

Annex A

# Air Quality Management Plan

Part III Annex A

## Air Quality Management Plan

Version 0.1

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### Yara Dallol Potash Project, Danakil Depression, Ethiopia

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## LIST OF ACRONYMS

Abbreviation	Full Definition
$\mu\text{g}/\text{m}^3$	microgram per cubic meter
$\mu\text{m}$	Micrometer
Aermod	Aermod is the USEPA near field regulatory dispersion model
ALARP	As Low As Reasonably Practicable
EHS	Environmental Health and Safety
ESIA	Environmental Social Impact Assessment
$\text{g}/\text{m}^2$	Grams per meter squared
$\text{g}/\text{m}^2/\text{day}$	Grams per meter squared per day
IFC	International Finance Corporation
km	Kilometer
kph	Kilometers per hour
m/s	Meter per second
$\text{mg}/\text{m}^2/\text{day}$	Milligrams per meter squared per day
$\text{mg}/\text{m}^3$	Milligrams per cubic meter
mm	Millimeter
$\text{NO}_2$	Nitrogen dioxide
$\text{PM}_{10}$	Particulate matter which passes through a size-selective inlet with a 50% efficiency cut-off at 10 $\mu\text{m}$ aerodynamic diameter
$\text{PM}_{2.5}$	Particulate matter which passes through a size-selective inlet with a 50% efficiency cut-off at 2.5 $\mu\text{m}$ aerodynamic diameter
$\text{SO}_2$	Sulphur dioxide
TSP	Total Suspended Particulates
USEPA	United States Environmental Protection Agency
WHO	World Health Organization

## DEFINITIONS

The following definitions are of relevance within this plan:

- **Air Quality Guideline and Air Quality Interim Target** - are the maximum allowable concentrations of pollutants in air, defined either in terms of the entire concentration in air, or the concentration arising from the Project related activity.
- **Dust Deposition Nuisance Criteria** - are the levels of dust deposition which are set to avoid causing nuisance issues at receptors.
- **Air Quality Action Level** - are levels relating to concentrations of pollutants in air, or dust deposition at which action should be taken on site to reduce emissions.
- **Friable Material** - material which can result in emissions of dust when disturbed, or when handled.
- **Real Time Monitoring** - this is monitoring undertaken with a sample that actively draws an air sample (i.e. pumped) and provides instantaneous, immediate monitoring results.
- **Passive Monitoring** - this is monitoring that utilises the passive deposition of samples into a collection bottle or passive diffusion of gases into a sampler and requires subsequent laboratory analysis.
- **Visual Monitoring** - this is monitoring undertaken by eye and relying upon professional judgment to identify excessive emissions and any potentially significant issues associated with nuisance.

Yara International is a leading global fertilizer company with sales of fertilizer to about 150 countries globally. As part of Yara International's overall upstream strategy, the company is exploring for suitable raw sources that can be developed and used as a source to Yara International's global fertilizer production and directly as finished product in its product portfolio. To complement these upstream processes, Yara International has recently started a subsidiary company, Yara Dallol BV, which is involved in the exploration and mining development of potash concessions in Ethiopia. These concessions are located in the Danakil Depression, Afar National Regional State (ANRS), Ethiopia. Yara International, through its subsidiary, proposes to develop a potash mine - the Yara Dallol Potash Project (hereafter referred to as the proposed Project) within these concession areas.

As part of the environmental approval process for the Project a suite of environmental and social management plans is needed to address the issues identified in the Environmental and Social Impact Assessment (ESIA). Several management plans have been developed to address impacts identified in the ESIA and are implemented as part of an environmental management system for the Yara Dallol Potash Project.

Several activities associated with the proposed Project will impact upon the air quality of the environment at a local and regional scale. Activities associated with the proposed Project activities that will be a source of emissions of dust, PM<sub>10</sub> and PM<sub>2.5</sub>, NO<sub>x</sub> and SO<sub>2</sub>, and which can cause impacts on the receiving environment include groundworks, road construction, power generation and traffic generation.

This Air Quality Management Plan (AQMP) has been compiled to address the specific impacts that are anticipated to occur as a result of planned mining developments as identified in the ESIA and associated impact assessment. This plan sets out a formal system by which Yara Dallol BV can manage mitigation measures that will reduce the impacts on air quality.

## **1.1 POLICY STATEMENT AND OBJECTIVES**

### **1.1.1 Policy Statement**

The development of this AQMP has been guided by the Yara Dallol BV Health, Environment, Safety, Quality and Product Stewardship Policy, as set out in *Box 1.1*. This Policy is a high-level corporate statement of intent and establishes the principles to be followed in the management of environmental and health issues.

**Box 1.1**

***Health, Environment, Safety, Quality and Product Stewardship Policy Statement***

**COMPANY COMMITMENT**

Yara Dallol BV's aim is to establish sustainable growth and the creation of shareholder and societal value. Yara Dallol BV affirms to their stakeholders, including employees, customers and the public, their commitment to continuously improve and reach standards of excellence in Health Environment, Safety, Quality and Product Stewardship through their operations.

**ENVIRONMENTAL POLICY**

Yara Dallol BV will manage their business in a life cycle perspective. In its operations Yara Dallol BV will contribute to eco-efficiency by continuously improving energy consumption and reducing waste, emissions and discharges. Waste that is generated will be handled and disposed if safely and responsibly.

Yara Dallol BV will design their products and develop product applications to have the minimum adverse effect on the environment throughout their lifecycle.

