# 8. WATER QUALITY IMPACT

## Introduction

8.1 This section presents an assessment of the potential water quality impacts associated with the construction and operation phases of the Project. Recommendations for mitigation measures have been provided, where necessary, to minimise the identified water quality impacts to an acceptable level.

## Environmental Legislation, Standards and Guidelines

### *Environmental Impact Assessment Ordinance (EIAO)*

8.2 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 the 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)*

8.3 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 Victoria Harbour (Phase 2) WCZ. The corresponding WQOs are listed in **Table 8.1**.

**Table 8.1 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 human activity | Inland waters |
| 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 |

| Parameters | Objectives | Sub-Zone |
|---|---|---|
| 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).

***Technical Memorandum on Effluent Discharge Standard***

8.4 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 Victoria Harbour as shown in Table 9a and 9b of the TM.

***Practice Notes***

8.5 The Practice Note (PN) for Professional Persons on Construction Site Drainage (ProPECC PN 1/94) was issued by the EPD to provide environmental guidelines for handling and disposal of construction site discharges. It 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. Other Practice Notes including the ProPECC PN 5/93 Drainage Plan (subject to Comment by the Environmental Protection Department) would also be considered.

**Description of the Environment**

8.6 The EPD water quality monitoring stations VM4 and VM5 in Victoria Harbour are the nearest monitoring stations to the Project area. The EPD monitoring data collected at VM4 and VM5 in 2009 were summarised in **Table 8.2**.

8.7 According to the "2009 Marine Water Quality in Hong Kong", which is the latest information published on the EPD website at the moment of preparing this Report, full compliance with WQO for bottom dissolved oxygen (DO), depth-average DO, unionised ammonia (UIA) and total inorganic nitrogen (TIN) was achieved in VM4 and VM5 in 2009. Improvement in water quality in Victoria Harbour were recorded since full commissioning of Harbour Area Treatment Scheme (HATS) Stage 1 in 2001, which collects sewage from Kowloon Peninsular, Tseung Kwan O, Kwai Tsing and Hong Kong Island East to Stonecutters Island Sewage Treatment Works for Treatment.

**Table 8.2 Baseline Marine Water Quality Condition for Victoria Harbour WCZ**

| Parameter | Victoria Harbour (Central) | | WPCO WQO (in marine waters) |
|---|---|---|---|
| | VM4 | VM5 | |
| Temperature ($^oC$) | 23.8 (18.6 – 28.6) | 24.0 (18.7 – 28.6) | Not more than 2 $^oC$ in daily temperature range |
| Salinity | 31.8 (24.9 – 33.6) | 31.2 (21.4 – 33.4) | Not to cause more than 10% change |

