13. ENVIRONMENTAL MONITORING AND AUDIT

13.1 Introduction

13.1.1 This section further elaborates the requirements of environmental monitoring and audit (EM&A) for the construction and operation phases of the Project, based on the assessment results of the various environmental issues. The objectives of carrying out EM&A for the Project include the following:

- Provide a database against which any short or long term environmental impacts of the Project can be determined;
- Provide an early indication should any of the environmental control measures or practices fail to achieve the acceptable standards;
- Monitor the performance of the Project and the effectiveness of mitigation measures;
- Verify the environmental impacts predicted in the EIA study;
- Determine project compliance with regulatory requirements, standards and government policies;
- Take remedial action if unexpected problems or unacceptable impacts arise; and
- Provide data to enable an environmental audit.

13.1.2 The following sections summarise the recommended EM&A requirements for the Project. Details of the specific requirements are provided in a stand-alone EM&A Manual.

13.2 Air Quality Impact

Construction Phase

13.2.1 With the implementation of the dust suppression measures stipulated in the Air Pollution Control (Construction Dust) Regulation, good site practices and proposed mitigation measures on the work sites and barging points, no adverse dust impact would be expected at the ASRs in the vicinity of the construction sites. Dust monitoring and site audit requirement during construction phase of the Project have been recommended in the EM&A Manual to ensure that the mitigation measures are to be properly implemented.

Operational Phase

13.2.2 Since no adverse operation air quality impact would be expected, hence no monitoring and audit is required during operation phase.

13.3 Noise Impact

Construction Phase

13.3.1 An EM&A programme is recommended to be established according to the expected occurrence of noisy activities. All the recommended mitigation measures for daytime normal working activities should be incorporated into the EM&A programme for implementation during construction. Details of the EM&A requirements are provided in the EM&A Manual.

Operation Phase

13.3.2 The assessment has indicated that the noise from ventilation buildings and pumping station would comply with the EIAO-TM standards. Having said that, monitoring of operation noise from the proposed ventilation buildings and pumping station during the testing and commissioning stage would be recommended to verify the compliance of the EIAO-TM criteria.

13.3.3 Road traffic noise monitoring should be carried out during the first year and after road opening at representative NSRs located in the vicinity of the recommended direct mitigation measures. Details of the programme are provided in the EM&A Manual.

13.4 Water Quality Impact

Operational Phase

13.4.1 As adverse water quality impact will not be generated from the operation of the TKO-LT Tunnel Project (Section 5.10), operational water quality monitoring and audit is not considered necessary. However, a four-week post-construction water quality monitoring will be carried out on completion of marine works. Details of the monitoring programme are provided in the EM&A Manual.

13.4.2 After completion of the tunnel construction, a 1-year post-monitoring on the groundwater levels (piezometer monitoring) above the tunnel will need to be carried out by contractor responsible for tunnel construction. The frequency of groundwater level monitoring should be proposed by the Engineer and agreed with the EPD.

Construction Phase

13.4.3 A water quality monitoring and audit programme will be conducted before and during filling operations to verify whether or not impact predictions are representative, and to ensure that the filling operations do not result in unacceptable impacts. When monitoring shows unacceptable water quality impact, appropriate mitigation measures, such as re-scheduling of construction programmes might need to be considered to slow down construction activities (e.g. to reduce the number of plant) to minimise the impacts.

13.4.4 Details of the EM&A programme will be presented in the standalone EM&A Manual. Water quality monitoring will be carried out at selected potentially affected sensitive receivers. The Manual includes site-specific monitoring and auditing protocols for baseline and impact monitoring. Such protocols include but are not limited to the locations of monitoring stations, parameters and frequencies for monitoring, monitoring equipment, data management procedures, and reporting of monitoring results.

13.4.5 Environmental audit specifications will be developed for all phases of the works, including procedures to ensure compliance with mitigation measures, environmental quality performance limits, and procedures for reviewing results and auditing compliance with specified performance limits.

13.4.6 Environmental controls on groundwater during the tunneling contract would consist of 3 periods of monitoring: Baseline, Construction and Post-Construction (as stated in Section 13.4.2) piezometer monitoring to control the work:

Baseline

13.4.7 Baseline controls each year, or as directed by the Engineer – a full suite of hourly monitoring for a 26 hour period, wet and dry season, spring and neap tides. Concurrently, tidal reference shall also be taken hourly from the tide gauge measurement at Quarry Bay for each of the four monitoring periods. On the basis of the four sets of results the Engineer will define an acceptable baseline groundwater envelope for the tunnel section of TKO-LT Tunnel project, for the two seasons and two tides.