**1.1.2**

***Objectives***

The objectives of this AQMP are as follows:

1. Provide measures and controls for the reduction in emissions of NO<sub>x</sub>, SO<sub>2</sub>, dust, PM<sub>10</sub> and PM<sub>2.5</sub>;
2. Provide measures and controls for the maintenance of equipment and vehicles;
3. Provide a schedule for ambient air quality monitoring;
4. Provide action levels relating to monitored impacts, and the implementation of remedial actions in the event of action levels being triggered;
5. Establish an appropriate air quality training programme for Project Management and staff; and
6. Define the roles and responsibilities for implementing the measures to minimise or eliminate air quality impacts.

**1.2**

***PURPOSE AND SCOPE***

The purpose of the AQMP is to provide a clear set of actions and responsibilities for the control of impacts affecting the air quality within the Project's area of influence.

The scope of this AQMP covers construction, operational and decommissioning/closure phases of the proposed Project. Mitigation

measures are presented to ensure that sensitive receptors (residential areas and ecological habitats) do not experience excessive nuisance or health effects.

This plan should be considered to be a “living” document that is amended in light of the learning experienced during its implementation.

### 1.3

#### *LINKAGE TO OTHER ENVIRONMENTAL AND SOCIAL PLANS*

This AQMP should be read in the context of the Environmental and Social Management System (ES-MS) (discussed in *Chapter 13 of Part I of the ESIA*), which has been structured to provide a vehicle for the integrated management of the suite of management plans described in *Part III*, which have been designed to address a broad range of social and environmental risks.

It is recognised that the ES-MS and associated plans are living tools that will be constantly updated to accommodate changing circumstances.

The AQMP links with the Community Health, Safety and Security Management Plan (CHSSMP). Air Quality has a direct link to social plans, specifically in regard to areas where people reside. The primary concern pertaining to air quality is people’s health followed by negative impacts on the environment. Thus it is imperative that any future social development takes into account the zones of air quality impacts.



A summary of the legal requirements and standards relevant to the AQMP are presented below.

## 2.1 NATIONAL LEGISLATION AND POLICY

The following Ethiopian regulations informed the development of this AQMP:

### 2.1.1 *The Constitution of the Federal Democratic Republic of Ethiopia*

Article 44 of the Constitution of Ethiopia (1995) states that all persons have the right to a clean and healthy environment; moreover, Article 51(3) of the Constitution of the Ethiopia (1995), states that the Federal Government shall, amongst others, establish and implement national standards (refer to *Section 2.2.1*) and basic policy criteria for public health.

Article 92 identifies amongst others that:

- The Government shall endeavour to ensure that all Ethiopians live in a clean and healthy environment;
- The design and implementation of programs shall not damage or destroy the environment; and
- Government and citizens shall have the duty to protect the environment.

### 2.1.2 *Environmental Pollution Control Proclamation (300/2002)*

Complementary to the Environmental Policy of Ethiopia (1997) and the Environmental Impact Assessment Proclamation (299/2002) (which requires developmental activities to provide a number of guiding principles that require adherence to principles of sustainable development), the Pollution Control Proclamation requires ongoing activities to implement measures that would reduce their degree of pollution to a set limit or quality standard.

## 2.2 NATIONAL GUIDELINES AND STANDARDS

Within Ethiopia, the following document sets out the key considerations pertaining to air quality:

### 2.2.1 *Environmental Standards for Industrial Pollution Control in Ethiopia*

The Ethiopian Federal Government has developed a list of environmental standards for the purposes of preventing significant industrial pollution. These standards present pollution limits for emissions to atmosphere.

This document sets out emission limits for emissions to air from fertiliser production, which in the absence of any more relevant guidance has been adopted for this assessment. The document also sets out emission limits for other processes, including emission limits for total particulate matter and emission limits from combustion processes, which are relevant to this study. Of particular relevance to this project are the following NO<sub>x</sub> emission limits for combustion sources of Fuel oil: 1000 mg/Nm.

It must be noted that there are no standards enforced in Ethiopia through national legislation that are applicable to ambient air quality (as opposed to emissions, as set out above), and none relating to dust deposition. Therefore, the air quality guidelines advocated by the IFC and dust deposition guidelines from a number of sources, as discussed in *Section 2.4.1*, are used instead.

### 2.3 *IFC PERFORMANCE STANDARDS*

The following IFC Performance Standards are applicable to this AQMP:

#### 2.3.1 *Performance Standard 1 (Assessment and Management of Environmental and Social Risks and Impacts)*

IFC Performance Standard (PS) 1 is primarily a prescriptive document (with reference to quantitative guidelines) and includes objectives, which are considered key to the proposed Yara Dallol Potash Project, such as:

- Identify adverse and beneficial impacts;
- Avoid, minimise, mitigate or compensate adverse impacts;
- Appropriate engagement of community on issues that could potentially impact them; and
- Promote improved social and environmental performance through effective use of management systems.

#### 2.3.2 *Performance Standard 3 (Resource Efficiency and Pollution Prevention)*

IFC PS 3 is primarily a prescriptive document and includes two objectives:

- Avoid or minimise adverse impacts to human health and the environment by avoiding or minimising pollution from project activities; and
- Promote the reduction of emissions that contribute to climate change

In addition to the above IFC PS, the following IFC Environmental, Health and Safety Guidelines are applicable to this AQMP:

#### 2.4.1 IFC EHS Guidelines –1.1 Environmental Air Emissions and Ambient Air Quality

IFC EHS Guideline 1.1 Air Emissions and Ambient Air Quality cover the general principles of assessing impacts to air quality. In addition to the air quality standards set out, emission limits and guidelines for specific technologies and operations are also specified.

