

4. WATER QUALITY

4.1 Introduction

It has been recommended that monitoring of water quality is included in the impact monitoring and audit programme. The purpose of the impact monitoring of water quality is to determine any deterioration of the water quality when marine construction works are carried out for the Toll Plaza.

4.2 Water Quality Parameters

Monitoring of turbidity in NTU, dissolved oxygen (DO) in mg/l and suspended solids (SS) in mg/l shall be carried out by the ET to ensure that any deteriorating water quality is readily detected and timely action taken to rectify the situation. The former two parameters are measured in-situ while the latter one is determined in an approved laboratory.

In association with the water quality parameters, other relevant data shall be measured and recorded. These shall include, as appropriate, location/position, time, water depth, water temperature, salinity, DO saturation, weather conditions, sea conditions, tidal stage, and any special phenomena and work underway at the construction site.

4.3 Monitoring Equipment

Dissolved oxygen and temperature measuring equipment

- (a) The instrument should be a portable, weatherproof dissolved oxygen measuring instrument complete with cable, sensor and comprehensive operation manuals, and it shall use a DC power source. It should be capable of measuring:-
 - a dissolved oxygen level in the range of 0-20 mg/l and 0-200% saturation;
 - a temperature of 0-45 degree Celsius.
- (b) It should have a membrane electrode with automatic temperature compensation complete with a cable. Sufficient stocks of spare electrodes and cables should be available for replacement where necessary. (e.g. YSI model 59 meter, YSI 5739 probe, YSI 5795A submersible stirrer with reel and cable or an approved similar instrument).
- (c) Should salinity compensation not be built-in in the DO equipment, in-situ salinity shall be measured to calibrate it prior to each measurement.

Turbidity Measurement Instrument

The instrument should be a portable, weatherproof turbidity-measuring instrument complete with comprehensive operation manual. The equipment should use a DC power source. It should have a photoelectric sensor capable of measuring turbidity between 0-1000 NTU (e.g. Hach model 2100P or an approved similar instrument).

Suspended Solids

- (a) A water sampler shall be a transparent PVC cylinder, with a capacity of not less than 2 litres, which can be effectively sealed with latex cups at both ends. The sampler should have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth (e.g. Kahlsico Water Sampler or an approved similar instrument).
- (b) Water samples for suspended solids measurement should be collected in high density polythene bottles, packed in ice (cooled to 4°C without being frozen), and delivered to the laboratory as soon as possible after collection.

Water Depth Detector

A portable, battery-operated echo sounder should be used for the determination of water depth at each designated monitoring station. This unit can either be handheld or affixed to the bottom of the work boat if the same vessel is to be used throughout the monitoring programme.

Salinity

A portable salinometer capable of measuring salinity in the range of 0-40 part per thousand (ppt) shall be provided for measuring salinity of the water at each monitoring location.

Position Fixing

A hand-held or boat-fixed type digital Differential Global Positioning System (GPS) with way point bearing indication and Radio Technical Commission for Maritime (RTCM) Type 16 error message screen pop-up facilities (for real-time auto-display of error messages and DGPS corrections from the Hong Kong Hydrographic Office) or other equivalent instrument of similar accuracy shall be provided. This shall be used during monitoring to ensure the monitoring vessel is at the correct location before taking measurements.

Calibration of In-Situ Instruments

All in-situ monitoring instruments shall be checked, calibrated and certified by a laboratory accredited under HOKLAS (or other international accreditation scheme) before use, and subsequently re-calibrated at 3 monthly intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes should be checked with certified standard solution before each use. Wet bulb calibration for a DO meter shall be carried out before measurement at each monitoring location.

For the on site calibration of field equipment, the BS 1427:1993, "Guide to Field and on-site test methods for the analysis of waters" should be observed.

Sufficient stocks of spare parts should be maintained for replacements when necessary. Backup monitoring equipment shall also be made available so that monitoring can proceed uninterrupted even when some equipment is under maintenance, calibration, etc.

The equipment list and testing methods for water quality baseline monitoring are as follows:

- (a) water depth (on board),
measured by portable echo sounder (Seafarer 901);
- (b) temperature (on board),
measured by using the temperature probe of the Dissolved Oxygen meter (Model YSI 58);
- (c) dissolved oxygen (on board),
a submersible D.O. probe (YSI 5739) equipped with a stirrer (YSI 5795A) lowered to the appropriate depth, the D.O. content being measured in-situ;
- (d) turbidity (on board),
water from the appropriate depth taken by a water sampler (model Kahlsico 135WB 153) and the turbidity measured by a turbidimeter (Model HACH 2100P);
- (e) suspended Solids (laboratory),
method used was in accordance with APHA led 2540D;
- (f) pH (laboratory),
measured by pH meter (Hanna - HI 9024).(APHA 17th ed. 4500 - H⁺);
- (g) salinity (laboratory),
materialab in-house method E-T-006.

