Air Quality Scoping Report for the EIA for a New Coal-Fired Power Plant near Makhado, Limpopo Province

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GLOSSARY OF ACRONYMS, TERMS AND UNITS

AEL	Atmospheric Emission License
APPA	The Atmospheric Pollution Prevention Act (Act 45 of 1965)
AQA	National Environmental Management: Air Quality Act (Act No. 39 of 2004)
DEA	Department of Environmental Affairs
CBIPPPP	Coal Baseload Independent Power Producer Procurement Programme
CFB	Circulating Fluidised Bed
CoAL	Coal of Africa Limited
DoE	Department of Energy
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GHG	Greenhouse Gas
HRA	Health Risk Assessment
IEP	Integrated Energy Plan
IFC	International Finance Corporation
IPP	Independent Power Producer
mg/m^3	Milligrams per cubic meter
NDP	National Development Plan
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen ($NO_x = NO + NO_2$)
PC	Pulverised Coal
PM_{10}	Particulate matter with a diameter less than 10 microns
$PM_{2.5}$	Particulate matter with a diameter less than 2.5 microns
SO_2	Sulphur dioxide
$\mu g/m^3$	Micrograms per cubic meter
VOC	Volatile organic compound
WML	Waste Management License

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1. INTRODUCTION

Mutsho Power (Pty) Ltd proposes the development of a new coal-fired power plant and associated infrastructure on a site near Makhado, in the Limpopo Province. The power plant will utilise coal mined at the Makhado Mine (roughly 20 km south-east of the project site), owned and operated by Coal of Africa Limited (CoAL), to fuel its operations. Once developed, the power plant is intended to form part of the Department of Energy's (DoE's) Coal Baseload Independent Power Producer (IPP) Procurement Programme (CBIPPPP). The project would have a generation capacity of up to 600 MW, and will make use of either Pulverised Coal (PC) or Circulating Fluidised Bed (CFB) technology.

Mutsho Power (Pty) Ltd has appointed Savannah Environmental (Pty) Ltd to undertake an integrated Environmental Impact Assessment (EIA) process to obtain Environmental Authorisation and a Waste Management License (WML) for the proposed Mutsho Power Project. uMoya-NILU (Pty) Ltd has been sub-contracted to undertake the air quality specialist study for the EIA.

This air quality scoping report is the first phase of the assessment. This air quality scoping report serves to:

- Provide a description of the project and potential sources of air pollution.
- Identify policies and legislation relevant to the activity.
- Identify the key issues to be addressed in the impact assessment phase.
- Provide an overview of the level of assessment to be undertaken to determine the impacts and risks the activity will impose on the preferred site through the life of the activity (including the nature, significance, consequence, extent, duration and probability of the impacts), and to inform the location of the development footprint within the preferred site.
- Identify potential sensitive environments and receptors that may be impacted on by the proposed facility and the types of impacts (i.e. direct, indirect and cumulative) that are most likely to occur.
- Provide an evaluation of the expected significance of identified impacts (including nature, extent, significance, consequence, duration and probability of the impacts including the degree to which these impacts can be reversed; may cause irreplaceable loss of resources; and can be avoided, managed or mitigated).
- Identify sensitive and "No-Go" areas, where applicable.
- Summarise the potential impacts that will be considered further in the EIA Phase through specialist assessments.
- Identify suitable measures to avoid, manage or mitigate identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

2. PROJECT DESCRIPTION

The proposed power plant will typically comprise of the following key components and associated infrastructure:

- The power island consisting of:
    - Pulverised Coal (PC) with Flue Gas Desulphurisation scrubbing / clean-up; or Circulating Fluidised Bed (CFB) boiler technology.
    - Electrostatic Precipitator (ESP) / Bag filtration systems and Flue / smoke stacks.
    - Direct or indirect air-cooling systems.