The IFC cite ambient air quality standards based upon the World Health Organisation (WHO) Air Quality Guidelines for Europe 2000 and 2005 update. These are the principle air quality standards and guidelines utilised in this AQMP in the absence of specific national standards (as is mentioned previously in Section 2.2.1). These are set out in Table 2.1.

Table 2.1 Air Quality Standards and Guidelines

Pollutant	Averaging Period	WHO Guideline Value ( $\mu\text{g}/\text{m}^3$ )
SO <sub>2</sub>	24-hour maximum	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)
	10-minute maximum	500 (guideline)
NO <sub>2</sub>	1-year mean	40 (guideline)
	1-hour maximum	200 (guideline)
TSP	1-year mean	No guideline
	24-hour maximum	No guideline
PM <sub>10</sub>	1-year mean	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)
	24-hour assessed as the third highest 24 hour period (99 <sup>th</sup> percentile)	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
PM <sub>2.5</sub>	1-year mean	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
	24-hour maximum	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)

The WHO air quality guidelines refer to guidelines for all pollutants. In addition, for PM<sub>10</sub>, PM<sub>2.5</sub> and SO<sub>2</sub> as the 24 hour mean, the WHO also refer to Interim Targets; within the assessment, the attainment of the Target-1 is

considered to be the minimum attainment level, in order to confer a reasonable degree of protection to human health, with the guideline remaining aspirational.

With regards to dust deposition standards, there are several standards and guidelines published by various bodies. These are set out in *Table 2.2*.

**Table 2.2** *Dust Deposition Nuisance Criteria*

Criteria definition	Measure of soiling (mg/m <sup>2</sup> /day)	Data source
<b>National Guidelines</b>		
Possible Nuisance	350 (monthly mean)	TA-Luft (Germany)
Very Likely Nuisance	650	TA-Luft (Germany)
First Loss of Amenity	133 (monthly mean)	West Australia Nuisance Standard
Unacceptable reduction in air quality	333	West Australia Nuisance Standard
Serious nuisance	200	UK recommended nuisance dust deposition rate
Nuisance dust deposition	133	Malaysia air quality standard
<b>Evidence Based Guidelines</b>		
Noticeable (urban)	95	Source 1
Possible complaint (rural)	119	Source 1
Objectionable	167	Source 1
Probable complaint	476	Source 1
Serious complaint	1191	Source 1

Note: Source 1: Cites:

- Hancock, R. P., Esmen, N. A., and Furber, C. P. (1976) "Visual Response to Dustiness", *Journal of the Air Pollution Control Association*, 26 (1), 1976, pp54 -57;
- Beaman, A. L. and Kingsbury, R. W. S. M. (1981) "Assessment of Nuisance from Deposited Particles Using a Simple and Inexpensive Measuring System". *Clean Air*, 11, 1981;
- Bate, K. J. and Coppin, N. J. (1991) "Dust impacts from mineral workings", *Mine and Quarry*, 20 (3), 1991, pp31 - 35;
- Hofschreuder, P. and Vrins, E. L. M. (1992) "Nuisance from coarse dust", *Journal of Aerosol Science*, 23 (S1), 1992, pp691 - S694;
- Quality of Urban Air Research Group. (1996) "Airborne Particulate Matter in the United Kingdom: Third Report of the Quality of Urban Air Review Group", prepared at the request of the Department of the Environment. University of Birmingham, Birmingham.

There is no clear consensus as to the level of dust deposition that is likely to result in nuisance issues, relating to the fact that nuisance is around perception rather than health based impacts. However, on the basis of pragmatic consideration of the various criteria set out in the ESIA, the following **nuisance magnitude criteria** have been developed for this assessment relating to dust deposition:

- Negligible: < 120mg/m<sup>2</sup>/day
- Small: 120 - 200 mg/m<sup>2</sup>/day
- Medium: 200 - 350 mg/m<sup>2</sup>/day
- Large: > 350mg/m<sup>2</sup>/day

With respect to this Plan, Yara Dallol BV has the responsibility to provide air quality management and to structure and coordinate air quality management procedures for the Yara Dallol Potash Project.

Furthermore, Yara Dallol BV has the responsibility for ensuring that specific air quality management and monitoring responsibilities allocated to them are organised and implemented. Yara Dallol BV has the responsibility to ensure that their employees and contracted third parties are trained and aware of all required air quality related procedures.

The roles and responsibilities within Yara Dallol BV for the implementation of the AQMP are presented in *Table 3.1*.

**Table 3.1** *Responsible Parties and Roles and Responsibilities*

<b>Responsible Parties</b>	<b>Roles and Responsibilities</b>
<b>Dallol General Manager</b>	Responsible for assuring that the <i>Environmental and Social Manager</i> has the resources, information and authority to implement the management measures described in this AQMP.
<b>Environmental and Social Manager</b>	Responsible enforcing the management/monitoring measures described in this AQMP.  Responsible for the provision of AQMP training to Yara Dallol BV staff and contractors
<b>Community Liaison Officer</b>	Responsible for stakeholder engagement applicable with this AQMP
<b>Project Manager</b>	Together with the Environmental and Social Manager is responsible for staffing, planning and day-to-day execution of the management measures described under the construction phase of this AQMP.  As needed, this individual will develop and propose staff plans and contractual language to ensure that these measures are implemented by Yara Dallol BV staff and contractors throughout the construction phase of the Project.
<b>Operations Manager</b>	Together with the Environmental and Social Manager, is responsible for staffing, planning and day-to-day execution of the management measures described under the operational phase of this AQMP.  As needed, this individual will develop and propose staff plans and contractual language to ensure that these measures are implemented by Yara Dallol BV staff and contractors during Project operation.
<b>Contractors (Construction and Operations)</b>	Responsible for following the air quality procedures and requirements indicated in construction and operational sections of this AQMP.

