria Harbour or on the boundary conditions of the detailed VH model. Similarly, the hydrodynamic and water quality simulation results generated from the Update Model under the 2016 baseline scenario (without any reclamation at the Project site) as shown **Figure 5.13** have been used to provide boundary conditions to the VH Model for the 2016 development scenario with the Project (namely Scenario 1B). Model results conducted under the approved WDIICFS EIA indicated that the net effect of WDII reclamation on the flow regime would be localized within the Victoria Harbour. The WDIICFS EIA was based on a maximum possible extent of reclamation at Wan Chai and Causeway Bay. The current concept plan involves a lesser extent of reclamation and the associated effect on the overall flow in Victoria Harbour would be even smaller. The change of WDII coastline would have little influence at the open boundary in the far field outside the Victoria Harbour.

Summary of Modelling Scenario

5.6.127 A summary of the proposed modeling scenario is given in **Table 5.13a**.

Table 5.13a Summary of Modelling Scenarios

Stage	Scenario	Purpose	Scenario ID	Description	Section Ref.
Operational phase	Water quality modeling scenarios	To assess the water quality impacts associated with the change of coastline configuration and the change of polluted storm water & spent cooling water discharges as a result of WDII and CWB	1A	2016 Baseline Scenario without the proposed WDII and CWB reclamation	Sections 5.6.2 to 5.6.40
			1B	2016 Development Scenario with the proposed WDII and CWB reclamation	
Construction Phase	Sediment plume modelling scenarios	To assess the impacts due to sediment release from marine construction activities for WDII and CWB	2A(1)	Early 2009 with dredging activities at HKCEC1, WCR1, TPCWAE, NPR1, TBW and WSD cross harbour water mains	Sections 5.6.41 to 5.6.92
			2B(2)	Late 2009/2010 with dredging activities at TCBR1W and Wan Chai East submarine sewage pipeline	
			2C(2)	2011 with dredging activities at HKCEC2W, WCR3 and TCBR3	
	Water quality modeling scenarios	To assess the water quality impacts in temporary embayments formed in different stages of the WDII and CWB reclamation and the overall water quality impact in Victoria Harbour due to the operation of the TBW and the sewage submarine outfalls	3A	2011 pre-construction conditions	Sections 5.6.96 to 5.6.113
			3B(3)	2011 with reclamations at HKCEC1, WCR1, TPCWAE, TBW, NPR1 and NPR2W only	
			3C(3)	2011 with reclamations at HKCEC, WCR2, WCR1, TPCWAE, TCBR1W, TCBR3, TCBR2, TBW, NPR1, NPR2W and NP2E only	

Note:
(1) Scenario 2A and Sensitivity Test cover the dredging impact due to the construction of TBW.
(2) The placement of the TBW would affect the flow regime. The transport of sediment plume modeled under Scenario 2B and Scenario 2C has incorporated the hydrodynamic effects due to the placement of TBW.
(3) Scenario 3B and Scenario 3C cover the water quality impact at the embayment of CBTS due to the placement of TBW.

Pollution Loading Inventory

5.6.128 The pollution loading inventory was compiled for two time horizons, namely 2011 scenario (for construction phase modelling) and 2016 scenario (for operational phase modelling). The background pollution loading was estimated for the whole HKSAR waters by desk-top method and was input to the water quality model for cumulative impact assessment. The pollution loading inventory for individual storm outfalls within the Project site boundary in Wan Chai, Causeway Bay and North Point was further refined and updated based on desk-top calculations and pollution loading field data.

HKSAR Waters (Outside the Project Site Boundary)

5.6.129 The pollution loading inventory covers the whole HKSAR waters and was input into the Update Model and the detailed VH Model for cumulative impact assessment. The inventory has incorporated all possible pollution sources within the HKSAR waters including those from landfill sites, marine culture zones, beach facilities and typhoon shelters, non-point source surface run-off and sewage from cross connections etc. The inventory has also taken into account the removal of pollutants due to wastewater treatment facilities and the possible redistribution of pollution loads due to different sewage disposal plans and sewage export schemes. The methodologies for compiling the pollution loading are given in **Appendix 5.3**.

5.6.130 To take account of the background pollution loading for cumulative assessment, pollution loading from the HATS was considered. Chemically enhanced primary treatment (CEPT) with disinfection is assumed as the treatment process of HATS in this EIA study for water quality modelling which involves a discharge of effluent at the existing Stonecutters Island Sewage Treatment Works (SCISTW). The HATS loading assumed in this EIA is given in **Table 5.14**.

Table 5.14 Pollution Loading from Stonecutters Sewage Treatment Works under HATS

Parameters	2011 Scenario (HATS Stage 1)		2016 Scenario (HATS Stage 2A)	
	Assumed Concentration	Assumed Flow and Loads	Assumed Concentration	Assumed Flow and Loads
Flow rate	-	1,638,000 m^3/day (1)	-	2,800,000 m^3/day (3)
BOD_5	68 mg/l (2)	107188400 g/day	68 mg/l (2)	190400000 g/day
SS	42 mg/l (2)	66204600 g/day	42 mg/l (2)	117600000 g/day
Organic Nitrogen	9.93 mg/l (2)	15652659 g/day	9.93 mg/l (2)	2780400 g/day
NH_3-N	17.43 mg/l (2)	27474909 g/day	17.43 mg/l (2)	48804000 g/day
E. coli	200,000 no./100ml (2 log bacterial kill) (2)	3.15E+15 no./day	20,000 no./100ml (3 log bacterial kill) (2)	5.6E+14 no./day
Total Phosphorus	3 mg/l (2)	4728900 g/day	3 mg/l (2)	8400000 g/day
Ortho-Phosphate	1.8 mg/l (2)	2837340 g/day	1.8 mg/l (2)	5040000 g/day
Silicate	8.6 mg/l (2)	13556180 g/day	8.6 mg/l (2)	24080000 g/day
Total nitrite and nitrate	0 mg/l (2)	0 g/day	0 mg/l (2)	0 g/day
Total Residual Chlorine	0.2 mg/l (2)	315260 g/day	0.2 mg/l (2)	560000 g/day

Notes:
(1) The projected flow rate for 2011 was estimated using the latest planning and employment statistics as detailed in **Appendix 5.3**.
(2) Based on the “Environmental and Engineering Feasibility Assessment Studies in Relation to the Way Forward of the Harbour Area Treatment Scheme (HATS EEFS) Final Study Report”.
(3) Design capacity of the future upgraded SCISTW based on the HATS EEFS.

5.6.131 The sewage flows generated from Wan Chai East (WCE) and Wan Chai West (WCW) catchments would be discharged via the submarine outfalls of Wan Chai East preliminary treatment works (WCEPTW) and Wan Chai West preliminary treatment works (WCWPTW) under the 2011 construction phase scenarios. Under the 2016 operation scenarios, it is assumed that the sewage flows from both WCWPTW and WCEPTW would be conveyed to the SCISTW for centralized treatment under the HATS Stage 2A. The locations of catchments WCE and WCW is shown in **Table A5-3-1** of **Appendix 5.3**. The water quality impacts upon the Victoria Harbour for the period after the commissioning of the new WCEPTW submarine sewage outfall and before diverting the sewage flow from WCEPTW to the SCISTW under HATS Stage 2A are addressed in Sections 5.7.31 and 5.7.32.

Storm Outfalls within the Project Site Boundary

5.6.132 Pollution loading discharged from the existing storm system of the Wan Chai, Causeway Bay and North Point catchments was quantified. The storm pollution within the catchments is mainly caused by polluted stormwater runoff or street washing to the drainage system; and expedient connections from trade and residential premises and integrity problems of aged drainage and sewerage systems in the catchment areas. The pollution loading inventory for individual storm outfalls along the coastline of Wan Chai, Causeway Bay and North Point was compiled by a combination of desk-top calculations and field surveys.

Wan Chai and Causeway Bay Area

Loading Growth Ratios by Sewage Catchment Area

5.6.133 The 2003-based Territorial Population and Employment Data Matrices (TPEDM) provided by Planning Department (PlanD), which were the latest planning data available at the time when this EIA was conducted, were used to compile the pollution loads from domestic, commercial and industrial activities. The TPEDM provides the projected population breakdown by Planning Vision and Strategy (PVS) zones. To facilitate the estimation of pollution loading, the population and employment data are required to be presented at the level of sewage catchment areas. The catchments of concern would be the Wan Chai East (WCE) and Wan Chai West (WCW) sewage catchments. However, the projected population from PlanD is provided in a smaller scale at PVS zones. Population and employment data for each of the WCE and WCW catchments were estimated by overlaying the PVS zones on top of the layout of the sewage catchment area for allocating the appropriate PVS zones to the catchment area.

5.6.134 The modeling work was carried out for two time horizons, namely 2011 and 2016 scenarios where the projected population data provided by PlanD at PVS zones are available for 2006, 2011 and 2016. Relevant per head flow and load were then assigned to residential, transient, commercial and industrial population to obtain the quantity and quality of total untreated wastewater by individual catchments. Further elaboration of the methodologies for compiling the pollution loading is given in **Appendix 5.3**.

5.6.135 The pollution loading generated within the WCE and WCW sewage catchments was calculated for 2006, 2011 and 2016 and was used to determine the loading growth ratios between different time horizons. For example, the growth ratios between 2006 and 2016 were calculated with reference to the projected loads (calculated by desk-top method) for 2006 and 2016.

Loading Inventory by individual Storm Culverts

5.6.136 An expedient connection survey and a stormwater flow and pollutant survey were conducted in 2000 [19, 20] under the WDIICFS to estimate the pollution loading discharged via the major storm outfalls along the coastline of Wan Chai and Causeway Bay. The corresponding 2000 dry weather loading results for these storm outfalls, namely Culverts L, M, N, O, P, Q, R and S, are presented in **Table 5.15**. The locations of these storm outfalls are shown in **Figure 5.3B**. The pollution loading discharged via individual storm culverts for future scenarios was estimated with reference to the 2000 survey data, taking account of the loading growth ratios compiled by desk-top approach as discussed in previous sections.

5.6.137 Based on the review of the population data for Wan Chai District, which covers the storm catchments in Wan Chai and Causeway Bay, released by Census & Statistics Department (C&SD), there was a slight reduction in the population size from mid-2000 to mid-2006 in Wan Chai District. It is therefore assumed that there would be no significant change in the pollution loading discharged via the concerned storm systems as a result of expedient connection or cross connections between drainage and sewerage system assuming that the percentage of sewage lost to the storm water system remains unchanged between 2000 and 2006. The loading due to storm water runoff or street washing to the drainage system can also be assumed to remain the same between 2000 and 2006 as there is no significant change in the land use within the concerned catchments.

5.6.138 The dry weather loading inventory for 2011 was thus compiled by applying the 2000 field data with the loading growth ratios between 2006 and 2011. Similarly, the loading inventory for 2016 was compiled by applying the loading growth ratios between 2006 and 2016 to take account of the population growth between the time horizons. The same loading growth ratios were applied to the storm culverts within the same sewage catchments. As there was only trace rainfall recorded during the 2000 survey period, the loading inventory compiled for 2011 and 2016 is treated as dry weather load.

5.6.139 The rainfall related pollution loads were calculated theoretically for WCW and WCE catchments and were added on top of the dry weather loading inventory to estimate the wet weather loads for conservative predictions. It was assumed that the rainfall related load would be evenly distributed amongst all the storm outfalls within the same sewage catchment. Calculations of the rainfall related loads are given in **Appendix 5.3.**

(19) EGS (Asia) Limited (2000). Wan Chai Development Phase II, Comprehensive Feasibility Study, Section I, Stormwater Flow and Pollutant Survey of Outfalls Entering Victoria Harbour of Outfalls Entering Victoria Harbour, Final Report.

(20) EGS (Asia) Limited (2000). Wan Chai Development Phase II, Expedient Connection Survey, Supplementary Report for Section I of Works.

5.6.140 The pollution loading discharged from the vessels in Causeway Bay Typhoon Shelter due to domestic activities was taken into account in the pollution load inventory. Data on marine population for the whole territory are available from C&SD for years 1986, 1991, 1996 and 2001 which show significant decline in the total marine population between 1986 and 2001 from 37,280 to 5,895. The annual vessel count in typhoon shelters conducted by Marine Department would provide information on the distribution of marine population between different typhoon shelters. The vessel count data for Causeway Bay typhoon shelter as reported in the EPD Update Study also indicated a trend of decline in the vessel number between 1986 and 1997. The pollution loading in Causeway Bay typhoon shelter was compiled using the marine population estimated for 1997 available from the EPD Update Study. Total pollution from marine population is expected to decrease in future as a result of continued reduction in marine population. So adopting pollution loadings for year 1997 for model input would represent a worst-case scenario.

North Point Area

5.6.141 It should be highlighted that no permanent marine embayment would be created along the coastline of North Point area as a result of the WDII reclamation and therefore the polluted storm water generated from the North Point catchment would be discharged into the open water and can be easily dispersed by the fast moving tidal currents. In addition, there would be no WSD flushing water intake located close to these storm water discharges. Thus, the level of pollution loading discharged via the storm system of North Point catchment will not be a critical water quality issue of concern.

5.6.142 The same desktop methods as described in Sections 5.6.133 to 5.6.135 for compiling the total loading generated in WCW and WCE catchments were used to estimate the loading inventory for North Point area except that the population data were refined to a smaller scale at the level of the catchments for individual stormwater outfalls, namely T, U, V and W as shown in **Figure 5.3B**, rather than at the level of sewage catchment areas. Population and employment data for each of the catchments of Culverts T, U, V and W were estimated by overlaying the PVS zones on top of the boundaries of the storm catchments for allocating the appropriate PVS zones to the catchment area. Per capital load factors were applied to the population to estimate the total sewage load generated in each storm catchment. It is assumed that 10 percent of the total load generated within the catchment would be lost to the storm water due to expedient connections or cross connections. Rainfall related load was also calculated theoretically as detailed in **Appendix 5.3** for compiling the wet season loading inventory. **Table 5.16** to **Table 5.19** show the pollution loading results for 2011 and 2016 scenarios for model input.

Table 5.15 Locations and Pollution Loadings Survey Results (in 2000) of Wan Chai Stormwater Outfalls

Outfall (Figure 5.3B)	Location		Flow rate (m^3 per day)	Pollution Loadings					
	Easting	Northing		BOD (kg per day)	Suspended Solids (kg per day)	Total Kjeldhal Nitrogen (kg per day)	Organic Nitrogen (kg per day)	Ammoniacal Nitrogen (kg per day)	*E. coli* (no. per day)
L	835467	815848	2743	1337.73	2144.12	129.86	106.70	23.16	7.889E+14
M	836000	815889	13775	514.28	581.30	93.60	58.58	35.02	1.84E+14
N	836397	815977	1761	18.80	11.37	5.76	2.69	3.07	1.86E+12
O	836551	816059	3500	378.87	346.35	53.09	33.29	19.80	3.078+14
P	836921	815940	127	84.19	50.92	7.97	2.93	5.04	6.41E+12
Q	837139	816106	13302	372.54	464.28	161.56	126.39	35.17	4.08E+13
R	837551	816230	1197	105.25	362.21	15.82	9.81	6.01	9.71E+12
S	837595	816322	1030	5.86	3.10	1.32	0.64	0.68	1.93E+12

Sources: (1) EGS (Asia) Limited (2000). Wan Chai Development Phase II, Comprehensive Feasibility Study, Section I, Stormwater Flow and Pollutant Survey of Outfalls Entering Victoria Harbour of Outfalls Entering Victoria Harbour, Final Report.
(2) EGS (Asia) Limited (2000). Wan Chai Development Phase II, Expedient Connection Survey, Supplementary Report for Section I of Works.

Table 5.16 Pollution Loading Inventory for Wan Chai, Causeway Bay and North Point - Year 2011 Dry Season

Outfall (Figure 5.3B)	Location		Flow rate (m^3 per day)	Pollution Loadings					
	Easting	Northing		BOD (kg per day)	Suspended Solids (kg per day)	Total Kjeldhal Nitrogen (kg per day)	Organic Nitrogen (kg per day)	Ammoniacal Nitrogen (kg per day)	*E. coli* (no. per day)
L	835467	815848	2793	1360.00	2176.44	133.12	109.19	23.77	8.10E+14
M	836000	815889	14007	523.19	590.40	96.22	60.07	36.07	1.90E+14
N	836397	815977	1782	18.99	11.47	5.85	2.73	3.12	1.89E+12
O	836551	816059	3523	382.05	348.72	54.0	33.80	20.17	3.14E+14
P	836921	815940	128	84.76	51.19	8.08	2.97	5.12	6.51E+12
Q	837139	816106	13500	376.25	468.15	165.36	129.02	36.08	4.19E+13
R	837551	816230	1217	106.39	365.50	16.22	10.03	6.18	9.98E+12
S	837595	816322	1061	5.95	3.14	1.37	0.66	0.71	2.01E+12
T	837588	816609	1109	294.63	260.34	37.56	16.77	20.80	1.72E+14
U	837889	816838	788	219.09	192.11	27.51	12.30	15.21	1.26E+14
V	837975	816937	164	46.17	40.44	5.71	2.56	3.15	2.60E+13
W	838226	817085	388	93.29	82.35	13.99	6.06	7.93	6.62E+13

Table 5.17 Pollution Loading Inventory for Wan Chai, Causeway Bay and North Point - Year 2011 Wet Season

Outfall (Figure 5.3B)	Location		Flow rate (m^3 per day)	Pollution Loadings					
	Easting	Northing		BOD (kg per day)	Suspended Solids (kg per day)	Total Kjeldhal Nitrogen (kg per day)	Organic Nitrogen (kg per day)	Ammoniacal Nitrogen (kg per day)	*E. coli* (no. per day)
L	835467	815848	12121	1983.60	4280.58	160.01	151.73	25.01	8.10E+14
M	836000	815889	66108	816.03	1278.17	120.09	88.58	38.39	1.90E+14
N	836397	815977	7300	26.17	20.93	6.88	3.65	3.26	1.89E+12
O	836551	816059	16329	579.71	732.93	67.19	49.40	21.46	3.14E+14
P	836921	815940	567	123.51	101.97	9.85	4.20	5.41	6.51E+12
Q	837139	816106	56940	520.33	855.20	196.35	174.80	37.84	4.19E+13
R	837551	816230	5321	165.88	741.93	20.89	15.09	6.68	9.98E+12
S	837595	816322	4039	7.46	4.85	1.55	0.83	0.73	2.01E+12
T	837588	816609	2885	334.55	337.14	40.05	18.90	21.15	1.72E+14
U	837889	816838	1631	238.05	228.58	28.69	13.31	15.38	1.26E+14
V	837975	816937	333	49.97	47.74	5.95	2.76	3.19	2.60E+13
W	838226	817085	709	100.49	96.21	14.44	6.45	7.99	6.62E+13

Table 5.18 Pollution Loading Inventory for Wan Chai, Causeway Bay and North Point - Year 2016 Dry Season

Outfall (Figure 5.3B)	Location		Flow rate (m^3 per day)	Pollution Loadings					
	Easting	Northing		BOD (kg per day)	Suspended Solids (kg per day)	Total Kjeldhal Nitrogen (kg per day)	Organic Nitrogen (kg per day)	Ammoniacal Nitrogen (kg per day)	*E. coli* (no. per day)
L	835467	815848	2975	1503.07	2387.15	143.20	117.84	25.51	8.65E+14
M	836000	815889	14551	556.49	624.94	101.01	63.13	37.84	1.98E+14
N	836397	815977	1884	20.86	12.50	6.26	2.93	3.33	2.01E+12
O	836551	816059	3553	390.64	355.73	55.11	34.49	20.58	3.20E+14
P	836921	815940	130	87.91	52.91	8.32	3.06	5.26	6.68E+12
Q	837139	816106	13816	377.47	467.67	167.99	130.80	36.71	4.26E+13
R	837551	816230	1249	106.24	363.35	16.45	10.15	6.28	1.01E+13
S	837595	816322	1110	5.82	3.05	1.39	0.67	0.72	2.04E+12
T	837588	816609	1186	233.38	202.49	36.16	15.65	20.50	1.70E+14
U	837889	816838	846	171.58	147.29	26.39	11.42	14.96	1.24E+14
V	837975	816937	177	35.54	30.41	5.47	2.37	3.10	2.57E+13
W	838226	817085	383	90.75	79.79	13.71	5.94	7.77	6.49E+13

.

