2.2.9.7 Concrete production

- Cement delivered in bulk should be stored in a closed silo fitted with an audible high level alarm which is interlocked with the material filling line such that, in the event of the silo approaching an overfilling condition, an audible alarm is triggered and the material filling stops within one minute;
- Silo used for the storage of cement should not be overfilled;
- The loading, unloading, transfer, handling or storage of any cement should be carried out in a totally enclosed system or facility, and any vent or exhaust should be fitted with an effective fabric filter or equivalent air pollution control system or equipment; and
- Cement collected by fabric filters or other pollution control system or equipment should be disposed of in a totally enclosed containers.

2.2.9.8 Excavation and earth moving

- The working area of any excavation or earth moving operation should be sprayed with water or a dusty suppression chemical immediately before, during and immediately after the operation so as the maintain the entire surface wet; and
- Exposed earth should be properly treated by compaction, turfing, hydroseeding, vegetation planting or sealing with latex, vinyl, bitumen, shotcrete or other suitable surface stabilizer within 6 months after the last construction activity on the construction site or part of the construction site where the exposed earth lies.

2.2.9.9 Stockpiling of dusty materials

Any stockpile of dusty material should be either covered entirely by impervious sheeting; placed in an area sheltered on the top and the 3 sides; or sprayed with water or a dust suppression chemical so as to maintain the entire surface wet.

2.2.9.10 Building construction

- Where a scaffolding is erected around the perimeter of a building under construction, effective dust screens, sheeting or netting should be provided to enclose the scaffolding from the ground floor level of the building, or if a canopy is provided at the first floor level, from the first floor level, up to the highest level of the scaffolding; and
- Any skip hoist for material transport should be totally enclosed by impervious sheeting.

2.3 Odour Monitoring

2.3.1 General

- 2.3.1.1 If dredging activities are involved in the reclamation of SEKD, potential odour impacts would be expected during the construction phase of this project. The ENPO(s) will then be required to carry out the odour EM&A program detailed in this Manual for the dredging activities.
- 2.3.1.2 Odour would also be generated from maintenance activities of drainage channel during the operational phase of SEKD. The odour EM&A program for those maintenance activities should be undertaken by the agents identified in the Implementation Schedule included in **Appendix A** of this Manual and not the ENPOs. The EMT, EAT, and other parties referenced in the following sections are therefore refer in general to those involved in the odour generating activities.
- 2.3.1.3 Initially, H_2S measurements and odour panel tests should be carried out at the odour sources and at nearby sensitive receivers. The purpose is to determine the correlation between H_2S concentrations and odour units obtained from the odour panel tests. Once such correlation is established, H_2S monitoring will be continued and H_2S concentrations measured will be converted to equivalent odour units.

2.3.2 *Monitoring Methodology*

- 2.3.2.1 Monitoring and audit of the odour level should be carried out by the EMT during the course of the odour generating activities to ensure that odour levels at the sensitive receivers meet the requirements and timely action would be undertaken to rectify any exceedances.
- 2.3.2.2 According to Annex 4 of the EIAO-TM, an odour concentration as a result of odour emission of 5 OU m⁻³ or above based on an averaging time of 5 seconds at an Air Sensitive Receiver (ASR) is considered an odour nuisance.
- 2.3.2.3 Hydrogen sulphide (H₂S) is one of the main components of odour emissions from dredging activities and maintenance of drainage channel. Since ambient H₂S concentration can be readily monitored at ASRs, it can serve as a surrogate indicator for SPS odours in addition to odour measurement using olfactometry techniques.
- 2.3.2.4 Prior to the operation of the odour generating activities, H_2S measurements and odour panel tests should be carried out at the odour sources and at nearby sensitive receivers. The purpose is to establish the averaged baseline H_2S concentration conditions at each measurement position at sources and at ASRs. These baseline H_2S concentrations will be used to establish the action levels of the odour EM&A program.
- 2.3.2.5 In addition, H_2S measurements and odour panel tests should be carried out at the odour sources and at nearby sensitive receivers in order to determine the correlation between H_2S concentrations and odour units obtained from the odour panel tests. Once such correlation is established, only H_2S monitoring should be continued and H_2S concentrations measured should be converted to equivalent odour units. The correlation is used to check whether the mitigation measures can reduce the odour concentration to meet the odour criteria.
- 2.3.2.6 During the operation of the odour generating activities, only measurements of H_2S concentrations at source and at the selected ASRs simultaneously are required. This is to indicate whether the odour concentrations are higher or lower than the baseline condition, and within the odour criteria.
- 2.3.2.7 Apart from the baseline and impact odour monitoring detailed in Sections 2.3.7 and 2.3.8 below, regular odour patrolling in the vicinity of the odour generating activities should also be conducted to ensure that prompt actions would be taken whenever any excessive odour emissions are detected.