#### **4.1** *SUMMARY OF IMPACT MANAGEMENT*

As with any project of this scale and nature, there are certain impacts that cannot be entirely eliminated, i.e. residual impacts after implementing mitigation measures. With respect to impact mitigation, the Project subscribes to the philosophy of impact avoidance (by changes to project planning and/or design) and impact reduction (to reduce impacts that cannot be avoided to acceptable levels). What follows is a description of the potential residual impacts and the mitigation measures proposed to reduce them to acceptable levels. These mitigation measures essentially comprise the “management plan” to address air quality related impacts. In addition, ‘Action Levels’ have been set out. These are based upon environmental monitoring during operation and are concentrations of pollutants in air which, if exceeded, trigger further mitigation or control.

The following sections will:

- Identify potential impacts associated with each phase of the proposed Project;
- Identify the objectives and targets related to the impacts;
- Describe the management measure(s) to minimise the impact;
- Assign responsibilities for the management measures; and
- Set out Action Levels.

#### **4.2** *MANAGEMENT DURING CONSTRUCTION*

##### **4.2.1** *Potential Impacts*

The key impacts during the construction phase are associated with significant emissions of dust and particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) due to construction activities and vehicle movements.

##### **4.2.2** *Management Actions*

The control and mitigation of dust, PM<sub>10</sub> and PM<sub>2.5</sub> emissions will be achieved by implementing the following measures during the construction phase:

- Impacts associated with road traffic will be adequately mitigated by salt (or through use of MgCl<sub>2</sub>) encrusting or chemical treatment of unpaved

roads as this will effectively attenuate dust emission and render all residual impacts negligible, or at worst minor adverse.

- At the early phases of construction works (i.e. prior to implementation of salt encrusting or chemical treatment), wetting of unpaved roads surfaces will be carried out as a short term mitigation of dust emissions; however, due to the arid conditions and elevated wind speeds in the Project Area, dampening will not be undertaken on large areas. Rather localised dampening or activity specific dampening will be used to reduce localised emissions of dust.
- A speed limit of 32kph <sup>(1)</sup> will be maintained on gravel roads where surface binding agents or salt encrusting have not been applied.
- Vehicles will be kept clean to avoid tracking dirt around the site.
- Vehicles transporting friable materials will be covered.
- Where feasible, surface binding agents will be used on exposed open earthworks.
- Within practical limits, the smallest possible area for cleared ground for work will be exposed, and where feasible, surface binding agents will be used on exposed open earthworks.
- Stockpiling of material, for example, rocks, wadi outwash, sand and soils will be minimised.
- Stockpiles will be located as far away from receptors as possible.
- Stockpiles will be enclosed or sheeted as much as possible.
- The design of stockpiles will be optimised to retain a low profile with no sharp changes in shape.
- Drop heights of material will be minimised.
- Wind breaks (perpendicular to the northerly prevailing wind direction and at a height of approx. 0.5m) will be erected around the key construction activities, specifically to the north and to the south of activities (i.e. processing plant, staff village, generator compound), and, if possible, in the vicinity of potentially dusty works.

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(1) **Please Note** - the UK Highway Agency (2007) states that a speed limit of 10 to 15 mph (16 to 24 kph) should be maintained on unpaved roads that have not been chemically treated; however, it is noted that such speed limits are impractical. As such, the speed limit of 32kph is based on professional judgement to be a speed that will ensure limited dust is generated while practical speed limits are maintained.

- Where feasible and reasonable, Yara Dallol BV will use vehicles that are compliant with recent emission standards (for example, EURO Tier 3). These vehicles will be maintained in reasonable working order. When not in use, vehicles will be switched off, unless impractical for health and safety reasons (for example maintenance of air conditioning).

#### *Additional Actions*

The abovementioned mitigation measures with regards to dust emissions will reduce impacts to a negligible level for the majority of the time. However, due to the exceptionally challenging local conditions, the impacts will be difficult to control at all times, and no guarantee can be made that significant impacts will not sporadically occur. In these circumstances, the following additional measures will be implemented:

- The use of localised water sprays to attenuate dust emissions;
- The use of mobile wind breaks immediately around activities to reduce dust generation; and
- The temporary cessation of activities if wind speeds exceed 10m/s.

### 4.2.3

#### *Objectives and Targets*

Site specific action levels are set out below. These are based upon real-time air quality monitoring, real time meteorological monitoring and the recording of visible dust emissions.

#### *Real-time PM<sub>10</sub> Monitoring*

- Undertaken upwind and downwind of construction activities.
- Will use the correct active techniques (i.e. Dusttrak or Osiris monitor or similar, as discussed in detail in *Section 5.2 on Page 5-1*).
- This method considers the effect of the naturally high baseline (arid conditions and elevated wind speeds), as well as emissions due to activities at other nearby sites.
- The monitoring data will be reviewed each day to determine if any activities executed on site are resulting in elevated emissions of particulates, i.e. where the difference between the upwind and downwind site is greater than 150µg/m<sup>3</sup>.
- Where elevated PM<sub>10</sub> concentrations are recorded, these will be considered in light of on-site activities.



#### ACTION LEVELS

Additional actions to reduce emissions (refer to *Section 4.2.2 – Additional Actions*) will be undertaken on site when PM<sub>10</sub> concentrations are greater than 150 µg/m<sup>3</sup> between 'upwind' and 'downwind' locations.

