

6. Water Quality

6.1 Introduction

6.1.1 This section presents the water quality impacts associated with the construction and operation of Route 16 under the Alternative Alignment option. The water quality impact assessment of the Conforming Alignment has already been presented in the *Route 16 from West Kowloon to Sha Tin - Investigation Assignment : EIA Study Final Assessment Report* which has already been registered under the EIAO (EIA-135\BC). This water quality assessment has focussed on assessing the extent of potential water quality impact upon the sensitive receivers along the alternative road alignment. Appropriate mitigation measures are proposed to control potential water quality impacts wherever necessary. The engineering background and information of the alternative alignment are presented in Section 2 of this Report.

6.2 Baseline Conditions

6.2.1 In order to evaluate the water quality impacts resulting from Route 16 Alternative Alignment, the water sensitive receivers (WSRs) have been identified in accordance with the *Hong Kong Planning Standards and Guidelines* (HKPSG), which provide criteria for identifying environmental factors influencing proposed developments. The major water bodies along the alternative alignment of Route 16 include:

- Victoria Harbour in the West Kowloon section;
- small streams along the Butterfly Valley and an open nullah near Wai Man Tsuen with water discharging into the Victoria Harbour;
- small reservoirs for temporary storage of floodwater downstream of Kowloon Reservoir;
- Tolo Harbour, Shing Mun River and a number of small streams at the Pak Shek village in the Sha Tin section; and
- a small stream near the ventilation building besides Tai Po Road near So Uk.

6.2.2 The small streams along the Butterfly Valley, the open nullah near Wai Man Tsuen, the reservoirs / storage ponds downstream of Kowloon Reservoir, the small streams at the Pak Shek village and Toll Plaza, and the small stream near the ventilation building will be directly affected by the Route 16 construction activities. The Victoria Harbour, the Tolo Harbour and Shing Mun River are the downstream receiving water bodies and located outside the construction area; these are located 1.5 km, 6.5 km and 1 km from the nearest works, respectively.

West Kowloon Section

6.2.3 Major biological sensitive receivers such as mariculture zones, or commercial fisheries, are not found in the Victoria Harbour. Owing to the highly urbanised nature of the Kowloon peninsula, there are no natural streams located within the West Kowloon construction area.

Sha Tin Section

6.2.4 Tolo Harbour is a partially enclosed water body which has used for commercial fisheries and includes three designated mariculture zones (about 9 km away from the nearest works), a sea bird roosting area (about 9 km away from the nearest works) and non-gazetted beaches along the coasts of Ma On Shan and Tai Po area (about 12 km from the nearest works). The water quality of Tolo Harbour has been improved in recent years as reported in the *EPD (1998), Marine Water Quality in Hong Kong for 1997*, but still show signs of pollution.

6.2.5 Shing Mun River is the main river channel of the south New Territories, which intercepts the flows from the upland and lowland areas adjacent to Tai Wai and Sha Tin, and drains into inner Tolo Harbour. The Shing Mun River has been used for secondary contact recreation such as boating. The water quality of Shing Mun River has been reported to show a gradual improvement. The EPD (1998), *River Water Quality in Hong Kong for 1997* has reported that the water quality of various Shing Mun River tributaries in 1997 ranging from fair to excellent in EPD's Water Quality Index for Inland Waters of Hong Kong.

6.2.6 There are also a number of local small streams that run through the agricultural area at the Pak Shek village in Sha Tin, where an embankment will be constructed to connect the northern portal of the Sha Tin Heights tunnel. These local streams could be modified or diverted to facilitate the construction of the proposed alignment.

6.3 Government Legislation and Standards

6.3.1 Under the EIAO-TM and the Water Pollution Control Ordinance (WPCO), Hong Kong waters are subdivided into 10 Water Control Zones (WCZs). Each WCZ has a designated set of statutory Water Quality Objectives (WQOs). For this Study, the marine water of Victoria Harbour and Tolo Harbour could be affected by construction discharges from the alternative alignment of Route 16.

6.3.2 The WQOs for the Victoria Harbour Phase II and Tolo Harbour and Channel WCZs (as shown in Annex 6A) will be applicable as evaluation criteria for assessing compliance of the Project. The parameters of most concern during the construction phase will be suspended solids (SS) and dissolved oxygen (DO) levels. The associated WQOs against which impacts will be assessed are as follows:

SS levels: For construction near the Victoria Harbour Phase II WCZ, human activity should not cause the natural ambient SS level to be raised by more than 30% nor give rise to accumulation of SS in the Victoria Harbour which may adversely affect aquatic communities.

