

**Brihanmumbai Municipal Corporation**



**Design and Build Contract**

**Construction of 45m wide Elevated Road from Link Road at Dahisar (West) in  
BMC limit to Bhayander (West) in MBMC limit (Coastal Road Last Leg)**

**Volume 7**

**Reference Documents**

**Section-2**

**OHS&E Document**

**Environmental Management**

**VOLUME 7-REFERENCE DOCUMENTS**

**SECTION 1-OCCUPATIONAL, SAFETY, HEALTH AND ENVIRONMENT**

**ENVIRONMENTAL MANAGEMENT**

## **STATEMENT OF INTENT**

Brihanmumbai Municipal Corporation firmly believes in a “development which meets the needs of the present without compromising the ability of future generations to meet their own needs”. This commitment towards sustainable development is manifested clearly in our corporate culture, as we continue to build a Dahisar-Bhayander Link road.

BMC intends to incorporate ISO 14001 standards in its construction. This commitment entails aggressive employment of methods and strategies during construction that maximize energy efficiency, use cleaner technologies, reuse and or recycle materials and similar other efforts that help to prevent and reduce environmental degradation.

It is the intent of BMC to demonstrate continual improvement in its environmental management system during the execution of the project.

This manual represents the minimum standards that Brihanmumbai Municipal Corporation will accept on matters of Environment. It lays down the guidance for environmental protection measures to be adopted as part of mitigation strategy for overcoming adverse environmental impacts during construction. It suggests environmental friendly construction practices that the Contractors are encouraged to adopt in order to contain various types of pollutants that may be generated due to construction activities.

Brihanmumbai Municipal Corporation actively supports the efforts and initiatives that are instigated by the Contractors and sub-contractors in their efforts for achieving good standards of Environment on the project. The Corporation will use its best endeavours to ensure that all of the Contractors employed on the Project achieve these Standards.

Chief Engineer/BMC

## **Construction of 45m wide Elevated Road from Link Road at Dahisar (West) in BMC limit to Bhayander (West) in MBMC limit (Coastal Road Last Leg)**

### **Environmental Policy**

We at Dahisar-Bhayander Link Road Project accord high priority to the protection of environment while building a road.

In this endeavour, we are committed to:

- ✓ Adopt environment friendly construction methods and practices so as to cause minimum inconvenience to public and protect ecological degradation.
- ✓ Create assets that are aesthetically appealing, optimise the use of energy and causing minimum impact on the environment.
- ✓ Conserve and enhance green cover through transplantation of trees and compensatory afforestation
- ✓ Make all efforts to create environmental awareness among our employees, Contractors and users.
- ✓ Strive for continual improvement in our environment policies, processes and procedures
- ✓ Comply with applicable local and National Environmental Legislations.

The above Environmental Policy is communicated to all employees for adherence and to be made available to interested persons/parties.

Date : ( )  
Place: Mumbai Additional Municipal Commissioner

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## 1 Introduction

Significant success has been made in India in developing and enforcing environmental regulations in many areas. However, there still remain a number of areas that have not yet seen the promulgation of environmental standards and regulations. Many of these areas have a high potential for adverse environmental impact if allowed to go unregulated. As the BMC undertakes to build this Dahisar-Bhayander Link Road it shall institute and enforce adequate environmental standards to provide for the protection of the people and the environment.

In response, the Contractor shall comply with all applicable Indian laws and regulations to mitigate the adverse environmental impacts from the construction activities. The Contractor shall conduct an analysis of the environmental impacts, and implement suitable measures to mitigate the adverse impacts so as to comply with all the environmental standards & regulations. All appropriate categories/areas, such as air quality, noise, water quality, etc. are to be considered in the environmental analysis. The Contractor will have to undertake Environmental Monitoring, Audit, Compliances of the Approval granted by the MoEFCC and Hon High Court during construction to measure the environmental impacts. The Contractor shall require to review and implement effective measures so as to ensure that the impact of the construction works will not exceed the respective limits set forth in the EIA report.

The Contractor shall prepare the Environment Impact Assessment Report (EIA) for the project along with the Environment Management Arrangement (EMA) for the project appraisal and implement it.

The Contractor shall be responsible for the total compliance of the Environmental Protection safeguards as elaborated in this Environmental Management Arrangements.

- 1.1 The 'Environmental Management Arrangements' (EMA) document forms an essential part of the overall Environmental protection system employed by BMC for the construction of the Road.
- 1.2 The EMA has been prepared to facilitate construction progress while ensuring fulfilment of environmental commitments. It provides systematic procedures for monitoring and minimizing environmental impacts that may arise from the construction activities.
- 1.3 The EMA will apply to all construction works of the road carried out by the Contractors and Sub-contractors.
- 1.4 The primary reason for adopting the EMA approach is to make the Contractor aware of his environmental responsibilities and to ensure his commitment to achieving the specified standards.
- 1.5 The BMC EMA is meant to be a living document that will be updated as design and construction progresses and when further environmental issues are identified.
- 1.6 Periodic reviews of the plan and procedures will be performed to ensure continual improvement of the Plan's adequacy and it will be expanded and updated during the project

duration.

1.7 Because the work potentially involves design-build contracts, this EMA is intended to be flexible and tailored to match highly variable construction activities and locations throughout the project.

1.8 The EMA is set out as follows:

- Section 2 highlights the purpose and scope
- Section 3 outlines the objective, which will form a basis for Environmental Management System
- Section 4 lists the definitions and abbreviation of terms used
- Section 5 sets out the responsibilities for application of the procedures
- Section 6 provides guidance to the Contractor for preparation of his contract specific Site Environmental Plan
- Section 7 commits the Contractor's Method Statement to incorporate environmental issues during execution of works
- Section 8 focuses on the Environmental Performance Review of Contractor's activities through Environmental Audits
- Section 9 details measures to contain Air, Water, and Noise Pollution and management of waste through Environmental Friendly Construction Practices
- Section 10 specifies good Housekeeping measures
- Section 11 is on Landscape and Aesthetics
- Section 12 suggests measures to conserve energy through effective Energy Management
- Section 13 deals with Traffic Management
- Section 14 focuses on requirements that the Contractor shall have to meet in case Archaeological and Historic Resources are encountered
- Section 15 on Environmental Monitoring - lists the relevant monitoring equipment, compliance criteria and monitoring programme to be undertaken by the Contractor during construction
- Section 16 details requirements for impact monitoring for air quality including Air Monitoring and Control Plan
- Section 17 details requirements for impact monitoring for noise including Noise Monitoring and Control Plan
- Section 18 describes the Environmental Site Inspection process to be implemented by the Contractor
- Section 19 details the Environmental Audits, which the Engineer may undertake as part of environmental performance review
- Section 20 details the Reporting requirements as related to submission of Contractor's Monthly Environmental Management Report under this EMA
- Section 21 sets out the Complaint response process and finally,
- Section 22 mentions the requirements of Completion of the EMA programme

## **2 Purpose & Scope**

- 2.1 The purpose of this Environmental Management Arrangements is to make the Contractors aware of the environmental concerns of BMC, and to establish guidelines for the application of environmental controls during the construction of the project.
- 2.2 The Environmental Management Arrangements is intended to translate into practice, three important principles of BMC's mandate, which the construction activities should not:
  - .. Inconvenience or endanger public
  - .. Create a permanent visual eyesore
  - .. Result in unmitigated ecological or environmental degradation specially mangrove.
- 2.3 The EMA is intended to guide and assist the Contractors in exploring all reasonable and feasible means for reducing construction related environmental impacts as they prepare and produce contract-specific Aspect / Impact Assessments and Site Environmental Plans.
- 2.4 The EMA stipulates environmental controls that in lieu of alternative controls specified by the Contractor must be applied.
- 2.5 Environmental controls adopted by the individual contractors as an alternative to the measures identified herein must be as protective of the environment.
- 2.6 The scope of the EMA is to establish procedures to:
  - .. Supervise Contractor's compliance with defined environmental control criteria by carrying out reviews of monitored impact data
  - .. Oversee the procedure for identification of mitigation measures, their design and implementation
  - .. Carry out environmental monitoring emissions during construction through an impact monitoring programme
  - .. Undertake additional ad hoc monitoring if required, to address specific instances

## **3 Objective**

- 3.1 The various components included in the EMA along with the Engineer requirements on Environment will form the basis of an Environmental Management System to be implemented by BMC, which will enable it to manage the environmental challenges and resolve environmental issues posed during construction of Dahisar-Bhayander Road Project.
- 3.2 The main objectives are to:
  - .. Provide database from which environmental impacts of the project can be determined.
  - .. Provide timely indication if any environmental control measure fails to achieve desired results.