Construction Monitoring

13.4.8 Daily piezometer monitoring, at a time of day to be agreed with the Engineer, will be required throughout the whole period when any tunnel construction activities are carried out within +/- 50m of the piezometer gate in plan.

13.4.9 The frequency of monitoring may be increased, as directed by the Engineer, should the monitored groundwater levels step outside the defined acceptable groundwater envelope for the particular gate, season and tide.

13.4.10 Additional ad hoc piezometer monitoring may be ordered by the Engineer, if any form of recharge is required to restore the local groundwater to the acceptable envelope or that any part of the Action Plan (as defined in the EIA Table 5.18) has to be invoked as a consequence of the passage of the tunnel drive.

13.4.11 Water quality monitoring should also be conducted at the four streams within the assessment area as identified in Section 6 (locations refer to **Figure 6.3**, Stream 1 to 4) to prevent drying out of streams and any contamination to the groundwater due to tunnel construction. Water quality parameters including DO, pH, temperature, turbidity, SS, BOD_5, TOC Total Nitrogen, Ammonia-N and Total Phosphate are recommended.

13.5 Ecological Impact

Terrestrial Ecology

13.5.1 As only minor impacts on terrestrial ecology are identified, no monitoring programme specific for terrestrial ecology is required. However, the implementation of all mitigation measures for terrestrial ecological impact described in **Section 6.8** should be subject to regular audit.

Marine Ecology

13.5.2 Water quality monitoring and audit designed to detect and mitigate any unacceptable impact on water quality will also serve to proactively protect marine ecological resource against water quality deterioration. Regular site audits should be carried out to ensure the effective implementation of mitigation measure stated in **Section 6.8**.

13.5.3 To avoid and minimize potential loss of small and sparsely distributed coral colonies found within the directly impacted area as well as to minimize the shading effect, it is recommended to translocate the directly impacted corals except *Oulastrea crispata* attached on the movable (< 50 cm in diameter) boulders / rocks within the proposed reclamation area and bridge footprint, as far as practicable, to a nearby suitable recipient site where similar hydrographic condition and healthy coral communities of the same coral species were recorded. Coral translocation should be carried out during the winter season (November-March) in order to avoid disturbance to the transplanted colonies during the spawning period (i.e. July to October). A detailed translocation plan with brief description on pre-

translocation coral survey, translocation methodology, identification of coral recipient site and post-translocation monitoring methodology should be prepared during the detailed design stage of the Project. Pre-translocation survey on coral within the reclamation area would be focused on identifying and mapping the coral colonies that would be directly impacted by the proposed marine works and investigating the translocation feasibility of these coral colonies (e.g. health status of coral colony and nature of the attaching susbtrata). The detailed translocation plan and marine ecologists involved in coral translocation should be approved by relevant authorities (e.g. EPD & AFCD) prior to commencement of the translocation exercises.

13.5.4 Information gathered during each post-translocation monitoring survey should include observations on the presence, survival, health condition and growth of the translocated coral colonies. These parameters should then be compared with the baseline results collected from the pre-translocation survey.

13.5.5 The untranslocable coral colonies of low coverage (< 1%) would be loss, while those that are unaffected by the direct loss would potentially be impacted by the indirect water quality change arising from the reclamation works. It is therefore recommended to monitor these nearby coral communities along with the water quality monitoring programme during the construction phase with a view to protect the natural coral communities in vicinity of the proposed marine works areas.

13.6 Fisheries Impact

13.6.1 No unacceptable fisheries impact is expected from the project. No monitoring program specified for fisheries is required.

13.7 Waste Management Implications

13.7.1 Waste management will be the contractor's responsibility to ensure that all wastes produced during the construction of the Project are handled, stored and disposed of in accordance with the recommended good waste management practices and EPD's regulations and requirements. The mitigation measures recommended in Section 8 should form the basis of the site Waste Management Plan to be developed by the Contractor at the construction stage.

13.7.2 It is recommended that the waste arisings generated during the construction activities should be audited periodically to determine if wastes are being managed in accordance with approved procedures and the site Waste Management Plan. The audits should look at all aspects of waste management including waste generation, storage, recycling, transport and disposal. An appropriate audit programme would be to undertake a first audit near the commencement of the construction works, and then to audit on a quarterly basis thereafter. In addition, the routine site inspections should check the implementation of the recommended good site practices and other waste management mitigation measures.