  - Balance of plant components (incl. steam turbine and generator etc.).
- Coal and Limestone / Lime Rail Spur and-or Road offloading Systems.
- Upgrading or establishment of a rail siding.
- Coal crusher (for CFB); or coal milling plant (for PC).
- Strategic and Working Coal stockpiles.
- Limestone or Lime storage and handling area (for use with CFB or PC technology).
- Ammonia storage and handling area (for use in flue gas clean-up with PC technology).
- Ash dump (dry-ashing is proposed in order to reduce the project's water requirements).
- Water infrastructure. This could include:
  - Raw water storage dams
  - Raw water storage dams.
  - Water supply pipelines and booster stations.
  - Pollution control dams.
  - Water treatment plant (WTP).
  - Wastewater treatment plant (WWTP)
  - Storm water management systems
- High Voltage (HV) Yard and substation components with HV overhead transmission lines connecting to the Eskom infrastructure.
- Control room, office / administration, workshop, storage and logistics buildings.
- Upgrading of external roads and establishment of internal access roads.
- Security fencing and lighting.

A minimum footprint of approximately 600 ha is required for the proposed power plant and associated infrastructure. The type of technology selected for implementation would ultimately influence the final project layout and the area of land required for development. While the physical power generation components (i.e. the power island) require approximately 50 ha, supporting areas for the establishment of coal and other raw material stockpiles, and an ash dump over life of plant, increase the development footprint.

Two properties have been identified for the development of the proposed project. These are the farms Du Toit and Vrienden. The possibility exists that the proposed power plant and associated infrastructure may be developed in its entirety on either of the properties, or alternatively portions of the project may be developed on both.

3. ELECTRICITY GENERATION AND AIR POLLUTANTS

In coal-fired power plants, crushed coal is burnt to generate heat, which in turn is used to heat water and generate steam. The steam then drives turbines that generate electricity. The combustion of coal results in emissions of numerous pollutants into the atmosphere. These include particulate matter (including trace metals), gases (including sulphur dioxide (SO_2)), nitrogen oxides (NO_x = NO + NO_2) and carbon monoxide (CO), organics (volatile organic compounds, polycyclic organic matter (PAH, PCDD, etc.)) and trace elements (mercury, arsenic, etc.). The resultant pollutants are a function of the sulphur and ash content of the coal, combustion temperature, oxygen mixing and sufficient time for complete combustion, and the efficiency of the air pollution abatement equipment. Greenhouse gases (GHG) emitted during coal combustion include carbon dioxide (CO_2), methane (CH_4) and nitrous oxides (N_2O). Dust emissions may emanate from the handling and storage of coal, lime and ash, from coal crushing or milling, working stockyard, silos and conveyor operations, limestone rail/road offloading, storage, ash-handling conveyors, silos, disposal and dump facility operations.

Known human health impacts of exposure to SO_2 and NO_2 are mainly respiratory effects such as narrowing of the airways, exacerbation of asthma and an influence on lung function. The effects of PM depend on the size and chemical composition of the particles. Particles with a diameter smaller than 10 µm (including PM_{10} and $PM_{2.5}$) may be inhaled and result in respiratory effects as well as cardiovascular effects. The health effects of volatile organic compounds (VOC) such as benzene, toluene, ethyl-benzene and xylene, associated with fossil fuel burning, include acute neurological effects such as headaches and dizziness when exposed to relatively high concentrations. Some VOCs such as benzene are carcinogenic.

4. THE RECEIVING ENVIRONMENT

Musina Local Municipality is located in the Vhembe District Municipality of Limpopo province, South Africa. The seat of Musina Local Municipality is Musina. The climate of the study area is temperate with warm summers and mild winters, with rainfall predominantly in summer. The average monthly temperatures and rainfall are shown in Table 4-1. The annual average rainfall at Musina of 793 mm is representative of the study area.

The winds at Makhado are generally light and rarely exceed 5.5 m/s (Figure 4-1). All winds occur from the broad sector east-northeast to southeast. Wind data for Makhado is obtained from Metroblue (www.metroblue.com) and is represented by a windrose in Figure 4-1. The windrose simultaneously depicts the frequency of occurrence of wind from the 16 cardinal wind directions and defined wind speed classes. Wind direction is given as the direction from which the wind blows, i.e., southwesterly winds blow from the southwest. Wind speed is given in m/s, and each arc represents a frequency of occurrence of 500 hours. There are 8 760 hours in a year.