- .. Monitor effectiveness of environmental mitigation measures
- .. Initiate remedial action if unacceptable impacts arise.
- .. Determine contractor's compliance with statutory and legal requirement

#### 4 Definitions & Abbreviations

- 4.1 **Air Monitoring and Control Plan** is abbreviated as AMCP.
- 4.2 **Auditor:** Person with the competence to conduct an audit.
- 4.3 **A – Weighted** Noise levels in Decibels (referenced to 20 micro-Pascal) as measured with A - weighting network of standard sound level meter, abbreviated dB(A).
- 4.4 **Central Pollution Control Board**, New Delhi is abbreviated as CPCB.
- 4.5 **Continual improvement:** Recurring process or enhancing the environmental management system in order to achieve improvements in overall environmental performance consistent with the organization's environmental policy.
- 4.6 **Corrective action:** Action to eliminate the cause of a detected nonconformity.
- 4.7 **Decibel** is measure on a logarithmic scale of the magnitude of a particular quantity (such as sound pressure, sound power) with respect to a standardized reference quantity.
- 4.8 **Document:** Information and its supporting medium.
- 4.9 **Energy Equivalent Level ( $L_{eq}$ )** is the level of a steady noise which has the same energy as the fluctuating noise level integrated over the period of measurement.  $L_{max}$  is the maximum Noise Level during the period of measurement.  $L_{10}$  and  $L_{90}$  are the percentile exceeding levels of sound which are exceeded 10% and 90% of the time of measurement.
- 4.10 **Environmental Pollutant** means any solid, liquid or gaseous substance present in such concentration as may be or tend to be injurious to environment.
- 4.11 **Environmental Pollution** means the presence in the environment of any environmental pollutant.
- 4.12 **Environment:** Surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation.
- 4.13 **Environmental Aspect:** Element of an organization's activities or products or services that can interact with the environment.
- 4.14 **Environmental Impact:** Any change to the environment whether adverse or beneficial, wholly or partially resulting from an organization's environmental aspects.
- 4.15 **Environmental Management Manual** is abbreviated as EMM.
- 4.16 **Environmental Management System:** Part of an organization's management system used to develop and implement its environmental policy and manage its environmental aspects.
- 4.17 **Environmental Objective:** Overall environmental goal, consistent with the environmental policy that an organization sets itself to achieve.
- 4.18 **Environmental Performance:** Measurable results of an organization's management of its

environment aspects.

- 4.19 **Environmental Policy:** Overall intentions and direction of an organization related to its environmental performance as formally expressed by top management, under signature.
- 4.20 **Environmental Target:** Detailed performance requirement applicable to the organization or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
- 4.21 **Interested Party:** Person or group concerned with or affected by the environmental performance of an organization.
- 4.22 **Internal audit:** Systematic, independent and documented process for obtaining audit evaluating it objectively to determine the extent to which the environmental management system audit criteria set by the organization are fulfilled.
- 4.23 **Ministry of Environment and Forest and Climate Change** , Government of India is abbreviated as MoEFCC.
- 4.24 **Monitoring** is the use of direct or indirect reading field instrumentation to provide information regarding the levels of pollutants released during construction.
- 4.25 **Noise** is any unwanted sound disturbance of the environment around the area of construction operations.
- 4.26 **Noise Monitoring and Control Plan** is abbreviated as NMCP.
- 4.27 **Nonconformity:** Non-fulfilment of a requirement.
- 4.28 **Nuisance** is annoyance, which results from any construction activity that affects the material comfort and quality of life of the inhabitants of the area surrounding the construction site.
- 4.29 **Organization:** Company, corporation, firm, enterprise, authority or institution, or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administration. It also includes the Contractor executing the BMC contract of Dahisar-Bhayander Road Project.
- 4.30 **Preventive Action:** Action to eliminate the cause of a potential nonconformity.
- 4.31 **Prevention of pollution:** Use processes, practices, techniques, materials, products, services or energy to avoid, reduce or control the creation, emission or discharge of any type of pollutant or waste, in order to reduce adverse environmental impacts.
- 4.32 **Procedure:** Specified way to carry out an activity or a process.
- 4.33 **Record:** Document stating results achieved or providing evidence of activities performed.
- 4.34 **Respirable Particulate Matter** is abbreviated as RPM and is particulate matter with size less than 10  $\mu\text{m}$  and is measured in  $\mu\text{g}/\text{m}^3$ (microgram per cubic meter)
- 4.35 **Suspended Particulate Matter** is abbreviated as SPM and measured in  $\mu\text{g}/\text{m}^3$ (microgram per cubic meter)
- 4.36 **Site Environmental Plan:** A document prepared by the Contractor that contains detailed

procedures on implementing the Engineer requirements on Environment.

- 4.37 **Usage factor:** Expressed as the percent of time that the equipment is operated at full power while on site.
- 4.38 **Waste** is unwanted surplus substance arising from the application of all construction operations and any substance or articles, which is required to be disposed.

## 5 Responsibilities

- 5.1 The Contractor shall set up an environmental team to execute the environmental requirements, and Prepare the Environment Management Plan (EMP) for Execution on the Site. The said plan shall be approved by the BMC.
- 5.2 The duties of the Contractor's Environmental Team will include (but not limited to):
- To monitor the various environmental parameters as required by the EMA
  - To inspect, investigate and audit the work methodology with respect to environmental mitigation and control
  - To anticipate environmental issues before they arise and plan for their mitigation
  - To audit and prepare audit reports, weekly/monthly reports on site environmental conditions for submission to the Engineer.
- 5.3 Reporting to the Engineer, the Contractor shall
- Work within the scope of contract and other tender condition.
  - Operate and strictly adhere to the requirements of his contract specific-SEP
  - Undertake any corrective actions as instructed by his Environmental Manager
- 5.4 To lead his Environmental team, the Contractor shall deploy an Environment Manager who shall be responsible for environmental control, pollution monitoring, and record keeping and be available to the Engineer for resolution of environmental issues.

## 6 Site Environmental Management Plan

- 6.1 To effectively implement monitoring, mitigation and remedial requirements, an appropriate contractual and supervisory framework needs to be established.
- 6.2 The basis of framework within which implementation will be managed is through the preparation of contract-specific Site Environmental Management Plan by the Contractor. The Engineer will audit this contract-specific plan and advise the necessary remedial actions required through contractual means.
- 6.3 The Site Environmental Management Plan shall provide details of the means by which the Contractor (and all subcontractors working for the Contractor) will implement the recommended mitigation measures and achieve the environmental performance standards defined both in Indian environmental legislation and in the Engineer's requirements.

- 6.4 Contractor shall prepare a Site Environmental Plan for submission as part of the tender process.
- 6.5 The outline Environmental Management Plan shall demonstrate the determination and commitment of Contractor's organisation towards environment and indicate how the environmental performance requirements laid out in the Engineer's requirements will be met and, where appropriate exceeded.
- 6.6 Within 28 days of the date of Notice to proceed, the Contractor shall submit a draft contract – specific Site Environmental Management Plan for Notice to proceed of the Engineer and a final version prior to the commencement of the works.
- 6.7 The contract-specific Site Environmental Management Plan will contain description of all procedures developed to control environmental pollution. Elements of the plan must address the management of pollution, the monitoring programme, and the reporting requirements.
- 6.8 The Site-Specific Environmental Management Plan shall contain an Aspect Impact register together with outline proposals/procedure for mitigating negative impacts.

## **7 Contractor's Method Statement**

- 7.1 It shall be the practice for the Contractor to prepare method Statement in advancement of actual works, for the Notice to proceed of the Engineer.
- 7.2 The Contractor's Environmental Manager will be one of the signatories to the Method Statement, after assessing and verifying the environmental impact of the prepared construction activity and ensuring that effective control measures will be in place, timely

## **8 Environmental Performance Reviews**

- 8.1 Environmental Performance Reviews, through an Environmental Audit Programme, may be carried out quarterly by the Engineer to assess the effectiveness of the Site Environmental Plan, and that the required mitigation measures are routinely implemented and environmental standards are maintained.
- 8.2 The preliminary objective of the audit programme will be to assess the effectiveness of management systems established by the Contractor to implement the environmental mitigation measures.
- 8.3 The reviews by Engineer shall focus on the effectiveness of the implemented measures to achieve the purpose not simply the fact that a measure has been implemented.
- 8.4 In such reviews, demonstrable evidence on the part of the environmental requirements will be sought.
- 8.5 The Contractor shall carry out daily, environment inspection of his works and submit a weekly report
- 8.6 The Contractor shall ensure that his weekly/monthly environmental reports and mandating audits are linked to respective previous submission. The Engineer will ensure that this procedure is followed by the institution of a monitoring and reporting system that provides

information about the environmental performance of the construction Contractor throughout the duration of the contract.

- 8.7 The Engineer will monitor Contractor's performance of tasks specified, and will inspect necessary records, reports and procedures as defined in this manual.