The locations of the water sampling shall be determined by Global Positioning Equipment - ENSIGN GPS Trimble Navigation System or similar approved.

4.4 Monitoring Methodology

Analysis of suspended solids shall be carried out in a HOKLAS or other international accredited laboratory. Water samples of 1000 ml shall be collected at the monitoring stations for carrying out the laboratory SS determination. The detection limit shall be 1 mg/L or better. The SS determination work shall start within 24 hours of collection of the water samples and shall follow APHA 17ed 2540D or equivalent methods subject to approval of DEP.

If a site laboratory is set up or a non-HOKLAS or non-international accredited laboratory is hired for carrying out the laboratory analysis, the laboratory equipment, analytical procedures, and quality control shall be approved by the DEP. All the analysis shall be witnessed by the ER. The ET Leader shall provide the ER with one copy of the relevant chapters of the "Standard Methods for the Examination of Water and Wastewater" updated edition and any other relevant document for his reference.

For the testing methods of other parameters as recommended in the EIA, or required by DEP, detailed testing methods, pre-treatment procedures, instrument use, Quality Assurance/Quality Control (QA/QC) details (such as blank, spike recovery, number of duplicate samples per batch, etc.), detection limits and accuracy shall be submitted to DEP for approval prior to the commencement of monitoring programme. The QA/QC shall be in accordance with the requirement of HOKLAS or international accredited scheme. The QA/QC results shall be reported. EPD may also request the laboratory to carry out analysis of known standards provided by EPD for quality assurance. Additional duplicate samples may be required by EPD for inter laboratory calibration. Remaining samples after analysis shall be kept by the laboratory for 3 months in case repeat analysis is required. If in-house or non-standard methods are proposed, details of their verification may also be required. In any circumstance, the sample testing shall have comprehensive quality assurance and quality control programmes. The laboratory shall be prepared to demonstrate the programmes to DEP or his representatives when requested.

4.5 Monitoring Locations

Monitoring shall be undertaken at five monitoring stations and two control station as shown in *Figure 4.1*.

The status and location of water quality sensitive receivers and marine activity sites may change after issuing this Manual. If such cases exist, the ET Leader shall propose updated monitoring locations and seek approval from the IC(E) and DEP. In addition to seawater intakes, the study has identified ecological features that are sensitive to degraded water quality impact. The status and locations of water quality sensitive receivers and the marine activities sites may change after issuing this manual. If such cases exist, the ET Leader shall propose updated monitoring locations and seek approval from the IC(E) and DEP.

When alternative monitoring locations are proposed, they should be chosen based on the following criteria:

- (a) at locations close to and preferably at the boundary of the major site activities as indicated in the EIA final report, which are likely to have water quality impacts
- (b) close to the sensitive receivers which are directly or likely to be affected
- (c) for monitoring locations in the vicinity of the sensitive receivers, care should be taken to cause minimal disturbance during monitoring
- (d) two or more control stations, shall be located at positions representative of the project site in its undisturbed condition. Control stations should be located, as far as is practicable, both upstream and down stream of the works area.

Control stations are necessary to compare the water quality from potentially impacted sites with the ambient water quality. Control stations shall be located within the same body of water as the impact monitoring stations but should be outside the area of influence of the works and, as far as practicable, not affected by any other works.

Measurements shall be taken at 3 water depths, namely, 1m below water surface, mid-depth and 1m above sea bed, except where the water depth is less than 6m when the mid-depth station may be omitted. Should the water depth be less than 3m, only the mid-depth station will be monitored. The ET Leader shall seek approval from the ICE(E) and DEP for all the monitoring stations.

4.6 Baseline Monitoring

Baseline conditions for marine water quality shall be established and agreed with DEP prior to the commencement of works. The purposes of the baseline monitoring are to establish ambient conditions prior to the commencement of the works and to demonstrate the suitability of the proposed impact, control and reference monitoring stations. The baseline conditions shall normally be established by measuring the water quality parameters specified in Section 4.1. The measurements shall be taken at all designated monitoring stations, including control stations, 3 days per week, at mid-flood and mid-ebb tides, for at least four weeks prior to the commencement of marine works.

There shall not be any marine construction activities in the vicinity of the stations during the baseline monitoring.

