2. AIR QUALITY

2.1 Introduction

2.1.1 Dust impacts would be the major air quality impacts during the construction phase of the project. There might also be odour impacts if dredging operation is required for the proposed reclamation in SEKD. During operational phase of the project, there would be potential odour impacts associated with the maintenance operation of the box culverts within SEKD. Sections 2.2 and 2.3 detailed the approaches, criteria and guidelines on monitoring and managing dust and odour impacts respectively.

2.2 Dust Monitoring

2.2.1 *General*

2.2.1.1 Dust would be the key environmental issue during construction. It is necessary to monitor the dust generates from the construction activities after timely implementation of the mitigation measures listed in Section 2.2.9 in the Manual. The purpose of the monitoring is to ascertain that the dust levels would comply with the 1-hour average and 24-hour average Total Suspended Particualtes (TSP) criteria at nearby sensitive receivers, and that the recommended mitigation measures are effective in suppressing dust levels.

2.2.2 *Monitoring Parameters*

2.2.2.1 Monitoring and audit of the TSP levels should be carried out by the ENPOs to ensure that any deteriorating air quality could be readily detected and timely and appropriate action be undertaken to rectify the situation.

2.2.2.2 1-hour and 24-hour TSP levels should be measured to indicate the impacts of construction dust on air quality. The TSP levels should be measured by following the standard high volume sampling method as set out in the Title 40 of the Code of Federal Regulations, Chapter 1 (Part 50), Appendix B. Upon approval of the ER, 1-hour TSP levels can be measured by direct reading methods which are capable of producing comparable results as that by the high volume sampling method, to indicate short event impacts.

2.2.2.3 All relevant data including temperature, pressure, weather conditions, elapsed-time meter reading for the start and stop of the sampler, identification and weight of the filter paper, and other special phenomena and work progress of the concerned site etc. should be recorded down in details. A sample data record sheet is shown in **Appendix B** for reference.

2.2.3 *Monitoring Equipment*

2.2.3.1 High volume sampler (HVS) in compliance with the following specifications should be used for carrying out the 1-hour and 24-hour TSP monitoring:

(a) 0.6-1.7m^3/min (20-60 SCFM) adjustable flow range;
(b) equipped with a timing/control device with +/- 5 minutes accuracy for 24 hours operation;
(c) installed with elapsed-time meter with +/- 2 minutes accuracy for 24 hours operation;
(d) capable of providing a minimum exposed area of 406cm^2 (63in^2);
(e) flow control accuracy: +/- 2.5% deviation over 24-hour sampling period;
(f) equipped with a shelter to protect the filter and sampler;
(g) incorporated with an electronic mass flow rate controller or other equivalent devices;

(h) equipped with a flow recorder for continuous monitoring;
(i) provided with a peaked roof inlet;
(j) incorporated with a manometer;
(k) able to hold and seal the filter paper to the sampler housing at horizontal position;
(l) easy to change the filter; and
(m) capable of operating continuously for 24-hour period.

2.2.3.2 The EMT should be responsible for provision of the monitoring equipment. The EMT Leader should ensure that sufficient number of HVSs with an appropriate calibration kit are available for carrying out the baseline monitoring, regular impact monitoring and *ad hoc* monitoring. The HVSs should be equipped with an electronic mass flow controller and be calibrated against a traceable standard at regular intervals. All the equipment, calibration kit, and filter papers should be clearly labelled.

2.2.3.3 Initial calibration of dust monitoring equipment should be conducted by the EMT upon installation and thereafter at bi-monthly intervals. The transfer standard should be traceable to the internationally recognized primary standard and be calibrated annually. The calibration data should be properly documented for future reference by the concerned parties including the EAT. All the data should be converted into standard temperature and pressure condition.

2.2.3.4 The flow-rate of the sampler before and after the sampling exercise with the filter in position should be verified to be constant and be recorded down in the data sheet (see **Appendix B**).