## **9 Environmentally Friendly Construction Practices**

### **9.1 Containment of Air Pollution**

#### **9.1.1 During Transport of Material**

- (a) The Contractor shall take precautions to minimise visible particulate matter from being deposited upon public roadways as a direct result of his operations. Precautions include removal of particulate matter from equipment before movement to paved streets or prompt removal of material from paved streets onto which such material has been dropped.
- (b) All construction equipment should be washed clean of visible dirt/mud before exiting the construction sites. Any deposition of material on public streets by construction equipment should be removed by manual sweeping, or by deploying electro – mechanical devices.
- (c) The Contractor shall provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from work sites such as construction depots and batching plants. At such facility, high-pressure water jets will be directed at the wheels of vehicles to remove all spoil and dirt. Water shall be pumped through an electrically operated pump set, to hydrants attached with rubber hoses, by activation of push button located at the hydrant, allowing for up to 10 minutes of wash time.
- (d) Wheel washing facilities will be provided with efficient drainage, incorporating silt traps to prevent any excessive build up of water. These facilities could include water re-circulation apparatus to minimise water consumption. At the wheel wash facility, water, dirt, gravel etc. shall be drained into precast trench drains with removable grated cover. This dirty water shall flow, through a piping, into solids separator and from there to oil separator before final discharge.
- (e) Where wheel-washing facility is not possible, the Contractor shall ensure manual cleaning of wheels by wire brushes or similar suitable means.
- (f) The Contractor shall ensure that vehicles with an open load carrying area used for moving potentially dust-producing materials shall have properly fitting side and tailboards. Materials having the potential to create dust shall not be loaded to a level higher than the side and tail boards, and shall be carried in vehicles fitted with covers.

#### **9.1.2 At Dumping Sites**

- (a) The Contractor shall place excavated materials in the dumping/disposal
- (b) The Contractor shall place material in a manner that will minimise dust production.

Material shall be stabilised each day by watering or other accepted dust suppression techniques.

- (c) The heights from which materials are dropped shall be the minimum practical height to limit fugitive dust generation.
- (d) The Contractor shall stockpile material in the designated and approved locations with suitable slopes. Access to the site shall be regulated for entry of men, material and machine.
- (e) During dry weather, dust control methods such as water sprinkling must be used daily especially on windy, dry days to prevent any dust from blowing and causing nuisance. During rains, the stockpile may be covered with tarpaulin or similar material to prevent run off.
- (f) The Contractor shall provide water sprinkling at any time that it is required for dust control use.
- (g) Sufficient equipment, water, and personnel shall be available on dumping sites at all time to minimise dust formation and movements to prevent nuisance.
- (h) Dust control activities shall continue even during work stoppages.

### **9.1.3 At Construction Site**

- (a) At each construction site, the Contractor shall provide storage facilities for dust generating materials and shall be closed containers/bins or wind protected shelters or mat covering or walled or any combination of the above to the satisfaction of the Engineer. The Contractor shall spray water at construction sites as required to suppress dust, during handling of excavation soil or debris or during demolition.
- (b) Stockpiles of sand and aggregate greater than 20m<sup>3</sup> for use in concrete manufacture shall be enclosed on three sides, with walls extending above the stockpile and two (2) metres beyond the front of the stockpile.
- (c) Effective water sprays shall be used during the delivery and handling of all raw sand and aggregate and other similar materials, when dust is likely to be created and to dampen all stored materials during dry and windy weather.
- (d) Areas within the Site such as construction depots and batching plants, where there is a regular movement of vehicles shall have an approved hard surface that is kept clear of loose surface material.
- (e) Unless the Engineer has given notice otherwise, the Contractor shall restrict all motorised vehicles on the Site to a maximum speed of 15 kilometres per hour and confine haulage and delivery vehicles to the designated roadways inside the site.
- (f) At the Batching plant the following additional conditions shall be complied with:
  - The Contractor shall undertake at all times the prevention of dust nuisance as a result of his activities.

- .. The Contractor shall frequently clean and water the concrete batching plant and crushing plant sites and ancillary areas to minimise any dust emission.
- (g) The Contractor shall erect hoardings as specified in Engineer requirements – construction, securely around all construction work sites during the main construction activity, to contain dust within the site area and also to reduce air turbulence caused by passing traffic. The hoarding shall be safely secured to the ground to prevent from toppling with minimum gap between the base of hoarding and ground surface.

#### **9.1.4 During Drilling and Blasting**

- (a) Water spray should be used to control dust during breaking of rock/concrete.
- (b) During blasting operations, appropriate precautions should be taken to minimise dust such as the use of blast nets, canvas covers and watering.
- (c) Wire mesh made of heavy-duty tyres or sand bags should be used over blast area on each shot to prevent flying rock and reduce dust.
- (d) Blasting technique should be consistent not only with nature and quantity of rock to be blasted but also the location of blasting.
- (e) The Contractor shall give due preference to explosives with better environmental characteristics.
- (f) Vibration shall be monitored during blasting and values shall not exceed as those given in this Environmental Management Manual

#### **9.2 Containment of Water Pollution**

- (a) The Contractor shall comply with the Indian Government legislation and other State regulations in existence in Mumbai in so far as they relate to water pollution control and monitoring.
- (b) The Contractor shall provide adequate precautions to ensure that no spoil or debris of any kind is pushed, washed, falls or deposited on land adjacent to the site perimeter.
- (c) In the event of any spoil or debris from construction works being deposited on adjacent land any silt washed down to any area, then all such spoil, debris or material and silt shall be immediately removed and the affected land and areas restored to their natural state by the Contractor to the satisfaction of the Engineer.
- (d) At construction depots and batching plants temporary drainage works should be maintained, removed and reinstated as necessary and all other necessary precautions should be taken for avoidance of damage by flooding and silt.
- (e) Sedimentation tanks or other acceptable measures, of sufficient capacity to trap silt-laden water before discharge into the outlet drain should be provided. The system should be flexible and be able to handle multiple inputs from a variety of sources.
- (f) Temporary open storage of excavated materials meant for backfilling on site, should be

covered with tarpaulin or similar fabric during rainy season or at any time of the year when rainstorms are likely. Washout of construction or excavated materials should be diverted to drainage system through appropriate sediment traps.

- (g) Bentonite slurries or other grouts used in diaphragm wall construction piling and other concrete works should be collected in a separate slurry collection system. If reuse is not practicable then it should be disposed off at nearest landfill site after obtaining permission from the agency owning the landfill and under the conditions imposed by the agency concerned. .
- (h) Due to lowering of potable water supplies in Mumbai and subsequent contamination of ground water, the Contractor is not allowed to discharge water from the site without the Notice to proceed of the Engineer. The Contractor must comply with the requirements of the Central Ground Water Board for discharge of water arising from dewatering. Any water obtained from dewatering systems installed in the works must be either re-used for construction purposes and this water may subsequently be discharged to the drainage system or, if not re-used, recharged to the ground water at suitable aquifer levels. The Contractor must submit his proposals for Notice to proceed of Engineer, on his proposed locations of dewatering of excavation and collection of water for either construction re-use or recharge directly to aquifers. The Contractor's recharge proposals must be sufficient for recharging of the quantity of water remaining after deduction of water re-used for construction. The Contractor will not be permitted to directly discharge, to the drainage system, unused ground water obtaining from the excavation without obtaining Notice to proceed from the Agency controlling the system.
- (i) The Contractor shall prevent soil particles and debris from entering the wells or water discharge points by use of filters and sedimentation basins as required.
- (j) The Contractor shall provide treatment facilities as necessary to prevent the discharge of contaminated ground water.
- (k) 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.
- (l) The Contractor shall discharge wastewater arising from site offices, canteens or toilet facilities constructed by him into sewers after obtaining prior Notice to proceed of agency controlling the system. A wastewater drainage system shall be provided by the Contractor to drain wastewater into the sewerage system.
- (m) Oil separator/interceptors shall be provided at Batching Plant and construction depot location for vehicle maintenance to prevent the release of oils and grease into the drainage system. These shall be cleaned on a regular basis.
- (n) A Spill Prevention and Control Procedure shall be prepared to identify project components such as storage areas, storage tanks that could allow discharge of oil grease or hazardous materials to the drainage system or ultimately in any water body during



spillage. The volume of spill should be calculated as well as storage volume to contain spill within the materials storage containment areas. The procedure shall include measures to contain and mitigate transportation of oil, grease or hazardous materials to the drainage system or any water body.

- (o) The Contractor shall ensure that earth, bentonite, chemicals and concrete agitator washings etc. are not deposited/drained in the watercourses but are suitably treated and effluents and residue disposed off in a manner approved by local Regulatory Authorities.
- (p) Perimeter channels/drains should be constructed in advance of site formation works and earthworks. Silt removal facilities, channels and manholes should be maintained and the deposited silt and grit should be removed regularly, to ensure that these facilities are functioning properly at all times.
- (q) Construction works should be programmed to minimize soil excavation works in rainy season. If excavation in soil could not be avoided in these months or at any time of year when rains are likely, for the purpose of preventing soil erosion, temporarily exposed slope surfaces should be covered e.g. by tarpaulin, and temporary access roads should be protected by crushed stone or gravel, as excavation proceeds. Arrangement should always be in place to ensure that adequate surface protection measures can be safely carried out well before the arrival of rains.
- (r) Measures should be taken to minimize the ingress of rainwater into trenches. If excavation of trenches in wet seasons is necessary, they should be dug and backfilled in short sections. Rainwater pumped out from trenches or foundation excavation should be discharged into storm drains via silt removal facilities.
- (s) Open stockpiles of construction materials (e.g. aggregates, sand and fill material) on sites should be covered with tarpaulin or similar fabric during rainstorms. Measures should be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system.
- (t) Manholes (including newly constructed ones) should always be adequately covered and temporarily sealed so as to prevent silt, construction materials or debris from getting into the drainage system, and to prevent storm run-off from getting into sewers. Discharge of surface run-off into sewers must always be prevented in order not to unduly overload the sewerage system.
- (u) Groundwater pumped out of wells, etc. for the lowering of ground water level in basement of foundation shall be discharged into storm water drains after the removal of silt in silt removal facilities.
- (v) Wastewater from Concrete Batching & Precast Concrete Casting and that generated from the washing down of mixer trucks and drum mixers and similar equipment should wherever practicable be recycled. The discharge of wastewater should be kept to a minimum.