Table 5.19 Pollution Loading Inventory for Wan Chai, Causeway Bay and North Point - Year 2016 Wet Season

Outfall (Figure 5.3B)	Location		Flow rate (m^3 per day)	Pollution Loadings					
	Easting	Northing		BOD (kg per day)	Suspended Solids (kg per day)	Total Kjeldhal Nitrogen (kg per day)	Organic Nitrogen (kg per day)	Ammoniacal Nitrogen (kg per day)	*E. coli* (no. per day)
L	835467	815848	12302	2126.66	4491.29	170.09	160.38	26.745	8.65E+14
M	836000	815889	66652	849.33	1312.71	124.88	91.64	40.154	1.98E+14
N	836397	815977	7401	28.03	21.97	7.28	3.85	3.468	2.01E+12
O	836551	816059	16359	588.30	739.94	68.30	50.10	21.871	3.20E+14
P	836921	815940	569	126.66	103.69	10.08	4.29	5.551	6.68E+12
Q	837139	816106	57256	521.55	854.71	198.98	176.58	38.477	4.26E+13
R	837551	816230	5353	165.73	739.77	21.11	15.20	6.781	1.01E+13
S	837595	816322	4089	7.34	4.76	1.57	0.83	0.744	2.04E+12
T	837588	816609	2962	273.29	279.29	38.64	17.78	20.859	1.70E+14
U	837889	816838	1689	190.54	183.75	27.57	12.44	15.131	1.24E+14
V	837975	816937	346	39.33	37.72	5.71	2.57	3.135	2.57E+13
W	838226	817085	703	97.96	93.65	14.16	6.32	7.838	6.49E+13

Uncertainties in Assessment Methodology

Marine-based Construction and Operational Phase Impacts

5.6.143 Quantitative uncertainties in the modelling were considered when making an evaluation of the modelling predictions. The following approach has been adopted to enhance the model performance:

- The computational grid of the detailed Victoria Harbour (VH) Model was refined along the coastline of Wan Chai, Causeway Bay and North Point to represent the coastal features under different interim construction and operational scenarios;
- Use of a fully calibrated and validated regional Update Model to provide boundary and initial conditions to the detailed VH Model;
- The performance of the detailed VH Model was extensively calibrated and validated with reference to the field data to ensure that reliable predictions of hydrodynamics are provided for the Study area.
- The simulation comprises a sufficient spin up period so that the initial conditions do not affect the results.

5.6.144 The level of uncertainties on the water quality predictions inside the temporary embayment areas would also depend on the accuracy of the pollution loading input into the embayment areas. The storm pollution loading discharged into the embayment areas along the coastline of Wan Chai and Causeway Bay including the Causeway Bay typhoon shelter was derived from detailed field investigation to provide accurate information for model input. The loading input to the water quality model under various future assessment scenarios has also taken into account the future development and population growth in order to provide conservative predictions.

5.6.145 The water quality impacts within the embayed area of Causeway Bay typhoon shelter during operational phase of the Project are of particular concern. It was assumed under the approved WDIICFS EIA that all the existing storm and spent cooling water outfalls within the Causeway Bay typhoon shelter would be permanently decommissioned and these outfalls would be diverted outside the typhoon shelter. This is deviated from the present Study that the existing storm and spent cooling water outfalls would remain within the Causeway Bay typhoon shelter. For the purpose of operational phase modelling, the grid mesh of the detailed VH model developed under the WDIICFS EIA was further modified under this EIA with a higher resolution (approximately 50m x 50m) at Causeway Bay typhoon shelter to address the water quality concern. The performance of the refined VH model has been checked against that of the detailed VH model approved under the WDIICFS EIA. The results predicted by both models are in general consistent with each other which implied that the model setting including the nesting procedure and the derivation of the boundary conditions were carried out correctly.

5.6.146 For construction phase modelling, the detailed VH model developed under the WDIICFS EIA was directly applied. This approach is considered acceptable considering that the construction phase impacts would be interim only.

5.6.147 The VH model was also used to assess the hydrodynamic impacts within the Victoria Harbour under both interim construction and operational phase scenarios. As the key concern would be the overall influences within the main flow channel of the Victoria Harbour, the approved detailed VH model developed under the WDIICFS is considered acceptable for use in the assessment of the potential hydrodynamic impacts.

5.6.148 It should be noted that all the predictions made in this water quality impact assessment were based on the latest available information and assumptions discussed in this section. If there are any major changes to the key assumptions during the actual implementation of the Project in the future, including those for the concurrent projects, the prediction and assessment findings presented in this EIA report should be reviewed accordingly.

Land-based Construction Phase Impacts

5.6.149 Proposed construction activities were reviewed to assess the land-based water quality impact upon the nearby water bodies. Practical water pollution control measures / mitigation proposals (Section 5.8) have been subsequently recommended to prevent local flooding and to ensure that effluent discharged from the construction site will comply with the WPCO criteria.

5.7 Prediction and Evaluation of Environmental Impacts

Hydrodynamic impacts - Operational and Interim Construction Phase

Tidal Flushing in Victoria Harbour

Hydrodynamic Impact from WDII and CWB

5.7.1 In order to assess the change in the overall assimilative capacity of Victoria Harbour, the flow discharge across two cross sections at the eastern and western ends of the harbour has been calculated. The mean and maximum discharge rates, during the flood and ebb tides, through Victoria Harbour under the interim construction and operational scenarios are presented in **Table 5.20**. The eastern cross section is located across the Lei Yue Mun Channel, while the western section is located between Yau Ma Tei and Sheung Wan (**Figure 5.14a**).

5.7.2 The model results indicated that the construction and operation of WDII reclamation would change the mean discharge through Victoria Harbour by not more than 1%. Considering the marginal change in flow discharge through Victoria Harbour, no major impacts on the assimilative capacity and, thus, the water quality of Victoria Harbour is expected to occur as a result of the Project.

5.7.3 The simulated surface flow patterns in the Victoria Harbour during operational stage of the Project are shown in **Appendix 5.4a** and **Appendix 5.4b** for dry and wet seasons respectively. The flow patterns correspond to the instantaneous water movements in Victoria Harbour at mid-ebb and mid-flood tides. Contour plots of depth-averaged flow speeds for the same tides are shown in **Appendix 5.4c** and **Appendix 5.4d** for dry and wet seasons respectively. The baseline conditions in 2016 without the WDII reclamation are also included in these figures for comparison.

5.7.4 The model results showed that the flow speed distributions within the Victoria Harbour before and after the implementation of the WDII reclamation are very similar. The reclamation causes only slight change in the prevailing currents along the coastline of Wan Chai. No significant change in the hydrodynamic condition within the Victoria Harbour is therefore expected from the WDII operation.

Table 5.20 Discharge Rates at Sections to the East and West of Victoria Harbour

Section	Season	Tide phase	Mean discharge ($m^3 s^{-1}$)					Percentage change (%)		
			Year 2011			Year 2016		Year 2011		Year 2016
			Baseline (without WDII) (1) Scenario 2A	Interim Construction Scenario 2B (2)	Interim Construction Scenario 2C (3)	Baseline (without WDII) (4) Scenario 1A	Operation (with WDII) (5) Scenario 1B	Due to Interim Construction 2B (6)	Due to Interim Construction 2C (7)	Due to WDII Operation (8)
Victoria Harbour East	Wet	Flood	3575	3575	3568	3575	3578	-0.01	-0.20	-0.08
		Ebb	4580	4542	4535	4552	4570	-0.84	-0.99	-0.40
	Dry	Flood	4529	4510	4508	4509	4523	-0.41	-0.46	-0.32
		Ebb	3712	3705	3702	3705	3711	-0.21	-0.29	-0.17
Victoria Harbour West	Wet	Flood	2981	2980	2979	2985	2985	-0.03	-0.07	0.01
		Ebb	3823	3790	3786	3803	3813	-0.88	-0.97	-0.27
	Dry	Flood	3894	3878	3879	3882	3891	-0.41	-0.39	-0.24
		Ebb	2986	2978	2978	2981	2982	-0.26	-0.25	-0.03

Section	Season	Tide phase	Maximum discharge ($m^3 s^{-1}$)					Percentage change (%)		
			Year 2011			Year 2016		Year 2011		Year 2016
			Baseline (without WDII) (1) Scenario 2A	Interim Construction Scenario 2B (2)	Interim Construction Scenario 2C (3)	Baseline (without WDII) (4) Scenario 1A	Operation (with WDII) (5) Scenario 1B	Interim Construction 2B (6)	Interim Construction 2C (7)	Due to WDII Operation (8)
Victoria Harbour East	Wet	Flood	8001	7991	7986	7967	7983	-0.12	-0.18	-0.20
		Ebb	11453	11349	11356	11426	11484	-0.91	-0.85	-0.50
	Dry	Flood	9927	9897	9894	9891	9918	-0.30	-0.33	-0.27
		Ebb	10890	10857	10846	10857	10879	-0.30	-0.40	-0.20
Victoria Harbour West	Wet	Flood	6610	6582	6578	6559	6584	-0.43	-0.49	-0.38
		Ebb	9270	9182	9191	9265	9287	-0.94	-0.85	-0.24
	Dry	Flood	8158	8132	8137	8132	8145	-0.33	-0.26	-0.17
		Ebb	8388	8360	8362	8369	8368	-0.34	-0.30	0.01

Note:
(1) Baseline condition in 2011 without WDII and CWB reclamation (Scenario 2A).
(2) Interim WDII and CWB construction Scenario 2B (**Figure 5.8**).
(3) Interim WDII and CWB construction Scenario 2C (**Figure 5.9**).
(4) Baseline condition in 2016 without WDII and CWB reclamation (Scenario 1A).
(5) Condition in 2016 with WDII and CWB reclamation (Scenario 1B).
(6) This is the percentage changes between "2011 Interim Construction Scenario 2B" and "2011 Baseline Scenario (without WDII and CWB) Scenario 2A".
(7) This is the percentage changes between "2011 Interim Construction Scenario 2C" and "2011 Baseline Scenario (without WDII and CWB) Scenario 2A".
(8) This is the percentage changes between "2016 Baseline Scenario (without WDII and CWB) Scenario 1A" and "2016 Operation Scenario (with WDII and CWB) Scenario 1B".

Hydrodynamic Impact from CRIII and WDII

5.7.5 As shown in **Table 5.21**, changes in tidal flushing due to the reclamation layout of the WDII and CWB alone would not be more than 0.5% during the operation of the WDII. Based on the information available from the approved EIA for WDIICFS, changes in tidal flushing due to the CRIII reclamation alone would not be more than 0.54%. Thus, the total influence on the tidal flushing due to the CRIII and WDII and CWB reclamations would not be more than 1.04%. Considering the marginal change in flow discharge through Victoria Harbour, no major impacts on the assimilative capacity and, thus, the water quality of Victoria Harbour is expected to occur as a result of the CRIII and WDII and CWB reclamations.

Water Quality Impacts – Operational Phase

Water Quality in Victoria Harbour

5.7.6 The water quality modelling results are presented as contour plots in **Appendix 5.5** for dissolved oxygen (DO), biochemical oxygen demand (BOD_5), suspended solids (SS), total inorganic nitrogen (TIN), unionized ammonia (UIA) and *E.coli*. Each figure attached in **Appendix 5.5** contains two contour plots for comparison. The upper plot shows the model output for 2016 baseline scenario (without the WDII reclamation), namely Scenario 1A, whereas the lower plot shows the model output for 2016 operation scenario (with the WDII reclamation), namely Scenario 1B. All contour plots are presented as annual arithmetic averages except for the *E.coli* levels which are annual geometric means and the DO levels which are 10 percentile values for comparison with the WQO.

5.7.7 Comparing the "without the Project" case (Scenario 1A) and "with the Project" case (Scenario 1B) in 2016, no significant change in the Harbour water quality is observed between the two scenarios for all the selected water quality parameters. Full compliance with the WQO for 10 percentile bottom DO (> 2mg/l), 10 percentile depth-averaged DO (> 4mg/l), TIN (< 0.4 mg/l) and UIA (< 0.021 mg/l) was observed in the Victoria Harbour except for some localized areas in close proximity of the storm outfalls within the Causeway Bay typhoon shelter where the level of TIN and UIA exceeded the WQO (see **Appendix 5.5**).

Water Quality in Marine Embayments

5.7.8 Because of the relatively low flushing capacity, the operational water quality of the marine embayments at the existing PWCA and Causeway Bay typhoon shelter as well as the inner waters on both sides of the HKCEC Extension are of particular concern. The contour plots in **Appendix 5.5** indicated that the marine embayments at the PWCA and HKCEC would fully comply with the WQO for DO, TIN and UIA after the completion of WDII.

5.7.9 As discussed in Section 5.6.145, the water quality in the CBTS would be affected by the discharges from existing storm outfalls. The model predicted that some localized WQO exceedances for TIN and UIA would occur at the southwest corner of the Causeway Bay typhoon shelter near Outfall P during the operational phase of the Project. As indicated in **Appendix 5.5**, exceedances of the UIA and TIN levels close to the Outfall P were however found to be small and of limited extent. The associated water quality impact is therefore considered acceptable given that the typhoon shelter has low marine ecological value. Full compliance with the WQO for DO would be achieved after the completion of WDII.

Water Quality at Sensitive Receivers

5.7.10 **Appendix 5.6** tabulates the modelling results of Scenario 1A (without the Project) and Scenario 1B (with the Project) at identified water sensitive receivers in 2016. The results provided for WSD flushing water intakes and cooling water intakes in **Appendix 5.6** are maximum values over the 1-year simulation period except for the minimum DO (which is the lowest value predicted over the entire simulation year). These data are the results predicted in the middle water layer where the seawater intake points are located.

5.7.11 The water quality model results for coral sites provided in **Appendix 5.6** are annual mean except for the DO (which is the 10 percentile value predicted over the entire simulation year) and the sedimentation rate (which is the peak value predicted over the entire simulation year).

5.7.12 Based on the model results, full compliance with the assessment criteria would be achieved at all identified sensitive receivers in 2016 (**Appendix 5.6**). The comparison between the modelling results of Scenario 1A (without the Project) and Scenario 1B (with the Project) (in **Appendix 5.6**) indicated that there would be no obvious difference in the extent of water quality impact between the scenarios. The Project would not contribute any water quality exceedance.

Thermal Plume and Biocide Impacts

5.7.13 Cooling water intakes and outfalls for the existing and proposed developments within the study area will be reprovisioned to or located on the new waterfront of the WDII reclamation. Potential water quality impacts in terms of temperature rise and residual biocide contamination may arise from cooling water discharges. Mathematical modelling was conducted to simulate and assess the potential impacts in the Victoria Harbour.

5.7.14 The WQO for the Victoria Harbour WCZ stipulated that the temperature rise in the water column due to human activity should not exceed 2 ^{o}C (**Table 5.1**). **Appendix 5.7A** to **Appendix 5.7D** show the surface temperature elevations over the ambient temperature at different tidal conditions for dry and wet seasons. The model results indicated that temperature rise of more than 2 ^{o}C would occur in a small area in close vicinity of the spent cooling water outfalls to the east of HKCEC Extension under some tidal conditions. The overall thermal plume impact was localised near the outfalls. The spent cooling waters would unlikely cause any unacceptable impact in the Victoria Harbour.

5.7.15 The predicted mean and 90 percentile temperature rises at the cooling water intakes within the project boundary of WDII are summarised in **Table 5.21**. The cooling water intakes and WSD flushing water intakes would be located at –3.35 mPD and -2.0 mPD respectively which corresponds to the mid layer of the water column in the Delft3D model. The 90-percentile temperature rise ranges from 0.13 ^{o}C to 0.87 ^{o}C. Hence, unacceptable temperature rise at the cooling water intakes is not anticipated.

5.7.16 It should be noted that the cooling water systems at North Point (City Garden and Provident Centre) as shown in **Figure 5.2** and **Figure 5.3A** was not included in the modelling exercise. From review of the model results, the cooling water discharged into the Causeway Bay typhoon shelter from Excelsior Hotel and World Trade Centre would only cause localized thermal impact. The model predicted that, even using the maximum flow of 1.4 m^3/s for continuous discharge at the typhoon shelter where the water was static and the flushing effect was low, the maximum distance between the cooling water discharge point and the edge of the mixing zone would be less than 85 m. The thermal impact on the two identified cooling water systems at North Point would be acceptable considering that (1) the cooling water flow rates for City Garden and Provident Centre should be less than that for the Excelsior and World Trade Centre; (2) the distance between the cooling water intake and cooling water discharge is larger than 85m for both of the cooling water systems at North Point; and (3) the flushing effect near the NP reclamation site should be better than that within the Causeway Bay typhoon shelter. It should be noted that the present simulation adopted a conservative approach where the maximum discharge flow rates from the water cooling systems have been assumed to discharge continuously (that is, 24 hours daily). In reality, the maximum flow discharge would only occur during the office hours and depends on the outdoor air temperature in different seasons.

Table 5.21 Operation Scenario – Temperature Elevations at Cooling Water Intakes

Sensitive Receiver	Temperature elevation in surface layer (°C)			
	Dry season		Wet season	
	Mean	90 percentile	Mean	90 percentile
Hong Kong Convention and Exhibition Centre Extension	0.11	0.18	0.07	0.14
Telecom House/HK Academy for Performing / Shui On Centre	0.10	0.16	0.07	0.14
Hong Kong Convention and Exhibition Centre Phase 1	0.10	0.16	0.07	0.14
Wan Chai Tower / Revenue Tower / Immigration Tower	0.11	0.18	0.07	0.14
Great eagle Centre / China Resources Building	0.11	0.18	0.07	0.14
Sun Hung Kai Centre	0.27	0.40	0.26	0.50
Proposed Exhibition Station	0.27	0.40	0.26	0.50
Excelsior Hotel & World Trade Centre/No. 27-63 Paterson Street	0.60	0.70	0.64	0.87
Windsor House	0.34	0.39	0.53	0.66
Proposed HKAPA Extension	0.12	0.18	0.08	0.13

5.7.17 Chlorine, in the form of sodium hypochlorite solution or produced through electrolysis of sea water, is commonly used as an anti-fouling agent or biocide for the treatment of cooling water within the cooling systems. Residual chlorine discharging to the receiving water is potentially harmful to the marine organisms. **Appendix 5.8** shows the predicted tidal and depth averaged chlorine concentration for a spring-neap cycle, in the wet and dry seasons. The model results indicated that the chlorine concentrations in the Victoria Harbour would generally comply with the assessment criterion of 0.075 mg/l and, thus, unacceptable impact on the marine organism is not anticipated. It should be noted that the chlorine decay rate used under this modelling exercise is smaller than that adopted under the approved EIA for WDIICFS to provide conservatism.