| Parameter | | Victoria Harbour (Central) | | WPCO WQO (in marine waters) |
|---|---|---|---|---|
| | | VM4 | VM5 | |
| Dissolved Oxygen (DO) (mg/L) | Depth average | 5.3 (4.1 – 6.7) | 5.2 (4.5 – 6.8) | Not less than 4 mg/L for 90% of the samples |
| | Bottom | 5.1 (2.6 – 6.8) | 5.2 (4.4 – 6.8) | Not less than 2 mg/L for 90% of the samples |
| Dissolved Oxygen (DO) (% Saturation) | Depth average | 76 (60 – 98) | 74 (64 – 100) | Not Available |
| | Bottom | 72 (39 – 100) | 74 (64 – 99) | Not Available |
| pH | | 8.0 (7.6 – 8.4) | 7.9 (7.6 – 8.3) | 6.5 - 8.5 (± 0.2 from natural range) |
| Secchi disc Depth (m) | | 2.4 (1.6 – 3.0) | 2.2 (1.2 – 3.0) | Not Available |
| Turbidity (NTU) | | 5.1 (2.5 – 10.0) | 5.4 (2.3 – 10.2) | Not Available |
| Suspended Solids (SS) (mg/L) | | 5.8 (3.5 – 7.5) | 5.7 (3.3 – 9.1) | Not more than 30% increase |
| 5-day Biochemical Oxygen Demand ($BOD_5$) (mg/L) | | 0.7 (0.2 – 1.2) | 0.8 (0.3 – 1.5) | Not Available |
| Ammonia Nitrogen ($NH_3$-N) (mg/L) | | 0.10 (0.049 – 0.203) | 0.12 (0.062 – 0.203) | Not Available |
| Unionised Ammonia (UIA) (mg/L) | | 0.004 (0.001 – 0.007) | 0.005 (0.002 – 0.011) | Not more than 0.021 mg/L for annual mean |
| Nitrite Nitrogen ($NO_2$-N) (mg/L) | | 0.029 (0.005 – 0.152) | 0.036 (0.008 – 0.197) | Not Available |
| Nitrate Nitrogen ($NO_3$-N) (mg/L) | | 0.112 (0.026 – 0.360) | 0.134 (0.043 – 0.370) | Not Available |
| Total Inorganic Nitrogen (TIN) (mg/L) | | 0.24 (0.08 – 0.57) | 0.29 (0.12 – 0.63) | Not more than 0.4 mg/L for annual mean |
| Total Kjeldahl Nitrogen (mg/L) | | 0.24 (0.15 – 0.38) | 0.28 (0.17 – 0.37) | Not Available |
| Total Nitrogen (TN) (mg/L) | | 0.38 (0.22 – 0.69) | 0.45 (0.29 – 0.79) | Not Available |
| Orthophosphate Phosphorus (OrthoP) (mg/L) | | 0.021 (0.011 – 0.032) | 0.025 (0.014 – 0.037) | Not Available |
| Total Phosphorus (TP) (mg/L) | | 0.04 (0.02 – 0.05) | 0.04 (0.03 – 0.05) | Not Available |
| Silica (as $SiO_2$) (mg/L) | | 0.74 (0.20 – 2.47) | 0.85 (0.19 – 3.30) | Not Available |
| Chlorophyll-*a* (µg/L) | | 3.3 (0.7 – 8.3) | 3.9 (0.7 – 10.1) | Not Available |
| *E coli* (cfu/100 mL) | | 2000 (510 – 8700) | 3900 (160 – 19000) | Not Available |
| Faecal Coliforms (cfu/100 mL) | | 4000 (760 – 12000) | 8900 (360 – 46000) | Not Available |

Notes:
1. Data source: Marine Water Quality In Hong Kong in 2009.
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.

**Identification of Water Sensitive Receivers**

8.8 This Project is located in the Hung Hom area adjacent to the Victoria Harbour. It involves only land-based construction with no marine works. The Study Area includes all areas within 300m from the Project boundaries and the Victoria Harbour (Phase 2) WCZ. No inland watercourse such as river or natural stream is identified within the Study Area. There is also no WSD flushing water intake within 300m from the Project Boundaries. Three cooling water intakes (namely East Rail Extension,

Metropolis and Hong Kong Coliseum respectively) are identified within 300m from the Project boundaries. Their locations are shown in **Figure No. NEX2213/C/361/ENS/M59/501**. Nevertheless, these cooling water intakes are considered to have high tolerance to suspended solids (SS) elevations. No statutory requirements on water quality parameters (e.g. SS) are available for these cooling water intakes.

**Assessment Approach and Methodology**

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

8.10 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 water quality impact were then evaluated and their impact significance was determined. The need for mitigation measures to reduce any identified adverse impacts on water quality to acceptable levels was determined.

**Identification of Pollution Sources**

***Construction Phase***

8.11 Major construction works include cut and cover works for tunnel and surface works, construction of superstructures including ventilation shafts, modification work to Hung Hom Station podium structures as well as loading and unloading at barging point and rock crushing plant. Details of the construction works are described in Section 3. No marine work including dredging was required for this Project. Potential sources of water quality impact associated with the land-based construction of the Project have been identified and described as follow:

Construction Site Run-off

8.12 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, stockpiles, C&D materials at barging point at Hung Hom Frieght Pier.
- Release of any bentonite slurries, concrete washings 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.

8.13 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.

8.14 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.

General Construction Activities

8.15 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, and dust suppression. These types of wastewater would contain high concentrations of SS. If uncontrolled, these effluents could lead to deterioration in water quality.

Accidental Spillage

8.16 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

8.17 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.

Excavation Activities

8.18 The construction of the Project involves excavation of soil materials for the tunnel, station and ventilation shafts. Excavated materials may have to be stored on-site before being sorted, reused or transported to disposal sites. If stored as open air stockpiles with no cover during rainfall, excavated materials would have a potential risk to be washed away and thereby causing sudden increase of SS and oxygen demand in the receiving water.