- (w) The section of construction road between the wheel washing bay and the public road should be paved to reduce vehicle tracking of soil and to prevent site run-off from entering public road drains.
- (x) Surface run-off should be segregated from the concrete batching plant and casting yard area as much as possible and diverted to the storm water drainage system. Surface run-off contaminated by materials in a concrete batching plant or casting yard must be treated to, within the discharge norms before disposal into storm water drains.

### **9.3 Containment of Noise**

- (a) Construction of facilities and structures would require the use of equipment, which may generate high noise levels and adversely affect noise sensitive receivers.
- (b) In assessing the impact of construction noise and hence its containment, the nature and level of activities that generate noise, the pathway through which noise travels, the sensitivity of the receptor, and the period of exposure should be considered.
- (c) Environmental noise is measured in decibels (dB). To better approximate the range of sensitivity of the human ear to sounds of different frequencies, the A-weighted decibel scale (dBA) was devised. As the human ear is less sensitive to low frequency sounds, the A-scale de-emphasizes these frequencies by incorporating frequency weighting of the sound signal. When the A-scale is used, the decibel levels are represented by dBA.
- (d) On this scale, the range of human hearing extends from about 3 dBA to about 140 dBA. A 10-dBA increase is judged by most people as a doubling of the sound level.
- (e) To the extent required to meet the noise limits the Contractor shall use reasonable efforts to include noise reduction measures listed below to minimize construction noise emission levels. Noise reduction measures – include, but not limited to the following:
  - (i) Minimize the use of impact devices, such as jackhammers, and pavement breakers. Where possible, use concrete crushers or pavement saws for tasks such as concrete deck removal and retaining wall demolition.
  - (ii) Equip noise producing equipment such as jackhammers and pavement breakers with acoustically attenuating shields or shrouds recommended by the manufacturers thereof, to meet relevant noise limitations.
  - (iii) Pneumatic impact tools and equipment used at the construction site shall have intake and exhaust mufflers recommended by the manufacturers thereof, to meet relevant noise limitations.
  - (iv) Provide mufflers or shield panelling for other equipment, including internal combustion engines, recommended by manufacturers thereof.
  - (v) Employ prefabricated structures instead of assembling on-site.
  - (vi) Use construction equipment manufactured or modified to dampen noise and vibration

emissions, such as:

- Use electric instead of diesel-powered equipment.
  - Use hydraulic tools instead of pneumatic impact tools.
- (f) Maximize physical separation, as far as practicable, between noise generators and noise receptors. Separation includes following measures:
- Provide enclosures for stationary items of equipment and barriers around particularly noisy areas on site.
  - Locating stationary equipment in such a way, so as to minimize noise and vibration impact on community.
- (g) To the extent feasible, configure the construction site in a manner that keeps noisier equipment and activities as far as possible away from noise sensitive locations and nearby buildings. Plant and equipment known to emit noise strongly in one direction should where possible, be oriented in a direction away from noise sensitive receptor and reduce the number of plant and equipment operating in critical areas close to noise sensitive receptors.
- (h) Scheduling truck loading, unloading, and hauling operations in such a way so as to minimize noise impact near noise sensitive locations and surrounding communities.
- (i) Minimize noise intrusive impacts during most noise sensitive hours by adopting the following.
- Plan noisier operations during times of highest ambient noise levels.
  - Keep noise levels relatively uniform; avoid excessive and impulse noises.
- (j) Equipment and plant are not to be kept idling when not in use.
- (k) Use only well maintained plant/equipment at site, which should be serviced regularly.
- (l) Maintain equipment such that parts of vehicles and loads are secure against vibrations and rattling.
- (m) Grading of surfaced irregularities on construction sites to prevent the generation of impact noise and ground vibrations by passing vehicles.
- (n) Schedule work to avoid simultaneous activities that generate high noise levels. (o) The construction of temporary noise barriers.
- (p) If back-up alarms are used on construction equipment, their noise emission level near noise sensitive receptors such as residences, schools, hospitals and similar areas where calmness is essential, should be regulated, especially at night time.
- (q) Select truck routes for muck disposal so that noise from heavy-duty trucks will have minimal impact on sensitive areas (e.g., residential) and submit to the Engineer for Notice to proceed:
- Conduct truck loading, unloading and hauling operations in a manner such that noise and vibration are kept to a minimum.

- Route construction equipment and vehicles carrying soil, concrete or other materials over streets and routes that will cause least disturbance to residents in vicinity of work.
  - Avoid operating truck on streets that pass by schools during school hours.
- (r) The maximum permissible sound pressure level for new generator sets (up to 1000 KVA) run on diesel, shall be 75 dB(A) at one metre from the enclosure surface.
- (s) For existing diesel generator sets, the noise from the DG set shall be controlled by providing an acoustic enclosure or acoustic treatment of the room for DG sets. Such acoustic enclosures/acoustically treated rooms, shall be so designed for minimum 25 dB(A) insertion loss or for meeting the ambient noise standards, whichever is on higher side.

#### **9.4 Containment of Waste**

- (a) Careful design, planning and good site management can minimise waste of materials such as concrete, mortars and cement grouts. The Contractor shall ensure regular maintenance and cleaning of the waste storage areas.
- (b) Construction activities are expected to generate a variety of waste such as:
- (i) General refuse
  - (ii) Construction Waste including waste from excavated material
  - (iii) Chemical waste and
  - (iv) Hazardous waste
- (c) Handling and disposal of such waste may cause environmental degradation and nuisance. To prevent it, such waste has to be handled and disposed properly. As such, transportation and disposal of all waste shall be strictly managed.
- (d) General Refuse
- (i) Each worksite would generate general refuse including paper and food waste. There is likely to be a concentration of such waste at batching plants on major worksite. The storage of general refuse has the potential to give rise to negative environmental impacts.
  - (ii) Handling and disposal of general refuse should cope with the peak construction workforce during the construction period. The refuse should be stored and transported in accordance with good practice and disposed at licensed landfills
  - (iii) General refuse should be stored in enclosed bins or units and has to be separated from construction and chemical wastes. An authorised waste collector should be employed by the Contractor to remove general refuse from the site, on a daily basis to minimise odour, pest and litter impacts.
- (e) Construction Waste

- (i) Construction Waste would mainly arise from the project construction activities and from the demolition of existing structures where necessitated. It includes unwanted materials generated during construction, rejected structures and materials, materials that have been over-ordered and materials, which have been used and discarded such as:
- Material and equipment wrapping packaging material
  - Unusable/surplus concrete/grouting mixes
  - Damaged/contaminated/surplus construction materials; and
  - Wood from formwork and false work.
- (ii) Also, demolition of buildings and houses to accommodate station buildings and construction depots will generate concrete rubble, plastics, metal, glass, asphalt from surfaces, wood and refuse.
- (iii) Waste from excavation would comprise soil, rubble, sand, rock, brick etc.
- (iv) It is estimated that construction activities used generate  $2.5\text{mm}^3$  of soil, majority of which will be used for filling purpose.
- (f) Chemical Waste
- (i) Chemical waste is likely to be generated by construction and maintenance activities.
- For those processes, which generate chemical waste, it may be possible to find alternatives, which generate reduced quantities or even no chemical waste, or less dangerous types of chemical waste.
- (ii) The contractor should explore the possibilities given in (i) above and produce evidence of acceptable disposal methods (e.g., waste transfer) to the Engineer.
- (iii) Containers used for the storage of chemical waste should:
- Be suitable for the substances they are holding, resistant to corrosion, maintained in good condition, and securely closed.
  - Be of adequate capacity and
  - Display a label in English and local language as to the contents, quantity and safe method of disposal in accordance with instructions contained in MSDS.
- (iv) The storage area for chemical waste should:
- Be clearly labelled and used solely for the storage of chemical waste;
  - Be enclosed on at least three sides;
  - Have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is higher
  - Have adequate ventilation;
  - Be covered to prevent rainfall entering and
  - Be arranged so that incompatible materials are adequately separated.