5.7.18 Besides chlorine, C-Treat-6 would be the only other chemical injection to the cooling system. C-Treat-6 is usually injected only for one hour per week to achieve 2 mg/L 30% tallow 1,3-propylene diamine (as amine content) at the spent cooling water outfall [21]. This small amount and intermittent releases of biocide would be readily diluted by tidal current in the Victoria Harbour such that the potential impact from the biocide within the Victoria Harbour would be minimal.

Floating Refuse and Debris Entrapment

5.7.19 The Causeway Bay Typhoon Shelter and PCWA basin are existing embayments and the Project would not cause any change of the shoreline configuration of these areas. The shoreline of the area adjacent to HKCEC Extension and at Wan Chai would be streamlined and thus the Project would not worsen the existing situation with respect to the potential for floating refuse accumulation.

Water Quality Impacts - Construction Phase

Marine-based Impact

Suspended Solids

5.7.20 Four sediment dispersion scenarios were modelled, as defined in **Table 5.22**, **Table 5.23** and **Table 5.24** for the base case scenarios and **Table 5.22a** for the sensitivity test. Absolute maximum and tidal-averaged SS concentrations predicted at mid-depth for a spring-neap cycle for each seawater intake, taking into account the background SS concentration, are presented in these tables. The 90 percentile SS level predicted at the corresponding indicator points under the pre-construction scenario (namely Scenario 3A) is used as the background SS concentrations for conservative predictions.

5.7.21 Each construction scenario was simulated with three typical spring-neap tidal cycles for spin-up and one cycle for actual simulation in both dry and wet seasons. The predicted mean and maximum SS concentrations at the water sensitive receivers for dry season and wet seasons are shown in **Table 5.22** to **Table 5.24** and **Table 5.22a**. The results shown in tables indicate exceedances (highlighted in bold) of WSD water quality (SS) criterion and target SS level of Admiralty Centre and MTRC cooling water intakes. Mitigation measures are therefore required to minimise the impact.

5.7.22 The construction contours presented in **Appendix 5.9a** to **Appendix 5.9h** show the extent of mid-depth SS elevations over a spring-neap cycle, during wet and dry seasons for the base case scenarios and the sensitivity test. The tidal-averaged sedimentation rate of SS during dry and wet seasons is also presented in **Appendix 5.9a** to **Appendix 5.9h**. As shown in the appendices, the sedimentation rates at waters near the Green Island and within Junk Bay would be lower than 0.1 kg m^{-2} per day (Section 5.3.10). **Table 5.43** to **Table 5.46** in Section 5.8 also summarise the predicted SS elevation at the coral site in Junk Bay under the mitigated scenario. The coral sites at Green Island and Junk Island were found not be impacted by marine works from WDII and are therefore not included in the tables. With the recommended measures, the SS elevation predicted at the Junk Bay would fully comply with the WQO. It is therefore predicted that that the WDII development would not adversely impact the coral communities at waters near the Green Island and within Junk Bay in terms of both sedimentation rate and SS elevation.

[21] Source of information: Agreement No. CE 47/2001 Implementation Study for Water-cooled Air Conditioning System at Wan Chai and Causeway Bay – Investigation, Final Report (submitted by Parsons Brinckerhoff (Asia) Limited) 2005.

Table 5.22 Construction Scenario 2A – Suspended Solids Concentrations at Sensitive Receivers (Base Case Scenario)

Sensitive Receiver	SS concentration (absolute value) in mid-depth (mg/l)						
	Criterion	Dry season			Wet season		
		Mean	Maximum	% time in compliance	Mean	Maximum	% time in compliance
Cooling Water Intakes							
Prince's Building Group	-	11.0	80.9	-	10.4	65.9	-
Queensway Government Offices	-	12.3	69.3	-	11.4	62.3	-
Admiralty Centre	< 40	12.9	**100.8**	**95.3%**	11.1	**50.6**	**98.9%**
HSBC	-	12.1	70.4	-	11.0	78.7	-
Excelsior Hotel & World Trade Centre	-	7.3	7.6	-	7.6	61.1	-
Great Eagle Centre / China Resources Building	-	15.3	69.8	-	12.7	75.7	-
Hong Kong Convention and Exhibition Centre Extension	-	9.9	66.5	-	10.7	54.1	-
Hong Kong Convention and Exhibition Centre Phase I	-	25.5	465.7	-	27.4	461.8	-
MTRC South Intake	< 40	7.1	**40.4**	**99.7%**	8.5	**44.1**	**99.7%**
Sun Hung Kai Centre	-	8.5	77.4	-	13.2	61.6	-
Telecom House / HK Academy for Performing Arts / Shun On Centre	-	19.7	122.5	-	14.6	94.9	-
Wan Chai Tower / Revenue Tower / Immigration Tower	-	16.5	93.7	-	14.2	92.4	-
Windsor House	-	7.7	7.8	-	8.2	52.7	-
Government Premises	-	5.9	15.7	-	9.6	36.4	-
City Garden	-	12.6	59.9	-	13.0	48.2	-
Provident Centre	-	11.6	66.6	-	12.9	45.3	-
WSD Saltwater Intakes							
Kennedy Town	< 10	6.6	**12.5**	**98.9%**	7.1	7.6	100.0%
Kowloon South	< 10	7.2	7.4	100.0%	7.3	**22.0**	**98.6%**
Quarry Bay	< 10	8.1	**43.3**	**82.3%**	7.2	**31.8**	**86.7%**
Sai Wan Ho	< 10	6.5	**51.1**	**88.9%**	6.6	**37.7**	**88.4%**
Sheung Wan	< 10	9.2	**42.4**	**77.0%**	8.7	**38.3**	**89.2%**
Siu Sai Wan	< 10	4.8	5.6	100.0%	5.0	8.8	100.0%
Wan Chai	< 10	6.6	**47.6**	**89.8%**	**10.1**	**38.7**	**82.8%**

Notes:

(1) The water quality modelling results for 90 percentile SS predicted under the pre-construction scenario (Scenario 3A) at the corresponding indicator points is adopted as the ambient SS levels.

- Other WSR, including WSD Tai Wan intake, WSD Cheung Sha Wan intake, WSD Cha Kwo Ling intake, Kau Yi Chau Fishery, PLA Headquarters intake, Queen Mary Hospital intake, Stage 1 Phase 1 intake and Wah Fu Estate intake were found not be impacted by the proposed marine works.
- **Bold and shaded number** indicates exceedence of criterion.

Table 5.22a Construction Scenario 2A – Suspended Solids Concentrations at Sensitive Receivers (Sensitivity Test using Higher Dredging Rate for Gas Main Construction)

Sensitive Receiver	SS concentration (absolute value) in mid-depth (mg/l)						
	Criterion	Dry season			Wet season		
		Mean	Maximum	% time in compliance	Mean	Maximum	% time in compliance
Cooling Water Intakes							
Prince's Building Group	-	11.0	80.9	-	10.6	66.4	-
Queensway Government Offices	-	12.3	69.3	-	11.5	62.3	-
Admiralty Centre	< 40	12.9	**100.8**	**95.3%**	11.2	**50.6**	**98.6%**
HSBC	-	12.1	70.4	-	11.2	78.7	-
Excelsior Hotel & World Trade Centre	-	7.3	7.6	-	7.6	61.1	-
Great Eagle Centre / China Resources Building	-	15.3	69.8	-	12.9	75.7	-
Hong Kong Convention and Exhibition Centre Extension	-	10.0	66.5	-	10.9	57.2	-
Hong Kong Convention and Exhibition Centre Phase I	-	25.5	465.7	-	27.6	461.8	-
MTRC South Intake	< 40	7.1	**40.4**	**99.7%**	8.5	**44.1**	**99.7%**
Sun Hung Kai Centre	-	8.5	77.4	-	13.3	61.6	-
Telecom House / HK Academy for Performing Arts / Shun On Centre	-	19.8	122.5	-	14.7	94.9	-
Wan Chai Tower / Revenue Tower / Immigration Tower	-	16.6	93.7	-	14.4	93.2	-
Windsor House	-	7.7	7.8	-	8.2	52.7	-
Government Premises	-	5.9	15.7	-	9.6	36.4	-
City Garden	-	12.6	59.9	-	13.0	48.2	-
Provident Centre	-	11.6	66.6	-	12.9	45.3	-
WSD Saltwater Intakes							
Kennedy Town	< 10	6.6	**12.5**	**98.9%**	7.2	7.6	100.0%
Kowloon South	< 10	7.2	7.4	100.0%	7.3	**22.0**	**98.6%**
Quarry Bay	< 10	8.1	**43.3**	**82.3%**	7.4	**32.0**	**86.7%**
Sai Wan Ho	< 10	6.5	**51.1**	**88.9%**	6.8	**38.3**	**88.4%**
Sheung Wan	< 10	9.2	**42.8**	**77.0%**	8.8	**38.3**	**88.6%**
Siu Sai Wan	< 10	4.8	5.6	100.0%	5.0	8.9	100.0%
Wan Chai	< 10	6.6	**47.6**	**89.8%**	**10.1**	**38.7**	**82.8%**

Notes:

(1) The water quality modelling results for 90 percentile SS predicted under the pre-construction scenario (Scenario 3A) at the corresponding indicator points is adopted as the ambient SS levels.

- Other WSR, including WSD Tai Wan intake, WSD Cheung Sha Wan intake, WSD Cha Kwo Ling intake, Kau Yi Chau Fishery, PLA Headquarters intake, Queen Mary Hospital intake, Stage 1 Phase 1 intake and Wah Fu Estate intake were found not be impacted by the proposed marine works.
- **Bold and shaded number** indicates exceedence of criterion.

Table 5.23 Construction Scenario 2B – Suspended Solids Concentrations at Sensitive Receivers

Sensitive Receiver	SS concentration (absolute value) in mid-depth (mg/l)						
	Criterion	Dry season			Wet season		
		Mean	Maximum	% time in compliance	Mean	Maximum	% time in compliance
Cooling Water Intakes							
Prince's Building Group	-	6.9	25.0	-	8.1	26.6	-
Queensway Government Offices	-	6.1	34.1	-	8.8	79.2	-
Admiralty Centre	< 40	6.5	26.0	100.0%	8.6	**58.5**	**99.7%**
HSBC	-	6.0	45.8	-	8.4	36.1	-
Excelsior Hotel & World Trade Centre	-	9.2	70.2	-	16.8	159.1	-
Great Eagle Centre / China Resources Building	-	7.3	18.9	-	7.5	21.5	-
Hong Kong Convention and Exhibition Centre Extension	-	6.5	54.2	-	9.5	50.8	-
Hong Kong Convention and Exhibition Centre Phase I	-	7.3	7.3	-	7.4	20.0	-
MTRC South Intake	< 40	7.5	20.1	100.0%	8.0	20.7	100.0%
Sun Hung Kai Centre	-	7.2	21.1	-	7.4	22.9	-
Telecom House / HK Academy for Performing Arts / Shun On Centre	-	7.8	20.2	-	8.6	29.8	-
Wan Chai Tower / Revenue Tower / Immigration Tower	-	7.3	8.1	-	7.2	19.9	-
Windsor House	-	9.0	9.0	-	11.4	111.3	-
Government Premises	-	4.8	6.3	-	7.5	10.2	-
City Garden	-	4.8	9.4	-	7.4	20.5	-
Provident Centre	-	4.8	12.4	-	7.5	13.8	-
WSD Saltwater Intakes							
Kennedy Town	< 10	6.4	7.6	100.0%	7.1	7.6	100.0%
Kowloon South	< 10	7.2	7.2	100.0%	7.1	8.1	100.0%
Quarry Bay	< 10	4.9	**18.4**	**98.9%**	5.4	**18.7**	**97.2%**
Sai Wan Ho	< 10	4.8	**15.9**	**99.4%**	5.2	**17.6**	**97.5%**
Sheung Wan	< 10	7.2	**33.1**	**89.2%**	7.7	**27.3**	**95.8%**
Siu Sai Wan	< 10	4.8	4.8	100.0%	4.8	5.8	100.0%
Wan Chai	< 10	6.8	6.8	100.0%	7.4	**23.4**	**98.6%**

Notes:

(1) The water quality modelling results for 90 percentile SS predicted under the pre-construction scenario (Scenario 3A) at the corresponding indicator points is adopted as the ambient SS levels.

- Other WSR, including WSD Tai Wan intake, WSD Cheung Sha Wan intake, WSD Cha Kwo Ling intake, Kau Yi Chau Fishery, PLA Headquarters intake, Queen Mary Hospital intake, Stage 1 Phase 1 intake and Wah Fu Estate intake were found not be impacted by the proposed marine works.
- **Bold and shaded number** indicates exceedence of criterion.

Table 5.24 Construction Scenario 2C – Suspended Solids Concentrations at Sensitive Receivers

Sensitive Receiver	SS concentration (absolute value) in mid-depth (mg/l)						
	Criterion	Dry season			Wet season		
		Mean (3)	Maximum (3)	% time in compliance	Mean (3)	Maximum (3)	% time in compliance
Cooling Water Intakes							
Prince's Building Group	-	5.2	15.4	-	8.6	37.0	-
Queensway Government Offices	-	5.6	16.0	-	11.6	95.6	-
Admiralty Centre	< 40	5.6	24.6	100.0%	10.2	**72.5**	**99.2%**
HSBC	-	5.4	27.2	-	10.6	69.6	-
Excelsior Hotel & World Trade Centre	-	12.2	77.0	-	7.4	47.2	-
Great Eagle Centre / China Resources Building	-	11.6	45.8	-	12.5	74.6	-
Hong Kong Convention and Exhibition Centre Extension	-	6.1	54.2	-	8.5	37.7	-
Hong Kong Convention and Exhibition Centre Phase I	-	9.1	31.3	-	11.5	58.2	-
MTRC South Intake	< 40	9.9	**42.1**	**99.7%**	8.8	**42.4**	**99.7%**
Sun Hung Kai Centre (reprovisioned)	-	6.6	32.5	-	9.2	37.9	-
Telecom House / HK Academy for Performing Arts / Shun On Centre	-	15.8	73.8	-	10.4	41.5	-
Wan Chai Tower / Revenue Tower / Immigration Tower	-	10.8	57.5	-	12.2	73.7	-
Windsor House (reprovisioned)	-	9.8	74.8	-	9.4	54.8	-
Government Premises	-	4.8	6.1	-	7.4	11.2	-
City Garden	-	4.7	8.9	-	7.2	12.5	-
Provident Centre	-	4.7	8.5	-	7.3	13.2	-
WSD Saltwater Intakes							
Kennedy Town	< 10	6.5	7.9	100.0%	7.1	7.6	100.0%
Kowloon South	< 10	7.2	8.1	100.0%	7.1	8.1	100.0%
Quarry Bay	< 10	4.8	**17.4**	**99.7%**	5.3	**18.0**	**97.8%**
Sai Wan Ho	< 10	4.8	5.5	100.0%	5.3	**25.3**	**97.2%**
Sheung Wan	< 10	6.4	**29.3**	**96.7%**	7.7	**18.2**	**95.8%**
Siu Sai Wan	< 10	4.8	4.8	100.0%	4.8	6.7	100.0%
Wan Chai (reprovisioned)	< 10	6.6	**32.5**	**87.3%**	9.2	**37.9**	**85.6%**

Notes:

(1) The water quality modelling results for 90 percentile SS predicted under the pre-construction scenario (Scenario 3A) at the corresponding indicator points is adopted as the ambient SS levels.

- Other WSR, including WSD Tai Wan intake, WSD Cheung Sha Wan intake, WSD Cha Kwo Ling intake, Kau Yi Chau Fishery, PLA Headquarters intake, Queen Mary Hospital intake, Stage 1 Phase 1 intake and Wah Fu Estate intake were found not be impacted by the proposed marine works.
- **Bold and shaded number** indicates exceedence of criterion.

Compliance with WQO for SS Elevation

5.7.23 Non-compliance with the WQO for SS (i.e. elevation of less than 30% of ambient baseline level) is predicted in the Victoria Harbour channel under various dredging scenarios. The worst case impact in terms of the SS elevation would occur in early 2009 under Scenario 2A as shown in **Appendix 5.9a to Appendix 5.9h**. Each figure attached in these appendices contains two contour plots where the upper plot shows the unmitigated scenarios and the lower plot shows the mitigated scenarios. As shown in the contour plots, the sediment plume would be relatively large under the unmitigated scenario and become localized after implementation of the mitigation measures as recommended in Section 5.8. The general compliance for DO, nutrients in Victoria Harbour is discussed in later sections.

Water Quality in Temporary Embayments

5.7.24 Temporary embayments will be formed between reclaimed areas of land in different stages of the WDII reclamation. Potential water quality impact associated with the accumulation of pollutants discharged from the storm culverts into the temporary embayment was modelled for two interim construction scenarios as detailed in Section 5.6 using the Delft3D-WAQ model. **Figure 5.10** and **Figure 5.11** show the locations of the temporary embayments.

5.7.25 Model simulations were carried out for both dry and wet seasons. For each seasonal condition simulated, the water quality model results are presented as contour plots for minimum depth-averaged DO, minimum bottom DO, mean depth-averaged UIA, TIN, and *E. coli* as shown in **Appendix 5.10a** to **Appendix 5.10d**. The contour plots for UIA and TIN are arithmetic means over one complete tidal cycle whilst the contour plots for *E. coli* are geometric means. Each figure attached in these appendices contains two contour plots. The lower plot represents the interim construction scenario whereas the upper plot shows the pre-construction scenario without any reclamation for comparison.

5.7.26 **Table 5.25** and **Table 5.26** summarises both the predicted water quality at water sensitive receivers within the temporary embayments, and the baseline water quality for the pre-construction scenarios (shown for comparison). Water sensitive receivers inside the temporary embayments include several cooling water intakes and a WSD flushing water intake. The model results presented for these seawater intakes are the predicted values at mid-depth where the intake points are located. The predicted water quality within the temporary embayments is presented as minimum depth-averaged DO, minimum bottom DO, mean depth-averaged UIA and TIN for comparison with the WQO.

5.7.27 The model results show that there would be some local exceedances of the TIN levels. However, most of these exceedances were not contributed by the Project as similar degree of TIN exceedances was also predicted under the pre-construction scenario. It should be noted that the background TIN level in Victoria Harbour is considered high in general. The predicted UIA levels also exceeded the WQO at Causeway Bay typhoon shelter which may have implication on the marine ecology as UIA is toxic to marine organisms. The associated water quality impact is however anticipated to be limited as Causeway Bay typhoon shelter has low marine ecological value and the plume of UIA would be confined within the typhoon shelter as shown in the figures attached in the appendices. Full compliance with the assessment criteria was predicted under the interim construction scenarios for other water quality parameters including DO and SS.