In exceptional cases when insufficient baseline monitoring data or questionable results are obtained, the ET Leader shall seek approval from the IC(E) and DEP for an appropriate set of data to be used as baseline reference.

The baseline monitoring schedule shall be faxed to EPD 1 week prior to the commencement of baseline monitoring. The interval between 2 sets of monitoring shall not be less than 36 hours.

4.7 Impact Monitoring

During the course of the marine works, monitoring shall be undertaken three days per week, at mid-flood and mid-ebb tides, with sampling/measurement at the marine monitoring stations and on three occasions per week at the stream sites. The interval between two sets of monitoring shall not be less than 36 hours except where there are exceedances of Action and/or Limit levels, in which case the monitoring frequency shall be increased.

Upon completion of all marine activities, a post project monitoring exercise for water quality shall be carried out for four weeks in the same manner as the impact monitoring.

The proposed water quality monitoring schedule shall be faxed to EPD on or before the first day of the monitoring month, EPD shall be notified immediately of any change in schedule by fax.

4.8 Event and Action Plan for Water Quality

The water quality criteria, namely Action and Limit levels are shown in Table 4.1. Should the monitoring results of the water quality parameters at any designated monitoring stations indicate that the water quality criteria are exceeded, the actions in accordance with the Action Plan in Table 4.2 shall be carried out.

This project has a duration of greater than 12 months and, therefore quarterly assessment of impacts of the construction activities on water quality at the project site shall be undertaken and reported in a quarterly report. The difference between the quarterly mean and 1.3 times of the ambient mean, which is defined as 30% increase of the baseline and/or EPD data, of the related parameters shall be compared using appropriate statistical procedures. If the analytical results demonstrate a quarterly mean which is significantly higher than 1.3 times the ambient mean ($P < 0.05$), appropriate mitigation measures shall be proposed in the quarterly report.

Table 4.1 : Action and Limit Levels for Water Quality

Parameters	Action	Limit
DO in mg/l (Surface, Middle & Bottom)	<u>Surface & Middle</u> 5%-ile of baseline data surface and middle layer <u>Bottom</u> 5%-ile of baseline data for bottom layer.	<u>Surface & Middle</u> 4 mg/l except 5 mg/l for FCZ or 1%-ile of baseline data for surface and middle layer <u>Bottom</u> 2 mg/l or 1%-ile of baseline data for bottom layer
SS in mg/l (depth-averaged)	95%-ile of baseline data or 120% of upstream control station's SS at the same tide of the same day	99%-ile of baseline, or 130% of upstream control station's SS at the same tide of the same day and specific sensitive receiver water quality requirements (e.g. required suspended solids level for concerned sea water intakes)
Turbidity (Tby) in NTU (depth-averaged)	95%-ile of baseline data or 120% of upstream control station's Tby at the same tide of the same day	99%-ile of baseline or 130% of upstream control station's Tby at the same tide of the same day

Notes:

- "depth-averaged" is calculated by taking the arithmetic means of reading of all three depths.
- For DO, non-compliance of the water quality limits occurs when monitoring result is lower than the limits.
- For SS and Tby, non-compliance of the water quality limits occurs when monitoring result is higher than the limits.
- All the figures given in the table are used for reference only and the EPD may amend the figures whenever it is considered as necessary.

Table 4.2 : Event and Action Plan for Water Quality

Action Level	ET Leader	IC(E)	ER	Contractor
1. Action level being exceeded by one sampling day	<ol style="list-style-type: none"> 1. Repeat in-situ measurement on next day of exceedance to confirm findings; 2. Identify source(s) of impact; 3. Inform IC(E), contractor & ER; 4. Check monitoring data, all plant, equipment & contractor's working methods; 	<ol style="list-style-type: none"> 1. Check monitoring data submitted by ET & contractor's working methods; 	<ol style="list-style-type: none"> 1. Confirm receipt of notification of failure in writing; 2. Notify, contractor 	<ol style="list-style-type: none"> 1. Inform the ER & confirm notification of the non-compliance in writing; 2. Rectify unacceptable practice; 3. Amend working methods if appropriate.
2. Action level being exceeded by two or more consecutive sampling days	<ol style="list-style-type: none"> 1. Repeat measurement on next day of exceedance to confirm findings; 2. Identify source(s) of impact; 3. Inform IC(E), contractor, ER & EPD; 4. Check monitoring data, all plant, equipment & contractor's working methods; 5. Discuss mitigation measures with IC(E), ER & contractor; 6. Ensure mitigation measures are implemented; 7. Increase monitoring to daily until no exceedance of Action level. 	<ol style="list-style-type: none"> 1. Checking monitoring data submitted by ET & contractor's working method; 2. Discuss with ET & contractor on possible remedial actions; 3. Review the proposed mitigation measures submitted by contractor & advise the ER accordingly; 4. Supervise the implementation of mitigation measures. 	<ol style="list-style-type: none"> 1. Discuss with IC(E) on the proposed mitigation measures; 2. Ensure mitigation measures properly implemented; 3. Assess the effectiveness of the implemented mitigation measures. 	<ol style="list-style-type: none"> 1. Inform the Engineer & confirm notification of the non-compliance in writing; 2. Rectify unacceptable practice; 3. Check all plant & equipment & consider changes of working methods; 4. Submit proposal of mitigation measures to ER within 3 working days of notification & discuss with ET, IC(E) & ER; 5. Implement the agreed mitigation measures.