2.2.3.5 If the EMT Leader proposes to use a direct reading dust meter to measure 1-hour TSP levels, he should submit sufficient information to the EAT to prove that the instrument is capable of achieving a comparable result as that of the HVS and may be used for the 1-hour sampling. The instrument should also be calibrated regularly, and the 1-hour sampling should be determined periodically by HVS to check the validity and accuracy of the results measured by direct reading method.

2.2.3.6 Wind data monitoring equipment should also be provided and set up at conspicuous locations for logging wind speed and wind direction near to the dust monitoring locations. The equipment installation location should be proposed by the EMT Leader and agreed with the ENPO Manager/EAT Leader, the ER and EPD. For installation and operation of wind data monitoring equipment, the following points should be observed:

(a) the wind sensors should be installed on masts at an elevated level 10m above ground so that they are clear of obstructions or turbulence caused by the buildings;
(b) the wind data should be captured by a data logger and to be downloaded for processing at least once a month;
(c) the wind data monitoring equipment should be re-calibrated at least once every six months; and
(d) wind direction should be divided into 16 sectors of 22.5 degrees each.

2.2.3.7 In exceptional situations, the EMT Leader may propose alternative methods to obtain representative wind data upon agreement with the ENPO Manager/EAT Leader, the ER and EPD.

2.2.4 *Laboratory Measurement / Analysis*

2.2.4.1 A clean laboratory with constant temperature and humidity control and equipped with necessary measuring and conditioning instruments to handle the dust samples collected should be available for sample analysis, and equipment calibration and maintenance. The laboratory should be HOKLAS accredited.

2.2.4.2 If a site laboratory is set up or a non-HOKLAS accredited laboratory is hired by the EMT for carrying out the laboratory analysis, the laboratory equipment should be approved by the ER and the EAT. Measurement performed by the laboratory should be demonstrated to the satisfaction of the ER and the EAT. The EAT should conduct regular audit to the measurement performed by the laboratory so as to ensure the accuracy of measurement results. The EMT Leader should provide the ER with one copy of the Title 40 of the Code of Federal Regulations, Chapter 1 (Part 50), Appendix B for his reference.

2.2.4.3 Filter paper of size 8"x10" should be labelled before sampling. It should be a clean filter paper with no pin holes, and should be conditioned in a humidity controlled chamber for over 24-hour and be pre-weighed before use for the sampling.

2.2.4.4 After sampling, the filter paper loaded with dust should be kept in a clean and tightly sealed plastic bag. The filter paper is then returned to the laboratory for reconditioning in the humidity-controlled chamber followed by accurate weighing by an electronic balance with a readout down to 0.1mg. The balance should be regularly calibrated against a traceable standard.

2.2.4.5 All the collected samples should be kept in a good condition for 6 months before disposal.

2.2.5 *Monitoring Locations*

2.2.5.1 Sufficient number of dust monitoring locations should be selected among the potentially affected ASRs during the construction of different works packages to monitor the potential dust impacts. A group of monitoring stations can serve to monitor the dust impacts from a number of concurrent works packages. The status and locations of air quality sensitive receivers may change after issuing this Manual. The EMT Leader should propose and alter monitoring locations and seek approval from ER and agreement from ENPO/EAT and EPD during the construction phase of the project.

2.2.5.2 When monitoring locations are proposed, the following criteria, as far as practicable, should be followed:

(a) at the site boundary or such locations close to the major dust emission source;
(b) close to the sensitive receptors;
(c) proper position/siting and orientation of the monitoring equipment; and
(d) take into account the prevailing meteorological conditions.