#### *Real-time Meteorological Monitoring*

- Will be undertaken at the construction site, at an upwind location.
- When wind speeds are elevated, consideration will be made of:
  - Potential dust raising activities being undertaken on site; and
  - The need to implement additional mitigation or controls;

#### ACTION LEVELS

When winds are directed from the site towards sensitive receptors within 5km from where the activity resulting in emissions is being undertaken, consideration will be made to implement additional action (refer to *Section 4.2.2 – Additional Actions*) mitigation or controls.

#### *Passive Dust Deposition Monitoring*

- Dust monitors (Bergerhoff gauges using dust buckets) will be placed at two upwind and two downwind locations, relative to the construction activities.
- The dust monitors will be placed at representative locations around the construction works, and relocated as required if construction works are undertaken in various locations.
- This method considers the effect of the naturally high baseline (arid conditions and elevated wind speeds), as well as emissions due to activities at other nearby sites.
- In addition, monitoring will continue to be undertaken at sensitive receptors (i.e. villages), where these may be subject to significant impacts arising from construction activities or construction related traffic.

#### ACTION LEVELS

Additional actions to reduce emissions (refer to *Section 4.2.2 – Additional Actions*) will be undertaken on site when long term (monthly) dust deposition at sensitive receptors exceeds 350 mg/m<sup>2</sup>/day, as the monthly average

### *Visual Monitoring*

If significant dust is observed (i.e. where dust is considered to be sufficient to result in nuisance at receptors) being lifted from site activities, measures will be implemented to reduce these.

## **4.3**            *MANAGEMENT DURING OPERATION*

### **4.3.1**        *Potential Impacts*

During operations the key impacts resulting in atmospheric emissions are associated with:

- Traffic through the Project Area;
- The processing and handling of potash product; and
- The generation of power by emergency generators.

It has to be noted that in impacts arising during the construction phase of the Project an important assumption was made that unpaved internal roads will be chemically treated or salt encrusted to eliminate the raising of dust. This management action is not included in the operational phase of the Project as these management actions would have been implemented during the construction phase.

Potash bearing raw salts is primarily handled in a moist condition, minimising the potential for dust emissions to arise. On this basis, emissions from the production process are expected to result in negligible impacts.

The processing plant will utilise power from the main power grid during normal operations. However the facility will be equipped with emergency power supply for the maintenance of critical systems during power failure. These units will only be used occasionally as a result.

The incineration of waste will occur approximately 36 hour per week, and will also utilise a small quantity of fuel. The incinerator will be a new unit designed to be compliant with best practice and international standards for emissions, for example the European Industrial Emissions Directive and in compliance with best practice for appropriate design of the stack (i.e. following IFC guidelines on appropriate stack design). On this basis, impacts are predicted to be negligible.

### **4.3.2**        *Management Actions*

Concerning impacts associated with the transport of the potash product during the operational phase of the Project, the following management actions will be implemented:

- Vehicles will be maintained in good working order, to ensure that exhaust emissions are minimised. When idling or not in use, vehicles will be powered down, where practical.
- Product will be loaded into silo trailers through the use of an overhead cone storage silo load out. This will result in zero product loss and no tyre entrainment.
- All heavy goods vehicles owned by Yara Dallol BV will be EURO Tier 3 compliant.

The following management measures will be implemented with respect to operations associated with the emergency generator set power plant:

- The power plant engines will be subject to routine maintenance to keep the engines in optimum working order.
- Diesel with the lowest possible sulphur content (and that is commercially available in Ethiopia) will be used to fuel the power plant.
- Engines will be checked to ensure on-going compliance with Ethiopian and IFC emission standards.

The following measures will be implemented with respect to operations associated with the waste incinerator:

- The incinerator will be compliant with best practice and international standards, for example the European Industrial Emissions Directive.
- The incinerator stack will be designed in compliance with IFC guidelines.

### 4.3.3 *Objectives and Targets*

Site specific action levels are set out below. These are based upon real-time air quality monitoring, real time meteorological monitoring and the recording of visible dust emissions.

#### *Real-time PM<sub>10</sub> Monitoring*

- Undertaken upwind and downwind of the processing plant and activities that may result in significant dust emissions, including mining activities and haul roads.
- Will use the correct active techniques (i.e. Dusttrak or Osiris monitor or similar, as discussed in detail in *Section 5.2 on Page 5-1*).
- This method considers the effect of the naturally high baseline (arid conditions and elevated wind speeds), as well as emissions due to activities at other nearby sites.

- The monitoring data is to be reviewed each month to determine if any activities executed on site are resulting in elevated emissions of particulates, i.e. where the difference between the upwind and downwind site is greater than 150µg/m<sup>3</sup> for a period of 1 hour or more.
- Where elevated PM<sub>10</sub> concentrations are recorded, these will be considered in light of on-site activities.

#### ACTION LEVELS

Additional Management Actions (i.e. – localised dampening or establishment of temporary wind breaks) to reduce emissions (in addition to what is mentioned in *Section 4.3.2*) will need to be considered on site when PM<sub>10</sub> concentrations are greater than 150 µg/m<sup>3</sup> between ‘upwind’ and ‘downwind’ locations.

#### *Real-time Meteorological Monitoring*

- Will be undertaken at the site, at an upwind location.
- When wind speeds are elevated consideration will be made of:
  - Potential dust raising activities being undertaken on site; and
  - The need to implement additional mitigation or controls;

#### ACTION LEVELS

When winds are directed from the site towards sensitive receptors within 5km from where the activity resulting in emissions is being undertaken, consideration will be made to implement Additional Management Actions (in addition to what is mentioned in *Section 4.3.2*) (i.e. – localised dampening or establishment of temporary wind breaks).