For construction near the Tolo Harbour and Channel WCZ, human activity should not cause the annual median SS levels to exceed 20 mg L⁻¹.

DO levels: DO levels in the Victoria Harbour Phase II WCZ should not be less than 2 mg L⁻¹ within 2 m of the seabed and above 4 mg L⁻¹ at an average of three water depths (1 m below the water surface; mid-depth; and 1 m above sea bed).

DO levels should remain above 4 mg L⁻¹ in Tolo Harbour WCZ at all times.

6.3.3 All discharges during the construction phase of the Route 16 alternative alignment are required to comply with the *Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* (TM) issued under Section 21 of the WPCO, which defines acceptable discharge limits to different types of receiving waters. Under the TM, effluents discharged into the drainage and sewerage systems, inshore and coastal waters of the WCZs are subject to pollutant concentration standards for particular volumes of discharge. These are defined by the EPD and specified in licence conditions for any new discharge within a WCZ. The pertinent discharge limits for the Victoria Harbour and Tolo Harbour and Channel WCZs are shown in Annex 6A of this Report.

6.4 Construction Phase Assessment

6.4.1 Assessment Methodology

6.4.1.1 Present construction design were reviewed to assess the proximity of the Route 16 construction activities to existing and committed WSRs. All WSRs were identified in

accordance with the guidance provided in the HKPSG, supplemented by field surveys and area appraisals.

6.4.1.2 Following the identification of WSRs and potential water quality impacts associated with the construction works, the scale, extent and severity of potential net (that is, unmitigated) construction impacts were evaluated, wherever possible quantitatively, taking into account all potential cumulative effects including those of adjacent projects, with reference to the WPCO criteria.

6.4.1.3 Practical water pollution measures / mitigation proposals were recommended where there were potential net water quality impact.

6.4.2 Potential Sources of Impacts

6.4.2.1 Potential sources of water quality impacts associated with the construction of alternative alignment of Route 16 comprise:

- construction runoff and drainage;
- runoff from the tunnelling activities;
- runoff from general construction activities;
- domestic sewage effluent produced by the on-site construction workers; and
- diversion of existing streams or watercourses, and local water quality impact due to construction works.

6.4.3 Evaluation of Impacts

Construction Runoff and Drainage

6.4.3.1 Runoff and drainage from construction sites may contain considerable loads of suspended solids (SS) and contaminants during cut and fill construction activities. Potential sources of water pollution from site runoff include:

- runoff and erosion of exposed bare soil and earth, drainage channels and eroded gullies, earth working area and stockpiles;
- release of grouting and cement materials with rain wash;
- wastewater from any concrete batching plant;
- wash water from dust suppression sprays and vehicle wheel washing troughs; and
- fuel, oil, and lubricants from maintenance of construction vehicles and mechanical equipment.

6.4.3.2 Local and coastal water pollution will be substantial if the construction site runoff at the urban or countryside areas is allowed to drain into the storm sewer or natural drainage without mitigation.

Runoff from the Tunnelling Work

6.4.3.3 It is considered that the potential water quality impact during tunnel construction will be limited to:

- seepage of ground water into tunnel area if uncontrolled or improper blasting or drilling operations are used;
- inflows of rain water from tunnel portals; and
- release of grouting materials used for construction of diaphragm walls.

Local watercourses and coastal waters could be adversely impacted by polluted tunnel runoff, if the runoff is allowed to discharge directly into water bodies without control. In addition, ground water may also be polluted by the grouting materials and silt, although the extent of contamination will depend on the vertical tunnel profile and its relationship with the water table height that varies with season, and the geological features along the route. It is recommended that the Contractor should carry out regular monitoring to ensure that the tunnelling work will not result in pollution of ground water and unacceptable draw down of ground water table.

Runoff from General Construction Activities

6.4.3.4 Potential water pollution associated with general site construction activities will be confined to:

- discharge of debris, rubbish, floating refuse and construction waste that are uncontrolled; and
- spillages of oil, diesel and solvent that drains into sewers or adjacent watercourses without control.

6.4.3.5 It is considered that the impact of these construction activities upon water quality will be minimal provided that site boundaries are well maintained and good construction practice and site management are observed. On-site litter should be disposed properly, and any oil, fuels and solvents stored on-site should be safely handled. The Contractors should prepare guidelines and procedures for immediate clean-up actions following spillages of oil, fuels and solvents.

Sewage Effluent from Construction Workers

6.4.3.6 Sewage effluents will arise from temporary fixed sanitary facilities for on-site workers. Sewage is characterised by high levels of bio-chemical oxygen demand (BOD), ammonia and *E. coli* counts.