2.3.3 *Monitoring Parameters*

- 2.3.3.1 15-min H_2S concentration (in parts per billion or in parts per million) should be measured at sources and at ASRs using the equipment described below. Meteorological conditions including temperature, wind speed, wind direction and relative humidity should also be measured at the time of the monitoring.
- 2.3.3.2 For olfactometry analysis, air samples should also be collected for a period of 15-min at the selected locations in order to provide sufficient volume for olfactometric analysis. Odour concentrations should be expressed as OUm⁻³.

2.3.4 *Monitoring Equipment and Methods*

Hydrogen Sulphide Monitoring

2.3.4.1 Concentrations of H_2S should be recorded using a Jerome H_2S Analyzers which utilises a gold film sensor for the detection of hydrogen sulphide. The instrument is controlled by

microprocessor, ensuring rapid accurate analyses, and should be fitted with the following accessories:

- Data logger (to allow the instrument to operate unattended);
- Interface cable and interface software; and
- Data download and graphics service.
- 2.3.4.2 The instrument is capable of measuring H_2S concentrations in the range 1ppb $(1.4\mu gm^{-3})$ to 50 ppm (70 mg m⁻³) to an accuracy of 6%. If the H_2S concentrations at sources are too high to be measured by this equipment, wet chemical method should be considered to analysis the H_2S concentrations of the collected air samples in the laboratory. Meteorological information including wind speed, wind direction and temperature should be retrieved from the meteorological monitoring station.

Olfactometry Analysis

- 2.3.4.3 The odour concentration should be measured by a force-choice dynamic olfactometer in accordance with the Dutch National Standard Method (NVN2820).
- 2.3.4.4 Large plastic bags of 40 litres are usually used to collect air samples. To avoid adsorption onto or chemical reaction with the bag surface, bags and connection tubing in contact with odour-laden gas should be made of inert material, e.g. poly-tetra fluro-ethylene (PTFE) or Tedlar.
- 2.3.4.5 During the sampling, weather condition including wind direction, wind speed and temperature should be recorded. The collected samples should be transported to an odour laboratory as soon as possible and shall be analyzed within 24 hours. Qualified odour panelists should be selected and those participating in the odour testings should be screened by using a 50ppm of certified n-butanol standard gas.

2.3.5 Laboratory Analysis and QA/QC

Basic Principle of Odour Measurement

2.3.5.1 The odour concentration of a gaseous sample is measured using dynamic olfactometry with a panel of human assessors being the sensor. The odour panel normally composes of 6 to 8 persons. The odour concentration is measured by determining the dilution factor required to reach the detection threshold. The odour concentration at the detection threshold is 1 odour unit (OUm⁻³), which has a probability of 50% being detected under the conditions of the test. The odour concentration of the examined sample is then expressed in terms of multiples of one OUm⁻³ of neutral gas at standard conditions.

Panel Selection and Control

- 2.3.5.2 In order to ensure repeatability of the sensor, composed of individual panel members, their olfactory sensitivity should be within a narrow bandwidth. To achieve this aim, assessors with a specific sensitivity to a reference odour are selected to be panel members. The screening is on reference materials n-butanol with the concentration of 50ppm in nitrogen (v/v).
- 2.3.5.3 At least ten individual thresholds for the reference gas are collected for selection purposes. These data are collected in at least three sessions on separate days with a pause of at least one day between sessions. To become a panel member, the data collected for that assessor must comply with the following criteria:
 - The geometric mean of the individual thresholds must fall between 20 and 80 ppb, when n-butanol standard gas is used; and

- A measuring history for each panel member is continuously recorded and their performance is compared with the selection criteria. If the panel member does not comply, he/she is excluded from all further measurements.
- 2.3.5.4 In order to control the quality of the results produced by panel members:
 - Panel members must not eat or smoke for one hour prior to the session;
 - Panel members should be in the odour room 15 minutes before measurements;
 - Panel members should not use perfumes, after-shave lotions or any other fragrant essences before the session;
 - Panel member should not attend a session if he/she has a cold, influenza or any other health problem, which will affect his/her nose;
 - No panel member should be involved for more than 4 hours of odour testing. Within this period at least 2 ten minutes breaks for olfactory rest should be taken; and
 - The odour panel should be housed in a room that is constructed of odour-free materials and is equipped with ventilation system to prevent build-up of odour in the room.