Table 4-1: Average monthly temperature in ˚C and average monthly rainfall in mm at Musina

	J	F	M	A	M	J	J	A	S	O	N	D
Avg temp	21.9	21.7	20.7	19.2	16.3	13.4	13.6	15.4	18.0	20.4	21.3	21.9
Rain fall	153	139	90	44	20	15	12	9	17	59	92	143

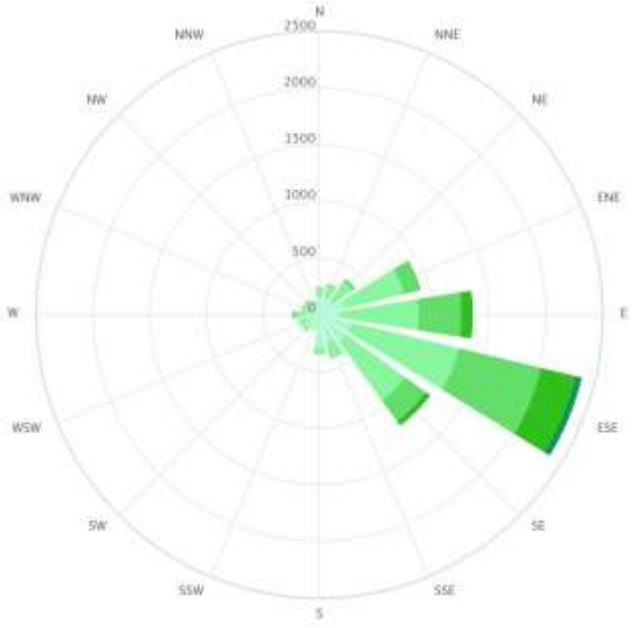

Figure 4-1: Annual wind rose at Makhado showing wind speed in m/s (https://www.meteoblue.com/)

The Makhado Local Economic Development Strategy (MLM, 2013) reports that agriculture is the biggest employer accounting for 17% of all employment in 2011 in the municipality. Manufacturing accounted for 5% of the total employment in 2011 in Makhado Local Municipality while mining is not a major source of employment in Makhado accounting for approximately 1% of the total employment.

There are no major sources of air pollution in Musina Municipality. There are seven Listed Activities in Makhado, including 2 sawmills, a fuel depot, brick manufacturing, an asphalt plant and a veterinary incinerator. The Makhado Coal Mine is the only opencast mine in the municipality. The Tshikondeni Mine is an underground mine extracting coking coal. The Local Economic Development Strategy (MLM, 2013) reports a strong reliance on biomass fuels in Makhado Local Municipality with only 36% and 39% of homes using electricity as the energy source for cooking and heating respectively in 2011.

The Air Quality Management Plan (AQMP) for Limpopo Province (LEDET, 2013) reports that ambient air quality monitoring is undertaken at four locations in the municipality, measuring SO_2, NO_X and O_3 using passive samplers. No ambient air quality data is however reported in the AQMP. Without monitored data it is difficult to comment on the state of ambient air quality in Musina Local Municipality. Despite this, ambient air quality is expected to be relatively good and is expected to comply with the National Ambient Air Quality Standards (NAAQS) considering that there are relatively few sources of air pollution. However, there is some reliance on biomass fuels for cooking and space heating in the Musina Municipality which implies that ambient air quality in high-density low income residential areas will be compromised and may be poor at times.

Residential areas are commonly classed as sensitive receptors as people generally spend more time at home than elsewhere. Potentially sensitive receptors in this study are therefore any residential areas relatively close to the facility, and particularly those in the downwind sector that may be affected by emissions of SO_2, NO_X and particulates from the proposed coal-fired power plant. The downwind sector is west-south-west to north-west of the facility, i.e. downwind under the prevailing east-north-easterly to south-easterly winds

5. LEGAL REVIEW

Air quality management in South Africa is regulated by the National Environmental Management: Air Quality Act (Act No. 39 of 2004) (NEM: AQA). Relevant sections of the NEM: AQA are discussed in the following sections.