Table 5.25 Predicted Water Quality at Temporary Embayment at Interim Construction Stage - Wet Season

Temporary Embayment ID	Sensitive Receiver	Scenario (ID)	Minimum (mg/l)		Depth-averaged (mg/l)		Middle Water Layer (mg/l)							
							NH_3-N		SS		DO		BOD_5	
			Depth-averaged DO	Bottom DO	Mean UIA	Mean TIN	Mean	Maximum	Mean	Maximum	Mean	Minimum	Mean	Maximum
			WPCO WQO:				WSD Criteria (applicable to WSD Flushing Water Intake only):							
			≥ 4	≥ 2	≤0.021	≤0.4	-	< 1	-	< 10	-	> 2	-	<10
Temporary Embayment I (**Figure 5.10**)	Marine embayment between CRIII and HKCEC1	Pre-construction (3A)	4.99	4.81	0.013	**0.41**	-	-	-	-	-	-	-	-
		Interim Construction (3B)	4.93	4.76	0.013	**0.43**	-	-	-	-	-	-	-	-
	Cooling water intake for Telecom House/HK Academy for Performing/Shui On	2009 Baseline (3A)	-	-	-	-	0.014	0.018	5.08	6.28	5.27	4.99	0.59	0.99
		Interim Construction (3B)	-	-	-	-	0.014	0.018	5.91	10.52	5.31	4.86	0.94	2.94
Temporary Embayment II (**Figure 5.10**)	Marine embayment adjacent to WCR1	Pre-construction (3A)	5.0	4.9	0.013	**0.42**	-	-	-	-	-	-	-	-
		Interim Construction (3B)	5.0	4.8	0.015	**0.47**	-	-	-	-	-	-	-	-
	Cooling water intake for Sung Hung Kai Centre	Pre-construction (3A)	-	-	-	-	0.013	0.015	4.99	5.70	5.29	5.02	0.59	0.87
		Interim Construction (3B)	-	-	-	-	0.014	0.026	5.42	8.15	5.25	4.92	0.74	2.14
	WSD Wan Chai flushing water intake	Pre-construction (3A)	-	-	-	-	0.013	0.018	4.99	5.93	5.28	5.01	0.58	1.06
		Interim Construction (3B)	-	-	-	-	0.012	0.016	5.17	6.43	5.21	4.96	0.62	1.21
Temporary Embayment III (**Figure 5.11**)	Marine embayment between HKCEC1 and WCR	Pre-construction (3A)	5.00	4.77	0.012	0.39	-	-	-	-	-	-	-	-
		Interim Construction (3B)	4.90	4.66	0.013	**0.41**	-	-	-	-	-	-	-	-
	Cooling water intake for HKCEC Phase I	Pre-construction (3A)	-	-	-	-	0.013	0.018	5.00	5.90	5.25	4.98	0.57	0.85
		Interim Construction (3B)	-	-	-	-	0.013	0.018	5.33	6.57	5.16	4.94	0.67	1.49
	Cooling water intake for Wan Chai Tower/Revenue Tower/Immigration Tower	Pre-construction (3A)	-	-	-	-	0.013	0.018	5.00	5.90	5.25	4.98	0.57	0.85
		Interim Construction (3B)	-	-	-	-	0.013	0.018	5.33	6.57	5.16	4.94	0.67	1.49
	Cooling water intake for Great Eagle Centre/China Resources Building	Pre-construction (3A)	-	-	-	-	0.013	0.018	5.00	5.90	5.25	4.98	0.57	0.85
		Interim Construction (3B)	-	-	-	-	0.013	0.018	5.33	6.57	5.16	4.94	0.67	1.49
Temporary Embayment IV (**Figure 5.11**)	Marine embayment at western Causeway Bay typhoon shelter	Pre-construction (3A)	5.07	5.05	0.015	**0.57**	-	-	-	-	-	-	-	-
		Interim Construction (3C)	5.15	5.08	0.017	**0.75**	-	-	-	-	-	-	-	-
	Cooling water intake for Excelsior Hotel & World Trade Centre	Pre-construction (3A)	-	-	-	-	0.015	0.021	5.63	7.20	5.47	5.18	0.93	1.68
		Interim Construction (3C)	-	-	-	-	0.017	0.021	6.42	7.31	5.22	5.20	1.32	2.08
Temporary Embayment V (**Figure 5.11**)	Marine embayment at eastern Causeway Bay typhoon shelter	Pre-construction (3A)	5.17	5.09	0.015	**0.57**	-	-	-	-	-	-	-	-
		Interim Construction (3C)	5.18	5.07	0.019	**0.94**	-	-	-	-	-	-	-	-
	Cooling water intake for Windsor House	Pre-construction (3A)	-	-	-	-	0.014	0.021	5.51	7.13	5.52	5.13	0.71	1.52
		Interim Construction (3C)	-	-	-	-	0.019	0.025	6.92	8.15	5.56	5.18	1.37	2.12

Table 5.26 Predicted Water Quality at Temporary Embayment at Interim Construction Stage - Dry Season

Temporary Embayment ID	Sensitive Receiver	Scenario (ID)	Minimum (mg/l)		Depth-averaged (mg/l)		Middle Water Layer (mg/l)							
							NH_3-N		SS		DO		BOD_5	
			Depth-averaged DO	Bottom DO	Mean UIA	Mean TIN	Mean	Maximum	Mean	Maximum	Mean	Minimum	Mean	Maximum
			WPCO WQO:				WSD Criteria (applicable to WSD Flushing Water Intake only):							
			≥ 4	≥ 2	≤0.021	≤0.4	-	< 1	-	< 10	-	> 2	-	<10
Temporary Embayment I (**Figure 5.10**)	Marine embayment between CRIII and HKCEC1	Pre-construction (3A)	6.19	6.17	0.010	0.246	-	-	-	-	-	-	-	-
		Interim Construction (3B)	5.79	5.72	0.012	0.304	-	-	-	-	-	-	-	-
	Cooling water intake for Telecom House/HK Academy for Performing/Shui On	Pre-construction (3A)	-	-	-	-	0.010	0.015	4.503	5.382	6.369	6.19	0.565	1.002
		Interim Construction (3B)	-	-	-	-	0.012	0.015	6.438	7.856	6.064	5.80	1.538	2.189
Temporary Embayment II (**Figure 5.10**)	Marine embayment adjacent to WCR1	Pre-construction (3A)	6.25	6.24	0.009	0.235	-	-	-	-	-	-	-	-
		Interim Construction (3B)	5.61	5.59	0.015	0.366	-	-	-	-	-	-	-	-
	Cooling water intake for Sung Hung Kai Centre	Pre-construction (3A)	-	-	-	-	0.009	0.013	4.193	4.702	6.398	6.25	0.395	0.534
		Interim Construction (3B)	-	-	-	-	0.015	0.017	5.167	5.604	5.788	5.61	0.685	0.797
	WSD Wan Chai flushing water intake	Pre-construction (3A)	-	-	-	-	0.009	0.014	4.221	4.813	6.390	6.22	0.401	0.598
		Interim Construction (3B)	-	-	-	-	0.009	0.013	4.929	5.485	5.945	5.73	0.668	0.885
Temporary Embayment III (**Figure 5.11**)	Marine embayment between HKCEC1 and WCR	Pre-construction (3A)	6.19	6.18	0.009	0.24	-	-	-	-	-	-	-	-
		Interim Construction (3B)	5.48	5.42	0.017	**0.42**	-	-	-	-	-	-	-	-
	Cooling water intake for HKCEC Phase I	Pre-construction (3A)	-	-	-	-	0.009	0.014	4.27	4.89	6.38	6.19	0.43	0.65
		Interim Construction (3B)	-	-	-	-	0.017	0.019	5.46	5.87	5.73	5.49	1.00	1.12
	Cooling water intake for Wan Chai Tower/Revenue Tower/Immigration Tower	Pre-construction (3A)	-	-	-	-	0.009	0.014	4.27	4.89	6.38	6.19	0.43	0.65
		Interim Construction (3B)	-	-	-	-	0.017	0.019	5.46	5.87	5.73	5.49	1.00	1.12
	Cooling water intake for Great Eagle Centre/China Resources Building	Pre-construction (3A)	-	-	-	-	0.009	0.014	4.27	4.89	6.38	6.19	0.43	0.65
		Interim Construction (3B)	-	-	-	-	0.017	0.019	5.46	5.87	5.73	5.49	1.00	1.12
Temporary Embayment IV (**Figure 5.11**)	Marine embayment at western Causeway Bay typhoon shelter	Pre-construction (3A)	6.19	6.17	0.018	**0.48**	-	-	-	-	-	-	-	-
		Interim Construction (3C)	5.96	5.92	**0.030**	**0.84**	-	-	-	-	-	-	-	-
	Cooling water intake for Excelsior Hotel & World Trade Centre	Pre-construction (3A)	-	-	-	-	0.017	0.021	6.684	7.508	6.292	6.19	1.739	2.073
		Interim Construction (3C)	-	-	-	-	0.030	0.032	11.011	11.733	6.148	5.96	3.459	3.716
Temporary Embayment V (**Figure 5.11**)	Marine embayment at eastern Causeway Bay typhoon shelter	Pre-construction (3A)	6.29	6.28	0.011	0.30	-	-	-	-	-	-	-	-
		Interim Construction (3C)	6.39	6.38	0.011	0.29	-	-	-	-	-	-	-	-
	Cooling water intake for Windsor House	Pre-construction (3A)	-	-	-	-	0.011	0.015	5.551	6.400	6.405	6.29	0.743	1.115
		Interim Construction (3C)	-	-	-	-	0.011	0.013	6.576	7.698	6.455	6.39	0.842	1.072

Water Quality Impact upon the Victoria Harbour Due to the TBW Operation

5.7.28 Scenario 3B and Scenario 3C aim to address the water quality impact due to the TBW operation. As indicated in **Appendix 5.10a** to **Appendix 5.10d**, the TBW operation would not cause any obvious change of water quality in the Victoria Harbour including the semi-enclosed area within the new TBW. The model results indicated that the water quality in central Victoria Harbour including the area inside the temporary typhoon shelter would comply with the WQO.

5.7.29 The interim construction scenarios (i.e. Scenario 3B and Scenario 3C) however did not cover a case with all permanent reclamation formed but before the TBW is removed/decommissioned. Although these interim construction scenarios would involve some partially reclaimed lands only, the remaining reclamation lands are relatively small and are unlikely to have a major effect on the Harbour water quality. The operational phase modelling assessment indicated that the change in tidal flushing in Victoria Harbour caused by all the permanent reclaimed lands of WDII would be no more than 0.5% (**Table 5.20**). Therefore, the net effect due to the remaining small portion of the permanent reclamation would be less than 0.5%. Considering the marginal change in flow discharge through Victoria Harbour, no major impacts on the assimilative capacity and, thus, the water quality of Victoria Harbour is expected from the case with all permanent reclamation formed but before the TBW is removed.

Water Quality in Victoria Harbour due to the Sewage Effluent from PTW Outfalls

5.7.30 Scenario 3B and Scenario 3C also aim to address the water quality impacts upon the Victoria Harbour for the period between the commissioning of the new Wan Chai East preliminary treatment works (WCEPTW) submarine sewage outfall and the abandonment of the existing Wan Chai West preliminary treatment works (WCWPTW) submarine sewage outfall. **Appendix 5.10a** to **Appendix 5.10d** give the water quality modelling results for this interim stage. The model results indicated that the water quality in central Victoria Harbour would comply with the WQO.

5.7.31 The submarine outfall of WCWPTW would be decommissioned and all flow originally discharged via the WCW would be diverted to that of WCEPTW in late 2010. It was however assumed in the model that the sewage flow from Wanchai would be distributed to both WCWPTW and WCEPTW under all the interim construction scenarios. It should be noted that the existing outfalls of both WCEPTW and WCWPTW as well as the new WCEPTW outfall are located in the middle of the Victoria Harbour channel with high currents where the pollutants discharged from these outfalls can be effectively dispersed by the tidal flushing. Therefore, the effects of the change in local distribution of flow amongst WCWPTW and WCEPTW should be localized and would unlikely affect the overall conclusion of the modelling results. This has been confirmed by the modelling assessment conducted under the approved WDIICFS EIA as described below.

5.7.32 An interim construction scenario (namely Scenario 2B) was assessed under the approved WDIICFS EIA for the period after the commissioning of the new WCEPTW and decommissioning of the existing WCWPTW outfall with only a small portion of the permanent reclaimed lands formed within the WDII site. As indicated in the approved WDIICFS EIA, the pollutant distributions in the Victoria Harbour predicted under this interim construction scenario due to the operation of the new WCEPTW outfall were very similar to those of the baseline scenario (using the existing outfalls of both WCWPTW and WCEPTW) and generally satisfied the corresponding WQO for the Victoria Harbour WCZ. The effluent flow rate adopted in the WDIICFS for the WCEPTW under this interim construction case was larger than the latest design flow rate derived from the on-going HATS Stage 2A EIA based on latest flow projection and is therefore considered conservative. The scenario after the completion of all the permanent reclamation and storm outfall diversion works at WDII is less critical as the areas of poorly flushed embayed waters in Wan Chai would be reduced after the permanent reclamation and the water quality along the new waterfront of the WDII site should be improved. Although the interim construction scenario (2B) assessed under the WDIICFS did not include the TBW, the TBW operation has already been confirmed under this EIA to have no major effect on the Harbour water quality as previously discussed. It is therefore expected that the discharge from the new WCEPTW outfall would not cause any unacceptable water quality impact upon the Victoria Harbour and the area inside the TBW.

Potential Contaminant Release During Dredging

Elutriate Test Results

5.7.33 An indication of the likelihood of release of contaminants from the marine mud during dredging is given by the results of the elutriation tests from the laboratory testing conducted under the Phase I and Phase II marine site investigation (SI) works. Phase I SI covers the waters at HKCEC water channel (with vibrocore sampling at V06-2W), within Causeway Bay Typhoon Shelter (with vibrocore sampling at V06-6W, V06-7W, V06-8W), North Point (with vibrocore sampling at V06-9W) and outside Causeway Bay Typhoon Shelter (with vibrocore sampling at V06-10W). Phase II SI covers the waters to the west of HKCEC Extension (with vibrocore sampling at V06-1W), Wan Chai (with vibrocore sampling at V06-3W and V06-4W), and within the PCWA (with vibrocore sampling at V06-5W). The locations of vibrocore samplings are shown in **Figure 6.1**. Permission to sample in the WSD prohibition zone and MTR protection zone in the area to the west of HKCEC was not obtained from WSD and MTRC for the marine site investigation. In addition, MTRC advised that anchoring is not permitted within 20m of their protection zone and hence it was not possible to collect sufficient elutriate samples within the marine embayment to the west of HKCEC Extension. Therefore, reference was made to the elutriate test results available from the approved WDIICFS EIA for two locations (namely MV1 and MV4) in the marine embayment to the west of HKCEC to supplement the elutriate test results obtained under the present Study. The locations of stations MV1 and MV4 are given in the approved EIA for WDIICFS (http://www.epd.gov.hk/eia/register/report/eiareport/eia_0582001/eia/Volume%20II/00000089.GIF).

5.7.34 As there is no existing legislative standard or guideline for individual heavy metal contents in marine waters, the UK Water Quality Standards for Coastal Surface Water [22] have been adopted as the assessment criteria.

(22) ERM-Hong Kong, Ltd. (January 1997). Environmental Quality Standards and Assessment Levels for Coastal Surface Water (from HMIP (1994) Environmental Economic and BPEO Assessment Principals for Integrated Pollution Control). (Source: Environmental Impact Assessment Study for Disposal of Contaminated Mud in the East Sha Chau Marine Borrow Pit.)

5.7.35 As shown in **Table 5.27** to **Table 5.29** below, the metal concentrations (other than silver at vibrocore V06-8W at sampling depth 3.0-4.0m and mercury at vibrocore MV4 at sampling depth 1.0-1.9m) in the elutriate samples from the Phase I SI fall within the UK Water Quality Standards. The maximum levels of silver and mercury measured in the elutriate samples collected at Stations V06-8W and MV4 are 2.8µg/l and 0.4µg/l respectively which only marginally exceeded the water quality standard of 2.3µg/l and 0.3µg/l respectively. Although exceedence of UK standards are predicted in the elutriate tests, it is expected that any release of heavy metals during dredging will be quickly diluted by the large volume of marine water within the construction site. Based on the detected highest concentrations, the required dilution to meet the assessment criteria for silver and mercury were calculated to be 1.5 only. The release of pollutants will also be minimised by the use of closed grab dredger and the dispersion of pollutants will be confined within the construction site by silt curtains (Section 5.8). Thus, it is considered that long-term off-site marine water quality impact is unlikely and any local water quality impact will be transient.

5.7.36 Elutriation tests were also conducted to assess the likelihood of release of organic compounds, such as total polychlorinated biphenyls (PCBs) and total polyaromatic hydrocarbons (PAHs), and tributyltin (TBT) from the marine mud during dredging activities. As there are no existing legislative standards or guidelines for the contaminants total PCBs and total PAHs in marine waters, reference was made to the Australia water quality guidelines [(23)] and USEPA water quality criteria[(24)]. The levels of total PCBs and total PAHs in the elutriate samples are all below the detection limit and well comply with the relevant water quality criteria except for the PCBs level at vibrocore V6-10W at sampling depth 1.9 - 2.4m. However, the high PCBs level measured at depth 1.9 -2.4 m of V6-10W is doubtful because all the rest of the levels measured at vibrocore V6-10W comply well with the assessment criterion and all the remaining contaminant levels were under the detention limit. The potential impact is therefore considered isolated and limited. In addition, V6-10W is located in open water in North Point, any release of PCBs during dredging at North Point water will be quickly dispersed by the fast moving current and diluted by the large volume of marine water. The release of PCBs, if any, will also be minimised by the use of closed grab dredger and the dispersion of pollutants will be confined within the construction site by silt curtains (Section 5.8). Thus, it is considered that long-term off-site marine water quality impact is unlikely and any local water quality impact will be transient. Further assessment on the impact of PCBs upon the sensitive receivers is given in later sections.

5.7.37 The elutriate test results of TBT do not indicate any levels higher than the blank results nor the threshold concentration recommended by Salazar and Salazar (1996) [(25)]. It is therefore concluded that adverse water quality impacts due to the potential release of TBT from the sediment are not expected during the dredging activities.

(23) Australian and New Zealand Environment and Conservation Council (1992). Australian Water Quality Guidelines for Fresh and Marine Waters.

(24) United States Environmental Protection Agency (1998). Water Quality Standards, Establishment of Numeric Criteria for Priority Toxic Pollutants; States' Compliance – Revision of Polychlorinated Biphenyls (PCBs) Criteria.

(25) Salazar, M. H. and Salazar, S. M. (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.