Action Level	ET Leader	IC(E)	ER	Contractor
<p>1. Limit level being exceeded by one sampling day</p>	<p>1. Repeat measurement on next day of exceedance to confirm findings; 2. Identify source(s) of impact; 3. Inform IC(E), contractor, ER & EPD; 4. Check monitoring data, all plant, equipment & contractor's working methods; 5. Discuss mitigation measures with IC(E), contractor & ER.</p>	<p>1. Checking monitoring data submitted by ET & contractor's working method; 2. Discuss with ET & contractor on the possible mitigation measures; 3. Review the proposed mitigation measures submitted by contractor & advise the ER accordingly.</p>	<p>1. Confirm receipt of notification of failure in writing; 2. Discuss with IC(E), ET & contractor on the proposed mitigation measures; 3. Request contractor to review the working methods.</p>	<p>1. Inform the ER & confirm notification of the non-compliance in writing; 2. Rectify unacceptable practice; 3. Check all plant & equipment & consider changes of working methods; 4. Submit proposal of mitigation measures to ER within 3 working days of notification & discuss with ET, IC(E) & ER.</p>
<p>2. Limit level being exceeded by two or more consecutive sampling days</p>	<p>1. Repeat measurement on the next day of exceedance to confirm findings; 2. Identify source(s) of impact; 3. Inform IC(E), contractor, ER & EPD; 4. Check monitoring data, all plant, equipment & contractor's working methods; 5. Discuss mitigation measures within IC(E), contractor & ER; 6. Ensure mitigation measures are implemented; 7. Increase the monitoring frequency to daily until no exceedance of Limit level for two consecutive days.</p>	<p>1. Checking monitoring data submitted by ET & contractor's working method; 2. Discuss with ET & contractor on potential remedial actions; 3. Review contractor's mitigation measures whenever necessary to assure their effectiveness & advise the ER accordingly; 4. Supervise the implementation of mitigation measures.</p>	<p>1. Discuss with IC(E), ET & contractor on the proposed mitigation measures; 2. Request contractor to critically review the working methods; 3. Make agreement on the mitigation measures to be implemented; 4. Ensure mitigation measures are properly implemented; 5. Consider & instruct, if necessary, the contractor to slow down or to stop all or part of the construction activities until no exceedance of Limit level.</p>	<p>1. Take immediate action to avoid further exceedance; 2. Submit proposal of mitigation measures to ER within 3 working days of notification & discuss with ET, IC(E) & ER; 3. Implement the agreed mitigation measures; 4. Resubmit proposals of mitigation measures if problem still not under control; 5. As directed by the Engineer, to slow down or to stop all or part of the construction activities until no exceedance of Limit level.</p>

4.9 Mitigation Measures

The EIA report has recommended water quality control and mitigation measures. The contractor shall be responsible for the design and implementation of these measures.