5.1 Listed Activities

Section 21 of the NEM: AQA required that the Minister publishes a list of activities which result in atmospheric emissions which the Minister believes have or may have a significant detrimental effect on the environment, including health, social conditions, economic conditions, ecological conditions or cultural heritage, so-called Listed Activities. The first list was published in

Government Notice No. 248 of 31 March 2010[1], and a revised list followed in Government Notice No. 893 on 22 November 2013[2].

The combustion of solid fuels for the purpose of steam raising or electricity generation at facilities with a generation capacity of more than 50 MW heat output per unit is a Listed Activity (Category 1, sub-category 1.1). With a proposed generation capacity of up to 600 MW the proposed coal-fired plant power plant is therefore a Listed Activity. The Minimum Emission Standards (MES) that apply are listed in Table 4-1 for sulphur dioxide (SO_2), oxides of nitrogen (NO_X) and particulate matter.

Table 5-1: National minimum emission standards for combustion units using solid fuels for steam rising or electricity generation (DEA, 2013)[2]

Pollutant	South African Nation MES (mg/Nm^3 under standard conditions of 273 K and 101.3 kPa)
Particulate matter	50
Sulphur dioxide (SO_2)	500
Oxides of nitrogen (NO_x expressed and NO_2)	750

The consequence of listing an activity is described in Section 22 of the NEM: AQA, that no person may conduct a Listed Activity without a provisional Atmospheric Emission License or an Atmospheric Emission License (AEL).

5.2 Atmospheric Emission Licence

The application process for an AEL is described in Section 37 of the NEM: AQA. The application should be lodged at the licensing authority with the prescribed licensing fee and documentation required by the licensing authority. The licensing authority for the Musina Municipality is the Air Quality Officer (AOQ) for the Vhembe District Municipality:

Mr Thikolelwi Robert Nemakhavhani
Telephone No: (015) 962 7500
Cell No: 0824839336
Fax No: (015)9624020
Email: nemakhavhanitr@thulamela.gov.za
Physical Address: Street No. 4, Zone 10, Shayandima, Thohoyandou, 0950
Postal Address: P O Box 621, Thohoyandou, 0950

The application for an AEL is a fundamental component of the environmental authorisation process. It is supported by an air quality specialist study in the form of an Atmospheric Impact Report (AIR) (Section 30 of the NEM: AQA).

[1] Listed Activities and Associated Minimum Emission Standards identified in terms of Section 21 of the Air Quality Act, Act No. 39 of 2004, Notice 248, Government Gazette, 35894, 31 March 2010

[2] Listed Activities and Associated Minimum Emission Standards identified in terms of Section 21 of the Air Quality Act, Act No. 39 of 2004, Notice 893, Government Gazette, 37054, 22 November 2013

5.3 Atmospheric Impact Report

The format of the AIR is defined in regulations published on 11 October 2013[3]. The methodology and level of the assessment required is defined in the DEA's guideline for dispersion modelling[4] (DEA, 2014).

According to the DEA guideline for dispersion modelling, a Level 3 air quality assessment is conducted in situations where the purpose of the assessment requires a detailed understanding of the air quality impacts (time and space variation of the concentrations) and when it is important to account for causality effects, calms, non-linear plume trajectories, spatial variations in turbulent mixing, multiple source types and chemical transformations. A Level 3 assessment may be used in situations where there is a need to evaluate air quality consequences under a permitting or environmental assessment process for large industrial developments that have considerable social, economic and environmental consequences. Under these circumstances, this study clearly demonstrates the need for a Level 3 assessment.

5.4 Ambient air quality standards and guidelines

The effects of air pollutants on human health occur in a number of ways with short-term, or acute effects, and chronic, or long-term, effects. Different groups of people are affected differently, depending on their level of sensitivity, with the elderly and young children being more susceptible. The factors that link the concentration of an air pollutant to an observed health effect are the level and the duration of exposure to that particular air pollutant.