Table 5.27 Comparison of Phase I Marine Site Investigation Sediment Elutriate Test Results with the Water Quality Standards

Vibrocore	Sampling Depth (m)	Metal content (µg/L)									Organic Compounds Content (µg/L)		
		Ag	Cd	Cu	Ni	Pb	Zn	Cr	As	Hg	Total PCBs	Total PAHs	TBT
V06-2W	Surface Grab	<1	0.61	<1	<1	<1	<10	<1	<1	<0.1	<0.01	<0.2	<0.015
	Blank	<1	<0.2	2.1	1.0	<1	<10	<1	1.1	<0.1	<0.01	<0.2	<0.015
V06-6W	0.0 – 0.9	<1	<0.2	<1	1	<1	<10	<1	<1	<0.1	<0.01	<0.2	<0.015
	0.9 – 1.9	<1	<0.2	<1	3.2	<1	<10	<1	<1	<0.1	<0.01	<0.2	<0.015
	1.9 – 2.9	<1	<0.2	<1	1.6	<1	<10	<1	<1	<0.1	<0.01	<0.2	<0.015
	3.0 – 4.0	<1	<0.2	<1	6.3	<1	<10	<1	<1	<0.1	<0.01	<0.2	<0.015
	Blank	<1	<0.2	5.5	<1	2.1	<10	<1	1.4	<0.1	<0.01	<0.2	<0.015
V06-7W	0.0 – 0.9	<1	<0.2	<1	2.9	<1	<10	<1	1.1	<0.1	<0.01	<0.2	<0.015
	0.9 – 1.9	<1	<0.2	<1	1.6	<1	<10	<1	<1	<0.1	<0.01	<0.2	<0.015
	1.9 – 2.9	<1	<0.2	<1	<1	<1	<10	<1	<1	<0.1	<0.01	<0.2	<0.015
	Blank	<1	<0.2	7.2	<1	<1	<10	<1	1.4	<0.1	<0.01	<0.2	<0.015
V06-8W	0.0 – 0.9	<1	0.27	<1	1.8	1.1	<10	<1	4.9	<0.1	<0.01	<0.2	<0.015
	0.9 – 1.9	<1	0.7	<1	1.9	18	11	<1	9.9	<0.1	<0.01	<0.2	<0.015
	1.9 – 2.9	<1	0.43	<1	2.7	9.5	<10	<1	18	<0.1	<0.01	<0.2	<0.015
	3.0 – 4.0	**2.8**	0.48	<1	2.5	1.5	<10	<1	13	<0.1	<0.01	<0.2	<0.015
	6.0 – 7.0	<1	<0.2	<1	1.5	3.5	<10	<1	8.0	<0.1	<0.01	<0.2	<0.015
	Blank	<1	<0.2	4.6	<1	<1	<10	<1	1.3	<0.1	<0.01	<0.2	<0.015
V06-9W	0.0 – 0.9	<1	<0.2	<1	2.1	<1	<10	<1	4.5	<0.1	<0.01	<0.2	<0.015
	0.9 – 1.9	<1	<0.2	<1	2.1	<1	<10	<1	<1	<0.1	<0.01	<0.2	<0.015
	Blank	<1	<0.2	1.1	1.2	<1	<10	<1	1.5	<0.1	<0.01	<0.2	<0.015
V06-10W	0 – 0.9	<1	<0.2	<1	1.1	<1	<10	<1	3.2	<0.1	<0.01	<0.2	<0.015
	0.9 – 1.9	<1	<0.2	<1	<1	<1	<10	<1	5.3	<0.1	<0.01	<0.2	<0.015
	1.9 – 2.4	<1	<0.2	<1	<1	<1	<10	<1	<1	<0.1	**0.17**	<0.2	<0.015
	2.9 – 3.9	<1	<0.2	<1	<1	<1	<10	<1	<1	<0.1	<0.01	<0.2	<0.015
	4.4 – 5.4	<1	<0.2	<1	1	<1	<10	<1	<1	<0.1	<0.01	<0.2	<0.015
	Blank	<1	<0.2	1.6	1.1	<1	<10	<1	1.2	<0.1	<0.01	<0.2	<0.015
Water Quality Standards		2.3 (2)	2.5 (2)	5 (2)	30 (2)	25 (2)	40 (2)	15 (2)	25 (2)	0.3 (2)	0.03 (3)	3.0 (4)	0.1 (5)

Notes:

(1) Value in bold indicates exceedance of the Water Quality Standard.
(2) UK Water Quality Standard.
(3) USEPA salt water criterion.
(4) Australian water quality guidelines for fresh and marine waters.
(5) 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.

Table 5.28 Comparison of Phase II Marine Site Investigation Sediment Elutriate Test Results with the Water Quality Standards

Vibrocore	Sampling Depth (m)	Metal content (μg/L)									Organic Compounds Content (μg/L)		
		Ag	Cd	Cu	Ni	Pb	Zn	Cr	As	Hg	Total PCBs	Total PAHs	TBT
V06-1W	0.0 – 0.9	<1	<0.2	2.0	1.0	<1	<10	<1	<1	<0.1	<0.01	<0.2	<0.015
	0.9 – 1.9	<1	0.20	2.2	2.1	<1	<10	<1	3.1	<0.1	<0.01	<0.2	<0.015
	1.9 – 2.9	<1	0.27	<1	<1	1.1	<10	<1	25	<0.1	<0.01	<0.2	<0.015
	2.9 – 3.9	<1	<0.2	<1	1.1	1.2	<10	<1	21	<0.1	<0.01	<0.2	<0.015
	Blank	<1	<0.2	3.1	1.3	1.2	<10	<1	1.7	<0.1	<0.01	<0.2	<0.015
V06-3W	0.0 – 0.9	<1	<0.2	1.1	1.2	<1	<10	<1	<1	<0.1	<0.01	<0.2	<0.015
	0.9 – 1.9	<1	<0.2	1.1	1.8	13	15	<1	6.0	<0.1	<0.01	<0.2	<0.015
	1.9 – 2.9	<1	0.28	<1	2.0	1.4	<10	<1	27	<0.1	<0.01	<0.2	<0.015
	2.9 – 3.9	<1	0.78	1.1	2.0	<1	<10	<1	16	<0.1	<0.01	<0.2	<0.015
	Blank	<1	<0.2	2.0	1.4	<1	10	<1	<1	<0.1	<0.01	<0.2	<0.015
V06-4W	0.0 – 0.9	<1	<0.2	2	<1	<1	<10	<1	2	<0.1	<0.01	<0.2	<0.015
	0.9 – 1.9	<1	<0.2	<1	<1	<1	<10	<1	1.2	<0.1	<0.01	<0.2	<0.015
	1.9 – 2.9	<1	<0.2	1.1	1.8	<1	<10	<1	1.8	<0.1	<0.01	<0.2	<0.015
	2.9 – 3.9	<1	<0.2	<1	<1	<1	<10	<1	2.3	<0.1	<0.01	<0.2	<0.015
	6.0 – 7.0	<1	<0.2	1	<1	<1	<10	<1	<1	<0.1	<0.01	<0.2	<0.015
	8.9 – 9.9	<1	<0.2	<1	<1	<1	<10	<1	2.3	<0.1	<0.01	<0.2	<0.015
	Blank	<1	<0.2	3.5	1.5	<1	<10	<1	<1	<0.1	<0.01	<0.2	<0.015
V06-5W	0.0 – 0.9	<1	<0.2	<1	2.4	<1	<10	<1	1.3	<0.1	<0.01	<0.2	<0.015
	0.9 – 1.9	<1	<0.2	2.1	2.9	<1	<10	<1	2	<0.1	<0.01	<0.2	<0.015
	1.9 – 2.9	<1	<0.2	<1	<1	2.8	<10	<1	15	<0.1	<0.01	<0.2	<0.015
	2.9 – 3.9	<1	<0.2	<1	3.4	<1	<10	<1	3	<0.1	<0.01	<0.2	<0.015
	Blank	1.0	<0.2	2.7	1.0	<1	10.0	<1	1.1	<0.1	<0.01	<0.2	<0.015
Water Quality Standards		2.3 (1)	2.5 (1)	5 (1)	30 (1)	25 (1)	40 (1)	15 (1)	25 (1)	0.3 (1)	0.03 (2)	3.0 (3)	0.1 (4)

Notes:

(1) UK Water Quality Standard.
(2) USEPA salt water criterion.
(3) Australian water quality guidelines for fresh and marine waters.
(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.

Table 5.29 Comparison of WDIICFS Marine Site Investigation Sediment Elutriate Test Results with the Water Quality Standards

Vibrocore	Sampling Depth (m)	Metal content (μg/L)									Organic Compounds Content (μg/L)		
		Ag	Cd	Cu	Ni	Pb	Zn	Cr	As	Hg	Total PCBs	Total PAHs	TBT (mg-Sn L^{-1})
MV1	0.55 - 0.9	<2	<0.5	<2	<5	<2	8	<10	6	<0.2	< 0.03	< 0.3	< 0.05
	1.0 - 1.9	<2	<0.5	<2	<5	<2	<5	<10	3	<0.2	< 0.03	< 0.3	< 0.05
	2.0 - 2.9	<2	<0.5	2	<5	<2	10	<10	3	<0.2	< 0.03	< 0.3	< 0.05
MV4	0.25 - 0.9	<2	<0.5	<2	<5	<2	<5	<10	6	<0.2	< 0.03	< 0.3	< 0.05
	1.0 - 1.9	<2	<0.5	<2	<5	<2	5	<10	9	**0.4**	< 0.03	< 0.3	< 0.05
	2.0 - 2.9	<2	<0.5	<2	<5	<2	<5	<10	6	<0.2	< 0.03	< 0.3	< 0.05
Blank	-	< 2	< 0.5	< 2	< 5	< 2	14	< 10	< 3	< 0.2	< 0.03	< 0.3	< 0.05
Water Quality Standard		2.3 (1)	2.5 (1)	5 (1)	30 (1)	25 (1)	40 (1)	15 (1)	25 (1)	0.3 (1)	0.03 (2)	3.0 (3)	0.1 (4)

Notes:

(1) Value in bold indicates exceedance of the Water Quality Standard.
(2) UK Water Quality Standard.
(3) USEPA salt water criterion.
(4) Australian water quality guidelines for fresh and marine waters.
(5) 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.

Oxygen Depletion During Dredging

5.7.38 An assessment of dissolved oxygen depletion during dredging has been made in relation to the results of the sediment plume modelling of dredging activities (unmitigated scenario) and the sediment quality data for the study area. The predicted maximum elevations in SS concentrations at various indicator points were used to estimate the effects of increased SS concentrations on DO. Seawater intakes along the waterfront were selected as reference points for presentation of the assessment results. In the calculation, it was assumed that all of the chemical oxygen demand is exerted. These are conservative assumptions and will likely result in an over-prediction of the potential impacts. The calculation was performed using the highest levels of 5-day SOD measured in the sediment samples collected during the SI for conservative predictions. The highest 5-day SOD level was recorded at station V06-2W inside the HKCEC water channel. The 10 percentile DO predicted under the pre-construction scenario (Scenario 3A) at the corresponding indicator points were used as the background levels for reference. The results of DO depletion are given in **Table 5.30** to **Table 5.32**.

Table 5.30 Calculation of the Effects of Increased Suspended Sediment Concentrations on Dissolved Oxygen Concentrations under Scenario 2A

Indicator Point	Maximum Predicted SS Elevation (mg/l)	SOD_5 in Sediment (mg/kg)	Maximum DO depletion (mg/l)	Background DO (mg/l)	Resultant DO (mg/l)
Cooling Water Intake within the Project Site					
Hong Kong Convention and Exhibition Centre Extension	61.73	6100	0.377	4.58	4.20
Telecom House / HK Academy for Performing Arts / Shun On Centre	117.50	6100	0.717	6.08	5.36
Hong Kong Convention and Exhibition Centre Phase I	460.97	6100	2.812	6.08	**3.26**
Wan Chai Tower / Revenue Tower / Immigration Tower	88.98	6100	0.543	6.08	5.53
Great Eagle Centre / China Resources Building	68.66	6100	0.419	4.64	4.22
Sun Hung Kai Centre	72.66	6100	0.443	6.08	5.63
Excelsior Hotel & World Trade Centre	53.91	6100	0.329	5.26	4.93
Windsor House	45.21	6100	0.276	5.25	4.98
WSD Saltwater Intake within the Project Site					
Wan Chai	42.90	6100	0.262	6.08	5.81
Cooling Water Intake outside the Project Site					
Admiralty Centre	96.08	6100	0.586	6.08	5.49
WSD Saltwater Intake outside the Project Site					
Kennedy Town	6.17	6100	0.038	6.08	6.04
Quarry Bay	38.57	6100	0.235	6.08	5.84
Sai Wan Ho	46.33	6100	0.283	6.08	5.80
Sheung Wan	36.40	6100	0.222	6.08	5.85
Tai Wan	12.65	6100	0.077	4.58	4.50

Table 5.30a Calculation of the Effects of Increased Suspended Sediment Concentrations on Dissolved Oxygen Concentrations under Scenario 2A (Sensitivity Test using Higher Dredging Rate for Gas Main Construction)

Indicator Point	Maximum Predicted SS Elevation (mg/l)	SOD_5 in Sediment (mg/kg)	Maximum DO depletion (mg/l)	Background DO (mg/l)	Resultant DO (mg/l)
Cooling Water Intake within the Project Site					
Hong Kong Convention and Exhibition Centre Extension	61.73	6100	0.377	4.58	4.20
Telecom House / HK Academy for Performing Arts / Shun On Centre	117.50	6100	0.717	6.08	5.36
Hong Kong Convention and Exhibition Centre Phase I	460.97	6100	2.812	6.08	**3.26**
Wan Chai Tower / Revenue Tower / Immigration Tower	88.98	6100	0.543	6.08	5.53
Great Eagle Centre / China Resources Building	68.66	6100	0.419	4.64	4.22
Sun Hung Kai Centre	72.66	6100	0.443	6.08	5.63
Excelsior Hotel & World Trade Centre	53.91	6100	0.329	5.26	4.93
Windsor House	45.21	6100	0.276	5.25	4.98
WSD Saltwater Intake within the Project Site					
Wan Chai	42.90	6100	0.262	6.08	5.81
Cooling Water Intake outside the Project Site					
Admiralty Centre	96.08	6100	0.586	6.08	5.49
WSD Saltwater Intake outside the Project Site					
Kennedy Town	6.17	6100	0.038	6.08	6.04
Quarry Bay	38.57	6100	0.235	6.08	5.84
Sai Wan Ho	46.33	6100	0.283	6.08	5.80
Sheung Wan	36.40	6100	0.222	6.08	5.85
Tai Wan	12.69	6100	0.077	4.58	4.50

Table 5.31 Calculation of the Effects of Increased Suspended Sediment Concentrations on Dissolved Oxygen Concentrations under Scenario 2B

Indicator Point	Maximum Predicted SS Elevation (mg/l)	SOD_5 in Sediment (mg/kg)	Maximum DO depletion (mg/l)	Background DO (mg/l)	Resultant DO (mg/l)
Cooling Water Intake within the Project Site					
Hong Kong Convention and Exhibition Centre Extension	49.42	6100	0.301	6.08	5.77
Telecom House / HK Academy for Performing Arts / Shun On Centre	22.07	6100	0.135	4.68	4.55
Hong Kong Convention and Exhibition Centre Phase I	12.79	6100	0.078	4.59	4.52
Wan Chai Tower / Revenue Tower / Immigration Tower	12.68	6100	0.077	4.59	4.52
Great Eagle Centre / China Resources Building	14.35	6100	0.088	4.59	4.50
Sun Hung Kai Centre	15.63	6100	0.095	4.65	4.55
Excelsior Hotel & World Trade Centre	152.02	6100	0.927	5.31	4.38
Windsor House	104.00	6100	0.634	5.27	4.64
WSD Saltwater Intake within the Project Site					
Wan Chai	16.24	6100	0.099	4.62	4.52
Cooling Water Intake outside Project Site					
Admiralty Centre	51.43	6100	0.314	4.65	4.34
WSD Saltwater Intake outside the Project Site					
Kennedy town	1.27	6100	0.008	6.08	6.07
Quarry Bay	13.74	6100	0.084	4.59	4.51
Sai Wan Ho	12.77	6100	0.078	4.61	4.53
Sheung Wan	27.20	6100	0.166	6.08	5.91
Tai Wan	10.70	6100	0.065	4.58	4.52

Table 5.32 Calculation of the Effects of Increased Suspended Sediment Concentrations on Dissolved Oxygen Concentrations under Scenario 2C

Indicator Point	Maximum predicted SS Elevation (mg/l)	SOD_5 in Sediment (mg/kg)	Maximum DO depletion (mg/l)	Background DO (mg/l)	Resultant DO (mg/l)
Cooling Water Intake within the Project Site					
Hong Kong Convention and Exhibition Centre Extension	49.43	6100	0.301	6.08	5.77
Telecom House / HK Academy for Performing Arts / Shun On Centre	66.08	6100	0.403	5.60	5.20
Hong Kong Convention and Exhibition Centre Phase I	50.99	6100	0.311	4.60	4.29
Wan Chai Tower / Revenue Tower / Immigration Tower	66.56	6100	0.406	4.60	4.19
Great Eagle Centre / China Resources Building	67.45	6100	0.411	4.60	4.19
Sun Hung Kai Centre	31.08	6100	0.190	4.62	4.44
Excelsior Hotel & World Trade Centre	64.96	6100	0.396	6.07	5.67
Windsor House	67.55	6100	0.412	6.08	5.66
WSD Saltwater Intake within the Project Site					
Wan Chai (Reprovisioned)	31.08	6100	0.190	4.62	4.44
Cooling Water Intake outside the Project Site					
Admiralty Centre	65.37	6100	0.399	4.65	4.25
WSD Saltwater Intake outside the Project Site					
Kennedy Town	1.46	6100	0.009	6.08	6.07
Quarry Bay	13.07	6100	0.080	4.58	4.50
Sai Wan Ho	20.51	6100	0.125	4.60	4.48
Sheung Wan	23.27	6100	0.142	6.08	5.94
Tai Wan	9.87	6100	0.060	4.58	4.52

5.7.39 The interim construction scenario 2A represents 6 concurrent dredging activities at HKCEC1, WCR1, TPCWAE, TBW, NPR2W and WSD cross harbour water mains respectively. As presented in **Table 5.30**, the maximum DO depletion was predicted to be 2.8 mg/l at the HKCEC water channel which was mainly contributed by the dredging activities at HKCEC1. Therefore, non-compliance of DO level would be expected inside the HKCEC water channel during seawall dredging at HKCEC1. The impact from the dredging at WRC1 under the same scenario is considered less significant as the maximum DO depletion predicted at the WSD Wan Chai flushing water intake closest to the WRC1 would be less than 0.3 mg/l. The cumulative impact from these concurrent dredging activities would cause a DO depletion of less than 0.4 mg/l at the Causeway Bay typhoon shelter.

5.7.40 The interim construction Scenario 2B represents 2 concurrent dredging activities at TCBRW1 and the proposed sewage pipeline respectively. As presented in **Table 5.31**, the maximum DO depletion was predicted to be less than 1 mg/l inside the Causeway Bay typhoon shelter which was mainly contributed by the dredging activities at the TCBRW1. Thus, exceedance of the WQO may occur at some occasions when the background DO level is low. The DO depletion predicted at the indicator points outside the typhoon shelter is significantly smaller (< 0.4 mg/l).

5.7.41 No significant DO depletion was predicted under the interim construction Scenario 2C where dredging at seawall was conducted at HKCEC2W, WCR3 and TCRE3 at the same time. The maximum DO depletions predicted at all the indicator points were less than 0.5 mg/l (**Table 5.32**).