Diaphragm Wall

8.19 As cut and cover construction is required, diaphragm walls are used as retaining wall for excavation and serve as either temporary or permanent support for the tunnel. Potential impacts from any required diaphragm walling include turbid site run-off from the works, and bentonite and concrete washings entering water environment. Bentonite is a highly turbid material and will cause damage to aquatic organisms in receiving waters. Run-off may arise during extraction of the bentonite or during preparation for recycling or disposal. Concrete washings are potentially toxic to aquatic organisms, raising pH of receiving water bodies. Concrete washings also increase turbidity in a waterbody.

Groundwater Seepage

8.20 During excavation works, groundwater would be required to be pumped out from works areas in case seepage of groundwater occurs. Groundwater pumped out or from dewatering activities as a potential source of site run-off may wash away exposed soil at construction site and therefore would cause potential water quality impacts by increasing the SS levels and turbidity in the nearby water environment. Moreover, uncontrolled discharge of the groundwater from contaminated areas may affect the surface or groundwater quality. Nonetheless, site investigation (SI) involving sampling and testing of soil and groundwater from works areas having potential land contamination issue have been undertaken that no contaminated groundwater is expected. Details of the SI are presented in **Section 10** of the EIA Study.

Change of Hydrology and Groundwater Level

8.21 The excavation works for the tunnel, station and ventilation shafts could have potential impacts on groundwater system. The major concern would be the change of hydrology and the potential groundwater drawdown in any soil and aquifer layers. Any potential drawdown could result in different degrees of settlement.

***Operation Phase***

8.22 Major water quality impacts from the Project operation would include:

- Tunnel run-off and drainage;
- Sewerage and storm effluents; and
- Station run-off.

Tunnel Run-off and Drainage

8.23 The proposed railway alignment under the SCL – Mong Kok East to Hung Hom Section would be initially open and at-grade for the section connecting to the existing EAL at Portal 1A near Oi Man

Estate. It would gradually descend and be within tunnel to the south of the Chatham Road Interchange. During rainstorm, rainwater on the train surface and run-off from the open section may generate tunnel run-off. Seepage of groundwater into the tunnel may also generate tunnel run-off. Such run-off may contain limited amount of lubricants, SS, iron, oil and grease. Directly discharge of tunnel run-off may cause adverse water quality impact on nearby water environment.

Sewage Effluents

8.24 Sewage and wastewater effluents would be generated from staffs and customers at the Hung Hom station. Sources of sewage may include the toilet sanitary wastewater and floor drainage.

Station Run-off

8.25 The station is likely to be completely enclosed and therefore run-off will be limited to wash-off from the outside of the station during storm event. Sources of potential polluted station run-off include dust from the roof of the buildings and cleaning agents used for washing building facade.

**Prediction and Evaluation of Impacts**

***Construction Phase***

Construction Site Run-off

8.26 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 and may result in local flooding when heavy rainfall occurs. High concentrations of suspended degradable organic material in marine water could lead to reduction in DO levels in the water column.

8.27 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 8.41** to **8.49** are properly implemented.

General Construction Activities

8.28 Effluent discharged from temporary site facilities should be controlled to prevent direct discharge to the neighbouring marine waters and storm drains. 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 8.50** to **8.56**) would minimize the potential impacts. Barging point is proposed to be operated at the Hung Hom Freight Pier for transportation of the spoil generated from the Project during construction phase. No dredging works, construction of marine working platform or reclamation would be required for barging point. Adoption of mitigation measures as outlined in **Sections 8.42** to **8.49** would minimize water quality impacts from site runoff where appropriate. Good site practices as outlined in **Section 8.68** will also be needed to minimize the disturbance of seabed from vessel berthing at the barging point as well as the potential release of the spoils or contaminants from loading of barges and transportation of construction spoils.

Accidental Spillage

8.29 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 nearby water environment, increasing hydrocarbon levels. The potential impacts could however be mitigated by practical mitigation measures and good site practices (as given in **Sections 8.57** to **8.59**).