General

- All waste water generated on the Site shall be collected, removed from Site via a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance.
- The contractor shall construct, maintain, remove and reinstate, as necessary, temporary drainage works and take all other precautions necessary for the avoidance of damage by flooding and silt washed down from the Works. He shall also provide adequate precautions to ensure that no spoil or debris of any kind is allowed to be pushed, washed down, fall or be deposited on land or on the seabed adjacent to the site.
- Around any material storage, batching plants or other facilities where spillage may occur, a bund with a capacity of 110% will be provided.
- The contractor shall not permit any sewage, waste water or other effluent containing sand, cement, silt or any other suspended or dissolved material to flow from the Site onto any adjoining land or allow any solid waste to be deposited anywhere within the Site or onto any adjoining land and shall have all such materials removed from the Site.
- The contractor shall be responsible for temporary drainage, diverting open streams or drains intercepted by any works and for reinstating these to their original courses on completion of the Works.
- Any proposed temporary diversions to stream courses or nullahs shall be submitted to the Engineer for agreement one month prior to such diversion works being commenced. Diversions shall be constructed to allow the water flow to discharge without overflow, erosion or washout. The area through which the temporary diversion runs is to be reinstated to its original condition when the temporary diversion is no longer required.
- The contractor shall not discharge directly or indirectly (by runoff), or cause or permit to be discharged into any public sewer, storm-water drain, channel, stream-course or sea, any effluent or foul or contaminated water or cooling water without the prior consent of the relevant Authority who may require the contractor to provide, operate and maintain at the contractor's own expense, within the premises or otherwise, suitable works for the treatment and disposal of such effluent or foul or contaminated or cooling or hot water.
- If any office, site canteen or toilet facilities is erected, foul water effluent shall, subject to obtaining prior consent as above, be directed to a foul sewer or to a sewage treatment facilities either directly or indirectly by means of pumping.

- The contractor shall at all times ensure that all existing stream courses and drains within, and adjacent to the Site are kept safe and free from any debris and any excavated materials arising from the Works. The contractor shall ensure that chemicals and concrete agitator washings are not deposited in watercourses.
- All contractor's equipment shall be designed and maintained to minimise the risk of silt and other contaminants being released into the water column or deposited in other than designated locations.

Pollution avoidance measures during Dredging

- Mechanical grabs shall be designed and maintained to avoid spillage and shall seal tightly while being lifted.
- All vessels shall be sized such that adequate clearance is maintained between vessels and the sea bed at all states of the tide to ensure that undue turbidity is not generated by turbulence from vessel movement or propeller wash.
- All pipe leakages are to be repaired promptly and plant is not to be operated with leaking pipes.
- The marine works shall cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water within the Site or dumping grounds.
- All barges and hopper dredgers shall be fitted with tight fitting seals to their bottom openings to prevent leakage of material.
- Excess material shall be cleaned from the decks and exposed fittings of barges and hopper dredgers before the vessel is moved.
- Loading of barges and hoppers shall be controlled to prevent splashing of dredged material to the surrounding water and barges or hoppers shall not be filled to a level which will cause overflowing of material or polluted water during loading or transportation.
- The Engineer may monitor any or all vessels transporting material to ensure that no dumping outside the approved location takes place. The contractor shall provide all reasonable assistance to the Engineer for this purpose.
- All vessels used for marine works must be currently registered as such with the marine department.
- The contractor shall ensure that all marine mud and unsuitable material is accurately disposed of at approved locations. He will be required to ensure accurate positioning of vessels before discharge and will be required to submit and agree proposals with the Engineer for accurate positioned control at disposal sites before commencing dredging. All disposal in designated marine dumping grounds shall be in accordance with conditions of a license issued by the DEP under the Dumping at Sea Act (Overseas Territories) Order 1975. Floatable and

certain contaminated material (as defined by the DEP) will not be acceptable at marine dumping grounds and will require other methods of disposal.

- Mud shall be dumped evenly over the mud disposal site so that no high spots are formed and the dumping works shall be carried out in accordance with the submitted programme, as per the last paragraph.
- Water quality monitoring will be carried out by the Engineer during the dumping of mud in marine disposal sites. Requirements and extent of monitoring will be agreed with DEP and FMC.

In addition to the foregoing general measures the following measures also apply

- use of closed and sealed grabs (reduce release by at least 50%),
- the period of active dredging should not exceed 2 months,
- the maximum number of dredgers working at any given time should not exceed two,
- silt curtains should be used when dredging activities take place at the Toll Plaza,
- control the rate of dredging and lifting of material (no more than 9,500m³/day),
- disposal of material only at approved locations.

It should also be noted that the dredging at Tang Lung Chau should be programmed to avoid them taking place at the same time as dredging works at the Toll Plaza, unless the contractor can demonstrate to the satisfaction of EPD that the cumulative impacts are acceptable at the Ma Wan Fish Culture Zone.

An implementation schedule is identified in Annex A.

Placing of Fill

In addition to the general good site practice measures the following will also apply

- fill shall only be placed behind a seawall,
- no rainbowing of materials will be allowed,
- no rehandling basins will be allowed.

If the above measures are not sufficient to restore the water quality to an acceptable level upon the advice of the ET Leader, the contractor shall liaise with the ET Leader on some other mitigation measures, propose to IC(E) and ER for approval, and carry out the mitigation measures.