Release of Nutrients During Dredging

5.7.42 An assessment of contaminant release for nutrients has been made in relation to the sediment quality results as presented in **Appendix 6.1**. Inert tracers (with zero decay) were introduced into the Delft3D-WAQ model for Scenario 2A, Scenario 2B and Scenario 2C model runs to represent the release of these contaminants during dredging. Discharge of inert tracers was assumed at the source points (discharge locations). In the calculation of the contaminant loss rate for model input, it was assumed that all of the contaminants in the sediment would be released to the water. The assessment conducted under this EIA on the potential release of nutrients focused on the impact from the WDII activities alone.

5.7.43 Three separate tracer simulations were performed for the three model scenarios, Scenario 2A (including source points A1, A2, A3, A4, A5, A6, A7), Scenario 2B (including source points B1, B2) and Scenario 2C (including source points C1, C2, C3) respectively. Each simulation covered two model runs for dry and wet seasons respectively. Under each modelling scenario, the highest nutrient levels measured under the marine SI were used to calculate the nutrient loss rate at all the source points for cumulative predictions. The highest levels of TIN and NH_3-N recorded from the marine SI were 300 mg/kg and 6.9mg/kg respectively which were measured in the sediment sample collected at Station V06-6W (inside Causeway Bay typhoon shelter).

5.7.44 The calculated NH_3-N released from the sediment will result in a concentration of total NH_3-N in the receiving waters. The levels of NH_3-N were converted to unionized NH_3-N which is a more critical parameter of concern. The data at EPD monitoring station VM5 indicates that on average the unionised NH_3-N constitutes 2.3% of the total NH3-N concentration.

5.7.45 **Table 5.33** to **Table 5.35** summarize the maximum elevations of nutrient levels estimated at the indicator points. All the maximum elevations for UIA were negligible as compared to the WQO of 0.021mg/l. The maximum elevations for TIN were also small as compared to the WQO of 0.4mg/l. It is therefore not anticipated that the dredging work would cause any unacceptable nutrient impact upon the receiving water and any elevations of nutrients caused by the dredging works would be transient only.

Table 5.33 Maximum Elevations of Nutrient Concentrations under Scenario 2A

Indicator Point	Maximum level of TIN in Sediment (mg/kg)	Maximum level of NH_3-N in Sediment (mg/kg)	Maximum Increase in TIN (mg/l)	Maximum Increase in UIA (mg/l)
		WQO:	**0.4**	**0.021**
Cooling Water Intake within the Project Site				
Hong Kong Convention and Exhibition Centre Extension	300	6.9	0.018	0.00001
Telecom House / HK Academy for Performing Arts / Shun On Centre	300	6.9	0.036	0.00002
Hong Kong Convention and Exhibition Centre Phase I	300	6.9	0.034	0.00002
Wan Chai Tower / Revenue Tower / Immigration Tower	300	6.9	0.034	0.00002
Great Eagle Centre / China Resources Building	300	6.9	0.034	0.00002
Sun Hung Kai Centre	300	6.9	0.087	0.00005
Excelsior Hotel & World Trade Centre	300	6.9	0.019	0.00001
Windsor House	300	6.9	0.020	0.00001
WSD Saltwater Intake within the Project Site				
Wan Chai	300	6.9	0.055	0.00003
Cooling Water Intake outside the Project Site				
Admiralty Centre	300	6.9	0.018	0.00001
WSD Saltwater Intake outside the Project Site				
Kennedy Town	300	6.9	0.002	0.000001
Quarry Bay	300	6.9	0.006	0.000003
Sai Wan Ho	300	6.9	0.003	0.000002
Sheung Wan	300	6.9	0.005	0.000002
Tai Wan	300	6.9	0.002	0.000001

Table 5.34 Maximum Elevations of Nutrient Concentrations under Scenario 2B

Indicator Point	Maximum level of TIN in Sediment (mg/kg)	Maximum level of NH_3-N in Sediment (mg/kg)	Maximum Increase in TIN (mg/l)	Maximum Increase in UIA (mg/l)
		WQO:	**0.4**	**0.021**
Cooling Water Intake within the Project Site				
Hong Kong Convention and Exhibition Centre Extension	300	6.9	0.009	0.000005
Telecom House / HK Academy for Performing Arts / Shun On Centre	300	6.9	0.003	0.000002
Hong Kong Convention and Exhibition Centre Phase I	300	6.9	0.006	0.000003
Wan Chai Tower / Revenue Tower / Immigration Tower	300	6.9	0.006	0.000003
Great Eagle Centre / China Resources Building	300	6.9	0.006	0.000003
Sun Hung Kai Centre	300	6.9	0.006	0.000003
Excelsior Hotel & World Trade Centre	300	6.9	0.053	0.000028
Windsor House	300	6.9	0.034	0.000018
WSD Saltwater Intake within the Project Site				
Wan Chai	300	6.9	0.006	0.000003
Cooling Water Intake outside the Project Site				
Admiralty Centre	300	6.9	0.004	0.000002
WSD Saltwater Intake outside the Project Site				
Kennedy Town	300	6.9	0.001	0.000000
Quarry Bay	300	6.9	0.001	0.000001
Sai Wan Ho	300	6.9	0.001	0.0000005
Sheung Wan	300	6.9	0.002	0.000001
Tai Wan	300	6.9	0.001	0.000000

Table 5.35 Maximum Elevations of Nutrient Concentrations under Scenario 2C

Indicator Point	Maximum level of TIN in Sediment (mg/kg)	Maximum level of NH_3-N in Sediment (mg/kg)	Maximum Increase in TIN (mg/l)	Maximum Increase in UIA (mg/l)
		WQO:	**0.4**	**0.021**
Cooling Water Intake within the Project Site				
Hong Kong Convention and Exhibition Centre Extension	300	6.9	0.008	0.000004
Telecom House / HK Academy for Performing Arts / Shun On Centre	300	6.9	0.009	0.000005
Hong Kong Convention and Exhibition Centre Phase I	300	6.9	0.011	0.000006
Wan Chai Tower / Revenue Tower / Immigration Tower	300	6.9	0.011	0.000006
Great Eagle Centre / China Resources Building	300	6.9	0.011	0.000006
Sun Hung Kai Centre	300	6.9	0.007	0.000004
Excelsior Hotel & World Trade Centre	300	6.9	0.035	0.000018
Windsor House	300	6.9	0.036	0.000019
WSD Saltwater Intake within the Project Site				
Wan Chai	300	6.9	0.007	0.000004
Cooling Water Intake outside the Project Site				
Admiralty Centre	300	6.9	0.005	0.000002
WSD Saltwater Intake outside the Project Site				
Kennedy Town	300	6.9	0.001	0.0000003
Quarry Bay	300	6.9	0.001	0.000001
Sai Wan Ho	300	6.9	0.001	0.0000004
Sheung Wan	300	6.9	0.001	0.000001
Tai Wan	300	6.9	0.000	0.0000002

Release of PCBs During Dredging

5.7.46 An assessment of contaminant release for PCBs has been made in relation to the sediment quality results as presented in **Appendix 6.1** and the tracer modelling results. As previously discussed, exceedance of water quality standard for PCBs was only recorded in one isolated elutriate sample collected in the proposed North Point reclamation area (PCBs were not detected in all the remaining elutriate samples and all the blank "ambient water" samples). Assessment of the potential impact from release of PCBs was performed using the highest PCB level recorded in the sediment samples collected in the North Point area. Inert tracers (with zero decay) were introduced into the Delft3D-WAQ model for Scenario 2A. Discharge of inert tracers was assumed at source point A4 within the North Point reclamation. In the calculation of the PCBs loss rate for model input, it was assumed that all of the PCBs in the sediment would be released to the water. The assessment conducted under this EIA on the potential release of PCBs focused on the impact from the WDII activities alone.

5.7.47 **Table 5.36** gives the maximum elevations of PCB levels estimated at the indicator points. All the maximum elevations for PCBs complied well with the water quality standard of 0.03 µg/l. It is therefore not anticipated that the dredging work would cause any unacceptable PCBs impact upon the receiving water and any elevations of PCBs caused by the dredging works would be transient only.

Table 5.36 Maximum Elevations of PCBs

Indicator Point	Maximum level of PCBs in Sediment measured in the North Point area (mg/kg)	Maximum Increase in PCBs (µg/l)
	WQO:	**0.03**
Cooling Water Intake within the Project Site		
Hong Kong Convention and Exhibition Centre Extension	0.13	0.0021
Telecom House / HK Academy for Performing Arts / Shun On Centre	0.13	0.0030
Hong Kong Convention and Exhibition Centre Phase I	0.13	0.0035
Wan Chai Tower / Revenue Tower / Immigration Tower	0.13	0.0035
Great Eagle Centre / China Resources Building	0.13	0.0035
Sun Hung Kai Centre	0.13	0.0237
Excelsior Hotel & World Trade Centre	0.13	0.0004
Windsor House	0.13	0.0004
WSD Saltwater Intake within the Project Site		
Wan Chai	0.13	0.0107
Cooling Water Intake outside the Project Site		
Admiralty Centre	0.13	0.0018
WSD Saltwater Intake outside the Project Site		
Kennedy Town	0.13	0.0002
Quarry Bay	0.13	0.0003
Sai Wan Ho	0.13	0.0002
Sheung Wan	0.13	0.0003
Tai Wan	0.13	0.0001

5.7.48 As shown in the SS elevation contour plots presented in **Appendix 5.9a** to **Appendix 5.9h**, it is considered that the potential impact of dredging will be confined near the marine works site and will have significantly smaller impact to open waters in Victoria Harbour.

5.7.49 In addition, the dredging works will only increase the local background concentrations during the construction works and will thus be of short duration, and will not prevent recovery of the water body in the future. It is therefore concluded that the dredging works for the WDII and CWB reclamation will not cause adverse impacts to water quality in Victoria Harbour.

General WQO Compliance in Victoria Harbour and Impact on Marine Ecological and Fisheries Resources

5.7.50 No significant DO depletion was predicted under all the assessment scenarios except for only a localized area within the HKCEC water channel. Full compliance with the WQO for depth-averaged and bottom DO of 4 mg/l and 2 mg/l respectively is predicted outside the Project site boundary in the Victoria Harbour under all the dredging scenarios. As exceedence of the WQO for DO is only expected within the WDII reclamation site (i.e. within the HKCEC water channel only), no mixing zone for DO can therefore be identified in the Victoria Harbour. No adverse impacts on the DO levels in the Victoria Harbour would be expected from the dredging works. Mitigation measures have been proposed in Section 5.8 to minimize the DO impact at the HKCEC water channel.

5.7.51 An indication of the likelihood of release of contaminants from the marine sediment during dredging is given by the results of the elutriation tests from the laboratory testing conducted under the Phase I and Phase II marine site investigation (SI) works (see Sections 5.7.33 to 5.7.37 for details). The levels of contaminants in the elutriate samples complied well with the relevant water quality criteria except only for the levels of silver and mercury measured in two isolated elutriate samples collected at Stations V06-8W and MV4 respectively which only marginally exceeded the water quality criteria. However, the laboratory tests do not take into account the dilution factor after the contaminants are released into the water column. Based on the detected highest concentrations, the required dilution rate to meet the water quality standards for silver and mercury were calculated to be very low (i.e. 1.5 times only), which can be naturally achieved once the contaminants are released into the water column. Thus, full compliance with the water quality criteria for silver and mercury is expected in the receiving water environment.

5.7.52 The elutriate tests also indicated that the levels of organic compounds (including TBT, total PCBs and total PAHs) in the elutriate samples complied well with the relevant water quality criteria except only for the PCBs level measured at one isolated sample collected within the NPR site (in vibrocore V6-10W at sampling depth 1.9 - 2.4m). The high level of PCBs detected at this isolated sample is however doubtful because all the rest of the levels measured at vibrocore V6-10W complied well with the assessment criterion and all the remaining contaminant levels were under the detention limit. The potential impact is therefore considered isolated and limited. In addition, V6-10W is located in open water at North Point, any release of PCBs during dredging at North Point water will be quickly dispersed by the fast moving current and diluted by the large volume of marine water. The release of PCBs, if any, will also be minimised by the use of closed grab dredger (Section 5.8). Nevertheless, tracer modelling was conducted for the release of PCBs at the NPR assuming that all of the PCBs measured in the sediment would be released to the water. This is a conservative assumption and will likely result in an over-prediction of the potential impacts because, in reality, not all the contaminants in the sediments would be released into the receiving water. Furthermore, the highest level of PCBs measured amongst all the sediment samples collected within the NPR site was used in the calculation of the maximum contaminant release rate for input to the model continuously over the entire dredging period. This is also a very adverse assumption as the maximum contaminant release rate would only occur for a short period of time within the dredging period. Thus, the actual water quality impact caused by the Project under the real situation would be smaller than that simulated by the tracer model. The model results indicated that, even with the adoption of such an adverse model assumption, the mixing zone of PCBs would be localized and confined in the NPR site.

5.7.53 In summary, the potential release of contaminants from the sediments within the WDII site would be low as demonstrated by the elutriation test results. It is therefore not expected that there would be any unacceptable impact on the marine ecological and fisheries resources from the potential contaminant release. **Appendix 5.10e** to **Appendix 5.10g** also show the contour plots of maximum contaminant concentrations for nutrients (TIN and UIA) and PCBs. As shown in the contour plots, the maximum concentrations for UIA fully complied with the WQO. For TIN and PCBs in which the water quality standard is exceeded, the mixing zone would be highly localized (confined within the WDII work site) and therefore would not affect the wider use of the Victoria Harbour as a habitat for marine life.

Floating Refuse and Debris Entrapment

5.7.54 The approved EIA for CRIII has conducted detailed assessment of floating refuse for the scenario with reduced tidal flushing in the embayment between the completed CRIII and the HKCEC extension prior to the construction of the planned WDII project. The assessment results indicated that there would be a tendency for some quantities of floating rubbish to be retained within the embayment for periods of the order of several days. The potential impacts from floating refuse accumulation within the temporary embayments would be mitigated by regular refuse scavenging.

Construction Phase Land-Based Impact

General Construction Activities

5.7.55 The effects on water quality from general construction activities are likely to be minimal, provided that site drainage is well maintained and good construction practices are observed to ensure that litter, fuels, and solvents are managed, stored and handled properly.

5.7.56 Based on the Sewerage Manual, Part I, 1995 of the Drainage Services Department (DSD), the global unit flow factors for employed population of 0.06 m^3 per worker per day and commercial activities in year 2016 of 0.29 m^3 per worker per day have been used to estimate the sewage generation from the construction site. The total sewage production rate is estimated at 0.35 m^3 per worker per day. Therefore, with 450 construction workers working simultaneously at the construction site, a total of about 158 m^3 of sewage will be generated per day. The sewage should not be allowed to discharge directly into the surrounding water body without treatment. Chemical toilets and subsequently on-site sewer should be deployed at the construction site to collect and handle sewage from workers (see Section 5.8 for recommended mitigation measures).

Construction Runoff and Drainage

5.7.57 Construction run-off and drainage may cause physical, chemical and biological effects. The physical effects could arise from any increase in SS from the construction site that could cause blockage of drainage channels and associated local flooding when heavy rainfall occurs, as well as local impact on water quality. High SS concentrations in marine water could lead to associated reduction in DO levels.

5.7.58 It is important that proper site practice and good site management be strictly followed to prevent run-off water and drainage water with high level of SS from entering the surrounding waters. With the implementation of appropriate measures to control run-off and drainage from the construction site, it is considered that disturbance of water bodies will be localised and deterioration in water quality will be minimal. Thus, unacceptable impacts on the water quality are not expected provided that the recommended measures described in Section 5.8 are properly implemented.

5.8 Mitigation of Adverse Environmental Impacts

Construction Phase Marine-based Impact

Construction Design

5.8.1 The following measures have been implemented in the design of reclamation phasing to ensure the continuous operation of the existing waterfront facilities and, simultaneously, to minimise the impacts on water quality:

- a number of small and confined areas of land formation are planned
- containment of fill within each of these areas by seawalls is proposed, with the seawall constructed first (above high water mark) with filling carried out behind the completed seawalls. Any gaps that may need to be provided for marine access will be shielded by silt curtains to control sediment plume dispersion away from the site. Filling should be carried out behind the silt curtain

5.8.2 Maximum dredging rates for the construction of seawall foundation are defined for five distinctly identifiable shoreline zones where reclamation will take place:

- The North Point shoreline (NPR) - the area to the east of Causeway Bay typhoon shelter
- The Causeway Bay shoreline - temporary reclamations within the Causeway Bay typhoon shelter (TCBR) and temporary typhoon shelter (TBW)
- The PCWA shoreline (TPCWA) – temporary reclamations within the PCWA
- The Wan Chai shoreline (WCR) - from the eastern boundary of HKCEC Extension to western boundary of the PCWA
- The HKCEC shoreline (HKCEC) - the area to the west of the HKCEC Extension.

5.8.3 Maximum dredging rates are also defined for two other distinctly identifiable marine works zones including:

- Dredging along the proposed alignment of the WSD cross harbour water mains from Wan Chai to Tsim Sha Tsui (Water Mains zone)
- Dredging along the proposed alignment of the submarine sewage pipeline of the Wan Chai East Sewage Treatment Works (Sewage Pipelines zone).

5.8.4 The definition of these marine works areas will ensure easier contract monitoring and control of production rates, removing possible ambiguity of interpretation even in the event of modification of the currently envisaged staging and programme by the contractor, and will maintain flexibility in respect of possible division of the reclamation into two or three different contract packages. The maximum dredging rates for seawall construction defined for the reclamation zones and the maximum dredging rates for construction of the water mains and sewage pipelines are consistent with the impact assessment modelling approach.

5.8.5 Dredging will be carried out by closed grab dredger for the following works:

- Seawall construction in all the reclamation shoreline zones
- Construction of the proposed water mains
- Construction of the proposed sewage pipelines.

5.8.6 The total dredging rate in each of the reclamation shoreline zones would not be more than 6,000m^3 per day. No more than one closed grab dredger would be operated at the same time for seawall construction in each of the reclamation shoreline zones.

5.8.7 The total dredging rate in each of the two marine works zones (namely the water mains zone and the sewage pipelines zone respectively) would not be more than 6,000 m^3 per day. No more than one closed grab dredger would be operated at the same time in each of these two marine works zones.

5.8.8 In addition, dredging for the sewage pipelines would not be carried out concurrently with the following activities to minimize the potential impacts:

- Dredging along the water mains
- Dredging along the seawall in the WCR zone.

5.8.9 The water body behind the temporary reclamations within the Causeway Bay typhoon shelter should not be fully enclosed. The current construction programme indicated that:

- TCBR3 and TCBR4 will not be implemented during the period when both TCBR1W and TBCR1E are in place at the same time.
- TCBR4 and TCBR1E will not be implemented during the period when both TCBR2 and TCBR3 are in place at the same time.
- TCBR1E, TCBR1W and TCBR2 will not be implemented during the period when TCBR3 and TCBR4 are in place at the same time.
- TCBR1W will not be in place together with TCBR4.
- TCBR1E will not be in place together with TCBR3 or TCBR4.
- TCBR2 will not be in place together with TCBR4.

5.8.10 As a mitigation measure, to avoid the accumulation of water borne pollutants within the temporary embayment between CRIII and HKCEC1, an impermeable barrier, suspended from a floating boom on the water surface and extending down to the seabed, will be erected by the contractor before the HKCEC1 commences. The barrier will channel the stormwater discharge flows from Culvert L to the outside of the embayment. The contractor will maintain this barrier until the reclamation works in HKCEC2W are carried out and the new Culvert L extension is constructed.

