5 WATER QUALITY IMPACT

5.1 Introduction

5.1.1 This section presents an assessment of the potential water quality impacts associated with the construction and operation of the proposed Roads D3A & D4A. Recommendations for mitigation measures have been provided, where necessary, to minimise the identified water quality impacts to an acceptable level. All construction works for the Project will be land-based, and therefore direct impacts on marine water quality are not expected to arise.

5.2 Environmental Legislation, Standards and Guidelines

Environmental Impact Assessment Ordinance (EIAO)

5.2.1 The Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) is issued by the EPD under Section 16 of the EIAO. It specifies the assessment method and criteria that need to be followed in EIA. Reference sections in the EIAO-TM provide the details of the assessment criteria and guidelines that are relevant to the water quality impact assessment, including:

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

Water Pollution Control Ordinance (WPCO)

5.2.2 The Water Pollution Control Ordinance (Cap. 358) is the major legislation relating to 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 (WCZ). 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 each of the WCZ based on their beneficial uses. The study area for this water quality impact assessment covers the Victoria Harbour (Phase 1 and 2) WCZ. The corresponding WQOs 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
E coli	Not to exceed 1000 per 100 mL, calculated as the geometric mean of the most recent 5 consecutive samples taken at intervals between 7 and 21 days	Inland waters
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
DO	Not less than 4.0 mg/l	Inland waters
pH	To be in the range of 6.5 - 8.5, change due to human activity not to exceed 0.2	Marine waters
	Not to exceed the range of 6.0 - 9.0 due to human activity	Inland 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
	Annual median not to exceed 25 mg/l due to	Inland waters

Parameters	Objectives	Sub-Zone
	human activity	
Unionized ammonia (UIA)	Annual mean not to exceed 0.021 mg(N)/l as unionized form	Whole zone
Nutrients	Shall not cause excessive algal growth	Marine waters
Total inorganic nitrogen (TIN)	Annual mean depth-averaged inorganic nitrogen not to exceed 0.4 mg(N)/l	Marine waters
5-Day biochemical oxygen demand (BOD_5)	Not to exceed 5 mg/l	Inland waters
Chemical Oxygen Demand (COD)	Not to exceed 30 mg/l	Inland 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

5.2.3 Besides the WQOs stipulated under the WPCO, the WSD has specified a set of objectives for water quality at flushing water intakes. The list is shown in **Table 5.2**. The target limit for suspended solids (SS) at these intakes is 10mg/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 100ml)	< 20,000

Technical Memorandum on Effluent Discharge Standard

5.2.4 Besides setting the WQOs, the WPCO controls effluent discharging into the WCZs through a licensing system. Guidance on the permissible effluent discharges based on the type of receiving waters (foul sewers, stormwater drains, inland and coastal waters) is provided in the Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-DSS). The limits given in the TM cover the physical, chemical and microbial quality of effluents. Any effluent discharge during the construction and operational stages should comply with the standards for effluents discharged into the inshore waters or marine waters of the Victoria Harbour as shown in Table 9a and 9b of the TM.

Practice Notes

5.2.5 A practice note (PN) for professional persons was issued by EPD to provide environmental guidelines for the handling and disposal of construction site discharges. The Practice Note

(PN) for Professional Persons on Construction Site Drainage (ProPECC PN 1/94) issued by EPD provides good practice guidelines for dealing with various types of discharge from a construction site. Practices outlined in the PN should be followed as far as possible during construction to minimize the water quality impact due to construction site drainage.

5.3 Identification of Water Sensitive Receivers

5.3.1 The Study Area includes all areas within 300m from the Project boundary. Within 300m of the Project Boundary, only one Water Sensitive Receiver (WSR), namely the proposed cooling water intake of District Cooling System (DCS) for KTD, was identified. The DCS is planned by EMSD to be implemented in the KTD area. The associated cooling water intake of DCS would be considered as a planned WSR. The cooling water intake will be located along the waterfront of the former Kai Tak airport runway. Location of this WSR is shown in **Figure 5.1**. No other existing or planned WSRs were identified within the Study area.