2.2.5.3 The EMT Leader should agree with the ER on the position of the HVS for installation of the monitoring equipment. When positioning the samplers, the following points should be noted:

(a) a horizontal platform with appropriate support to secure the samplers against gusty wind should be provided;
(b) no two samplers should be placed less than 2 meter apart;
(c) the distance between the sampler and an obstacle, such as buildings, must be at least twice the height that the obstacle protrudes above the sampler;
(d) a minimum of 2 metres of separation from walls, parapets and penthouses is required for rooftop samplers;
(e) a minimum of 2 metre separation from any supporting structure, measured horizontally is required;
(f) no furnace or incinerator flue is nearby;
(g) airflow around the sampler is unrestricted;
(h) the sampler is more than 20 metres from the dripline;
(i) any wire fence and gate, to protect the sampler, should not cause any obstruction during monitoring;
(j) permission must be obtained to set up the samplers and to obtain access to the monitoring stations; and

(k) a secured supply of electricity is needed to operate the samplers.

2.2.6 *Baseline Monitoring*

2.2.6.1 The EMT Leader should carry out baseline monitoring at all of the designated monitoring locations for at least 14 consecutive days prior to the commissioning of the construction works to obtain daily 24-hour TSP samples. 1-hour sampling should also be done at least 3 times per day while the highest dust impact is expected.

2.2.6.2 Before commencing the baseline monitoring, the EMT Leader should inform the EAT of the baseline monitoring programme such that the EAT can conduct on-site audit to ensure accuracy of the baseline monitoring results. During the baseline monitoring, there should not be any construction or dust generation activities in the vicinity of the monitoring stations.

2.2.6.3 In case the baseline monitoring cannot be carried out at the designated monitoring locations during the baseline monitoring period, the EMT Leader should carry out the monitoring at alternative locations which can effectively represent the baseline conditions at the impact monitoring locations. The alternative baseline monitoring locations should be approved by the ER and agreed with ENPO/EAT and EPD.

2.2.6.4 In exceptional case, when insufficient baseline monitoring data or questionable results are obtained, the EMT Leader should liaise with EPD and in consultation with ER to agree on an appropriate set of data to be used as a baseline reference.

2.2.6.5 Ambient conditions may vary seasonally and should be reviewed at three monthly intervals. If the ENPO Manager considers that the ambient conditions have been changed and a repeat of the baseline monitoring is required to be carried out for obtaining the updated baseline levels, the monitoring should be at times when the contractor's activities are not generating dust, at least in the proximity of the monitoring stations. Should change in ambient conditions be determined, the baseline levels and, in turn, the air quality criteria, should be revised. The revised baseline levels and air quality criteria should be agreed with EPD.

2.2.7 *Impact Monitoring*

2.2.7.1 The EMT should carry out impact monitoring during the course of the project. For regular impact monitoring, the sampling frequency of at least once in every six-days, should be strictly observed at all the monitoring stations for 24-hour TSP monitoring. For 1-hour TSP monitoring, the sampling frequency of at least three times in every six-days should be undertaken when the highest dust impact occurs.

2.2.7.2 Before commencing the impact monitoring, the EMT Leader should inform the EAT of the impact monitoring programme such that the EAT can conduct on-site audit to ensure accuracy of the impact monitoring results.

2.2.7.3 The specific time to start and stop the 24-hour TSP monitoring should be clearly defined for each location and be strictly followed by the operator.

2.2.7.4 In case of non-compliance with the air quality criteria, more frequent monitoring exercise, as specified in the Action Plan in Section 2.2.8, should be conducted within 24 hours after the result is obtained. This additional monitoring should be continued until the excessive dust emission or the deterioration in air quality is rectified.

2.2.8 *Event and Action Plan for Air Quality*

2.2.8.1 The baseline monitoring results form the basis for determining the air quality criteria for the impact monitoring. The EMT should compare the impact monitoring results with air quality criteria set up for 24-hour TSP and 1-hour TSP. **Table 2.1** shows the air quality criteria, namely Action and Limit levels to be used. Should non-compliance of the air quality criteria occurs, the EMT Leader, EAT Leader, ER, and Contractor should undertake the relevant action in accordance with the Action Plan in **Table 2.2**.