- (v) Disposal of chemical waste should be through a licensed waste collector, duly authorized by MoEF or State Pollution Control Board as the case may be. License of the waste collector shall be shown to the Engineer on demand.
  - (vi) The Contractor should maintain an inventory of chemicals, solvents and adhesives. He should minimise disposal of excess material, reuse when applicable and dispose of chemical waste properly. He should prepare a plan that identifies proper ventilation, protected clothing and personal protective equipment.
  - (vii) The Contractor should have a point of contact, who will maintain the above information and also conducts periodic inspections.
- (g) Hazardous Waste
- (i) Classification of waste as Hazardous shall be in accordance with Hazards Waste (Management & Handling) Rules 1989, and 2003 or its latest amendment.
  - (ii) The Contractor shall identify all the hazardous waste generated as a result of his activities. If such waste is generated then the Contractor shall apply to State Pollution Control Board for 'authorisation' according to Form 1 of the Hazardous Waste (Management & Handling) Rules and dispose the same only to currently authorised recyclers( a list of which can be obtained from State Pollution Control Board) under intimation to the Engineer.
  - (iii) The Rules given in (I) above shall govern the Classification, Handling, Storage and disposal of such Hazardous Waste.
  - (iv) Hazardous waste would mainly arise from the maintenance of equipment. These may include, but not be limited to, the following:
    - Used engine oils, hydraulic fluids and waste fuel;
    - Spent mineral oils/cleaning fluids from mechanical machinery;
    - Scrap batteries or spent acid/alkali; and
    - Spent solvents/solutions, some of which may be derived, from equipment cleaning activities.
  - (v) For disposal of waste requiring special attention and hazardous waste the contractor shall enter into agreement with authorised agencies dealing with the same.
  - (vi) The hazardous waste shall be stored on an impermeable surface with containment bunding to retain leaks, spills and ruptures.
  - (vi) Waste oil and chemical containers shall be delivered to the Contractor's Storage yard. The Contractor is responsible for the correct storage and handling of waste oil/waste chemical containers for such a time until they are transported to the chosen disposal area or waste oil containers.
  - (vii) All waste collection containers shall be of appropriate size with a closed lid. Each

container will be clearly labelled both with a colour code system and labelled in local language and English. Original labels of empty containers should be completely covered and the contents of the type of waste stored in the used containers clearly indicated.

(g) Storage and Segregation of Waste

- (i) Disposal and collection points should be established around all construction work sites. The waste containers should be of at least 50L/100L
- (ii) Burning of refuse at construction sites is not permitted.
- (iii) The contractor shall enter into a contract with a licensed organisation to collect waste from Construction depots, Labour Colony etc. and dispose it at their landfill as per existing norms.
- (iv) The Contractor is responsible for the separation of construction and demolition material into re-usable and non-reusable materials, and transfer of these materials to low lying areas or landfills, depending on the type of material and the percentage of inert material.
- (v) Segregation of Waste should be done on site. All construction waste including debris should be sorted on site into inert and non-inert components as given in Table - I. Different areas of the worksites should be designated for such segregation and storage wherever site conditions permit.

**Table –1**  
**Storage of Waste**

<b>Waste Container</b>	<b>Colour Code</b>	<b>Sign</b>
Landfill / Biodegradable	Green	Waste
Recyclable	Blue	Paper & Plastic
Burning / Combustible	Red	Burning
Scrap Metal	Brown	Metal

- (vi) On-site measures promoting proper segregation and disposal of construction waste should be implemented e.g. provide separate containers for inert (rubber, sand, stone etc.) and non-inert (wood, organics etc.) wastes. The inert waste should be used on site before disposed of at filling area and the non-inert waste should be sorted for re-use or recycling before being transported to landfills.
- (vii) Non-inert materials such as wood, glass and plastic are acceptable for disposal to a landfill as a last resort if these can no longer be reused or recycled.
- (viii) Inert materials such as excavated materials comprising soil, rubble, sand, rock, brick and concrete should be separated and broken down to size suitable for subsequent filling in low lying areas, if it is determined that such material can no longer be reused at the site itself.
- (h) Reuse and Recycle
  - (i) If some good quality reusable topsoil is expected from site clearance works it shall be locally stockpiled and used later in final landscaping works, thus saving on costs for such works and transportation and environmental impacts of disposal.
  - (ii) The design of framework should maximise use of wooden panels so that high reuse levels can be achieved. Alternatives such as steel framework should be considered to increase the potential for reuse.
  - (iii) The Contractor should recycle as much of the construction waste as possible on-site.
  - (iv) Excavated materials are usually inert such as soil and rock, and can normally be reused on site or in public filling areas. The excavated material may have to be temporarily stockpiled on-site for subsequent re-use.
  - (v) Steel and other metals should be recovered from the construction waste and recycled as far as practical. If possible, scrap steel mills can use steel bars.
- (k) Transportation of Waste
  - (i) The transportation of construction spoil shall be allowed only to officially designated dumpsites after obtaining necessary permission from appropriate authority.



- (ii) A procedure to facilitate tracking of loads should be developed to prevent illegal disposal of waste. This procedure should include, inter alia, the name of driver, vehicle registration number, type and quantity of waste, place and time of origin, place of disposal and route of haulage.
  - (iii) In orders to avoid dust or odour impacts, vehicles leaving a site carrying excavate should have their load covered. Vehicles should be routed as far as possible to avoid sensitive receivers in the area.
  - (iv) Contractors who produce significant quantities of scrap are obliged to enter into agreement with authorised dealers of scrap for its disposal. Copies of such agreements shall be shown to the Engineer on request.
- (l) Training
- (i) The Contractor's Environmental Department is responsible for training of workers and personnel involved in generation of waste.
  - (ii) The Contractor shall provide training for workers about the concepts of site cleanliness and appropriate waste management procedure, including waste separation, reduction, reuse and recycling. Failure to do so would result in poorly separated waste, resulting in difficulties in treating the waste correctly and/or a bad market for reuse /recycling.
  - (iii) The awareness will be created through briefings and toolbox talks. The personnel/workers should be trained in waste classification and separation. The training should include:
    - Organic waste
    - Combustible waste
    - Hazardous waste
    - Minimisation of waste
  - (iv) Separation awareness training shall be given to employees responsible for the separation of the waste and information regarding waste separation shall be posted at appropriate locations around the site.

## **10 Housekeeping**

- 10.1 The Contractor shall constitute a special group of housekeeping personnel in charge of each work section. Senior engineer of each section shall be responsible for housekeeping at their respective sites.
- 10.2 Each section of work site shall maintain the site reasonably clean, keep free from obstruction and properly store any construction equipment, tools, and materials. Any wreckage, rubbish shall be temporarily stored in wreckage and rubbish bins. These wreckage and rubbish bins shall be cleaned at frequent intervals. Special housekeeping group will ensure daily cleaning work at the site and its surrounding areas.

- 10.3 General Housekeeping shall be carried out and ensured at all times at work sites, Labour Camps, Stores and Offices.
- 10.4 Full height fence, barriers etc. will be installed at the site in order to preserve the surrounding area from excavated soil, rubbish etc which may cause inconvenience to public.
- 10.5 The Contractor will ensure that all sub-contractors maintain the site reasonably clean through the sub-contract's provision related to housekeeping.
- 10.6 The Contractor's designated department through daily pre-work meeting (tool box talk), safety meeting etc. will impart the necessary introduction and education to labour on housekeeping. Other staff such as supervisors and engineers working at the site will also be educated on the necessity of good housekeeping.
- 10.7 Every individual would be responsible for housekeeping in his area i.e.
- At Work Site: All workers should clean their work place after completion of their job. Supervisor should ensure good housekeeping of their respective work area through their workers. Section Managers shall ensure housekeeping in their area through their supervisors. Contractor's designate department will monitor this activity through section manager as well as site supervisor.
  - At Labour Camp: All workers should be responsible to maintain good housekeeping and hygienic condition in their respective rooms/dormitories. The Contractor should ensure the availability of dustbins at required place and regular cleaning of rooms, kitchens, toilet blocks and dustbins. Safe disposal of all waste materials should also be ensured. Arrangement for regular fumigation should be made by the contractor.
  - At Store: Proper access and stacking shall be ensured at the Stores. A list will display daily stock of materials. All work material should be stored in clearly marked containers or at designated storage area.
  - At Office: Everyone is responsible to maintain housekeeping of their work station. Disposal of waste materials (i.e. stationary, cigarette butts, tea bags etc.) must be in dustbin only.
- 10.8 Avoidance of Nuisance
- (a) The Contractor shall take all precautions to avoid any nuisance arising from his operations. This shall be accomplished, wherever possible by suppression of nuisance at source rather than abatement of the nuisance once generated.
  - (b) Following site clearing and before construction, the Contractor shall remove all trash, debris and other weeds.
  - (c) The Contractor shall ensure that the work place is free of trash, garbage, debris and weeds.
  - (d) The Contractor shall provide at site, metal or heavy-duty plastic 'Refuse Containers' with

tight fitting lids for disposal of all garbage or trash associated with food.

- (e) To keep the area free of litter and garbage, specific locations shall be designated for consuming food and snacks to prevent random disposal of waste. All waste shall be deposited in the refuse containers. Suitable all weather signage shall be prominently displayed for compliance of these requirements.
- (f) The refuse containers shall be kept upright with their lids shut. These containers shall be emptied at least once daily by the Contractor to maintain site sanitation. There shall be different containers for bio-degradable/recyclable and hazardous (flammable) wastes.
- (g) All plants/equipment/machinery shall be well maintained by regular servicing and kept free from oil/grease dripping. Drip pans of suitable size shall be used to collect oil leakages and spills. The area shall be cleaned after completion of maintenance/repair and generated waste disposed off in approved manner.
- (h) The contractor shall make available Material Supply Data Sheet (MSDS) for material/chemicals/substances used, for which these are available to the Engineer when requested.
- (i) Such material/chemicals/substances used shall be treated, handled, stored, transported and disposed off, by the contractor, in a manner specified in the MSDS.