6.4.3.7 It is considered that the construction workers will disperse along the route alignment and public foul sewers may not be available at certain areas. Owing to the lack of established guidelines for sewage generation rates for construction sites, the recommended design rate for offices, specified in the *Guidelines for the Design of Small Sewage Treatment Plants*, EPD Solids Waste Control Group, March 1990 has been used for this assessment. A maximum of about 350 workers will be working simultaneously along the alignment and about 19.25 m³ per day of sewage effluent could be generated. (The estimate does not include sewage effluent generated from any temporary canteen facilities for workers, of which about 0.5 m³ per m² kitchen area per day of sewage effluent could be generated from the facilities.) Significant water quality impact could arise only if the sewage effluent is allowed to discharge directly into the receiving water bodies such as natural streams, drainage channels and catchwaters adjacent to the construction site.

Local Impact upon Existing Streams and Watercourses

6.4.3.8 The construction of Route 16 will impinge freshwater streams and watercourses in the areas between Eagle's Nest Tunnel South Portal and Sha Tin Heights Tunnel, small streams along

the Butterfly Valley, the open nullah near Wai Man Tsuen, the reservoirs / storage ponds downstream of Kowloon Reservoir, and streams and a pond between Chainages 4900 and 5000. The size of the tunnel ventilation building besides Tai Po Road near So Uk will be smaller than the one for conforming alignment; the construction water quality impact upon the adjacent watercourse is therefore considered to be smaller.

- 6.4.3.9 Where temporary or permanent stream diversions and installation of culverts are necessary, an acceptable hydraulic performance should be maintained to avoid channel overflow during heavy rainfall. Drainage channels and channels near the construction site should be covered to block the entrance of large debris, rubbish and refuse. Where watercourses are not impacted upon directly, indirect impacts due to inflows of site runoff will be associated with elevated levels of suspended solids that may block drainage channels, hinder normal channel flow, and raise the threat of local flooding during heavy rainfall. Increased suspended solid loading could also cause locally reduced levels of DO in the watercourses.

6.4.4 Mitigation Measures

- 6.4.4.1 It is important that appropriate measures are implemented to control runoff and drainage and, thereby, prevent high loading of SS from entering the Victoria Harbour and Tolo Harbour and Channel WCZs causing impacts on the identified WSRs. Proper site management is essential to minimise surface water runoff, soil erosion and sewage effluents.
- 6.4.4.2 The control of 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 storm water best management practices (BMPs), detailed as follows, should be implemented to ensure that runoff from construction areas and any stored excavated material comply with the WPCO and no unacceptable impact on the WSRs arises due to the construction of the proposed Route 16 alternative alignment. All discharges from the construction site should be controlled in order to comply with the standards for effluents discharged into the Victoria Harbour and Tolo Harbour and Channel WCZs under the TM.

Construction Runoff and Drainage

- 6.4.4.3 Exposed soil areas should be minimised to reduce the potential for increased siltation, contamination of runoff, and erosion. Construction runoff related impacts associated with tunnelling work and above ground construction activities can be readily controlled through the use of appropriate mitigation measures which include:
- the use of sediment traps; and
 - the adequate maintenance of drainage systems to prevent flooding and overflow.
- 6.4.4.4 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.
- 6.4.4.5 All temporary and permanent drainage pipes and culverts provided to facilitate runoff discharge should be adequately designed for the controlled release of storm flows in accordance with DSD Stormwater Drainage Manual during the design and construction stage. All sediment traps should be regularly cleaned and maintained. 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.

- 6.4.4.6 Sand and silt in the wash water from the wheel washing facilities, which ensure no earth, mud and debris is deposited on roads, should be settled out and removed before discharging into storm drains. A section of the road between the wheel washing bay and the public road should be paved with backfall to prevent wash water or other site runoff from entering public road drains.
- 6.4.4.7 Oil interceptors should be provided in the drainage system and regularly emptied 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.

Tunnelling Work

- 6.4.4.8 Temporary open storage of excavated materials should be covered with tarpaulin or similar fabric during rainstorms. Any washout of construction or excavated materials from the drill-and-blast tunnelling work should be diverted to the drainage system via appropriate sediment traps.
- 6.4.4.9 Ground water pumped out of tunnels should be discharged into the drainage channels which incorporate sediment traps to enhance deposition rates and to remove silt.
- 6.4.4.10 Spent grouts used in diaphragm wall construction should be collected in a separate slurry collection system, reconditioned and reused wherever practicable. The disposal of used grouting materials will only be permitted if it is treated to the TM standards before discharge to the storm drains or disposal to landfill.