Sewage Effluent from Construction Workforce

8.30 Domestic sewage would be generated from the workforce during the construction phase. Provided that sewage is not discharged directly into stormwater drains or marine waters adjacent to the construction site, and this temporary sewage will be properly discharged to the public foul sewers, 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 8.60** to **8.61** should be implemented.

Excavation Activities

8.31 Excavation will be carried out for the construction of the tunnel, station and ventilation shafts. Some of the proposed works areas would be close to existing drainage system. Potential impacts may occur if rain falls during the excavation works, or silt and sand material and run-off from the excavation areas enters the marine waters, increasing turbidity. Other pollutants, such as oil and grease, chemicals, as well as bentonite and grouting materials, may be present in the run-off where it flows over storage or maintenance areas for the works. Erosion of soil enriched in organic matter may release nutrients into the adjacent water environment. Erosion of stockpiles may also release suspended solids into nearby water. Mitigation measures and good site practices (as given in **Section 8.62** and **Sections 8.41** to **8.49**) should be implemented to control site run-off and drainage and site effluent from the works areas, and to prevent run-off and drainage water entering the adjacent waters.

Diaphragm Wall

8.32 As cut and cover construction is required, diaphragm walls are used as retaining wall for excavation and serve as either temporary or permanent support for the tunnel. Potential impacts from any required diaphragm walling include turbid site run-off from the works, and bentonite and concrete washings entering water environment. As good site practice, mitigation measures (as given in **Sections 8.41** to **8.49**) should be implemented to control site run-off and drainage as well as any site effluents generated from the works areas, and to prevent run-off and construction wastes from entering the adjacent waters.

Groundwater Seepage

8.33 Excavation works are required for various construction activities during the construction. Different construction methods will be employed to minimize the intrusion of groundwater into works areas. Cofferdam wall will be required as necessary to limit groundwater inflow. In case seepage of groundwater occurs, groundwater would be pumped out from works areas and discharged to the stormwater system via silt trap. Uncontaminated groundwater from dewatering process should also be discharged to the storm system via silt removal facilities. As no groundwater would be directly discharged into streams and drainages, no adverse water quality impacts would be expected.

Change of Hydrology and Groundwater Level

8.34 The major concern of the hydrology impact is the potential groundwater drawdown in any soil and aquifer layers. The excavation works for the tunnel, station and ventilation shafts will only require dewatering temporarily during their construction. In the long term they are designed to be undrained with the full hydrostatic head. Mitigation measures as outlined in **Sections 8.65** to **8.67** will be put in place to mitigate any drawdown effects to the groundwater table during the operation of the temporary dewatering works. Provided that the mitigation measures are properly followed, no unacceptable impact in relation to the groundwater drawdown would be expected.

8.35 In order to reduce the potential for drawdown and ensure the safety of his works, the Contractor will initially adopt suitable water control strategies while undertaking the excavation works. In the event that the ground water table is observed to be lowered unacceptably even after the application of these water control strategies then post grouting or other similar acceptable remedial measures will be undertaken from within the tunnel as a suitable mitigation measure.

***Operation Phase***

Tunnel Run-off and Drainage

8.36 The tunnel wall should be equipped with water-tight liner to avoid ground water seepage. The amount of groundwater seepage into the tunnel would be insignificant. Any tunnel run-off could be contaminated with limited amount of lubricants, SS, iron, oil and grease from passing trains or from maintenance activities. The discharge quality of any tunnel run-off should satisfy the standards listed in the TM-DSS. Standard oil/grit interceptors/chambers should be provided to remove oil, lubricants, grease, silt and grit from the tunnel run-off before discharging into public storm drainage/foul sewerage systems. No adverse water quality impacts would be expected.

Sewage Effluents

8.37 Sewage and wastewater effluents would be generated from staffs and customers at the Hung Hom station. Sources of sewage may include the toilet sanitary wastewater and floor drainage. Generated sewage and wastewater would be connected to the existing foul sewer system. Run-off from cleaning activities at the stations which would enter floor drains would also be connected to the foul sewer. It is expected that no adverse water quality impact would arise from sewage and wastewater effluent generated during the operation of the Hung Hom station.