#### 10.9 Prevention of Mosquito Breeding

- (a) Measures shall be taken to prevent mosquito breeding at site. The measures to be taken shall include, but not limited to, the following:
  - (i) Construction run off shall not be allowed to stagnate at work sites specially at construction depots and batching plant locations, by executing an efficient drainage system and/ or levelling off low lying areas;
  - (ii) Empty cans, oil drums, packing and other receptacles which may retain water shall be deposited at a central collection point and shall be removed from the Site regularly;
  - (iii) Still waters shall be treated at least once every week with oil in order to prevent mosquito breeding;
  - (iv) Contractor's Equipment and other items on the Site, which may retain water, shall be stored, covered or treated in such a manner that water could not be retained.

Posters in both local language and English which draw attention to the dangers of permitting mosquito breeding shall be displayed prominently on the site.

### 11 **Mangroves restoration program**

- 11.1 The Contractor should prepare the mangroves restoration programme confining the applicable rules and Hon High Court judgments. The plantation Plan of mangroves should take in consultation of Mangroves foundation and Mumbai mangroves Conservation unit of Forest Department.

11.2 The construction of Dahisar - Bhayander link road will have negative but temporary impacts on the landscape and aesthetics due to loss of amenities and mangroves trees. Large-scale construction activity will impact negatively on mangroves areas and residential communities immediately adjacent to the construction sites.

11.3 The Mangroves Replantation and Restoration Schedule

Following species of Mangroves can be planted while restoring

- *Avicennia marina*
- *Ceriops tagal*
- *Avicennia officinalis*
- *Sonneratia apetala*

11.4 Light used for construction lighting can illuminate adjacent areas in undesired ways. Such lighting and glare shall be prevented from striking adjacent areas viz. mangroves, where feasible, through directional shielding.

11.5 The other measures include but not limited to:

- (a) Erection of decorative screen hoarding prominently displaying the logo of Brihanmumbai Municipal Corporation.
- (c) Careful positioning of construction equipment.
- (d) Eliminating the possibility of stockpiles of material from being visible to public.
- (e) Strategically placing hi visibility site markings at construction sites indicating facilities, offices and stores.
- (f) Adequate and properly managed parking of vehicles at construction depots and batching plants.

11.6 Consent for height of stacks of Diesel Engines with rating more than 800 KV shall be obtained by the Contractor from statutory Government agency. Where the calculated height of stack is obtrusive and does not blend with the neighbourhood, the contractor will provide either alternative source of power or provide a solution that is acceptable to the Engineer. This may include but not limited to providing appropriate cladding for the stack.

11.7 No Labour camp will allowed in the deemed forest area.

## 12 Energy Management

12.1 By using energy efficiently, the same services can be delivered with less energy, which helps protect the environment by preventing pollution.

12.2 The Contractor should optimize the use of tools and plants and equipment to perform tasks with correct power. Optimizing cable sizes and joints can control voltage drops.

- 12.3 The Contractor should use energy efficient pumps (at least 80% efficiency) and motors (95% efficiency or more). The efficiency should be measured during installation and also periodically.
- 12.4 The Contractor should use Diesel Generating sets that have specific fuel consumption of at least 3.5 units per litre of diesel. The Contractor should rigorously follow the maintenance regime of his DG sets.
- 12.5 The Contractor should maximize the use of energy efficient luminaries such as CFLs and T5 florescent tubes, metal halide lamps and similar and ensure optimum illumination levels to save energy. The Contractor shall make provision of Earth Leakage Circuit Breakers (ELCBS) to prevent loss of excessive earth currents which are unsafe.
- 12.6 The Contractor should plan in advance and select locations to receive and store material such that these are at the least distance from place of use. Such an approach will result in less energy being consumed since optimum energy will be expended for transport of material.
- 12.7 The Contractor should plan works in a manner as to avoid reworking especially during meeting the interface requirements of systems contractor.

### **13 Traffic Management**

- 13.1 Traffic Management for the project includes public roadways and sidewalks and the maintenance of access to residence, business and public services throughout the construction area. Traffic delays and reduction in roadways capacity are anticipated during aspects of the construction of the Dahisar-Bhayander Road.
- 13.2 Even though vehicular, pedestrian and surface transit traffic will be impacted at a few locations, the contractor should minimize such impacts through the development of Traffic Management Plans, which will be submitted in advance to the Engineer for his Notice to proceed. These plans will provide specific guidance on traffic management for various portions of construction zones and staging.
- 13.3 The types of mitigation measures to be implemented by the Contractors will be on a site-specific basis and will include
  - Signage and barriers for protecting and guiding pedestrians
  - Detour signs placed at strategic locations
  - Relocation of bus stops at construction sites
  - Provision of sidewalks of least 2m where feasible
  - Physical separation between construction zone and sidewalks of concrete barriers or wood fencing or mesh fencing
- 13.4 Wherever heavy equipment like cranes or dozers have to be moved on public roads and the normal moving dimensions are infringed, these shall be moved under advice to traffic police, and with adequate precautions and at low speed.

**14 Archaeological and Historic Resources**

- 14.1 During the construction period, archaeological or historic resources may potentially be affected by direct or indirect construction activity. If any such structures are likely to be affected, special measures to be initiated with the Notice to proceed of the Engineer.
- 14.2 Prior to the initiation of construction Engineer intends to review a resource protection plan for historic structures where it appears that they may be affected by the project. This plan will be developed by the Contractor in consultation with The Archaeological Survey of India (ASI).
- 14.3 The plan will identify the sensitive resources as well as specify the construction monitoring requirements. These requirements may include ground vibration monitoring and recording any components inadvertently subjected to impact.
- 14.4 If the project is likely to affect a previously unidentified historic property, work in that area shall cease until actions that will take into account the effect of the undertaking on the property can be implemented. .The Contractor shall consult the Engineer before proceeding further in such an event.

**15 Environmental Monitoring - General**

- 15.1 The Contractor's Environmental Team shall carry out the monitoring of environmental impacts during construction. Representative sensitive receivers in the vicinity of the works shall be monitored for noise, water and air quality impacts.
- 15.2 For carrying out impact monitoring for noise and air, equipment shall be provided, operated and maintained by the Contractor. The equipment shall be kept in a good state of repair in accordance with the manufacturer's recommendations and maintained in proper working order with sufficient spare equipment available in the event of breakdown to maintain the planned monitoring programme.
- 15.3 The calibration of monitoring instruments and their respective calibrators shall be carried out in accordance with the manufacturer's requirement to ensure they perform to the same level of accuracy as stated in the manufacturer's specifications.
- 15.4 Suspended Particulate Matter (SPM) levels shall be measured by following the standard high volume sampling method as set out in High Volume Method for Suspended Particulate, BIS: 5182-1981. Respirable Particulate Matter (RPM) shall be measured in accordance with BIS 5182 Part 4.
- 15.5 24-hour average SPM concentration shall be measured by drawing air through a High Volume Sampler (HVS) fitted with pre-weighted Glass Fibre filter paper at an average flow rate not less than  $1.1\text{m}^3$  per minute. Similarly for RPM, Respirable dust sampler, fitted with pre-weighted Glass Fiber and an average flow rate of not less than  $1.1\text{m}^3/\text{minute}$  shall be used. The duration of monitoring of RPM shall be 24 hrs.
- 15.6 The minimum requirements to the specifications of sound level meter are given in

IS: 9779- 1981.

- 15.7 The Contractor's monitoring programme shall be as per approved Environment Management plan approved by the Engineer

## **16 Air Monitoring**

- 16.1 Construction activities that will generate dust impacts include excavation, material handling and stockpiling, vehicular movement, and wind erosion of unpaved work areas.
- 16.2 The impact of fugitive dust on ambient air pollution depends on the quantity generated, as well as the drift potential of the dust particles injected into the atmosphere. Large dust particles will settle out near the source and smaller particles are likely to undergo dispersal over greater distance from the sources and impeded setting. SPM and RPM levels will be monitored to evaluate the dust impact during the construction phase of the Project.
- 16.3 The Air Quality Monitoring and Control Plan (AMCP) in contract-specific Site Environmental Plan prepared by the Contractor shall establish procedures to monitor impact air quality and measures to control air pollution including dust suppression due to construction activities at work sites. This plan shall contain description of activities that will cause degradation in air quality, environmental procedures to manage pollutants, monitoring programme record keeping and reporting.
- 16.4 The Engineer shall monitor Contractor's performance of tasks specified and will inspect necessary records, reports and procedures related to the control of air quality given in AMCP.
- 16.5 Information gathered during the AMCP will be catalogued and maintained by the Contractor and shall be available for review by the Engineer.
- 16.6 The exact location of the air monitoring stations located near air sensitive receptors adjoining the construction sites, such as residences, schools, and hospitals and placement of monitoring equipment shall be agreed with the Engineer prior to commencement of air monitoring programme.
- 16.7 Impact monitoring during the course of the Works shall be carried out at the monitoring stations for two days (continuous twenty-four hours) every fifteen days and where there is a perceived air quality problem.
- 16.8 The Contractor should construct suitable fence, lockable gate, 220V AC power point and suitable access at each air monitoring station. Monitoring stations should be free from local obstructions or sheltering.
- 16.9 Should impact monitoring record dust levels which are:
- .. Indicative of a deteriorating situation such that closer monitoring is reasonably indicated, or
  - .. When in the opinion of the Engineer additional measurements are required in view of deteriorating air quality;

Then, the Engineer may require the Contractor to increase the frequency of impact monitoring at any one or more of the monitoring stations until the results indicate an improving and acceptable level of air quality.