5.4 Description of the Environment

5.4.1 The EPD water quality monitoring station VM2 in the Victoria Harbour is the nearest monitoring station to the Project area. The EPD monitoring data collected at VM2 in 2011 were summarized in **Table 5.3**.

5.4.2 According to the "2011 Marine Water Quality in Hong Kong", which is the latest available information from EPD at the moment of preparing this Report, the baseline water quality monitoring shows that non-compliance with WQO for depth-averaged DO was identified in VM2 in 2011. Compliance in WQO for other parameters including bottom DO, TIN, pH and unionised ammonia (UIA) was achieved though.

Table 5.3 Baseline Marine Water Quality Condition for Victoria Harbour WCZ

Parameter		Victoria Harbour (East)	WPCO WQO (in marine waters)
		VM2	
Temperature (^{o}C)		22.5 (16.1-26.7)	Not more than 2 ^{o}C in daily temperature range
Salinity		32.2 (29.2-33.5)	Not to cause more than 10% change
Dissolved Oxygen (DO) (mg/L)	Depth average	5.4 (3.8-7.5)	Not less than 4 mg/L for 90% of the samples
	Bottom	5.4 (3.5-7.6)	Not less than 2 mg/L for 90% of the samples
Dissolved Oxygen (DO) (% Saturation)	Depth average	74 (55-92)	Not Available
	Bottom	74 (49-93)	Not Available
pH		7.8 (7.6-8.2)	6.5 - 8.5 ($\pm$ 0.2 from natural range)
Secchi disc Depth (m)		2.6 (1.9-3.5)	Not Available
Turbidity (NTU)		3.2 (1.7-12.5)	Not Available
Suspended Solids (SS) (mg/L)		3.7 (2.1-6.9)	Not more than 30% increase
5-day Biochemical Oxygen Demand (BOD_5) (mg/L)		0.8 (0.3-1.4)	Not Available
Ammonia Nitrogen (NH_3-N) (mg/L)		0.133 (0.068-0.283)	Not Available
Unionised Ammonia (UIA) (mg/L)		0.004 (0.001-0.008)	Not more than 0.021 mg/L for annual mean
Nitrite Nitrogen (NO_2-N) (mg/L)		0.029 (0.011-0.070)	Not Available

Parameter	Victoria Harbour (East)	WPCO WQO (in marine waters)
	VM2	
Nitrate Nitrogen (NO_3-N) (mg/L)	0.146 (0.065-0.286)	Not Available
Total Inorganic Nitrogen (TIN) (mg/L)	0.31 (0.20-0.50)	Not more than 0.4 mg/L for annual mean
Total Kjeldahl Nitrogen (mg/L)	0.29 (0.22-0.43)	Not Available
Total Nitrogen (TN) (mg/L)	0.46 (0.30-0.65)	Not Available
Orthophosphate Phosphorus (OrthoP) (mg/L)	0.027 (0.012-0.036)	Not Available
Total Phosphorus (TP) (mg/L)	0.04 (0.03-0.06)	Not Available
Silica (as SiO_2) (mg/L)	0.93 (0.43-1.37)	Not Available
Chlorophyll-*a* (µg/L)	2.3 (0.4-9.1)	Not Available
E coli (cfu/100 mL)	710 (60-11000)	Not Available
Faecal Coliforms (cfu/100 mL)	1500 (110-26000)	Not Available

Notes:
1. Data source: Marine Water Quality in Hong Kong in 2011.
2. Except as specified, data presented are depth-averaged values calculated by taking the means of three depths: surface, mid-depth, bottom.
3. Data presented are annual arithmetic means of depth-averaged results except for *E. coli* and faecal coliforms that are annual geometric means.
4. Data in brackets indicate the ranges.