Station Run-off

8.38 The station is likely to be completely enclosed and therefore run-off will be limited to wash-off from the outside of the station. Sources of potentially polluted stormwater that may arise from station run-off include dust from the roof of the buildings and cleaning agents used for washing building facade. Station run-off would contain low levels of SS and surfactants used for washing. With good washing practice, adverse impacts from station run-off would be minimal.

8.39 For handling, treatment and disposal of other operational stage effluent, the practices outlined in ProPECC PN 5/93 should be adopted where applicable.

**Cumulative Impacts from Concurrent Projects**

8.40 Information on concurrent projects is presented in **Section 3**. As all the Project works would be land-based and provided that proper mitigation measures will be implemented by the project, the water quality impact generated from the projects would be localized and no adverse cumulative water quality impacts would be expected.

**Recommended Water Quality Mitigation Measures**

***Construction Phase***

Construction Site Run-off and General Construction Activities

8.41 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 coastal area, and when properly implemented should be sufficient to adequately control site discharges so as to avoid water quality impacts:

*Construction Site Run-off*

8.42 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 at site boundaries should be provided 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.

8.43 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 distances of 100 m should be maintained between the discharge points of construction site run-off and the existing saltwater intakes.

8.44 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 run-off 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.

8.45 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.

8.46 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.

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

8.48 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.

8.49 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.

*Wheel Washing Water*

8.50 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.

*Bentonite Slurries*

8.51 Bentonite slurries used in diaphragm wall construction should be reconditioned and used again wherever practicable. If the disposal of a certain residual quantity cannot be avoided, the used slurry should either be dewatered or mixed with inert fill material for disposal to a public filling area.

8.52 If the used bentonite slurry is intended to be disposed of through the public drainage system, it should be treated to the respective effluent standards applicable to foul sewer, storm drains or the receiving waters as set out in the TM-DSS.

*Wastewater from Building Construction*

8.53 Before commencing any demolition works, all sewer and drainage connections should be sealed to prevent building debris, soil, sand etc. from entering public sewers/drains.

8.54 Wastewater generated from building construction activities including concreting, plastering, internal decoration, cleaning of works and similar activities should not be discharged into the stormwater drainage system. If the wastewater is to be discharged into foul sewers, it should undergo the removal of settleable solids in a silt removal facility, and pH adjustment as necessary.

*Acid Cleaning, Etching and Pickling Wastewater*

8.55 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*

8.56 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 run-off and wastewater generated from the works areas should be treated so that it satisfies all the standards listed in the TM-DSS. Minimum distances of 100 m should be maintained between the discharge points of construction site effluent and the existing seawater intakes. 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 of EPD.

Accidental Spillage

8.57 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.

8.58 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.

8.59 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

8.60 The construction workforce on site will generate sewage. It is recommended that all the sewage generated from the workforce should be discharged into the public foul sewers. If disposal of sewage to public sewerage system is not feasible, appropriate numbers of portable toilets shall be provided by a licensed contractor to serve the construction workers over the construction site to prevent direct disposal of sewage into the water environment. The Contractor shall also be responsible for waste disposal and maintenance practices.

8.61 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.

Excavation Activities

8.62 The construction programme should be properly planned to minimise soil excavation, if any, in rainy seasons. This prevents soil erosion from exposed soil surfaces. Any exposed soil surfaces should also be properly protected to minimise the potential for dust emission, increased siltation and contamination of runoff. In areas where a large amount of exposed soils exist, earth bunds or sand bags should be provided. Exposed stockpiles should be covered with tarpaulin or impervious sheets at all times. The stockpiles of materials should be placed at locations away from water environment so as to avoid releasing materials into the water bodies. Final surfaces of earthworks should be compacted and protected by permanent work.

Diaphragm Wall

8.63 Mitigation measures, as given in **Sections 8.41** to **8.49** should be implemented to control site run-off and drainage as well as any site effluents generated from the works areas, and to prevent run-off and construction wastes from entering nearby water environment. Proper handling of bentonite slurries used in diaphragm wall construction should refer to **Sections 8.51** to **8.52**.

Groundwater Seepages

8.64 As some proposed works areas are near the Victoria Harbour, high ground water level regime due to both tidal effects and rainwater infiltration is anticipated. A cofferdam wall should be built as necessary to limit groundwater inflow to the excavation works areas. Appropriate measures will be deployed to minimize the intrusion of groundwater into excavation works areas. In case seepage of groundwater occurs, groundwater should be pumped out from the works areas and discharged into the storm system via silt removal facilities. Groundwater from dewatering process should also be discharged into the storm system via silt traps.