#### *Passive Dust Deposition Monitoring*

- Dust monitors (Bergerhoff gauges using dust buckets) will be placed upwind and downwind from the processing plant and dust raising activities (i.e. mining activities and internal access roads).
- The dust monitors will be placed at representative locations around the dust raising activities, and relocated as required if these activities are undertaken in various locations.
- This method considers the effect of the naturally high baseline (arid conditions and elevated wind speeds), as well as emissions due to activities at other nearby sites.

#### ACTION LEVELS

Additional Management Actions (i.e. – localised dampening or establishment of temporary wind breaks) to reduce emissions (in addition to what is mentioned in *Section 4.3.2*) will be undertaken on site when long term (monthly) dust deposition at sensitive receptors exceeds 350 mg/m<sup>2</sup>/day, as the monthly average

#### *Long Term Monitoring using Passive Diffusion Tubes for Monitoring NO<sub>2</sub> and SO<sub>2</sub>*

- Passive diffusion tubes will be placed upwind and downwind from the processing plant, with focus on sensitive receptor locations downwind of the diesel emergency generator sets.
- The monitoring data is to be reviewed six monthly to determine if long term impacts are acceptable, i.e. where the impacts are greater than the action levels (see below).

#### ACTION LEVELS

Additional Management Actions (i.e. – such as increasing the height of exhausts stacks) to reduce emissions (in addition to what is mentioned in *Section 4.2.2*) will be undertaken on site when long term (quarterly) concentrations of NO<sub>2</sub> and SO<sub>2</sub> exceed 40µg/m<sup>3</sup> for NO<sub>2</sub> and 20µg/m<sup>3</sup> for SO<sub>2</sub>.

- If long term impacts are unacceptable, consideration will be made to modify the operation of the emergency power plant or the emission points (i.e. stack height, combine stacks).

#### *Visual Monitoring*

If significant dust is observed (i.e. where dust is considered to be sufficient to result in nuisance at receptors) being lifted from site activities, measures will be implemented to reduce these.

## **4.4** *MANAGEMENT FOR DECOMMISSIONING AND CLOSURE*

### **4.4.1** *Potential Impacts*

The closure and decommissioning of the Project has the potential to result in impacts that are associated with emissions of dust and particulate matter due to:

- The deconstruction of buildings and process installations;
- Transport of materials from the site by trucks;
- Earthworks for restoration of the site; and
- Decommissioning and restoration of the mine workings and evaporation ponds.

These emissions are similar as those that arise during the construction phase.

#### **4.4.2**      *Management Actions*

Based on the assumption that the internal haul roads will be removed but that the main haul road will remain, the management and mitigation measures are similar to those for the construction phase. As such, the management actions that will be adopted during the decommissioning and closure phase of the Project will be those that are detailed for during the construction phase (refer to *Section 4.2.2 on Page 4-1*).

#### **4.4.3**      *Objectives and Targets*

The same site specific action levels based upon real-time air quality monitoring, real time meteorological monitoring and the recording of visible dust emissions set out for the construction phase will be applicable for the decommissioning and closure phase of the Project.

### 5.1 OVERVIEW

As previously discussed, monitoring is required during construction, operation and decommissioning/closure of the Project. The monitoring programme is designed to:

- Assist in the decision making process around the implementation of mitigation.
- Verify the efficiency of mitigation measures.
- Ensure that unacceptable impacts are not arising at nearby sensitive receptors.

The monitoring programme includes the following elements:

- Real time monitoring of PM<sub>10</sub>;
- Real time monitoring of meteorological parameters;
- Passive monitoring of dust deposition; and
- Passive monitoring of nitrogen dioxide (NO<sub>2</sub>) and SO<sub>2</sub> (sulphur dioxide).

Next to physical monitoring, visual inspections will also be required as well as recording and taking care of/reacting to substantiated complaints from local communities. Suggested monitoring locations are subject to finalisation following design finalisation of the Project.

### 5.2 PM<sub>10</sub> MONITORING

Real time monitoring of PM<sub>10</sub> will be undertaken upwind and downwind of the processing plant during construction, operational and decommissioning/closure phases. The difference in the upwind and downwind concentrations of PM<sub>10</sub> will be used to ascertain the contribution to ambient PM<sub>10</sub> from the site. On this basis the site will be required to employ one upwind monitoring location and two downwind monitoring locations during construction and operation. Given the variability in localised wind conditions, three monitoring sites at relevant locations on the site boundary are considered appropriate to adequately capture upwind and downwind PM<sub>10</sub> concentrations.

During the construction phase the monitoring data will be reviewed on a daily basis; and during the operational phase will be considered on a monthly basis. Where PM<sub>10</sub> emissions associated with the site are above the action levels investigations will be made into the sources of emissions and measures implemented to manage emissions.

PM<sub>10</sub> monitoring will be undertaken using devices that are recognised by a suitable international standard as being suitable for purpose. Examples include light scattering devices such as the Dusttrak, Topas, Osiris, AirQual and methods such as the Beta Attenuation Monitor. The equipment will be serviced by a competent party on a monthly basis to ensure effective operation, and will be overhauled by a qualified engineer on an annual basis.