5.5 Assessment Approach and Methodology

5.5.1 The Study Area includes all areas within 300m from the Project boundary, and covers relevant water sensitive receivers that have a bearing on the environmental acceptability of the Project within the Victoria Harbour (Phase 1 and 2) WCZ.

5.5.2 The water sensitive receivers that may be affected by the land-based construction activities for the Project have been identified. Potential sources of water quality impact that may arise during the land-based construction works were described. This task included identifying pollutants from point discharges and non-point sources that could affect the quality of surface water run-off. All the identified sources of potential water quality impact were then evaluated and their impact significance determined. The need for mitigation measures to reduce any identified adverse impacts on water quality to acceptable levels was determined.

5.6 Identification of Potential Impacts

Construction Phase

5.6.1 No marine works would be required for the Project. Potential sources of water quality impact associated with the land-based construction of the Project have been identified and include:

- General construction activities;
- Construction site run-off;
- Accidental spillage; and
- Sewage effluent from construction workforce.

General Construction Activities

5.6.2 The land-based construction works could have the potential to cause water pollution. Various types of construction activities may generate wastewater. These include general

cleaning and polishing, wheel washing, dust suppression and utility installation. These types of wastewater would contain high concentrations of suspended solids (SS). If uncontrolled, these effluents could lead to deterioration in water quality.

Construction Site Run-off

5.6.3 Construction site run-off would cause potential water quality impacts. Potential pollution sources of site run-off may include:

- Run-off and erosion of exposed bare soil and earth, drainage channel, earth working area and stockpiles.
- Release of any bentonite slurries, concrete washings and other grouting materials with construction run-off or storm water.
- Wash water from dust suppression sprays and wheel washing facilities.
- Fuel, oil and lubricants from maintenance of construction vehicles and equipment.

5.6.4 During rainstorms, site run-off would wash away the soil particles on unpaved lands and areas with the topsoil exposed. The run-off is generally characterized by high concentrations of SS. Release of uncontrolled site run-off would increase the SS levels and turbidity in the nearby water environment. Site run-off may also wash away contaminated soil particles and therefore cause water pollution.

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

Accidental Spillage

5.6.6 A large variety of chemicals may be used during construction activities. These chemicals may include petroleum products, surplus adhesives, spent lubrication oil, grease and mineral oil, spent acid and alkaline solutions/solvent and other chemicals. Accidental spillage of chemicals in the works areas may contaminate the surface soils. The contaminated soil particles may be washed away by construction site run-off or stormwater drainage which in turn causes water pollution.

Sewage Effluent from Construction Workforce

5.6.7 During the construction of the Project, the workforce on site will contribute to the local population of the area, although the number of workers will vary over the construction period. Potential impacts may arise from wastewater generated from eating areas, temporary sanitary facilities and waste disposal areas.

Operation Phase

5.6.8 The identified potential sources of impact on water quality during the operation phase would be runoff from the road surfaces, which may contain small amount of oil and grit leaked from passing vehicles. However, impacts upon water quality will be minimal provided that the road works are designed with adequate drainage systems and appropriate silt trap, as required.

5.7 Prediction and Evaluation of Impacts

Construction Phase

General Construction Activities

5.7.1 Effluent discharged from temporary site facilities should be controlled to prevent direct discharge to the neighbouring marine waters and storm drains. Such effluent may include wastewater resulting from wheel washing of site vehicles at site entrances, discharge of debris and rubbish such as packaging, construction materials and refuse. Adoption of the guidelines and good site practices for handling and disposal of construction discharges as part of the construction site management practices (as given in **Sections 5.8.1** to **5.8.13**) would minimized the potential impacts.

Construction Site Run-off

5.7.2 Construction site run-off and drainage may cause local water quality impacts. Increase in SS arising from the construction site could block the drainage channels. High concentrations of suspended degradable organic material in marine water could lead to reduction in DO levels in the water column.

5.7.3 It is important that proper site practice and good site management be followed to prevent run-off 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, disturbance of water bodies would be avoided and deterioration in water quality would be minimal. Thus, unacceptable impacts on the water quality are not expected, provided that the recommended measures described in **Sections 5.8.1** to **5.8.13** are properly implemented.