Table 2.1 Action and Limit Levels for Air Quality (Dust)

Parameters	Action	Limit
24 Hour TSP Level in $\mu g/m^3$	For baseline level < 108 $\mu g/m^3$, Action level = average of baseline level plus 30% and Limit level For baseline level > 108 $\mu g/m^3$ and baseline level < 154 $\mu g/m^3$, Action level = 200 $\mu g/m^3$ For baseline level > 154 $\mu g/m^3$, Action level = 130% of baseline level	260
1 Hour TSP Level in $\mu g/m^3$	For baseline level < 154 $\mu g/m^3$, Action level = average of baseline level plus 30% and Limit level For baseline level > 154 $\mu g/m^3$ and baseline level < 269 $\mu g/m^3$, Action level = 350 $\mu g/m^3$ For baseline level > 269 $\mu g/m^3$, Action level = 130% of baseline level	500

Table 2.2 Event/Action Plan for Air Quality (Dust)

EVENT	ACTION			
	EMT	EAT	ER	CONTRACTOR
Action Level being exceeded for one sample	1. Identify source; 2. Inform EAT, ER; 3. Repeat measurement to confirm finding; 4. Increase monitoring frequency to daily.	1. Discuss with Contractor on the mitigation measures; 2. Review proposals on mitigation measures submitted by Contractor and advise the ER accordingly; 3. Assess the effectiveness of the implemented mitigation measures.	1. Notify Contractor; 2. Check monitoring data and Contractor's working methods.	1. Rectify any unacceptable practice; 2. Amend working methods if appropriate.
Action Level being exceeded for two or more consecutive samples	1. Identify source; 2. Inform ER; 3. Repeat measurements to confirm findings; 4. Increase monitoring frequency to daily; 5. Discuss with ER for remedial actions required; 6. If exceedance continues, arrange meeting with ER; 7. If exceedance stops, cease additional monitoring.	1. Discuss with Contractor on the mitigation measures; 2. Review proposals on mitigation measures submitted by Contractor and advise the ER accordingly; 3. Ensure agreed mitigation measures are fully implemented; 4. Assess the effectiveness of the implemented mitigation measures.	1. Confirm receipt of notification of failure in writing; 2. Notify Contractor; 3. Check monitoring data and Contractor's working methods; 4. Discuss with Environmental Supervisor and Contractor on potential remedial actions; 5. Ensure remedial actions properly implemented.	1. Submit proposals for remedial actions to ER within 3 working days of notification; 2. Implement the agreed proposals; 3. Amend proposal if appropriate.
Limit Level being exceeded for one sample	1. Identify source; 2. Inform EAT, ER and EPD; 3. Repeat measurement to confirm finding; 4. Increase monitoring frequency to daily; 5. Assess effectiveness of 6. Contractor's remedial actions; 7. Keep EPD and ER informed of the results.	1. Checking monitoring data submitted by EMT and Contractor's method; 2. Discuss with Contractor on the possible mitigation measures; 3. Review the proposed mitigation measures submitted by Contractor and advise the ER accordingly.	1. Confirm receipt of notification of failure in writing; 2. Notify Contractor; 3. Check monitoring data and Contractor's working methods; 4. Discuss with ENPO and Contractor potential remedial actions; 5. Ensure remedial actions properly implemented.	1. Take immediate action to avoid further exceedance; 2. Submit proposals for remedial actions to ER within 3 working days of notification; 3. Implement the agreed proposals; 4. Amend proposal if appropriate.
Limit Level being exceeded for two or more consecutive samples	1. Identify source; 2. Inform ER and EPD the causes & actions taken for the exceedances; 3. Repeat measurement to confirm findings; 4. Increase monitoring frequency to daily; 5. Investigate the causes of exceedance 6. Arrange meeting with EPD and ER to discuss the remedial actions to be taken; 7. Assess effectiveness of Contractor's remedial actions and keep EPD and ER informed of the results; 8. If exceedance stops, cease additional monitoring.	1. Checking monitoring data submitted by EMT and Contractor's method; 2. Discuss with Contractor on the possible mitigation measures; 3. Review the proposed mitigation measures submitted by Contractor and advise the ER accordingly; 4. Supervise the implementation of mitigation measures.	1. Confirm receipt of notification of failure in writing; 2. Notify Contractor; 3. Carry out analysis of Contractor's working procedures to determine possible mitigation to be implemented; 4. Discuss amongst ENPO and the Contractor potential remedial actions; 5. Review Contractor's remedial actions whenever necessary to assure their effectiveness; 6. If exceedance continues, consider what portion of the work is responsible and instruct the Contractor to stop that portion of work until the exceedance is abated.	1. Take immediate action to avoid further exceedance; 2. Submit proposals for remedial actions to ER within 3 working days of notification; 3. Implement the agreed proposals; 4. Resubmit proposals if problem still not resolved; 5. Stop the relevant portion of works as determined by the ER until the exceedance is abated.