13.8 Impact on Cultural Heritage

13.8.1 To ensure no damage to the Cha Kwo Ling Tin Hau Temple, monitoring of the indirect impact such as monitoring of vibration should be conducted during the construction phase.

13.9 Landscape and Visual Impact

Construction Phase

13.9.1 It is recommended that professionally qualified Resident Site Landscape Architect supervise

and monitor the implementation of construction phase landscape and visual mitigation measures. This is necessary to ensure the minimisation of the works footprint, to ensure that topsoil is saved for re-use, to ensure that those existing trees earmarked for retention on site or transplanting are protected and to monitor advance screen planting works and the effectiveness of temporary screen hoardings and all the recommended landscape and visual mitigation measures under Chapter 10 of the EIA. Regular site inspections should be undertaken to closely monitor all these aspects of the work.

Operational Phase

13.9.2 During the Operational Phase, landscape and visual mitigation measures should be monitored during the first 10 years to check that the intended mitigation effects are realised. Regular monitoring should be undertaken to ensure that the landscape and visual mitigation measures have been implemented, are effective and are being managed and maintained. The compensatory tree planting required to offset the loss of existing trees, and the additional planting works for screening, slope stabilisation and amenity purposes should be checked. Planting must be established and become sustainable to provide long term landscape and visual mitigation. Hardworks elements that have been provided as part of the new works or as the reinstatement of impacted works should also be monitored and checked that they are being maintained and are achieving their mitigation function.

13.10 Landfill Gas Hazard Assessment

13.10.1 A landfill restoration monitoring programme, conducted on a monthly basis, is part of the Urban Landfills Restoration Contract on the Sai Tso Wan Landfill. However, landfill gas monitoring is still considered necessary during the construction and operational phase in order to identify any migration between the landfill and the Project sites and to ensure the safety of the Contractor's personnel.

Construction Phase

13.10.2 During construction activities within 250m Consultation Zones of Sai Tso Wan Landfill, a Safety Officer, trained in the use of gas detection equipment and landfill gas-related hazards, should be present on site throughout the groundworks phase. The Safety Officer should be provided with an intrinsically safe portable instrument, which is appropriately calibrated and able to measure methane, carbon dioxide and oxygen.

13.10.3 Routine monitoring should be carried out in all excavations, manholes, chambers, relocation of monitoring wells and any other confined spaces that may have been created. All measurements in excavations should be made with the extended monitoring tube located not more than 10 mm from the exposed ground surface. Monitoring should be performed properly to make sure that the area is free of landfill gas before any man enters into the area.

13.10.4 For excavations **deeper than 1m**, measurements should be carried out:

- at the ground surface before excavation commences;
- immediately before any worker enters the excavation;
- at the beginning of each working day for the entire period the excavation remains open; and
- periodically throughout the working day whilst workers are in the excavation.

13.10.5 For excavations **between 300mm and 1m deep**, measurements should be carried out:

- directly after the excavation has been completed; and
- periodically whilst the excavation remains open.

13.10.6 For excavations **less than 300mm deep**, monitoring may be omitted, at the discretion of the Safety Officer or other appropriately qualified person.

13.10.7 The exact frequency of monitoring should be determined prior to the commencement of works, but should be at least once per day, and be carried out by a suitably qualified or qualified person before starting the work of the day. Measurements shall be recorded and kept as a record of safe working conditions with copies of the site diary and submitted to the Engineer for approval.

Operational Phase

13.10.8 During operation, regular monitoring of methane, carbon dioxide and oxygen should be done at the tunnel, subway, and any other underground structures within the landfill consultation zone a precautionary measure.

13.10.9 Inspection and LFG monitoring should be carried out at buildings and enclosures (e.g. administration building, ventilation building, workshop, tunnel etc) prior to the operation as preventive measures. The monitoring should be continued through the operation of the Project. In particular for the first year of operation, monthly monitoring is recommended. Should the monitoring reveal the presence of landfill gas within the tunnel, buildings or other confined area, the seal of the joints shall be inspected and consideration shall be given to seal the cracks.

13.10.10 In addition, if any construction is required for the maintenance work during operational stage, the responsible party should follow the monitoring works as recommend in **Clauses 13.10.02 to 13.10.7** of this section and **Clauses 11.5.26 to 11.5.31** of this report.

13.10.11 The monitoring programme and detailed actions should be submitted to EPD for approval in the detailed design stage.