Accidental Spillage

5.7.4 The use of engine oil and lubricants, and their storage as waste materials has the potential to create impacts on the water quality if spillage occurs and enters adjacent water environment. Waste oil may infiltrate into the surface soil layer, or run-off into marine water environment, increasing hydrocarbon levels. The potential impacts could however be mitigated by practical mitigation measures and good site practices (as given in **Sections 5.8.14** to **5.8.16**).

Sewage Effluent from Construction Workforce

5.7.5 Domestic sewage would be generated from the workforce during the construction phase. However, this temporary sewage can be adequately treated by interim sewage treatment facilities, such as portable chemical toilets. Provided that sewage is not discharged directly into stormwater drains or marine waters adjacent to the construction site, and temporary sanitary facilities are used and properly maintained, it is unlikely that sewage generated from the site would have a significant water quality impact. Mitigation measures and good site practices given in **Sections 5.8.17** to **5.8.18** should be implemented.

Operation Phase

5.7.6 The identified potential source of impact on water quality during the operation phase of the Project is runoff from the road surfaces. The road run-off may contain minimal amount of oil, grease and grit that may cause water quality impacts to the receiving waters of Victoria Harbour. To minimise the impacts from road run-off, a road drainage system will be properly planned to receive road run-off at the planning and design stages. With proper implementation of recommended mitigation measures described in **Section 5.8.19**, adverse impact associated with the discharge of runoff is not anticipated.

5.8 Recommended Water Quality Mitigation Measures

Construction Phase

Construction Site Run-off and General Construction Activities

5.8.1 The site practices outlined in ProPECC PN 1/94 "Construction Site Drainage" should be followed as far as practicable to minimise surface run-off and the chance of erosion. Effluent discharged from the construction site should comply with the standards stipulated in the TM-DSS. The following measures are recommended to protect water quality and sensitive uses of the inland and coastal waters, and when properly implemented should be sufficient to adequately control site discharges so as to avoid water quality impacts:

Construction Site Run-off

5.8.2 Surface run-off from construction sites should be discharged into storm drains via adequately designed sand/silt removal facilities such as sand traps, silt traps and sedimentation basins. Channels or earth bunds or sand bag barriers should be provided on site to properly direct stormwater to such silt removal facilities. Perimeter channels should be provided on site boundaries where necessary to intercept storm run-off from outside the site so that it will not wash across the site. Catchpits and perimeter channels should be constructed in advance of site formation works and earthworks.

5.8.3 Silt removal facilities, channels and manholes should be maintained and the deposited silt and grit should be removed regularly, at the onset of and after each rainstorm to prevent local flooding. Any practical options for the diversion and re-alignment of drainage should comply with both engineering and environmental requirements in order to provide adequate hydraulic capacity of all drains. Minimum distance of 100 m should be maintained between the discharge points of construction site run-off and the existing saltwater intakes.

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

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

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

5.8.7 Open stockpiles of construction materials (e.g. aggregates, sand and fill material) on sites should be covered with tarpaulin or similar fabric during rainstorms.

5.8.8 Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris from getting into the drainage system, and to prevent storm run-off from getting into foul sewers. Discharge of surface run-off into foul sewers must always be prevented in order not to unduly overload the foul sewerage system.

5.8.9 Good site practices should be adopted to remove rubbish and litter from construction sites so as to prevent the rubbish and litter from spreading from the site area. It is recommended to clean the construction sites on a regular basis.

Boring and Drilling Water

5.8.10 Water used in ground boring and drilling for site investigation or rock / soil anchoring should as far as practicable be re-circulated after sedimentation. When there is a need for final disposal, the wastewater should be discharged into storm drains via silt removal facilities.