2.2.9 Dust Mitigation Measures

2.2.9.1 The EIA report has recommended dust control mitigation measures to minimise the impacts. These are also summarised in the Implementation Schedule given in **Appendix A** of this Manual. The Contractor should be responsible for the design and implementation of these measures. If the recommended mitigation measures are not sufficient to restore the air quality to acceptable levels upon the advice of ENPO, the Contractor should liaise with the ENPO on some other mitigation measures, propose to ER for approval, and implement the mitigation measures.

2.2.9.2 In order to ensure that dust emission is minimised during the construction phase of the project, relevant dust control requirements set out in the *Air Pollution Control (Construction Dust) Regulation* should be met. The site agent is required to adopt dust reduction measures when carrying out construction works. In particular, the mitigation measures listed below should be adopted where applicable. With the implementation of effective dust control measures, adverse dust impacts from the construction works of the project is not expected.

2.2.9.3 Site clearance and demolition of existing structures

- The working area for the uprooting of trees, shrubs, or vegetation or for the removal of boulders, poles, pillars or temporary or permanent structures should be sprayed with water or a dust suppression chemical immediately before, during and immediately after the operation so as to maintain the entire surface wet; and
- All demolished items (including trees, shrubs, vegetation, boulders, poles, pillars, structures, debris, rubbish and other items arising from site clearance) that may dislodge dust particles should be covered entirely by impervious sheeting or placed in an area sheltered on the top and the 3 sides within a day of demolition.

2.2.9.4 Site boundary and entrance

- Vehicle washing facilities including a high pressure water jet should be provided at every discernible or designated vehicle exit point;
- The area where vehicle washing takes place and the section of the road between the washing facilities and the exit point should be paved with concrete, bituminous materials or hardcores; and
- Where a site boundary adjoins a road, street, service and or other area accessible to the public, hoarding of not less than 2.4m from ground level should be provided along the entire length of that portion of the site boundary except for a site entrance or exit.

2.2.9.5 Access road

- Every main haul road (i.e. any course inside a construction site having a vehicle passing rate of higher than 4 in any 30 minutes) should be paved with concrete, bituminous materials, hardcores or metal plates, and kept clear of dusty materials; or sprayed with water or a dust suppression chemical so as to maintain the entire road surface wet; and
- The portion of any road leading only to a construction site that is within 30m of a discernible or designated vehicle entrance or exit should be kept clear of dusty materials, say by means of suction sweepers.

2.2.9.6 Use of vehicle

- Immediately before leaving a construction site, every vehicle should be washed to remove any dusty materials from its body and wheels; and
- Where a vehicle leaving a construction site is carrying a load of dusty materials, the load should be covered entirely by clean impervious sheeting to ensure that the dusty materials do not leak from the vehicle.

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.