- 16.10 The Contractor shall keep records of air quality monitoring (including location, date, time). The Contractor shall submit a copy of monitoring results to the Engineer. The results should represent a statistical evaluation of data by calculating maximum, minimum, mean, for valuation of trends, and comparison with emission standards.
- 16.11 The National Ambient Air Quality Standards given in Air (Prevention and Control of Pollution) Act, 1981 may be referred by the Contractor for Limit Levels of SPM and RPM in ambient air which may be followed in estimating the pollution level caused by Contractor's activities.
- 16.12 Where the Engineer determines that the recorded SPM level is significantly greater than the Limit levels, the Engineer may direct the Contractor to take effective remedial measures including, but not limited to, reviewing dust sources and modifying working procedures.
- 16.13 Where the recorded baseline levels exceed the ambient air quality standards, then at such locations the limit level is the recorded base line. Contractor shall take all effective remedial measures to contain the levels to their baseline value as a result of his activities.
- 16.14 The Contractor should inform Engineer of all steps taken to investigate cause of non-conformance and immediate action taken to avoid further occurrences through written reports and proposals for action.

## **17 Noise Monitoring**

- 17.1 The activities which are expected to cause noise during the construction include noise from construction equipment, construction activities such as portal construction, earthwork excavation, concreting, removal of spoil, movement of construction vehicles and delivery vehicles travelling to and from the construction and disposal sites etc.
- 17.2 The level of impact of these noise sources depends upon the noise characteristics of the equipment and activities involved the construction schedule, and the distance from noise sensitive receptors.
- 17.3 The Noise Monitoring and Control Plan (NMCP) in contract specific site Environmental Management Plan prepared by the Contractor shall establish procedures to monitor construction noise and determine when to apply measures to control noise pollution due to construction activities at works site.
- 17.4 The NMCP will provide site description, define acceptable noise monitoring equipment, provide monitoring locations and operating procedures for noise equipment and indicate reports and record keeping on noise monitoring data.
- 17.5 The NMCP will provide guidance for construction activity. It shall also address noise performance criteria used in the selection of construction equipment. In defining the



requirements of the NMCP, available measures for noise control, such as, the use of equipment with special exhaust silencers or enclosures, and the construction of temporary enclosures or noise barriers around specific construction site activity areas shall be considered.

- 17.6 The NMCP will be reviewed on a regular basis and updated as necessary to assure current construction activities are addressed.
- 17.7 The Engineer shall monitor Contractor's performance of tasks specified, and will inspect necessary records, report and procedures related to the control of noise.
- 17.8 Noise monitoring shall be carried out at noise sensitive receptor locations within 200 feet of the construction site once each week and after a change in construction activity. Construction noise measurements shall coincide with daytime and night-time periods of maximum noise generating construction activities.
- 17.9 The appropriate parameter for measuring construction noise impacts shall be the equivalent A-weighted sound pressure level ( $L_{eq}$ ) measured in decibels (dB). The two statistical sound levels  $L_{10}$  and  $L_{90}$ ; the level exceeded for 10 and 90 percent of the time respectively, shall also be recorded during monitoring. The  $L_{90}$  may be considered as the ambient level into which the  $L_{10}$  as average peak level intrudes. The  $L_{max}$ ,  $L_{eq}$ ,  $L_{10}$  and  $L_{90}$  values will be reported in the noise measurement form along with allowable noise limit. The duration of monitoring shall be  
on hourly basis for 24hours.
- 17.10 In no case shall the Contractor expose the public to construction noise levels exceeding 90dBA(slow) or to impulsive noise levels with a peak sound pressure level exceeding 140dB as measured on an impulse sound level meter.
- 17.11 Limit for construction noise is based on the existing ambient noise levels in areas adjoining the construction sites. If the measured noise levels exceed the noise limits, the noise levels shall be reduced by appropriate abatement measures.
- 17.12 The noise levels emanating from any source during construction, shall not exceed 10 dB(A) or more above existing ambient pre-construction noise levels when measured at a point outside the premises of the location of source. The same may be varied from time to time by and at the sole discretion of the Engineer.
- 17.13 The construction activities shall be limited to levels measured at a distance of 200 feet from the construction limits or at the nearest affected building, whichever is closer, as given in **Table - 4**.

**Table- 4**  
**Allowable construction noise**

LAND USE	MAXIMUM NOISE LEVELS – L <sub>max</sub> dB (A)	
	Day Time	Night Time
Residential	75	65
Commercial	At all Times 85	
Industrial	90	

17.14 The ground borne noise levels within building structures due to tunnel boring machine and any other underground and tunnelling construction activities shall not cause interior noise levels to exceed the levels given below as measured in the inside of the affected noise sensitive structure:

Residential: L<sub>max</sub> 55 dB(A)

Commercial: L<sub>max</sub> 60 dB(A)

17.14 At the surface of the construction site during night time hours, the Contractor shall use only equipment that operating under full load meets the noise limits specified in **Table-5**, if a sensitive receptor would be affected.

**Table - 5**  
**Noise emission limits for construction equipment measured at 50 feet from construction equipment\***

Equipment Category	L <sub>max</sub> Level dB(A)
Backhoe	80
Bar Bender	75
Chain Saw	81
Compactor	80
Compressor	80
Concrete Mixer	85
Concrete Pump	82
Crane	85
Dozer	85

Front End Loader	80
Generator	82
Gradall	85
Grader	85
Paver	85
Pneumatic Tools	85
Scraper	85
Tractor	84

17.15 The adjustments for close in equipment noise measurement shall be made in accordance with **Table - 6**.

**Table – 6**

**Adjustments for close in equipment noise measurements**

**(Measurement Values to be subtracted from Measured Sound)**

<b>Distance (Feet)</b>	<b>Level to Estimate Sound Level at 50 Feet dB(A)</b>
19-21	8
22-23	7
24-26	6
27-29	5
30-33	4
34-37	3
38-42	2
43-47	1
48-50	0

17.16 Should the impact monitoring record noise levels which are:

- indicative of a deteriorating situation such that closer monitoring is reasonably indicated, or
- when in the opinion of the Engineer additional measurements are required in view

- of deteriorating noise environment,
- then, the Engineer may require the Contractor to increase the frequency of impact monitoring at any one or more of the monitoring stations until the results indicate an improving and acceptable level of noise.
- 17.17 The Contractor shall inform the Engineer of all steps taken to investigate cause of non-conformance and immediate action taken to avoid further occurrences through written reports and proposals for action.
- 17.18 The Contractor shall submit a copy of monitoring results. The results should represent a statistical evaluation of data for evaluation of trends and comparison with noise emission standards.
- 17.19 Where the Engineer determines that the recorded Noise level is significantly greater than the acceptable levels, the Engineer may direct the Contractor to take effective remedial measures including, but not limited to, reviewing noise sources and modifying working procedures.
- 17.20 Protection against the effects of occupational noise exposure should be provided when the sound levels exceed those shown in Table No. 6 below when measured on the A-scale of a standard sound level meter at slow response.
- 17.21 When employees are subjected to sound levels exceeding those listed in the Table No. 7 feasible administrative or engineering controls should be utilized.
- 17.22 If such controls fail to reduce sound levels within the levels of the table, personal protective equipment shall be provide and used to reduce sound levels within the levels of the table.

**Table – 7**  
**Permissible Noise Exposures**

Duration per day, Hours	Sound level (slow Response)
8	90
6	92
4	95
3	97
2	100
1 ½	102
1	105
½	110
¼ or less	115

- 17.23 When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect

of each. Exposure to different levels for various periods of time shall be computed according to the formula as given below.

$$F_e = (T_1/L_1) + (T_2/L_2) + \dots + (T_n/L_n) \text{ where,}$$

$F_e$  = the equivalent noise exposure factor.

$T$  = the period of noise exposure at any essentially constant level.

$L$  = the duration of the permissible noise exposure at the constant level (from Table)

If the value of  $f$  exceeds unity (1) the exposure exceeds permissible levels.

17.24 A sample computation showing an application of the above formula is as follows. An employee is exposed at these levels of these periods:

11 dB(A) 1/4 hour.

100 dB(A) 1/2 hour.

90 dB(A) 1/2

hours. Then,

$$F_e = (1/41/2) + (1/2/2) + (1$$

$$1/2/8) F_e = 0.500 + 0.25$$

$$+ 0.188$$

$$F_e = 0.938$$

Since the value of  $F_e$  does not exceed unity, the exposure is within permissible limits.