Specific Mitigation Measures

5.8.11 No unacceptable impact in terms of contaminant release from the dredging operation is predicted under the unmitigated scenarios. No specific mitigation measure would be required for control of contaminant release. Also, non-compliance for DO is only predicted in a localized area within the WDII reclamation site (i.e. within HKCEC channel only). Specific mitigation measures have been recommended as discussed in later section to minimize the DO impact in the HKCEC water channel. Full compliance for DO is predicted in the Victoria Harbour.

5.8.12 As indicated in **Table 5.22** to **Table 5.24**, exceedence of target SS levels at the Admiralty Centre and MTRC cooling water intakes and WSD salt water intakes are predicted during the construction. To minimise the potential SS impact, deployment of silt curtains around the closed grab dredgers is recommended as an appropriate mitigation measure to minimize the SS impact due to the dredging activities. However, silt curtains should not be used in areas where current speeds are higher than 1.0 m s^{-1}, and the effectiveness of the silt curtains will be reduced in areas of current speeds greater than around 0.5 m s^{-1}. Thus, silt curtains are recommended for seawall dredging and seawall trench filling near the existing coastline where current speeds are less than 0.5 m s^{-1}.

5.8.13 For the dredging works to be carried out at the sewage pipelines zone, water mains zone and TBW, the associated sediment plume can easily be transported to farther field by the fast moving tidal currents and thus would potentially affect the sensitive use on both sides of the Victoria Habour. As silt curtains are considered ineffective to mitigate the SS impacts in such areas, reduction of the maximum dredging rate from 6,000 m^3 per day to 1,500 m^3 per day in each of these works zones is recommended to reduce SS impacts.

5.8.14 Based on the current programme, dredging along the sewage pipelines would be carried out after the seawall of WCR1 is completed. As a result of the proposed reduction of the dredging rate, the required dredging period would be longer but the dredging duration would not be extended beyond the planned seawall dredging at WCR2. Thus, dredging along the sewage pipelines would not be carried out simultaneously with the seawall dredging in WCR even with the extended dredging period. As a result, no extra SS impact would be induced by the reduced dredging rate. Similarly, at the TBW, the dredging duration would not be extended beyond the planned dredging at the TCWBR site as a result of the reduced dredging rate. Also, dredging along the water mains would not be extended beyond the planned commencement of the sewage pipelines construction due to the reduced dredging rate. The worst-case dredging scenarios modelled under this EIA take into account all potential concurrent dredging activities. The proposed reduction of the dredging rate would not result in any change in the worst-case dredging scenarios.

5.8.15 Deployment of silt curtains around the closed grab dredgers to contain SS within the construction site during seawall dredging and seawall trench filling is recommended for the areas of HKCEC, WCR, TCBR and NPR where the current speeds are expected to be less than 0.5 m s^{-1}. Based on the water quality modelling and assessment result, deployment of silt curtains is considered not necessary for the dredging works within the PCWA provided that the maximum dredging rate within the PCWA can be reduced from 6,000 m^3 per day to 5,000 m^3 per day to minimize the SS impacts.

5.8.16 Based on the modelling results, residual SS impacts were still predicted at some of the cooling water intakes and WSD flushing water intakes after the deployment of the silt curtains and reduction of the dredging rate as recommended above. Thus, deployment of silt screens is also proposed at selected cooling water intakes and WSD salt water intakes as shown in **Table 5.39** to further minimize the residual impact. **Table 5.39** summarises the application of silt screens under the interim construction stages (i.e. Scenario 2A (and Sensitivity Test), Scenario 2B and Scenario 2C).

Table 5.39 Application of Silt Screens at Interim Construction Stages

Interim Construction Stage	Location of Applications
Scenario 2A in early 2009 with concurrent dredging activities at HKCEC, WCR, TPCWA, TBW, NPR and Water Mains Zone	• **WSD saltwater intakes** at Sai Wan Ho, Quarry Bay, Sheung Wan, Kowloon South, Wan Chai • **Cooling water intakes** for Hong Kong Convention and Exhibition Centre Extension, Hong Kong Convention and Exhibition Centre Phase I, Telecom House / HK Academy for Performing Arts / Shun On Centre, Wan Chai Tower / Revenue Tower / Immigration Tower and Sun Hung Kai Centre.
Scenario 2B in late 2009 to 2010 with concurrent dredging activities at Sewage Pipelines Zone and TCBR.	• **WSD saltwater intakes** at Sheung Wan, Wan Chai. • **Cooling water intakes** for Queensway Government Offices. Excelsior Hotel & World Trade Centre and Windsor House.
Scenario 2C in 2011 with concurrent dredging activities at HKCEC and TCBR.	• **WSD saltwater intakes** at Sheung Wan and Reprovisioned WSD Wan Chai saltwater intake. • **Cooling water intakes** for MTR South, Excelsior Hotel & World Trade Centre and reprovisioned Windsor House.

5.8.17 According to the Contaminated Spoil Management Study [26], the implementation of silt curtain around the closed grab dredgers will reduce the dispersion of SS by a factor of 4 (or about 75%). Similarly, the implementation of silt screen at the intake could reduce the SS level by a factor of 2.5 (or about 60%). This SS reduction factor has been established under the Pak Shek Kok Reclamation, Public Dump EIA (1997) and has been adopted in a number of recent studies, including the Western Coast Road EIA study. **Figure 5.15** shows typical configuration of silt curtains and silt screens, design and set-up of silt curtain [27].

5.8.18 **Table 5.40**, **Table 5.40a**, **Table 5.41** and **Table 5.42** summarise the predicted SS levels at the intakes after the implementation of all the mitigation measures as recommended above. With the recommended measures, all sensitive receivers would fully comply with the relevant water quality criteria.

(26) Mott MacDonald (1991). Contaminated Spoil Management Study, Final Report, Volume 1, for EPD, October 1991.
(27) Silt curtains should be made from impervious material such as coated nylon and primarily redirect flow around the dredging area rather than blocking the entire water column. In contrast, silt screens are made from synthetic geotextile fabrics, which allow water to flow through but retain a fraction of the suspended solids.

Compliance with WQO for SS Elevation

5.8.19 The sediment plumes (SS elevation) under mitigated scenarios are shown in **Appendix 5.9a to Appendix 5.9h**. Each of the figures attached in these appendices contains two contour plots where the upper plot shows the unmitigated scenarios and the lower plot shows the mitigated scenarios. Non-compliance with the WQO for SS (i.e. elevation of less than 30% of ambient baseline level) is predicted to be localized and acceptable after implementation of the recommended mitigation measures.

5.8.20 **Table 5.43** to **Table 5.46** summarise the predicted SS elevation at the coral site in Junk Bay after the implementation of all the mitigation measures as recommended above. The coral sites at Green Island and Junk Island were found not be impacted by marine works from WDII and are therefore not included in the tables. With the recommended measures, the SS elevation predicted at the Junk Bay would fully comply with the WQO.

Table 5.40 Construction Scenario 2A –Predicted SS levels at the Seawater Intakes after the Implementation of Mitigation Measures (Base Case Scenario)

Sensitive Receiver	SS concentration (absolute value) in the mid-depth (mg/l)		
		Dry season	Wet season
	Criterion	Maximum (1)	Maximum (1)
Cooling Water Intakes			
Prince's Building Group	-	24.8	23.9
Queensway Government Offices	-	21.6	21.1
Admiralty Centre	< 40	29.5	18.5
HSBC	-	21.4	25.2
Excelsior Hotel & World Trade Centre	-	7.6	20.7
Great Eagle Centre / China Resources Building	-	21.3	32.2
Hong Kong Convention and Exhibition Centre Extension	-	8.1	8.7
Hong Kong Convention and Exhibition Centre Phase I	-	48.0	48.4
MTRC South Intake	< 40	13.8	16.3
Sun Hung Kai Centre	-	9.2	15.0
Telecom House / HK Academy for Performing Arts / Shun On Centre	-	13.8	11.9
Wan Chai Tower / Revenue Tower / Immigration Tower	-	10.8	15.0
Windsor House	-	7.8	18.8
Government Premises	-	9.4	15.1
City Garden	-	18.4	17.3
Provident Centre	-	20.1	18.2
WSD Saltwater Intakes			
Kennedy Town	< 10	8.4	7.4
Kowloon South	< 10	3.0	4.4
Quarry Bay	< 10	5.9	5.4
Sai Wan Ho	< 10	6.6	6.1
Sheung Wan	< 10	6.6	6.0
Siu Sai Wan	< 10	5.0	6.1
Wan Chai	< 10	6.2	9.7

Notes:
(1) The water quality modelling results for 90 percentile SS predicted under the pre-construction scenario at the corresponding indicator points are adopted as the ambient SS levels.
- Other WSR, including WSD Tai Wan intake, WSD Cheung Sha Wan intake, WSD Cha Kwo Ling intake, Kau Yi Chau Fishery, PLA Headquarters intake, Queen Mary Hospital intake, Stage 1 Phase 1 intake and Wah Fu Estate intake were found not be impacted by the proposed marine works.

Table 5.40a Construction Scenario 2A –Predicted SS levels at the Seawater Intakes after the Implementation of Mitigation Measures (Sensitivity Test using Higher Dredging Rate for Gas Main Construction)

Sensitive Receiver	SS concentration (absolute value) in the mid-depth (mg/l)		
		Dry season	Wet season
	Criterion	Maximum (1)	Maximum (1)
Cooling Water Intakes			
Prince's Building Group	-	24.8	24.4
Queensway Government Offices	-	21.6	21.1
Admiralty Centre	< 40	29.5	19.2
HSBC	-	21.4	25.2
Excelsior Hotel & World Trade Centre	-	7.6	20.7
Great Eagle Centre / China Resources Building	-	21.7	32.2
Hong Kong Convention and Exhibition Centre Extension	-	8.1	10.0
Hong Kong Convention and Exhibition Centre Phase I	-	48.0	48.4
MTRC South Intake	< 40	13.8	16.3
Sun Hung Kai Centre	-	9.2	15.0
Telecom House / HK Academy for Performing Arts / Shun On Centre	-	13.8	11.9
Wan Chai Tower / Revenue Tower / Immigration Tower	-	10.8	15.3
Windsor House	-	7.8	18.8
Government Premises	-	9.4	15.1
City Garden	-	18.4	17.3
Provident Centre	-	20.1	18.2
WSD Saltwater Intakes			
Kennedy Town	< 10	8.4	7.4
Kowloon South	< 10	3.0	4.6
Quarry Bay	< 10	6.0	6.2
Sai Wan Ho	< 10	6.6	6.4
Sheung Wan	< 10	7.4	6.1
Siu Sai Wan	< 10	5.0	6.2
Wan Chai	< 10	6.2	9.7

Notes:

(2) The water quality modelling results for 90 percentile SS predicted under the pre-construction scenario at the corresponding indicator points are adopted as the ambient SS levels.

- Other WSR, including WSD Tai Wan intake, WSD Cheung Sha Wan intake, WSD Cha Kwo Ling intake, Kau Yi Chau Fishery, PLA Headquarters intake, Queen Mary Hospital intake, Stage 1 Phase 1 intake and Wah Fu Estate intake were found not be impacted by the proposed marine works.

Table 5.41 Construction Scenario 2B – Predicted SS levels at the Seawater Intakes after the Implementation of Mitigation Measures

Sensitive Receiver	SS concentration (absolute value) in the mid-depth (mg/l)		
		Dry season	Wet season
	Criterion	Maximum (1)	Maximum (1)
Cooling Water Intakes			
Prince's Building Group	-	10.0	12.4
Queensway Government Offices	-	4.8	10.1
Admiralty Centre	< 40	10.1	20.0
HSBC	-	15.0	14.4
Excelsior Hotel & World Trade Centre	-	9.4	18.0
Great Eagle Centre / China Resources Building	-	10.2	12.0
Hong Kong Convention and Exhibition Centre Extension	-	17.1	17.9
Hong Kong Convention and Exhibition Centre Phase I	-	7.3	10.4
MTRC South Intake	< 40	10.6	11.0
Sun Hung Kai Centre	-	10.7	11.2
Telecom House / HK Academy for Performing Arts / Shun On Centre	-	10.7	13.3
Wan Chai Tower / Revenue Tower / Immigration Tower	-	8.1	10.9
Windsor House	-	3.6	13.3
Government Premises	-	6.1	8.1
City Garden	-	5.7	12.2
Provident Centre	-	6.4	8.8
WSD Saltwater Intakes			
Kennedy Town	< 10	6.8	7.2
Kowloon South	< 10	7.2	8.1
Quarry Bay	< 10	8.8	9.0
Sai Wan Ho	< 10	7.5	9.1
Sheung Wan	< 10	5.1	5.3
Siu Sai Wan	< 10	4.8	5.1
Wan Chai	< 10	2.7	4.5

Notes:
(1) The water quality modelling results for 90 percentile SS predicted under the pre-construction scenario at the corresponding indicator points are adopted as the ambient SS levels.
- Other WSRs, including WSD Tai Wan intake, WSD Cheung Sha Wan intake, WSD Cha Kwo Ling intake, Kau Yi Chau Fishery, PLA Headquarters intake, Queen Mary Hospital intake, Stage 1 Phase 1 intake and Wah Fu Estate intake were found not be impacted by proposed marine works.

Table 5.42 Construction Scenario 2C – Predicted SS levels at the Seawater Intakes after the Implementation of Mitigation Measures

Sensitive Receiver	SS concentration (absolute value) in the mid-depth (mg/l)		
		Dry season	Wet season
	Criterion	Maximum [(1)]	Maximum [(1)]
Cooling Water Intakes			
Prince's Building Group	-	7.9	14.6
Queensway Government Offices	-	8.1	29.2
Admiralty Centre	< 40	9.7	24.0
HSBC	-	11.1	22.7
Excelsior Hotel & World Trade Centre	-	11.3	6.9
Great Eagle Centre / China Resources Building	-	16.9	24.7
Hong Kong Convention and Exhibition Centre Extension	-	17.1	15.1
Hong Kong Convention and Exhibition Centre Phase I	-	13.3	19.9
MTRC South Intake	< 40	6.5	6.5
Sun Hung Kai Centre (reprovisioned)	-	11.7	14.6
Telecom House / HK Academy for Performing Arts / Shun On Centre	-	24.2	16.1
Wan Chai Tower / Revenue Tower / Immigration Tower	-	19.8	23.8
Windsor House (reprovisioned)	-	9.7	7.6
Government Premises	-	6.1	8.2
City Garden	-	5.6	8.2
Provident Centre	-	5.5	8.6
WSD Saltwater Intakes			
Kennedy Town	< 10	6.9	7.3
Kowloon South	< 10	8.1	8.1
Quarry Bay	< 10	7.9	8.2
Sai Wan Ho	< 10	5.5	10.0
Sheung Wan	< 10	5.4	4.4
Siu Sai Wan	< 10	4.8	5.4
Wan Chai (reprovisioned)	< 10	4.7	5.8

Notes:
(1) The water quality modelling results for 90 percentile SS predicted under the pre-construction scenario at the corresponding indicator points are adopted as the ambient SS levels.
- Other WSRs, including WSD Tai Wan intake, WSD Cheung Sha Wan intake, WSD Cha Kwo Ling intake, Kau Yi Chau Fishery, PLA Headquarters intake, Queen Mary Hospital intake, Stage 1 Phase 1 intake and Wah Fu Estate intake were found not be impacted by the proposed marine works.

Table 5.43 Predicted SS Elevations at Corals for Construction Scenario 2A - Mitigated

Corals	Background SS Level (mg/l)	SS Elevation in Bottom Layer (mg/l)		
		Criterion (30% of Mean SS Level)	Mean	Maximum
Wet Season				
Junk Bay (CR27)	4.75	< 1.10	0.03	0.53
Dry Season				
Junk Bay (CR27)	3.93	< 1.06	0.07	1.03

Remark: The coral sites at Green Island and Junk Island were found not be impacted by marine works from Wan Chai Development Phase II

Table 5.44 Predicted SS Elevations at Corals for Construction Scenario 2A - Mitigated (Sensitivity Test using Higher Dredging Rate for Gas Main Construction)

Corals	Background SS Level (mg/l)	SS Elevation in Bottom Layer (mg/l)		
		Criterion (30% of Mean SS Level)	Mean	Maximum
Wet Season				
Junk Bay (CR27)	4.75	< 1.10	0.03	0.54
Dry Season				
Junk Bay (CR27)	3.93	< 1.06	0.07	1.03

Remark: The coral sites at Green Island and Junk Island were found not be impacted by marine works from Wan Chai Development Phase II

Table 5.45 Predicted SS Elevations at Corals for Construction Scenario 2B – Mitigated

Corals (ID)	Background SS Level (mg/l)	SS Elevation in Bottom Layer (mg/l)		
		Criterion (30% of Mean SS Level)	Mean	Maximum
Wet Season				
Junk Bay (CR27)	4.75	< 1.10	0.00	0.03
Dry Season				
Junk Bay (CR27)	3.71	< 1.06	0.00	0.00

Remark: The coral sites at Green Island and Junk Island were found not be impacted by marine works from Wan Chai Development Phase II

Table 5.46 Predicted SS Elevations at Corals for Construction Scenario 2C – Mitigated

Corals (ID)	Background SS Level (mg/l)	SS Elevation in Bottom Layer (mg/l)		
		Criterion (30% of Mean SS Level)	Mean	Maximum
Wet Season				
Junk Bay (CR27)	4.75	< 1.10	0.00	0.04
Dry Season				
Junk Bay (CR27)	3.71	< 1.07	0.00	0.00

Remark: The coral sites at Green Island and Junk Island were found not be impacted by marine works from Wan Chai Development Phase II

5.8.21 In recognition of the potentially higher level of impacts caused by dredging close to the seawater intakes, dredging along the seawall at WCR1 should be undertaken initially at 1,500 m^3 per day for construction of the western seawall (which is in close proximity of the WSD intake), followed by partial seawall construction at the western seawall (above high water mark) to isolate the adjacent intakes as much as possible from further dredging activities. Thus, the intakes would be shielded from most of the SS generated from further dredging along the northern and eastern seawall.

5.8.22 High DO depletion was predicted inside the HKCEC water channel during the seawall dredging at HKCEC1 (refer to Section 5.7). To minimize the potential DO depletion inside the water channel, it is recommended that the seawall trench dredging in HKCEC1 and HKCEC3 should be undertaken at no more than the maximum rate of 1,500 m^3 per day.

5.8.23 For dredging within the Causeway Bay typhoon shelter, seawall should be partially constructed to protect the nearby seawater intakes from further dredging activities. For example, at TCBR1W, the southern and eastern seawalls should be constructed first (above high water mark) so that the seawater intakes at the inner water would be protected from the impacts from the remaining dredging activities along the northern boundary.

5.8.24 Based on the considerations above, the maximum dredging rates under different marine works zones are recommended in **Table 5.47**. It should be noted that the dredging rates listed in **Table 5.47** have not considered the effect of silt curtains as recommended in Section 5.8.15. The equivalent sediment loss rates shown in the table below represent the values before applying the silt curtains.