Change of Hydrology and Groundwater Level

8.65 For the construction works for the tunnel, station and ventilation shafts, which will require dewatering temporarily during their construction, the following measures should be put in place in order to mitigate any drawdown effects to the groundwater table during the operation of the temporary dewatering works:

- Toe grouting should be applied beneath the toe level of the temporary/permanent cofferdam walls as necessary to lengthen the effective flow path of groundwater from outside and thus control the amount of water inflow to the excavation.
- Recharge wells should be installed as necessary outside the excavation areas. Water pumped from the excavation areas should be recharge back into the ground.

8.66 In addition, the Contractor should initially adopt suitable water control strategies as far as practicable while undertaking the excavation works. The water control strategies are given as follow:

- Probing Ahead: The Contractor will undertake rigorous probing of the ground ahead of tunnel excavation works to identify zones of significant water inflow. The probe drilling results will be evaluated to determine specific grouting requirements in line with the tunnel advance. In such zones of significant water inflow that could occur as a result of discrete, permeable features, the intent would be to reduce overall inflow by means of cut-off grouting executed ahead of the tunnel advance.
- Pre-grouting: Where water inflow quantities are excessive, pre-grouting will be required to reduce the water inflow into the tunnel. The pre-grouting will be achieved via a systematic and carefully specified protocol of grouting.
- In principle, the grout pre-treatment would be designed on the basis of probe hole drilling ahead of the tunnel face.

8.67 In the event of excessive drawdown being observed within the ground water table as a result of the tunnelling works even after incorporation of the water control strategies, post-grouting should be applied as far as practicable as described below:

- Post-grouting: Groundwater drawdown will be most likely due to inflows of water into the tunnel that have not been sufficiently controlled by the pre-grouting measures. Where this occurs post grouting will be undertaken before the lining is cast. Whilst unlikely to be required in significant measure, such a contingency should be allowed for reduction in permeability of the tunnel surround (by grouting) to limit inflow to acceptable levels.

Barging Point

8.68 Mitigation measures as outlined in **Sections 8.41** to **8.49** should be applied to minimize water quality impacts from site runoff where appropriate. Other good site practices include:

- 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 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.
- Loading of barges and hoppers should be controlled to prevent splashing of 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.

***Operation Phase***

Tunnel Run-off and Drainage

8.69 Mitigation measures are required to mitigate tunnel run-off from track during the operation phase as illustrated in follow:

- Track drainage channels discharge should pass through oil/grit interceptors/chambers to remove oil, grease and sediment before discharging into the public storm drainage/foul sewerage systems.
- The silt traps and oil interceptors should be cleaned and maintained regularly.
- Oily contents of the oil interceptors should be transferred to an appropriate disposal facility, or to be collected for reuse, if possible.

Sewage Effluents

8.70 Connection of domestic sewage generated from the Project should be diverted to the foul sewer. All the discharge should comply with the requirements stipulated in the TM-DSS. For handling, treatment and disposal of other operational stage effluent, the practices outlined in ProPECC PN 5/93 should be adopted where applicable.

**Evaluation of Residual Impacts**

8.71 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.

**Environmental Monitoring and Audit Requirements**

***Construction Phase***

8.72 Minimisation of water quality deterioration from land-based construction activities could be achieved through implementing adequate mitigation measures. No surface water monitoring is proposed. However, it is recommended that regular site inspections should be undertaken to inspect the construction activities and works areas in order to ensure the recommended mitigation measures are properly implemented.

***Operation Phase***

8.73 No adverse water quality impact was identified during the operational phase with proper implementation of the recommended mitigation measures. Operation phase water quality monitoring is considered not necessary.

**Conclusion**

***Construction Phase***

8.74 The key issue from the land-based construction activities would be the potential release of sediment-laden water from surface works areas and open cut excavation. Minimisation of water quality deterioration could be achieved through implementing adequate mitigation measures. 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***

8.75 The main operational impacts from the Project would come from tunnel/station run-off and effluent discharges from the Hung Hom Station and maintenance activities, which could also be minimized through implementing adequate mitigation measures.