17.25 The vibration level limits at work sites adjacent to the alignment shall conform to permit values of peak particle velocity as give in Table No. 8

**Table 8**

**Permitted Values of PPV**

Sl. No.	Condition of Structure	Max. PPV in mm/sec
1.	Most structures in "good condition"	25
2.	Most structures in "fair condition"	12
3.	Most structures in "poor condition"	5
4.	Water supply structures	5
5.	Heritage structures/bridge structures	5

- 17.26 When Diesel Generator (DG) Sets are used for operation of equipment and machinery, then Ministry of Environment and Forest notification dated 17<sup>th</sup> May 2002, issued under Environment Protection Act (Protection) Rules, 1986, on noise limits shall apply.

## **18 Environmental Site Inspection**

- 18.1 Site inspection shall be undertaken by the Contractor's staff to inspect the construction activities in order to ensure that appropriate environmental protection and pollution control measures are properly followed and implemented. The frequency of site inspection shall be at least once a week.
- 18.2 The Contractor shall prepare an 'Environmental Inspection and Action Reporting System', submit to the Engineer for Notice to proceed and make amendments as suggested. It shall contain a contract specific comprehensive Environment Inspection checklist as requirement of Site Environmental Plan.
- 18.3 The area of inspection shall not be limited to environmental compliance within the site but areas outside the site which are likely to be affected, directly or indirectly by activities at site.
- 18.4 Results of inspection shall be discussed with Engineer and his recommendations on better environmental protection shall be notified to the Contractor for taking immediate action and rapid resolution of identified non-compliance.
- 18.5 If significant environmental problems are identified or if there is an environmental complaint or as a part of investigation work, then the Engineer shall also carry out Ad hoc site inspection which shall be attended by Contractor's Representative.

## **19 Environmental Audits**

- 19.1 As indicated earlier in this EMA, the Engineer may undertake regular audits at quarterly intervals, of the Contractor's onsite practices and procedures as a means of assessing the ongoing performance of the Contractor.
- 19.2 A checklist of environmental requirements will be prepared and amended as necessary, throughout the construction phase to focus on areas of frequent non-compliance and to reflect the potential impacts associated with specific activities within the construction programme
- 19.3 The criteria against which the review will be undertaken will be derived from (but not be limited to):
- (a) The approaches, procedures and commitments given by the Contractor in the 'Site Environmental Plan'
  - (b) The clauses contained within the Engineer's Requirement on Environment.
  - (c) The allocation of responsibility for fulfilling environmental requirements and the effective lines of communication with regard to environmental issues;
  - (d) Compliance with procedures established to enable and effective response to

- environmental incident or non-compliance;
- (e) The extent and accuracy of record-keeping related to environmental performance indicators;
  - (f) The effectiveness of ensuring high levels of awareness with regard to environmental requirements; and
  - (g) The effectiveness of environmental management activities, including the speed and effectiveness of responses to complaints.
- 19.4 The likely protocol will include (but not limited), the auditing of the following activities:
- The allocation of responsibility for fulfilling environmental requirements and effectiveness of lines of communication.
  - Compliance with procedures established to enable effective response to environmental issues.
  - The extent and accuracy of record keeping related to environment.
  - The effectiveness of staff training ensuring high levels of awareness with regard to environmental requirements.
  - The speed and effectiveness of responses to complaints.
- 19.5 The criteria against which the audits will be undertaken shall be derived from the clauses within the Engineers Requirements contract-specific Site Environmental Plan and previous site inspection results.

## **20 Reporting System**

- 20.1 Reporting under the Environmental Management System will contain results of monitoring and inspection programmes.
- 20.2 In Site Environmental Plan, the Contractor shall prepare and submit monthly Environmental Management Reports in accordance with Engineers Requirements.
- 20.3 The monthly report shall include (but not limited to) the following:
- Executive Summary
  - Brief mention of construction activities
  - Monitoring results under AMCP, and NMCP
  - Interpretation of monitoring results, significance and influencing factors
  - Graphical representation of monitored results over past four reporting periods.
  - Details on Fly ash consumption as given in Appendix-III.
  - Raw material consumption details such as electricity, diesel, water
  - Generation of scrap during the month and sold to authorised recyclers
  - Generation of other type of waste and sold to respected authorised buyers.

- Measures to control spills
- Action taken on recommendation under site inspection programme or specific directions.
- Summary of complaints, results of investigations and follow-up action
- Future key issues.

## **21 Complaint Response Process**

- 21.1 Enquiries, complaints and requests for information can be expected from a wide range of individuals and organisations both private and government. The majority of complaints is likely to be received by BMC, although the site offices are also likely to be contacted.
- 21.2 The objective of complaint process is to ensure that public and agency complaints are addressed and resolved consistently and expeditiously.
- 21.3 The Contractor's Site Manager will be notified immediately on receipt of complaint that may relate to environmental impacts. The Site Manager will immediately inform the Engineer.
- 21.4 Field investigation should determine whether the complaint has merit, and if so action should be taken to address the impact.
- 21.5 The outcome of the investigation and the action taken shall be documented on a complaint Performa prepared by the Contractor and submitted for notice by the Engineer in advance of the works.
- 21.6 Where possible, a formal response to each complaint received shall be prepared by the Contractor within seven days in order to notify the concerned person(s) that action has been taken.

## **22 Completion of the EMA Programme**

- 22.1 The construction of Dahisar-Bhayander Road will be undertaken as a series of individual construction contracts with necessarily different construction programme and completion dates.
- 22.2 The Engineer shall maintain an overview of the 'impact causing potential' of each site, monitoring parameter or contract with a view to maintaining the most cost effective use of the environmental resources dedicated to the Project.
- 22.3 For release of final bill the contractor shall ensure
- (i) Closure of all non-conformance reports
  - (ii) Submittal of all environment related documents and records pertaining to monitoring and trend analysis on key parameters such as but not limited to consumption/efficient use of resources such as energy, water, material such as cement, fly ash, iron and steel, recycle/reuse of waste etc that shall demonstrate continual improvement in the Implementation of Environmental Management System.



**Appendix –I SITE ENVIRONMENTAL PLAN  
OUTLINE**

SI. NO.	SITE ENVIRONMENTAL PLAN OUTLINE
<b>1</b>	<b>GENERAL</b>
(i)	The Environmental Policy of the Contractor is clearly defined in the Site Environmental Plan, which, inter-alia, commits the Contractor to follow national and state environmental legislation and regulations.
(ii)	The Contractor is committed to BMC's Environmental Management System and shall provide desired manpower and financial resources for its success
(iii)	The person responsible for day-to-day environmental matters is identified and vested with authority to execute the Site Environmental Plan.
(iv)	Procedure is available for Contractor's system of enforcing good environmental practices of its Sub-contractor.
(v)	The Site Environmental Plan contains procedures for screening material used in the contract, for their environmental friendliness.
<b>2</b>	<b>ENVIRONMENTAL FRIENDLY CONSTRUCTION PRACTICES</b>
(i)	The Site Environmental Plan must contain specific procedures for achieving environmental performance requirements as given in the Engineer's requirement on Environment and BMC Environmental Management Manual.
(ii)	Procedures for carrying out Aspect/Impact analysis of contractor's proposed works and their affect on environment.
(iii)	Procedures for setting up Objectives and Targets commensurate with Engineer's requirement on Environment and BMC Environmental Management Manual and how these shall be met.
(iv)	Procedures for formulating Environmental Management Plans and Operational Control Procedures to meet contractual requirements.
(v)	Procedures for offering environmental training and methods for promoting environmental awareness amongst his employees.
(vi)	The SEP must contain details on Air Monitoring and Control Plan which details Mitigation measures / Corrective Action / Preventive Action and Monitoring Schedule.
(vii)	The SEP must contain details on Noise Monitoring and Control Plan which details Mitigation measures / Corrective Action / Preventive Action and Monitoring Schedule.

(viii)	The SEP must contain procedures on prevention and control of water pollution from sanitary surface runoff and process wastewater
(ix)	The SEP must contain details on procedures for Storage, handling and disposal of waste including, municipal, construction, chemical and hazardous wastes.
(x)	The SEP must contain procedures for reuse/recycle of waste, selling to authorised recyclers and records thereof.
(xi)	The SEP must contain procedures for preservation of landscape disturbed due to construction, housekeeping and traffic management as required under the contract.
(xii)	The SEP must contain procedures for dealing with unforeseen environmental situations under Environmental Emergency.
(xiii)	The SEP must contain details on action plans with respect working principle with respect to the mangroves eco system which details Mitigation measures / Corrective Action / Preventive Action and Monitoring Schedule.
<b>3</b>	<b>MONITORING, AUDITS AND RECORDS</b>
(i)	The Contractor keeps records of monitoring and the SEP contains provision for reporting results of environmental monitoring in a manner as specified in the contract.
(ii)	The Contractor carries out weekly inspection under the 'Environmental Inspection and Action Reporting System' through Environmental Inspection checklist and submits to the Engineer.
(iii)	The SEP contains procedures for mandatory audits by the contractor as given in the contract.
(iv)	The SEP contains provisions for submitting monthly / Six monthly Environmental Quality Management reports of the required appraisal authority.
(v)	The SEP contains procedures for recording environmental complaints and response process.