

2 AIR QUALITY

Introduction

- 2.1 In this section, the requirements, methodology, equipment, monitoring locations, criteria and protocols for the monitoring and audit of air quality impact during the construction phase of the Project are presented. As identified in the EIA report, the Project would not cause any adverse operational air quality impacts. Therefore, no environmental monitoring and audit is required during the operation phase. Odour emission was not identified during construction phase of the Project, and hence the following monitoring and audit requirement would only focus on the construction dust impact.
- 2.2 The objectives of the air quality monitoring are:
- to identify the extent of construction dust impact on sensitive receivers;
 - to determine the effectiveness of mitigation measures in controlling fugitive dust emission from activities during the construction phase;
 - to audit the compliance of the Contractor with regard to dust control, contract conditions and the relevant dust impact criteria;
 - to recommend further mitigation measures if found to be necessary; and
 - to comply with Action and Limit (A/L) Levels for air quality as defined in this Manual.

Air Quality Parameters

- 2.3 The ambient air quality criteria to be monitored and assessed are:
- The Hong Kong Air Quality Objectives (AQOs) for TSP, 24-hour TSP levels of $260 \mu\text{gm}^{-3}$; and
 - 1-hour TSP limit of $500 \mu\text{gm}^{-3}$.
- 2.4 These levels are not to be exceeded at Air Sensitive Receivers (ASRs).
- 2.5 Monitoring and audit of the TSP levels shall be carried out by the ET to detect any deteriorating air quality and to take timely action to rectify such situation.
- 2.6 1-hour and 24-hour TSP levels shall be measured to indicate the impacts of construction dust on air quality. The 24-hour TSP levels shall be measured by following the standard high volume sampling method as set out in the Title 40 of the United States Code of Federal Regulations, Chapter 1 (Part 50), Appendix B. Upon agreement from the ER and the IEC, 1-hour TSP levels can be measured by direct reading methods to indicate short event impacts.
- 2.7 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, other local atmospheric factors affecting or affected by site conditions and work progress of the concerned site etc. shall be recorded in detail. A sample data record sheet based on the one presented in the *EM&A Guidelines for Development Projects in Hong Kong*, is shown in [Appendix B](#). The ET Leader may modify the data record sheet for this EM&A programme, of which the format should be agreed by the ER and the IEC.

Monitoring Equipment

High Volume Sampler

- 2.8 High volume sampler (HVS) in compliance with the following specifications shall be used for carrying out the 1-hour and 24-hour monitoring:
- $0.6 - 1.7 \text{ m}^3$ per minute (20 - 60 standard cubic feet per minute) adjustable flow range;

- equipped with a timing / control device with ± 5 minutes accuracy for 24 hours operation;
- installed with elapsed-time meter with ± 2 minutes accuracy for 24 hours operation;
- capable of providing a minimum exposed area of 406 cm^2 ;
- flow control accuracy: $\pm 2.5\%$ deviation over 24-hour sampling period;
- equipped with a shelter to protect the filter and sampler;
- incorporated with an electronic mass flow rate controller or other equivalent devices;
- equipped with a flow recorder for continuous monitoring;
- provided with a peaked roof inlet;
- incorporated with a manometer;
- able to hold and seal the filter paper to the sampler housing at horizontal position;
- easy to change the filter;
- capable of operating continuously for 24-hour period.

2.9 The ET shall be responsible for the provision of the monitoring equipment. He shall provide sufficient number of HVSs with appropriate calibration kit for carrying out the baseline, regular impacts monitoring and ad-hoc monitoring. The HVSs shall be equipped with an electronic mass flow controller and be calibrated against a traceable standard at regular intervals. All the equipment, calibration kit, filter papers, etc, shall be clearly labelled.

2.10 Initial calibration of the dust monitoring equipment shall be conducted upon installation and prior to commissioning, and at bi-monthly intervals subsequently. The transfer standard shall be traceable to the internationally recognised primary standard and be calibrated annually. The calibration data shall be properly documented for future reference by the concerned parties such as the IEC. All the data shall be converted into standard temperature and pressure condition.

2.11 The flow-rate of the sampler before and after the sampling exercise with the filter in position shall be verified to be constant and be recorded on the data sheet as shown in [Appendix B](#).

Potable Dust Meter

2.12 If the ET proposes to use a direct reading dust meter to measure 1-hour TSP levels, he shall submit sufficient information to the ER and the IEC to prove that the instrument is capable of achieving a comparable result as that of the HVS before it may be used for the monitoring works. The instrument shall also be calibrated regularly, and the 1-hour sampling shall be determined periodically by HVS to check the validity and accuracy of the results measured by direct reading method.