Wheel Washing Water

5.8.11 All vehicles and plant should be cleaned before they leave a construction site to minimize the deposition of earth, mud, debris on roads. A wheel washing bay should be provided at every site exit if practicable and wash-water should have sand and silt settled out or removed before discharging into storm drains. The section of construction road between the wheel washing bay and the public road should be paved with backfall to reduce vehicle tracking of soil and to prevent site run-off from entering public road drains.

Acid Cleaning, Etching and Pickling Wastewater

5.8.12 Acidic wastewater generated from acid cleaning, etching, pickling and similar activities should be neutralized to within the pH range of 6 to 10 before discharging into foul sewers.

Effluent Discharge

5.8.13 There is a need to apply to EPD for a discharge licence for discharge of effluent from the construction site under the WPCO. The discharge quality must meet the requirements specified in the discharge licence. All the runoff and wastewater generated from the works areas should be treated so that it satisfies all the standards listed in the TM-DSS. Minimum distance of 100 m should be maintained between the discharge points of construction site effluent and the existing seawater intakes and the planned WSR mentioned in **S5.3.1** as appropriate. The beneficial uses of the treated effluent for other on-site activities such as dust suppression, wheel washing and general cleaning etc., can minimise water consumption and reduce the effluent discharge volume. If monitoring of the treated effluent quality from the works areas is required during the construction phase of the Project, the monitoring should be carried out in accordance with the relevant WPCO licence which is under the ambit of regional office (RO) of EPD.

Accidental Spillage

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

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

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

- Suitable containers should be used to hold the chemical wastes to avoid leakage or spillage during storage, handling and transport.

- Chemical waste containers should be suitably labelled, to notify and warn the personnel who are handling the wastes, to avoid accidents.
- Storage area should be selected at a safe location on site and adequate space should be allocated to the storage area.

Sewage Effluent from Construction Workforce

5.8.17 The construction workforce on site will generate sewage. It is recommended to provide sufficient chemical toilets in the works areas. A licensed waste collector should be deployed to clean the chemical toilets on a regular basis.

5.8.18 Notices should be posted at conspicuous locations to remind the workers not to discharge any sewage or wastewater into the surrounding environment. Regular environmental audit of the construction site will provide an effective control of any malpractices and can encourage continual improvement of environmental performance on site. It is anticipated that sewage generation during the construction phase of the project would not cause water pollution problem after undertaking all required measures.

Operation Phase

5.8.19 A surface water drainage system will be provided to collect road runoff. The following measures are recommended to ensure road runoff will comply with the standards stipulated in the TM for discharges into storm water drains:

- The road drainage should be directed through silt traps in the gully inlets to remove silt and grit before entering the public storm water drainage system; and
- The silt traps should be regularly cleaned and maintained in good working condition.

5.9 Evaluation of Residual Impacts

5.9.1 With the full implementation of the recommended mitigation measures for the construction and operation phases of the proposed Project, no adverse residual impacts on water quality are anticipated.

5.10 Environmental Monitoring and Audit Requirements

5.10.1 No adverse water quality impact would be expected during the construction and operation of the Project, provided recommended mitigation measures are properly implemented. Water quality monitoring is therefore not considered necessary. However, it is recommended that regular site inspections during the construction phase should be undertaken to inspect the construction activities and works areas in order to ensure the recommended mitigation measures are properly implemented.

5.11 Conclusion

Construction Phase

5.11.1 Water quality impacts from land-based construction are associated with the general construction activities, construction site run-off, accidental spillage, and sewage effluent from construction workforce. Impacts can be controlled to comply with the WPCO standards by implementing the recommended mitigation measures. No unacceptable residual impacts on water quality are anticipated. Regular site inspections should be undertaken routinely to inspect the construction activities and works areas in order to ensure the recommended mitigation measures are properly implemented.

Operation Phase

5.11.2 The only source of potential impact on water quality during the operation phase will be runoff from the road surfaces. It is anticipated that the water quality impacts associated with

the operation phase would be minimal and acceptable, provided that the recommended mitigated measures for the surface water drainage system are properly implemented.