Instrument Calibration

2.3.5.5 Regular calibration of the olfactometer should be performed to check the accuracy and repeatability of its dilution settings and to establish its calibration history. The calibration may be performed using carbon monoxide as a tracer gas and a carbon monoxide monitor. The accuracy and repeatability of the olfactometer are calculated from two carbon monoxide concentrations with one measured at the sniffing port of the olfactometer and one being the certified carbon monoxide concentration.

2.3.6 *Monitoring Locations*

Monitoring Locations at ASRs

- 2.3.6.1 Odour monitoring should be carried out at representative ASRs nearest to the odour generating activities. The monitoring locations can only be determined during detailed design of the works upon confirmation of the locations of odour generating activities. The EMT Leader should propose monitoring locations and seek approval from ER and agreement from EAT.
- 2.3.6.2 Odour sampling or H_2S measurements should be taken outside the premises of the identified ASRs and these locations should preferably not be influenced by other nearby odour sources.

Monitoring Locations at Odour Sources

2.3.6.3 Odour monitoring and H_2S measurements should be undertaken at the selected locations at the odour sources. The selected locations should be determined by the EMT Leader and agreed with ER and EPD.

2.3.7 Baseline Monitoring

- 2.3.7.1 Odour and H_2S monitoring should be taken prior to the operation of the odour generating activities in order to establish baseline odour and H_2S concentrations and to set up the Action and Limit levels. These will be compared with the results obtained during the impact monitoring stage.
- 2.3.7.2 Odour baseline monitoring should consist of both odour sampling and H_2S measurement. Sampling at sources and at any selected ASRs using olfactometry and an H_2S analyser should be carried out simultaneously using the equipment and methodology described above. The purpose is to establish both the correlations between odour level (OUm⁻³) and H_2S

concentration, and the averaged baseline H_2S concentration condition for each measurement position at source and at ASRs.

- 2.3.7.3 A 15-min sample should be collected every 3 hours for a duration of 24 hours at each of the monitoring locations. The purpose of sampling in 3-hour intervals and to cover a duration of a whole day is to capture the different atmospheric conditions at different time periods. If there is insufficient monitoring equipment or monitoring personnel, sampling/monitoring can be spread to 3 to 4 consecutive days as long as the different monitoring periods and each of monitoring locations are covered. Pairwise monitoring at ASRs and at source should be carried out simultaneously. However, as the variation of odour concentration at sources should be less significant, timing of sampling or monitoring near the odour sources should be more flexible so as to accommodate the available resources for the monitoring programme.
- 2.3.7.4 As the first set of odour sampling/monitoring is fundamentally to establish the correlation between OUm^{-3} and H_2S , the timing of this event should be selected during the summer period, as far as possible, to capture the highest odour concentrations.
- 2.3.7.5 In exceptional cases, when insufficient baseline monitoring data or questionable results are obtained, the EMT Leader should liaise with EPD to agree on an appropriate set of data to be used as the baseline.

2.3.8 Impact Monitoring

2.3.8.1 The EMT Leader should carry out the odour monitoring at all the designated monitoring locations during operation of the odour generating activities.

The First Set of Odour Monitoring

- 2.3.8.2 The first set of odour monitoring should consist of both odour sampling and H_2S measurement. Sampling at sources and at any selected ASRs using olfactometry and an H_2S analyser should be carried out simultaneously using the equipment and methodology described above. The purpose is to establish both the correlations between odour level (OUm⁻³) and H_2S concentration, and the averaged baseline H_2S concentration condition for each measurement position at source and at ASRs.
- 2.3.8.3 A 15-min sample should be collected every 3 hours for a duration of 24 hours at each of the monitoring locations. The purpose of sampling in 3-hour intervals and to cover a duration of a whole day is to capture the different atmospheric conditions at different time periods. If there is insufficient monitoring equipment or monitoring personnel, sampling/monitoring can be spread to 3 to 4 consecutive days as long as the different monitoring periods and each of monitoring locations are covered. Pairwise monitoring at ASRs and at source should be carried out simultaneously. However, as the variation of odour concentration at sources should be less significant, timing of sampling or monitoring near the odour sources should be more flexible so as to accommodate the available resources for the monitoring programme.
- 2.3.8.4 As the first set of odour sampling/monitoring is fundamentally to establish the correlation between OUm^{-3} and H_2S , the timing of this event should be selected during the summer period, as far as possible, to capture the highest odour concentrations. Once the correlation between H_2S concentrations and odour units is established, H_2S monitoring should be continued during the subsequent odour monitoring and H_2S concentrations measured should be converted to equivalent odour units. The degree of correlation should be constantly reviewed in order to ascertain that the most realistic correlation factor be used.