Wind Velocity Logger

2.13 Wind data monitoring equipment shall also be provided by the ET and set up at conspicuous locations for logging wind speed and wind direction near to the dust monitoring locations. The equipment installation location shall be proposed by the ET and agreed with the ER in consultation with the IEC. For installation and operation of wind data monitoring equipment, the following points shall be observed:

- (i) The wind sensors shall be installed 10m above ground so that they are clear of obstructions or turbulence caused by the buildings;

- (ii) The wind data shall be captured by a data logger. The data shall be downloaded for analysis at least once a month;
- (iii) The wind data monitoring equipment shall be re-calibrated at least once every six months;
- (iv) Wind direction should be divided into 16 sectors of 22.5 degrees each.

2.14 In exceptional situations, the ET may propose alternative methods to obtain representative wind data upon approval from the ER and agreement from the IEC.

Laboratory Measurement / Analysis

- 2.15 A clean laboratory with constant temperature and humidity control and equipped with necessary measuring and conditioning instruments to handle the dust samples collected, shall be available for sample analysis, and equipment calibration and maintenance. The laboratory shall be HOKLAS accredited or other internationally accredited laboratory.
- 2.16 If a site laboratory is set up or a non-HOKLAS accredited laboratory is hired for carrying out the laboratory analysis, the laboratory equipment shall be approved by the IEC. Measurement performed by the laboratory shall be demonstrated to the satisfaction of the IEC.
- 2.17 The IEC shall conduct regular audit of the measurement performed by the laboratory so as to ensure the accuracy of measurement results. The ET shall provide the ER and the IEC with one copy of the Title 40 of the Code of Federal Regulations, Chapter 1 (Part 50), Appendix B for their reference.
- 2.18 Filter paper of size 8"x10" shall be labelled before sampling. It shall be a clean filter paper with no pinholes, and shall be conditioned in a humidity-controlled chamber for over 24-hour and be pre-weighed before use for the sampling.
- 2.19 After sampling, the filter paper loaded with dust shall be kept in a clean and tightly sealed bag. The filter paper shall then be 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 shall be regularly calibrated against a traceable standard.
- 2.20 All the collected samples shall be kept in a good condition for 6 months before disposal.

Monitoring Locations

2.21 The dust monitoring locations are shown in [Figure 2.1](#). The selected monitoring locations are the air sensitive receivers located closest to the Project. The proposed air quality monitoring locations are listed in **Table 2.1** below.

Table 2.1 Proposed Air Quality Monitoring Stations

Station	ASR ID (EIA Report)	Location
AM1	AS2	Government Dockyard (Offices)
AM2	AS4	Ngong Shuen Chau Barracks – Group 2

- 2.22 The status and locations of the air quality sensitive receivers may change after issuing this Manual. The ET shall propose updated monitoring locations and seek approval from EPD, and agreement from the ER and the IEC before baseline monitoring commences.
- 2.23 When alternative monitoring locations are proposed, the following criteria, as far as practicable, shall be followed:
 - (i) at the site boundary or such locations close to the major dust emission source;
 - (ii) close to the air sensitive receivers;

- (iii) proper position/sitting and orientation of the monitoring equipment; and
 - (iv) take into account the prevailing meteorological conditions.
- 2.24 The ET shall agree with the ER on the position of the HVS for installation of the monitoring equipment. When positioning the samplers, the following points shall be noted:
- (i) a horizontal platform with appropriate support to secure the samplers against gusty wind shall be provided;
 - (ii) no two samplers shall be placed less than 2 metres apart;
 - (iii) 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;
 - (iv) a minimum of 2 metres of separation from walls, parapets and penthouses is required for rooftop samplers;
 - (v) a minimum of 2 metres of separation from any supporting structure, measured horizontally is required;
 - (vi) no furnace or incinerator flue is nearby;
 - (vii) airflow around the sampler is unrestricted;
 - (viii) the sampler is more than 20 metres from the dripline;
 - (ix) any wire fence and gate, to protect the sampler, shall not cause any obstruction during monitoring;
 - (x) permission must be obtained to set up the samplers and to obtain access to the monitoring stations; and
 - (xi) a secured supply of electricity is needed to operate the samplers.

Baseline Monitoring

- 2.25 Baseline monitoring shall be carried out to determine the ambient 1-hour and 24-hour TSP levels at the monitoring locations prior to the commencement of the Project works. During the baseline monitoring, there shall not be any construction or dust generating activities in the vicinity of the monitoring stations. The baseline monitoring will provide data for the determination of the appropriate Action levels with the Limit levels set against statutory or otherwise agreed limits.
- 2.26 Before commencing the baseline monitoring, the ET shall inform the IEC of the baseline monitoring programme such that the IEC can conduct on-site audit to ensure accuracy of the baseline monitoring results.
- 2.27 Baseline monitoring shall be carried out 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. One-hour sampling shall also be done at least 3 times per day. Baseline monitoring shall be carried out under typical weather conditions. General meteorological conditions (wind speed, direction and precipitation) and notes regarding any significant adjacent dust producing sources shall also be recorded throughout the baseline monitoring period.
- 2.28 In case the baseline monitoring cannot be carried out at the designated monitoring locations during the baseline monitoring period, the ET Leader shall carry out the monitoring at alternative locations which can effectively represent the baseline conditions at the impact monitoring locations. The alternative baseline monitoring location shall be approved by the ER and agreed with the IEC.