The NAAQS consists of a limit value and a permitted frequency of exceedance. The limit value is the fixed concentration level aimed at reducing the harmful effects of a pollutant. The permitted frequency of exceedance represents the tolerated exceedance of the limit value and accounts for high concentrations as a result of process upsets and meteorological variation. Compliance with the ambient standard therefore implies that ambient concentrations are below the limit value and the frequency of exceedance does not exceed the permitted tolerance. Being a health-based standard, ambient concentrations below the standard imply that air quality is acceptable and poses little or no risk to human health; while exposure to ambient concentrations above the standard implies that there is a risk to human health, particularly for sensitive individuals. The NAAQS for SO_2, NO_2, PM_{10} and $PM_{2.5}$ are shown in Table 5-2.

Table 5-2*: NAAQS for SO_2, NO_2, PM_{10} and $PM_{2.5}$ (DEA, 2009 and 2012). The limit values for $PM_{2.5}$ in brackets come into effect on 1 January 2030*

Pollutant	Averaging period	Limit value (µg/m³)	Number of permissible exceedances per annum
SO_2	1 hour	350	88
	24 hour	125	4
	1 year	50	0
NO_2	1 hour	200	88
	1 year	40	0
PM_{10}	24-hour	75	4

[3] Regulations prescribing the format of the Atmospheric Impact Report, Notice 747, Government Gazette, 36904, 11 October 2013

[4] Regulations regarding air dispersion modelling, Notice 533, Government Gazette, 37804, 11 July 2014

Pollutant	Averaging period	Limit value (µg/m³)	Number of permissible exceedances per annum
	1 year	40	0
$PM_{2.5}$	24-hours	40 (25)	0
	1 year	20 (15)	0

The National Dust Control Regulations were published on 1 November 2013 (DEA, 2013). It lists guidance on the requirements for monitoring dust fallout and provides limit values for acceptable dustfall rates for residential and non-residential areas (Table 5-3).

Table 5-3: National limit values for dustfall rates in mg/m²/day as a 30-day average (DEA, 2013)

Area	Dustfall rate (D)	Permitted frequency of exceedance
Residential	D < 600	Two within a year, not in sequential months
Non-residential	600 < D < 1 200	Two within a year, not in sequential months

6. POTENTIAL IMPACTS

The route of exposure to air pollutants is principally through inhalation. Impacts are therefor most likely to occur where people reside, i.e. sensitive receptor areas.

Direct impacts associated with the operational phase of the proposed power plant may therefore result from the inhalation of pollutants emitted from the stacks and from the different diffuse sources of dust. Deposition of dust may result in a nuisance impact. Stable winter atmospheric conditions can result in the accumulation of pollutants in the boundary layer. The potential for ambient concentrations to exceed ambient air quality standards therefore exists. The potential impacts during operations are described in Tables 6-1 to 6-3.

Direct impacts associated with the construction and decommissioning phase of the proposed power plant may result in localised nuisance impacts (Tables 6-4).

Table 6-1: Impact table associated with SO_2, NO_X and particulates from the stacks during operations

Impact: Emissions of SO_2, NO_X and particulates from the stacks			
Desktop sensitivity analysis of the site:			
Issue	**Nature of impact**	**Extent of impact**	**No-Go areas**
Potential increase of existing ambient concentrations of SO_2, NO_X and particulates (PM_{10} and $PM_{2.5}$)	Exceedances of the NAAQS and respiratory health impacts	Regional scale	West-south-west to north-west of the facility, i.e. downwind under the prevailing east-north-easterly to south-easterly winds
Description of expected significance of impact: The significance of the potential impact is expected to be low as elevated stack emissions generally disperse effectively resulting in low ground-level concentrations. The impact can be mitigated through optimisation of emission abatement.			
Gaps in knowledge & recommendations for further studies:			

A comprehensive air quality assessment is required including a detailed emission inventory and predictive modelling

Table 6-2: Impact table associated with particulates from diffuse sources during operations