Subsequent Odour Monitoring

- 2.3.8.5 The subsequent odour impact monitoring should provide a continuation of the H_2S monitoring at sources and at ASRs. Impact monitoring should be carried out every 3 months. With reference to the odour monitoring results, the frequency of monitoring may be revised to fit the situation.
- 2.3.8.6 The same monitoring regime as the baseline monitoring should be followed, except that odour sampling and analysis by olfactometry is not required in the subsequent odour impact monitoring.

2.3.9 Event and Action Plans for Air Quality

2.3.9.1 The baseline monitoring results form the basis for determining the odour criteria for the impact monitoring. The EMT Leader should compare the impact monitoring results with the odour criteria shown in **Table 2.3**, namely Action and Limit Levels. Should a non-compliance of the odour criteria occur, the relevant parties should undertake the relevant actions in accordance with the Event/Action Plan in **Table 2.4**.

Table 2.3 Action and Limit Levels for Odour Monitoring

Parameters	Action Level	Limit Level			
H ₂ S concentration in ppb/ppm	Averaged baseline H ₂ S concentration measured at odour sources.	Average baseline H ₂ S conc. or the 5 OUm ⁻³ equivalent whichever is greater at ASRs.			

Table 2.4 Event/Action Plan for Odour Monitoring

Fuent	Action								
Event		EMT		EAT		ER		Contractor/Operator	
Exceedance of Action Level for one sample at source	1. 2. 3.	Identify source/ reason of exceedance; Inform EAT and ER; Repeat measurement to confirm finding.	 1. 2. 3. 4. 	Check with Contractor and Operator on the operating activities and implementation of odour mitigation measures; Discuss with EMT, Contractor and Operator on the possible remedial actions; Advise the ER on the effectiveness of the proposed remedial measures; Supervise implementation of remedial measures.	1. 2. 3.	Confirm receipt of notification of exceedance in writing; Notify Contractor and Operator; Ensure remedial actions properly implemented.	1. 2. 3. 4. 5.	Carry out investigation to identify the source/reason of exceedance or complaints. Investigation shall be completed within 1 week; Rectify any unacceptable practice; Amend working methods as required; Inform EAT and EPD if the cause of exceedance is considered to be caused by the project; Implement amended working methods.	
Exceedance of Limit Level for one or more samples at ASRs	1. 2. 3. 4. 5. 6. 7.	Notify EAT, ER, Contractor / Operator and EPD; Identify source of odour; Increase monitoring frequency; Carry out analysis of the operating activities and implementation of odour mitigation measures to determine possible mitigation to be implemented Arrange meeting with EAT and ER to discuss the remedial actions to be taken; Assess effectiveness of the remedial actions and keep EAT, EPD and ER informed of the results; Carry out odour measurement using dynamic olfactometry after implementation of remedial measures to confirm their effectiveness.	1. 2. 3.	Discuss amongst EMT, ER and the Contractor/Operator on the potential remedial actions; Review the proposed remedial actions whenever necessary to assure their effectiveness and advise the ER accordingly; Supervise implementation of remedial measures.	1. 2. 3. 4. 5.	Confirm receipt of notification of exceedance in writing; Notify Contractor and Operator; In consultation with the EAT, agree with the Contractor / Operator on the remedial measures to be implemented; Ensure remedial measures properly implemented; If exceedance continues, consider what portion of the work is responsible and instruct the Contractor/Operator to stop that portion of work until the exceedance is abated.	1. 2. 3. 4. 5. 6. 7.	Carry out investigation to identify the source/reason of exceedance. Investigation shall be completed within 1 week; Rectify any unacceptable practice; Amend working methods as required; Inform EAT and EPD; Formulate remedial actions; Ensure amended working methods and remedial actions properly implemented; If exceedance continues, consider what portion of the work is responsible and stop that portion of work until the exceedance is abated.	

2.3.10 *Mitigation Measures*

- 2.3.10.1 The EIA report has recommended the odour control and mitigation measures. The agents identified in the Implementation Schedule should be responsible for the design and implementation of these measures.
- 2.3.10.2 If the recommended mitigation measures are not sufficient to restore the air quality to acceptable levels upon the advice of EAT Leader, the Contractor / Operator should liaise with the EAT Leader on some other mitigation measures, propose to ER for approval, and implement the mitigation measures.