- 2.29 In exceptional cases, when insufficient baseline monitoring data or questionable results are obtained, the ET Leader shall liaise with the ER, the IEC and EPD to agree on an appropriate set of data to be used as a baseline reference and submit to the ER and the IEC for agreement and EPD for approval.
- 2.30 Baseline checking of ambient TSP levels shall be carried out every three months at each monitoring location, when no dusty works activities are in operation. If the ET considers that significant changes in the ambient conditions have arisen, a repeat of the baseline monitoring may be carried out to update the baseline levels. The revised baseline levels, in turn, the air quality criteria, shall be agreed with the ER, EPD and the IEC.

Impact Monitoring

- 2.31 The ET shall carry out impact monitoring during the construction phase of the Project. For regular impact monitoring, a sampling frequency of at least once in every six-days shall be strictly observed at all of 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 shall be undertaken when the highest dust impact occurs.
- 2.32 Before commencing the impact monitoring, the ET shall inform the IEC of the impact monitoring programme such that the IEC can conduct on-site audit to ensure accuracy of the impact monitoring results.
- 2.33 The specific time to start and stop the 24-hour TSP monitoring shall be clearly defined for each location and be strictly followed by the field operator.
- 2.34 In case of non-compliance with the air quality criteria, more frequent monitoring, as specified in the Event and Action Plan in **Table 2.3**, shall be conducted within the 24 hours after the non-compliance is known. This additional monitoring shall be continued until the excessive dust emission or the deterioration in air quality is rectified.

Event and Action Plan

- 2.35 The baseline monitoring results form the basis for determining the air quality criteria for the impact monitoring. The ET shall compare the impact monitoring results with air quality criteria set up for 1-hour and 24-hour TSP. **Table 2.2** shows the air quality criteria, namely Action and Limit levels to be used. Should non-compliance of the air quality criteria occur, action in accordance with the Event and Action Plan in **Table 2.3** shall be carried out.

Table 2.2 Action and Limit Levels for Air Quality (Dust)

Parameter	Action Level ⁽¹⁾	Limit Level
24-hour TSP	BL ≤ 200 µg m ⁻³ , AL = (BL * 1.3 + LL)/2 BL > 200 µg m ⁻³ , AL = LL	260 µg m ⁻³
1-hour TSP	BL ≤ 384 µg m ⁻³ , AL = (BL * 1.3 + LL)/2 BL > 384 µg m ⁻³ , AL = LL	500 µg m ⁻³

Note: (1) BL = Baseline level, AL = Action level, LL = Limit level.

Table 2.3 Event and Action Plan for Air Quality (Dust)