Impact: Potential impact of increased dust deposition			
Desktop sensitivity analysis of the site:			
Issue	**Nature of impact**	**Extent of impact**	**No-Go areas**
Emission of particulates from the coal transfer-house, the strategic stockpile, the working stockyard, silos and conveyors operations, limestone offloading, storage and transfer, ash-handling conveyors, silos, disposal and dump facilities operations	Exceedance of the national limit for acceptable dust fallout resulting in nuisance impacts	Local scale	West-south-west to north-west of the facility, i.e. downwind under the prevailing east-north-easterly to south-easterly winds
Description of expected significance of impact: The significance of the potential impact is expected to be low as low-level sources generally impact close to the source. The impact can be mitigated through optimisation of dust control measures			
Gaps in knowledge & recommendations for further studies: A comprehensive air quality assessment is required including a detailed emission inventory and predictive modelling			

Table 6-3: Impact table associated with GHG emissions during operations

Impact: Potential increase in GHG emissions			
Desktop sensitivity analysis of the site:			
Issue	**Nature of impact**	**Extent of impact**	**No-Go areas**
GHG emission of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) from coal combustion	Contribution to GHG concentrations and global warming	International scale	N/A
Description of expected significance of impact: The significance of the potential contribution to global warming is expected to be very low and will not be directly measurable. The impact can be mitigated through GHG emission reduction measures			
Gaps in knowledge & recommendations for further studies: An assessment of the relative GHG emission is required			

Table 6-4: Impact table associated with dust deposition during construction and decommissioning

Impact: Potential impact of increased dust deposition			
Desktop sensitivity analysis of the site:			
Issue	**Nature of impact**	**Extent of impact**	**No-Go areas**
Emission of dust from construction and decommissioning activities	Exceedance of the national limit for acceptable dust fallout resulting in nuisance impacts	Local scale	West-south-west to north-west of the facility, i.e. downwind under the prevailing east-north-easterly to south-easterly winds
Description of expected significance of impact: The significance of the potential impact is expected to be low as low-level sources generally impact close to the source. The impact can be mitigated through optimisation of dust control measures			
Gaps in knowledge & recommendations for further studies: A qualitative air quality assessment is required			

7. SIGNIFICANT IMPACTS TO BE ASSESSED

It is recommended that the following are assessed in the air quality specialist study:

1) Predict ambient concentrations of SO_2, NO_x, and particulates resulting from stack emissions as well as coal processing and ash disposal at the proposed coal-fired power plant for the following scenarios:
   - Construction (particulates only);
   - Operations, for the power plant in isolation and against the existing air pollution load of the area, i.e. cumulative effects;
   - Decommissioning (particulates only).
2) The potential risk impact associated with the predicted ambient concentration in potentially affected communities; and
3) Relative contribution of GHG emissions associated with the proposed facility to global warming.

8. METHODOLOGY

The following is required in order to assess the issues:

1) The compilation of a detailed emission inventory for the proposed coal-fired power plant, for the construction, operations and decommissioning phases. The inventory will be based on activity data such as the proposed generation technology, air pollution abatement technology, coal quality and consumption, coal processing and ash disposal.
2) Air dispersion modelling using the DEA recommended CALPUFF model to predict ambient concentrations of air pollutants resulting from the coal-fired power plant for emissions during the operational phase.
3) Assessment of the significance of potential impacts by comparing predicted ambient concentrations with the relevant NAAQS.

9. CONCLUSIONS

Emissions from coal-fired power plants include SO_2, NO_x, and particulates from stack emissions, coal processing and the ash disposal site, as well as greenhouse gases. As a result, the proposed power plant will impact on air quality in the vicinity of the plant and further afield by increasing ambient concentrations. The power plant will be required to operate according to Minimum Emissions Standards for SO_2, NO_X and particulates and within respective NAAQS for SO_2, NO_2 and PM_{10}. Air dispersion modelling should be used in the EIA with a detailed emission inventory to predict ambient concentrations resulting from the power plant emissions in the context of other sources. The significance of impacts will be assessed through comparison with the NAAQS.

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