There are a number of PM<sub>10</sub> monitoring techniques available that would be suitable for use at the site; however, techniques based upon the principle of light scattering will be employed. These have the benefit of providing short term real-time data upon which decisions around mitigation and control can be based. The use of filter based monitoring will not be employed as this technique requires the daily changing of filters in a hostile environment such as the Danakil Depression, and there is a 'lag time' as the filters require analysis from a certified laboratory. The use of devices utilising Tapered Element Oscillating Microbalance (TEOM) will also not be employed as these require highly specialised servicing.

### 5.3 *METEOROLOGICAL MONITORING*

Real time monitoring of meteorological conditions will continue at the existing Yara Dallol BV Camp as this location is representative of site conditions, and is not subject to interference by the site itself, i.e. changes in wind patterns due to the interference of building structures. Meteorological data will be reviewed on a daily basis, during construction along with the PM<sub>10</sub> data to ascertain those conditions under which significant impacts arise; this will include consideration of wind direction in terms of the migration of emissions towards sensitive receptors in addition to wind speed. During the operational phase, the meteorological data will be reviewed on a monthly basis, along with the PM<sub>10</sub> and dust deposition data. The review will identify those meteorological conditions when impacts are significant and the efficacy of any mitigation implemented.

### 5.4 *PASSIVE MONITORING OF DUST DEPOSITION*

Monitoring will be undertaken using passive deposition monitoring upwind and downwind of the site during construction and operation phases. The difference in the upwind and downwind deposition will be used to determine the contribution to deposited dust from the site. On this basis the site will be required to employ one upwind monitoring location and two downwind monitoring locations during construction and operation in the vicinity of the site boundary. Given the variability in localised wind conditions, three monitoring sites at relevant locations on the site boundary are considered appropriate to adequately capture upwind and downwind dust deposition.



During the construction and operational phases the monitoring data will be reviewed on a monthly basis. Where dust emissions associated with the site are above the action levels investigations will be made into the sources of emissions and measures implemented to manage emissions.

The monitoring will be undertaken using an internationally recognised technique, for example with the use of Bergerhoff Gauges, or Frisbee Gauges. The analysis of samples will be undertaken by a suitably certified laboratory, or at the on-site laboratory should Yara Dallol BV purchase the necessary laboratory equipment (driers/fine scale).

## 5.5 *PASSIVE MONITORING OF NO<sub>2</sub> AND SO<sub>2</sub>*

Long term monitoring of NO<sub>2</sub> and SO<sub>2</sub> using passive diffusion tubes will be undertaken upwind and downwind of the emergency power plant, specifically representative of sensitive receptor locations downwind of the power plant. Three locations on the site boundary adjacent to the emergency power generation compound are considered adequate to capture impacts; in addition, two further monitoring locations should be implemented at nearby sensitive receptors. The monitoring data will be reviewed on a six monthly basis.

The analysis of samples will be undertaken by a suitably certified laboratory.

Diffusion tubes utilise the principle of targeted diffusion of gases onto a reagent, in this case NO<sub>2</sub> and SO<sub>2</sub>. In the laboratory the tubes are titrated to calculate a concentration in air, when taking into account exposure time.

## 5.6 *VISUAL INSPECTION*

During the construction, operation and decommissioning/closure phase's commitment is made to undertake visual inspections of activities resulting in dust on-site. In the event that activities on site are observed to be generating significant airborne dust. The visual inspections will be undertaken on a daily basis, and will reflect the ethos of 'see it, own it', in terms of identifying and addressing significant air quality impacts. Where significant impacts are observed, these will be recorded. On the basis of the reports, where there are activities that repeatedly result in significant impacts, further investigations will be undertaken to reduce these impacts.

This will be the role of the Environmental and Social Manager, or nominated representative.

Complaints arising from construction and site establishment works or from mining and processing operations will be treated sensitively and in a manner that recognises the potential for dust emissions to become a nuisance.

Records of any complaints associated with dust emissions will be kept and captured on a grievance register, identifying the nature of the complaint, the particular activity, plant and/or equipment that initiated the complaint, and documenting the action taken. All complaints will be investigated and feedback provided to the complainant.

## 6 *REPORTING AND DOCUMENTATION*

### 6.1 *GOVERNMENT/AUTHORITY REPORTING*

There are no Ethiopian regulatory requirements dealing specifically with the need to submit air quality monitoring reports to the Ethiopian Government.

### 6.2 *INTERNAL REPORTING*

On the basis of the daily and monthly monitoring undertaken during construction and decommissioning/closure phases, monthly reports will be generated and lodged with the Yara Dallol BV board of directors as part of Yara Dallol BV's Environmental and Social Monitoring. During the operational phase, the monthly monitoring will be reported on a six monthly basis.

The reports will summarise the data collected through the monitoring programme, identifying any occasions when the action levels were triggered and the remedial action that was taken. The reports will also include the findings of the visual observations, and will include a record of the activities resulting in impacts and any remedial actions taken, and the likelihood of a repetition of impact. The reports will also summarise any complaints received from the local communities, setting out the complaint, whether it was substantiated and any actions taken to alleviate the impact.

### 6.3 *COMMUNITY REPORTING*

On the basis of the monthly and six monthly reporting undertaken during the construction, operational and decommissioning/closure phases, a summary report suitable for understanding by a non-technical community audience will be developed and disclosed on a six monthly basis. This report will focus upon graphical representation of information, and in particular outcomes of any community complaints and those actions taken to remedy significant impacts.