EVENT	ACTION			
	ET	IEC	ER	CONTRACTOR
Action level being exceeded by one sampling	<ol style="list-style-type: none"> 1. Identify source and investigate the causes of exceedance; 2. Inform Contractor, IEC and ER; 3. Repeat measurement to confirm finding. 	<ol style="list-style-type: none"> 1. Check monitoring data submitted by ET; 2. Check Contractor's working method. 	<ol style="list-style-type: none"> 1. Notify Contractor. 	<ol style="list-style-type: none"> 1. Rectify any unacceptable practice; 2. Amend working methods if appropriate.
Action level being exceeded by two or more consecutive sampling	<ol style="list-style-type: none"> 1. Identify source and investigate the causes of exceedance; 2. Inform Contractor, IEC and ER; 3. Increase monitoring frequency to daily; 4. Discuss with IEC and Contractor on remedial actions required; 5. Assess the effectiveness of Contractor's remedial actions; 6. If exceedance continues, arrange meeting with IEC and ER; 7. If exceedance stops, cease additional monitoring. 	<ol style="list-style-type: none"> 1. Check monitoring data submitted by ET; 2. Check Contractor's working method; 3. Discuss with ET and Contractor on possible remedial measures; 4. Advise the ER on the effectiveness of the proposed remedial measures; 	<ol style="list-style-type: none"> 1. Confirm receipt of notification of exceedance in writing; 2. Notify Contractor; 3. In consolidation with the IEC, agree with the Contractor on the remedial measures to be implemented; 4. Supervise implementation of remedial measures; 5. Conduct meeting with ET and IEC if exceedance continues. 	<ol style="list-style-type: none"> 1. Discuss with ET and IEC on proper remedial actions; 2. Submit proposals for remedial actions to ER and IEC within three working days of notification; 3. Implement the agreed proposals; 4. Amend proposal if appropriate.
Limit level being exceeded by one sampling	<ol style="list-style-type: none"> 1. Identify source and investigate the causes of exceedance; 2. Inform Contractor, IEC, ER, and EPD; 3. Repeat measurement to confirm finding; 5. Assess effectiveness of Contractor's remedial actions and keep EPD, IEC and ER informed of the results. 	<ol style="list-style-type: none"> 1. Check monitoring data submitted by ET; 2. Check Contractor's working method; 3. Discuss with ET and Contractor on possible remedial measures; 4. Advise the ER on the effectiveness of the proposed remedial measures. 	<ol style="list-style-type: none"> 1. Confirm receipt of notification of exceedance in writing; 2. Notify Contractor; 3. In consolidation with the IEC, agree with the Contractor on the remedial measures to be implemented; 4. Supervise implementation of remedial measures; 5. Conduct meeting with ET and IEC if exceedance continues. 	<ol style="list-style-type: none"> 1. Take immediate action to avoid further exceedance; 2. Discuss with ET and IEC on proper remedial actions; 3. Submit proposals for remedial actions to ER and IEC within three working days of notification; 4. Implement the agreed proposals.
Limit level being exceeded by two or more consecutive sampling	<ol style="list-style-type: none"> 1. Notify IEC, ER, Contractor and EPD; 2. Repeat measurement to confirm findings; 3. Carry out analysis of Contractor's working procedures to identify 	<ol style="list-style-type: none"> 1. Check monitoring data submitted by ET; 2. Check Contractor's working method; 3. Discuss amongst ER, ET, and Contractor on the potential 	<ol style="list-style-type: none"> 1. Confirm receipt of notification of exceedance in writing; 2. Notify Contractor; 3. In consolidation with the IEC, agree with the Contractor on the remedial measures to be 	<ol style="list-style-type: none"> 1. Take immediate action to avoid further exceedance; 2. Discuss with ET, ER and IEC on proper remedial actions; 3. Submit proposals for remedial actions to IEC within three working

EVENT	ACTION			
	ET	IEC	ER	CONTRACTOR
	source and investigate the causes of exceedance; 4. Increase monitoring frequency to daily; 5. Arrange meeting with IEC, ER and Contractor to discuss the remedial actions to be taken; 6. Assess effectiveness of Contractor's remedial actions and keep EPD, IEC and ER informed of the results; 7. If exceedance stops, cease additional monitoring.	remedial actions; 4. Review Contractor's remedial actions whenever necessary to assure their effectiveness and advise the ER accordingly.	implemented; 4. Supervise implementation of remedial measures; 5. If exceedance continues, consider stopping the Contractor to continue working on that portion of work which causes the exceedance until the exceedance is abated.	days of notification; 4. Implement the agreed proposals; 5. Submit further remedial actions if problem still not under control; 6. Stop the relevant portion of works as instructed by the ER until the exceedance is abated.

Mitigation Measures

- 2.36 Mitigation measures for dust control have been recommended in the EIA Report. The Contractor shall be responsible for the design and implementation of these measures.
- 2.37 To comply with the guideline level and AQO at the ASRs, the good site practices and mitigation measures stipulated in the *Air Pollution Control (Construction Dust) Regulation* should be implemented to minimize construction dust impact. A number of practical measures are listed below:
- Vehicle washing facilities should be provided at every 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 hardcore;
 - Where a site boundary adjoins a road, streets or other areas accessible to the public, hoarding of not less than 2.4 m high from ground level should be provided along the entire length except for a site entrance or exit;
 - Use of regular watering, with complete coverage, to reduce dust emissions from exposed site surfaces and unpaved roads, particularly during dry weather.
 - Side enclosure and covering of any aggregate or dusty material storage piles to reduce emissions. Where this is not practicable owing to frequent usage, watering shall be applied to aggregate fines.
 - Open stockpiles shall be avoided or covered. Where possible, prevent placing dusty material storage piles near ASRs.
 - Tarpaulin covering of all dusty vehicle loads transported to, from and between site locations.
 - Imposition of speed controls for vehicles on unpaved site roads. A speed limit of 10km/hr is recommended.
 - Every stock of more than 20 bags of cement should be covered entirely by impervious sheeting placed in an area sheltered on the top and 3 sides;
 - Every vehicle should be washed to remove any dusty materials from its body and wheels before leaving the construction sites;
 - All dusty materials shall be sprayed with water prior to any loading, unloading or transfer operation so as to maintain the dusty material wet; and
 - Implementation of an environmental monitoring and audit program to monitor the construction process in order to enforce controls and modify method of work if dusty conditions arise.
- 2.38 The implementation schedule for the recommended air quality impact mitigation measures is presented in [Appendix A](#).