Odour Impact from KTAC Reclamation

- 2.3.10.3 For no dredged option with *in-situ* treatment, no sediment dredging would be required. Spills and losses of the contaminated sediments can also be avoided because no sediment handling would be required and odour emission is not likely to be an important issue in this case.
- 2.3.10.4 For the fully dredged or minimum dredged option with *ex-situ* treatment, suction dredging would be used for sediment dredging. This serves as a mitigation measure to minimise the potential odour impacts since the dredging operation is under a submerged condition and would prevent the exposure of dredged sediments in the atmosphere. In additional, odour emission would be minimized by the addition of Fenton's reagent into the dredged sediments in the dredge pipeline, which would oxidize much of the acid volatile sulphide (AVS) almost instantaneously and hence reduce the generation potential of odorous hydrogen sulphide gas.
- 2.3.10.5 Besides, to further limit odour emission during dredging operation, it is recommended to cover the dredged sediments after loaded into the dredger. Dispersion of odour would be minimised during the transport of the sediments to the disposal sites or treatment facilities. The treatment facility and the associated stockpiles should be suitably enclosed to minimise any odour emission.
- 2.3.10.6 The dredging activity is best to be carried out in winter where practicable. The wind direction is mostly from the northeast during this period. The wind would disperse the odour towards the Victoria Harbour and away from the residential and commercial buildings in the areas of Kowloon Bay, Ngau Tau Kok and Kwun Tong. The low temperature in winter would reduce the organic decomposition rate and hence minimising the odour impact.
- 2.3.10.7 For both the fully dredged and minimum dredged options, with the implementation of the above measures to be confirmed by field trials, odour impacts resulted from the dredging activities could be minimised and insurmountable odour impact is therefore not expected. For the no dredged option, no dredging activities would be involved and no odour impact is therefore expected.

Odour Impact from Maintenance of Drainage Channel

- 2.3.10.8 Two desilting methods have been proposed: the winching method and the man-entry method. The winching method has been recommended for routine maintenance, whereas the man-entry method should only be adopted for emergency events such as when shock loadings occur and also for those sections around bends and junctions where winching could not be deployed.
- 2.3.10.9 Both methods have the potential for short-term release of odorous gas when the sediments are disturbed during the desilting process. It should be recognised that the odour problem is inherent in this type of maintenance work and some odour will always be present to some extent. This issue is not uncommon to some of the current box culvert maintenance practices at other locations in the territory, where sufficient measures were not or could not be provided.

Although this problem cannot be totally eliminated, the aim is to adopt the best practicable means to minimise odour impact as much as possible.

- 2.3.10.10 Two options are available for adoption and their practicability and effectiveness should be confirmed by field trials at the detailed design stage:
 - Option 1: Apply odour mist over the desilting openings
 - Option 2: Use "mobile" enclosures with odour control system over the downstream desilting openings
- 2.3.10.11 Based on the information currently available, Option 2 is a more well-established technology and thus a preferred option to control the odour. For both options, some form of forced ventilation should be applied to the access point so that the air (and thus odour) could be forced through the length of the culvert to the odour control system. This system could be a portable unit consisting of extraction fans, particulate filters and activated carbon filters.
- 2.3.10.12 It is easier to deploy odour mitigation measures to the winching method because of the fewer desilting openings (and thus easier to force ventilate and to apply odour mist). The man-entry method would require more desilting openings and the opening of smaller access manholes to provide sufficient light to men working in the box culvert. As such, it would be more difficult to force ventilate. However the man-entry method should be used infrequently (during shock loading and for areas not accessible to the winching method) and potential odour impact should be infrequent and short-term.
- 2.3.10.13 The silt from the box culverts should be directly transferred to a lorry using mechanical grabs. The sealed tray should then be covered either with purpose-designed lids or tight fitting polypropylene tarpaulin or equivalent to minimise the escape of odour. Dewatering of the silty sediments should occur at the centralised dewatering facility that is completely enclosed and ventilated to an odour control system such as a wet chemical scrubber. With the installation of practicable and effective odour control system, adverse odour impact from the centralised dewatering system is not anticipated. This should be further investigated in the detailed design stage.
- 2.3.10.14 With the detailed consideration and proper application of best practicable mitigation measures such as those described above, there should be considerable reduction in odour problem from maintaining the SEKD box culverts compared to the conventional practice of desilting box culverts.
- 2.3.10.15 The practicability and effectiveness of the proposed odour mitigation measures should be confirmed by field trial at the detailed design stage. During the operational stage, an odour monitoring program in accordance with this Manual should be implemented to check that the odour reduction measures are effective in preventing adverse odour impacts to nearby sensitive receivers.