General Construction Activities

- 6.4.4.11 Debris and rubbish on site should be collected, handled and disposed of properly to avoid entering the water column and cause water quality impacts. The solid waste management requirement on site to prevent such impacts is detailed in *Section 5*.
- 6.4.4.12 All fuel tanks and storage areas will 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 or 20% by volume of the fuel stored in that area, whichever is the greatest) to prevent spilled fuel oils from reaching coastal waters of the Victoria Harbour and Tolo Harbour and Channel WCZs.

Sewage Effluent

- 6.4.4.13 Construction work force sewage discharges from fixed toilet facilities on-site should be connected to the nearby existing trunk sewer wherever feasible. However, for areas where existing trunk sewer is not available, it is recommended that appropriate and adequate on-site portable chemical toilets should be provided by a licensed contractor who will be responsible for appropriate disposal and maintenance of these facilities.
- 6.4.4.14 In addition, it is considered that sewage discharges could also be treated by on-site chemical toilets. Minimum clearance away from streams and catchments and other requirements for the chemical toilets should be referred to EPD's Practice Note for Professional Persons, Drainage Plans.

6.4.5 Residual Impact

- 6.4.5.1 General construction activities and tunnelling could lead to site runoff containing elevated concentrations of SS and associated contaminants that may enter 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 provided all of the recommended mitigation measures are implemented and all construction site / works area discharges comply with the TM standards.

6.4.6 Environmental Monitoring and Audit

6.4.6.1 It is considered that only site inspections are required to ensure proper implementation, functioning and maintenance of the recommended water pollution mitigation measures at the work site during construction.

6.5 Operational Phase Assessment

6.5.1.1 The potential sources of impact on water quality from the operation of the Route 16 will be related to runoff from road and open areas. However the operation of the proposed Route 16 is not expected to generate a large volume of discharge. The maximum storm water flow for the paving area along the alternative alignment is about $3.12 \text{ m}^3 \text{ s}^{-1}$. The road drainage discharges will contain minimal amounts of oil, grease and grit that may cause downstream water quality impact to the public storm water drains.

6.5.1.2 The tunnel sections will be both confined and underground, therefore the volume of operational tunnel drainage or seepage is expected to be minimal. Appropriate measures to minimise potential sources of contamination will still be taken to ensure full compliance with the standards stipulated in the TM for discharges into storm water systems, and nearby water bodies.

6.5.2 Mitigation Measures

6.5.2.1 It is important that appropriate measures are implemented to control road runoff and domestic sewage effluents entering the Victoria Harbour and Tolo Harbour to cause impact on the identified WSRs. The following recommendations should be implemented, as appropriate, to ensure that the potential water quality impacts during the operation of the Route 16 are minimised and meet the existing regulatory requirements:

- sewage effluents generated at Toll Plaza will be treated at the on-site septic tanks. Septic tanks should be located far away from the streams and catchwaters wherever possible. Adequate clearance and maintenance should be undertaken to ensure proper functioning of the tanks without polluting any streams and watercourses nearby.

6.5.3 Residual Impact

6.5.3.1 With the adoption and incorporation of appropriate drainage and effluent collection systems, and pollution prevention measures, minimal residual operational water quality impacts are expected, since the effluent discharge standards in the TM must be followed.

6.5.4 Environmental Monitoring and Audit

6.5.4.1 It is considered that only site inspections are required to ensure that the recommended water pollution mitigation measures are properly implemented, functioned and maintained during operation.

6.6 Conclusions

6.6.1 Construction Phase

6.6.1.1 This water quality assessment has determined that no insurmountable water quality impact should result from the construction of the proposed Route 16 alternative alignment provided that:

- all the recommended mitigation measures including appropriate drainage and silty runoff collection facilities are incorporated into the construction area;
- any modification or diversion of local streams, floodwater storage ponds, and drainage pipes or channels will be constructed to allow the water flow to the discharge point or outfall without overflow or washout; and
- all temporary drainage diversions will be reinstated, wherever possible, to the original condition after the construction works are completed and implemented properly with regular routine monitoring and audit.

6.6.1.2 All construction site / works area discharges must comply with the TM standards of the WPCO. Any practical options for the diversion and re-alignment of drainage should comply with both engineering and environmental requirements. It is considered that controls on discharges from land based construction activities and proper site management procedures, as referenced above, will minimise residual water quality impacts to the acceptable levels stipulated in the in the WPCO criteria.

6.6.2 Operational Phase

6.6.2.1 With the adoption and incorporation of appropriate drainage and effluent collection and treatment systems, no detrimental operational water quality impacts are expected. It is considered that provided these drainage facilities are implemented, along with regularly cleaning and maintenance practices, operational water quality will comply with the WPCO standards.