Table 5.47 Recommended Maximum Dredging Rates

Reclamation Area		Maximum Dredging Rate		Maximum Dredging Rate (m^3 per week)	Equivalent Sediment Loss Rate (kg s^{-1})
		m^3 per day	m^3 per hour		
Dredging along seawall or breakwater					
North Point Shoreline Zone (NPR)		6,000	375	42,000	2.08
Causeway Bay Shoreline Zone	TBW	1,500	94	10,500	0.52
	TCBR	6,000	375	42,000	2.08
PCWA Zone		5,000	313	35,000	1.73
Wan Chai Shoreline Zone (WCR)		6,000	375	42,000	2.08
HKCEC Shoreline Zone (HKCEC)	HKCEC Stage 1 & 3	1,500	94	10,500	0.52
	HKCEC Stage 2	6,000	375	42,000	2.08
Dredging along pipelines					
Cross Harbour Water Mains		1,500	94	10,500	0.52
Wan Chai East Submarine Sewage Pipeline		1,500	94	10,500	0.52

Notes: (1) Dredging to be carried out by closed grab dredger (16 hours per day)
(2) Silt curtains to be deployed around seawall dredging and seawall trench filling in NPR, TCBR, WCR and HKCEC areas.
(3) Reduced dredging rates of 1,500 m^3 per day are applicable to construction of the western seawall of WCR1 which is close to the WSD intake (refer to Section 5.8.21).
(4) Silt screens to be deployed at selected seawater intakes as recommended in **Table 5.39**.

5.8.25 With the recommended reduction of dredging rates, deployment of silt curtains around seawall dredging and seawall trench filling, it is not expected that there would be any unacceptable DO depletion caused by the release of organic pollutants from the dredging activities within the temporary embayment areas.

5.8.26 It is expected that any water quality exceedance of action / limit levels would be readily captured by an effective site audit and water quality monitoring mechanism. The water quality monitoring frequency should be increased to once per day when dredging in the vicinity of the seawater intakes, and 24 hour monitoring of turbidity at the intakes should be implemented as and when necessary.

5.8.27 Dredging of contaminated mud is recommended as a mitigation measures for control of operational odour impact from the Causeway Bay typhoon shelter (as detailed in Section 3). In recognition of the potential impacts caused by dredging activities close to the seawater intakes, only 1 small close grab dredger should be operated within the typhoon shelter (for the dredging to mitigate odour impact) at any time to minimize the potential impact. Double silt curtains should be deployed to fully enclose the closed grab dredger during the dredging operation. In addition, an impermeable barrier, suspended from a floating boom on the water surface and extended down to the seabed, should be erected to isolate the adjacent intakes as much as possible from dredging activities. For example, if dredging is to be carried out at the southwest corner of the typhoon shelter, physical barriers should be erected to west of the cooling water intake for Excelsior Hotel (namely Intake 8) so that the intake would be shielded from most of the SS generated from the dredging operation to the west of the intake. For area in close proximity of the cooling water intake point, the dredging rate should be reduced as much as practicable. Site audit and water quality monitoring should be carried out at the seawater intakes during the dredging operations. Daily monitoring of SS at the cooling water intake should be carried out, and 24 hour monitoring of turbidity at the intakes should be implemented during the dredging activities. If the monitoring results indicate that the dredging operation has caused significant changes in water quality conditions at the seawater intakes, appropriate actions should be taken to stop the dredging and mitigation measures such as slowing down the dredging rate should be implemented.

<u>Cumulative Impacts from WDII and Gas Main Relocation</u>

5.8.28 To investigate the worst-case impact on the WSD flushing intake at Quarry Bay, additional sensitivity test was conducted using an alternative source point for the new gas main near the pipeline landing point at North Point with a dredging rate of 5,000 m^3 per day based on the latest information provided by the HKCGCL and the indicative alignment provided in the Project Profile for the new gas main (refer to Section 5.6.83). **Table 5.48** below compares the potential SS impact upon the Quarry Bay intake under the basecase scenario (assuming the dredging for gas main construction is conducted near Tai Wan intake) and the additional sensitivity test (assuming the dredging for gas main construction is conducted near the Quarry Bay intake). The predicted SS levels shown in **Table 5.48** represent the mitigated scenario with implementation of all the mitigation measures recommended for WDII (including the installation of silt screen at the Quarry Bay intake) as discussed above.

Table 5.48 Cumulative Impact on Quarry Bay Intake

<table>
<tr><th>Description</th><th colspan="2">Basecase Scenario assuming the dredging for gas main relocation is conducted near Tai Wan intake</th><th colspan="2">Sensitivity Analysis assuming the dredging for gas main relocation is conducted near Quarry Bay intake</th></tr>
<tr><td>Dredging Rate for Gas Main Construction (m^3 per day)</td><td colspan="2">5000</td><td colspan="2">5000</td></tr>
<tr><td>WSD Standard for SS at flushing water intake (mg/l)</td><td colspan="4">10</td></tr>
<tr><td rowspan="2">Maximum SS Level Predicted at the Quarry Bay Intake under the mitigated scenario(mg/l)</td><td>Maximum</td><td>Mean</td><td>Maximum</td><td>Mean</td></tr>
<tr><td>6.2
(see **Table 5.40a**)</td><td>2.4</td><td>**19.9**</td><td>3.1</td></tr>
<tr><td>% time in compliance</td><td>100%</td><td>-</td><td>99.4%</td><td>-</td></tr>
<tr><td>Contribution from WDII activities</td><td>35.5%</td><td>7.4%</td><td>0.0%</td><td>10.1%</td></tr>
<tr><td>Contribution from Gas Main Relocation</td><td>20.5%</td><td>3.4%</td><td>89.3%</td><td>25.4%</td></tr>
<tr><td>Contribution from other concurrent projects and background sources</td><td>43.9%</td><td>89.2%</td><td>10.7%</td><td>64.5%</td></tr>
</table>

Note: Shaded value indicates exceedance of the WSD standard for flushing water intake

5.8.29 It should be noted that the dispersion and movement of pollutants and sediment plume in the Victoria Harbour will be driven by the changing tidal current. Therefore, the relative SS contribution at the flushing water intake from individual projects would also be changing at different tidal status and time. The % contributions for the maximum SS levels as shown in the above table represent the relative contributions at a particular instant when the SS level predicted at the Quarry Bay intake reached the maximum value. In terms of the contribution due to the WDII activity alone, the SS impact upon the Quarry Bay intake is considered minor and acceptable. The model predicted that the WDII works would not cause any non-compliance at the Quarry Bay intake with implementation of all the recommended mitigation measures. Under the case when dredging for the gas main construction is conducted near the North Point at a rate of 5,000 m^3 per day, the SS level at the Quarry Bay intake would likely exceed the WSD water quality standard. However, as indicated by the sensitivity modelling conducted under this EIA, feasible mitigation measures such as installation of silt curtains around the gas main dredging work in areas close to the North Point or reduction of the dredging rate for gas main construction for the dredging activities near the North Point would effectively eliminate the SS exceedance and achieve full compliance at all the WSD flushing water intakes. The water quality impact due to the gas main relocation and the necessary mitigation measures required for protection of the flushing water intake will be addressed under the separate EIA study for the new gas main (also refer to Section 5.6.83).

Other Mitigation Measures

5.8.30 Other good site practices that should be undertaken during sand filling, public filling and dredging include:

- mechanical grabs, if used, should be designed and maintained to avoid spillage and sealed tightly while being lifted. For dredging of any contaminated mud, closed watertight grabs must be used

- 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

- all hopper barges and dredgers should be fitted with tight fitting seals to their bottom openings to prevent leakage of material

- construction activities should not cause foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the site or dumping grounds

- loading of barges and hoppers should be controlled to prevent splashing of dredged material into the surrounding water. Barges or hoppers should not be filled to a level that will cause the overflow of materials or polluted water during loading or transportation

- before commencement of the reclamation works, the holder of the Environmental Permit shall submit plans showing the phased construction of the reclamation, design and operation of the silt curtain.

Regular Maintenance of Silt Screens

5.8.31 Silt screens are recommended to be deployed at the seawater intakes during the reclamation works period. Installation of silt screens at the seawater intake points may cause a potential for accumulation and trapping of pollutants, floating debris and refuse behind the silt screens and may lead to potential water quality deterioration at the seawater intake points. Major sources of pollutants and floating refuse include the runoff and storm water discharges from the nearby coastal areas. As a mitigation measure to avoid the pollutant and refuse entrapment problems and to ensure that the impact monitoring results are representative, regular maintenance of the silt screens and refuse collection should be performed at the monitoring stations at regular intervals on a daily basis. The Contractor should be responsible for keeping the water behind the silt screen free from floating rubbish and debris during the impact monitoring period.

Construction Phase Land-based Impact

5.8.32 It is important that appropriate measures are implemented to control runoff and drainage and prevent high loading of SS from entering the marine environment. Proper site management is essential to minimise surface water runoff, soil erosion and sewage effluents.

5.8.33 Any practical options for the diversion and re-alignment of drainage should comply with both engineering and environmental requirements in order to ensure adequate hydraulic capacity of all drains.

5.8.34 Construction site runoff and drainage should be prevented or minimised in accordance with the guidelines stipulated in the EPD's Practice Note for Professional Persons, Construction Site Drainage (ProPECC PN 1/94). Good housekeeping and stormwater best management practices, as detailed in below, should be implemented to ensure that all construction runoff complies with WPCO standards and that no unacceptable impact on the WSRs arises due to construction of the WDII. All discharges from the construction site should be controlled to comply with the standards for effluents discharged into Victoria Harbour WCZ under the TM-DSS.

Construction Runoff

5.8.35 Exposed soil areas should be minimised to reduce the potential for increased siltation, contamination of runoff, and erosion. Construction runoff related impacts associated with the above ground construction activities can be readily controlled through the use of appropriate mitigation measures which include:

- use of sediment traps
- adequate maintenance of drainage systems to prevent flooding and overflow.

5.8.36 Construction site should be provided with adequately designed perimeter channel and pre-treatment facilities and proper maintenance. The boundaries of critical areas of earthworks should be marked and surrounded by dykes or embankments for flood protection. Temporary ditches should be provided to facilitate runoff discharge into the appropriate watercourses, via a silt retention pond. Permanent drainage channels should incorporate sediment basins or traps and baffles to enhance deposition rates. The design of efficient silt removal facilities should be based on the guidelines in **Appendix A1** of ProPECC PN 1/94.

5.8.37 Ideally, construction works should be programmed to minimise surface excavation works during the rainy season (April to September). All exposed earth areas should be completed as soon as possible after earthworks have been completed, or alternatively, within 14 days of the cessation of earthworks where practicable. If excavation of soil cannot be avoided during the rainy season, or at any time of year when rainstorms are likely, exposed slope surfaces should be covered by tarpaulin or other means.

5.8.38 Sediment tanks of sufficient capacity, constructed from pre-formed individual cells of approximately 6 to 8 m^3 capacity, are recommended as a general mitigation measure which can be used for settling surface runoff prior to disposal. The system capacity is flexible and able to handle multiple inputs from a variety of sources and particularly suited to applications where the influent is pumped.

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

5.8.40 Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris being washed into the drainage system and storm runoff being directed into foul sewers.

5.8.41 Precautions to be taken at any time of year when rainstorms are likely, actions to be taken when a rainstorm is imminent or forecast, and actions to be taken during or after rainstorms are summarised in **Appendix A2** of ProPECC PN 1/94. Particular attention should be paid to the control of silty surface runoff during storm events.

5.8.42 Oil interceptors should be provided in the drainage system and regularly cleaned to prevent the release of oils and grease into the storm water drainage system after accidental spillages. The interceptor should have a bypass to prevent flushing during periods of heavy rain.

5.8.43 All vehicles and plant should be cleaned before leaving a construction site to ensure no earth, mud, debris and the like is deposited by them on roads. An adequately designed and located wheel washing bay should be provided at every site exit, and wash-water should have sand and silt settled out and removed at least on a weekly basis to ensure the continued efficiency of the process. The section of access road leading to, and exiting from, the wheel-wash bay to the public road should be paved with sufficient backfall toward the wheel-wash bay to prevent vehicle tracking of soil and silty water to public roads and drains.

<u>Drainage</u>

5.8.44 It is recommended that on-site drainage system should be installed prior to the commencement of other construction activities. Sediment traps should be installed in order to minimise the sediment loading of the effluent prior to discharge into foul sewers. There shall be no direct discharge of effluent from the site into the sea.

5.8.45 All temporary and permanent drainage pipes and culverts provided to facilitate runoff discharge should be adequately designed for the controlled release of storm flows. All sediment control measures should be regularly inspected and maintained to ensure proper and efficient operation at all times and particularly following rain storms. The temporarily diverted drainage should be reinstated to its original condition when the construction work has finished or the temporary diversion is no longer required.

5.8.46 All fuel tanks and storage areas should be provided with locks and be located on sealed areas, within bunds of a capacity equal to 110% of the storage capacity of the largest tank, to prevent spilled fuel oils from reaching the coastal waters of Victoria Harbour WCZ.

<u>Sewage Effluent</u>

5.8.47 Construction work force sewage discharges on site are expected to be connected to the existing trunk sewer or sewage treatment facilities. The construction sewage may need to be handled by portable chemical toilets prior to the commission of the on-site sewer system. Appropriate numbers of portable toilets shall be provided by a licensed contractor to serve the large number of construction workers over the construction site. The Contractor shall also be responsible for waste disposal and maintenance practices.

<u>Floating Refuse and Debris</u>

5.8.48 Surface runoff, storm water discharges and marine vessels are the major sources of floating refuse and debris. The accumulation and trapping of floating refuse is a common and inevitable problem, which causes potential impact on the aesthetic appearance of the coastal waters and may lead to potential water quality deterioration. These adverse impacts will be minimised by the proposed construction phasing which minimises temporary water embayments and prevent storm runoff from discharging into these embayments by temporary diversion channels to the open waters. It is recommended that collection and removal of floating refuse should be performed at regular intervals on a daily basis. The contractor should be responsible for keeping the water within the site boundary and the neighbouring water free from rubbish during the WDII and CWB construction. On-site waste management requirements are described further in Section 6 of this Report.

Stormwater Discharges

5.8.49 Minimum distances of 100 m shall be maintained between the existing or planned stormwater discharges and the existing or planned WSD flushing water intakes.

Operational Phase

5.8.50 Adverse water quality impact associated with the operation of WDII and CWB is not expected. Thus, operational mitigation measures are not considered necessary. Regular maintenance and refuse collection are proposed at locations of embayed waters and locations with potential floating refuse entrapment problems.

5.8.51 For the operation of CWB, a surface water drainage system would be provided to collect road runoff. The following operation stage mitigation measures are recommended to ensure road runoff would comply with the TM under the WPCO:

- The drainage from tunnel sections shall be directed through petrol interceptors to remove oil and grease before being discharged to the nearby foul water manholes.
- Petrol interceptors shall be regularly cleaned and maintained in good working condition.
- Oily contents of the petrol interceptors shall be properly handled and disposed of, in compliance with the requirements of the Waste Disposal Ordinance.
- Sewage arising from ancillary facilities of CWB (for examples, car park, control room, ventilation and administration buildings and tunnel portals) shall be connected to public sewerage system. Sufficient capacity in public sewerage shall be made available to the proposed facilities.
- Road drainage should also be provided with adequately designed silt trap to minimize discharge of silty runoff.

5.8.52 The design of the operational stage mitigation measures for CWB shall take into account the guidelines published in ProPECC PN 5/93 "Drainage Plans subject to Comment by the EPD." All operational discharges from the CWB into drainage or sewerage systems are required to be licensed by EPD under the WPCO.

5.9 Evaluation of Residual Impacts

Construction Phase

Marine-based Construction Impact

5.9.1 The major water quality impact associated with dredging and filling activities is the elevation of SS within the marine water column. Provided the recommended mitigation measures are implemented, including restriction on the maximum dredging rates, the deployment of silt curtains at the dredging and filling areas, and installation of silt screens at seawater intakes, there would be no unacceptable residual water quality impact due to the proposed reclamation works.

Land-based Construction Impact

5.9.2 General construction activities associated with the construction of WDII and CWB could lead to site runoff containing elevated concentrations of SS and associated contaminants that may enter into the marine water. However, it is anticipated that the above water quality impacts will generally be temporary and localised during construction. Therefore, no unacceptable residual water quality impacts are anticipated during the construction of the proposed infrastructure, provided all of the recommended mitigation measures are implemented and all construction site / works area discharges comply with the TM-DSS standards.

Operational Phase

5.9.3 Adverse water quality impacts associated with the operation of WDII and CWB are not expected. Thus, there would be no unacceptable residual impact associated with the operation of the Project.

5.10 Environmental Monitoring and Audit

Construction Phase

5.10.1 There would be potential water quality impacts upon the water sensitive receivers due to the marine reclamation works. Appropriate mitigation measures are recommended in order to minimize the potential impacts. Water quality monitoring and audit during construction phase will need to be carried out to ensure that such mitigation measures are implemented properly.

Operational Phase

5.10.2 No unacceptable water quality impacts would be expected from the Project. No monitoring programme specific for operational water quality would be required.

5.11 Conclusion

Construction Phase

Marine-based Impact

5.11.1 The water quality impacts during the reclamation of WDII and CWB have been quantitatively assessed by numerical modelling. Suspended sediment is identified as the most significant water quality parameter during the reclamation. The worst-case scenarios during reclamation, taking into account the anticipated reclamation stages and possible overlapping dredging and filling activities, have been assessed. The assessment also takes into account the cumulative effects that arise from other concurrent marine works in the Harbour. It is predicted that potential water quality impacts could occur at seawater intakes along the Central and Wan Chai shorelines and in the CBTS. However, the water quality impacts at the seawater intakes can be effectively minimised with the implementation of proposed mitigation measures, which include silt curtains around the dredging operations, silt screens at the intakes, restricted dredging rates and bulk filling behind constructed seawalls. With the implementation of these mitigation measures, there would be no unacceptable residual water quality impacts due to the WDII and CWB reclamation and due to the cumulative effects from other concurrent reclamation activities. A water quality monitoring and audit programme will be implemented to ensure the effectiveness of the proposed water quality mitigation measures.

Land-based Impact

5.11.2 Water quality impacts from land-based construction, including road works, waterfront facilities and public utilities, are associated with surface runoff and effluent discharge from the site. Impacts can be controlled to comply with statutory standards by implementing mitigation measures such as on-site drainage and sediment traps to control run-off. No unacceptable residual impact on water quality is anticipated.

Operational Phase

5.11.3 An assessment of the hydrodynamic and water quality impacts due to the Project has been carried out by numerical modelling, taking into consideration all other concurrent developments and water pollution sources. For both hydrodynamics and water quality, the baseline (without the WDII and CWB reclamation) and operational phase (with the WDII reclamation) simulations have been compared. The model results indicate that the WDII and CWB reclamation would have minimal impact on the hydrodynamic regime of the study area. The model results also suggest that the levels of pollutants near Wan Chai and the neighbouring areas are similar under both baseline and operational scenarios. No unacceptable impacts associated with the operation of the WDII project upon the water quality in Victoria Harbour are therefore anticipated.

5.11.4 The key water quality issue in relation to the operation of the CWB would be the potential oil-contaminated surface road runoff and tunnel seepage. However, the CWB will be designed with adequate drainage systems and appropriate oil interceptors, as required, and no adverse water quality impact is therefore expected.