Table 7.1 Construction and Decommissioning/Closure Phases

Impact	Objective	Mitigation/Management Measures	Monitoring Plan	Responsibility
Emissions of PM <sub>10</sub> and dust	<p>Site emissions result in airborne concentrations of PM<sub>10</sub> less than 150µg/m<sup>3</sup>.</p> <p>Site emissions do not result in substantiated nuisance issues at sensitive receptors, and daily average (as the monthly mean) dust deposition associated with site activities does not exceed 350mg/m<sup>2</sup>/day</p>	<p>Impacts associated with road traffic will be adequately mitigated by salt (or through use of MgCl<sub>2</sub>) encrusting or chemical treatment of unpaved roads</p> <p>At the early phases of construction works (i.e. prior to implementation of salt encrusting or chemical treatment), wetting of unpaved roads surfaces will be carried out as a short term mitigation of dust emissions; however, due to the arid conditions and elevated wind speeds in the Project Area, dampening will not be undertaken on large areas.</p> <p>A speed limit of 32kph will be maintained on gravel roads where surface binding agents or salt encrusting have not been applied.</p> <p>Vehicles will be kept clean to avoid tracking dirt around the site.</p> <p>Vehicles transporting friable materials will be covered.</p> <p>Where feasible, surface binding agents will be used on exposed open earthworks.</p> <p>Within practical limits, the smallest possible area for cleared ground for work will be exposed, and where feasible, surface binding agents will be used on exposed open earthworks.</p> <p>Stockpiling of material, for example, rocks, wadi outwash, sand and soils will be minimised.</p> <p>Stockpiles will be enclosed or sheeted as much as possible.</p> <p>Stockpiles will be located as far away from receptors as possible</p> <p>The design of stockpiles will be optimised to retain a low profile with no sharp changes in shape.</p> <p>Drop heights of material will be minimised.</p> <p>Wind breaks will be erected around the key construction activities, specifically to the north and to the south of activities (i.e. processing plant, staff village, generator compound), and, if possible, in the vicinity of potentially dusty works.</p> <p>Where feasible and reasonable, Yara Dallol BV vehicles compliant with recent emission standards (for example, EURO Tier 3) will be used. These vehicles will be maintained in reasonable working order. When not in use, vehicles will be switched off, unless impractical for health and safety reasons (for example maintenance of air conditioning).</p> <p>Where significant air quality impacts sporadically occur, the following will be implemented:</p> <ul style="list-style-type: none"> <li>• The use of localised water sprays to attenuate dust emissions;</li> <li>• The use of mobile wind breaks immediately around activities to reduce dust generation; and</li> <li>• The temporary cessation of activities until improvements in wind conditions occur.</li> </ul>	<p>PM<sub>10</sub> monitoring at three locations on the site boundary</p> <p>Meteorological monitoring at one location, unaffected by site buildings etc.</p> <p>Dust monitoring at three site boundary locations, and at two sensitive receptor locations</p>	<ul style="list-style-type: none"> <li>• Environmental and Social Manager</li> </ul>

Table 7.2 Operational Phase

Impact	Objective	Mitigation/Management Measures	Monitoring Plan	Responsibility
Emissions of PM <sub>10</sub> and dust	<p>Site emissions result in airborne concentrations of PM<sub>10</sub> less than 150µg/m<sup>3</sup>.</p> <p>Site emissions do not result in substantiated nuisance issues at sensitive receptors, and daily average (as the</p>	<p>Vehicles will be maintained in good working order, to ensure that exhaust emissions are minimised. When idling or not in use, vehicles will be powered down, where practical.</p> <p>Product will be loaded into silo trailers through the use of an overhead cone storage silo load out. This will result in zero product loss and no tyre entrainment</p>	<p>PM<sub>10</sub> monitoring at three locations on the site boundary</p> <p>Meteorological monitoring at one location, unaffected by site buildings etc.</p> <p>Dust monitoring at three site boundary</p>	<ul style="list-style-type: none"> <li>• Yara Dallol BV Project Team associated with detailed design and planning of the Project</li> </ul>

Impact	Objective	Mitigation/Management Measures	Monitoring Plan	Responsibility
	monthly mean) dust deposition associated with site activities does not exceed 350mg/m <sup>2</sup> /day	All Yara Dallol BV heavy goods vehicles will EURO Tier 3 compliant	locations, and at two sensitive receptor locations	<ul style="list-style-type: none"> <li>Operations Manager</li> </ul>
Emissions of NO <sub>2</sub> and SO <sub>2</sub> from emergency generator set power plant	Ensure that the air quality standards for NO <sub>2</sub> (40µg/m <sup>3</sup> ) and SO <sub>2</sub> (20µg/m <sup>3</sup> ) are not exceeded at sensitive receptors	<p>The power plant engines will be subject to routine maintenance to keep the engines in optimum working order</p> <p>Diesel with the lowest sulphur content (and that is commercially available) will be used to fuel the power plant.</p> <p>Engines will be checked to ensure on-going compliance with Ethiopian and IFC emission standards</p>	NO <sub>2</sub> and SO <sub>2</sub> monitoring at three site boundary locations, and at two sensitive receptor locations	<ul style="list-style-type: none"> <li>Yara Dallol BV Project Team associated with detailed design and planning of the Project</li> <li>Operations Manager</li> </ul>
Emissions of NO <sub>2</sub> and SO <sub>2</sub> from the waste incinerator	Ensure that the air quality standards for NO <sub>2</sub> (40µg/m <sup>3</sup> ) and SO <sub>2</sub> (20µg/m <sup>3</sup> ) are not exceeded at sensitive receptors	<p>The incinerator will be compliant with best practice and international standards, for example the European Industrial Emissions Directive</p> <p>The incinerator stack will be designed in compliance with IFC guidelines</p>	Associated with the above monitoring plan	Yara Dallol BV Project Team associated with detailed design and planning of the Project