Air Quality Status Quo Assessment for the Mbizana Local Municipality

REPORT DETAILS

Client:	IKAMVA Consulting
Report title:	Air Quality Status Quo Assessment for the Mbizana Local Municipality
Project:	Mbizana Air Quality Status Quo Assessment
Report number:	uMN050-2016
Version:	Draft 8 April 2016

AUTHOR DETAILS

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When used as a reference this report should be cited as follows:

uMoya-NILU (2016): *Air Quality Status Quo Assessment for the Mbizana Local Municipality*, uMoya-NILU Consulting (Pty) Ltd., Report No. uMN050-16.

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1. INTRODUCTION

Mbizana is a Local Municipality (LM) in the Alfred Nzo District Municipality (DM) in the Eastern Cape Province (Figure 1-1). It is bordered by KwaZulu-Natal's Ugu DM to the northeast, the Eastern Cape's O R Tambo DM to the southwest and Alfred Nzo's Ntabankulu LM and Umzimvubu LM to the north and northwest. It lies between the between Umtamvuna and Mtentu Rivers. The R61 connects Mbizana to KwaZulu-Natal and the N2 highway.

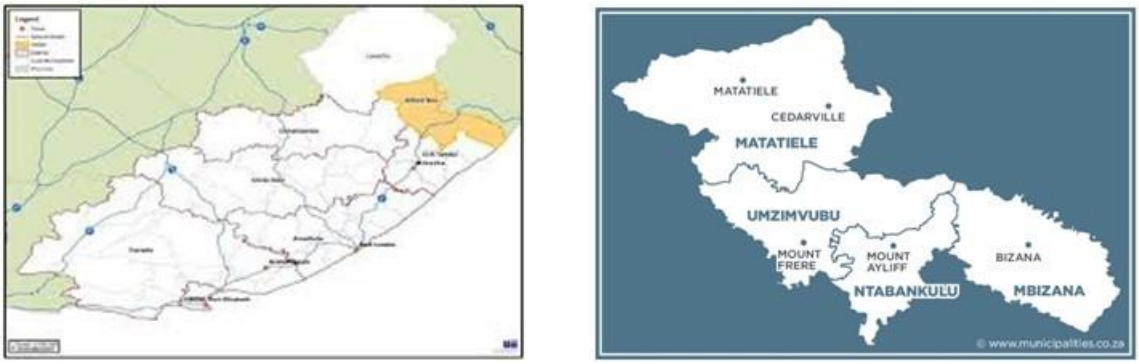

Figure 1-1: Location of the Alfred Nzo DM in the Eastern Cape (left) with the Mbizana local municipality shown on the right

Mbizana LM (MLM) is currently made up of 31 wards. It is made up of the main town of Bizana and surrounding villages, covering an area of roughly 2 806 km^2. It has a population of approximately 246 516 people occupying approximately 48 000 households. Mbizana LM is rural and close to 95% of the population resides in the surrounding villages, with the rest living in the urban area of Mbizana. Subsistence farming the basis of most livelihoods.

IKAMVA Consulting, a Mthatha based company, has been appointed to compile the Environmental Status Quo report for Mbizana LM. IKAMVA, in turn, has appointed uMoya-NILU Consulting (Pty) Ltd to compile the air quality baseline, as input to the Environmental Status Quo for MLM. uMoya-NILU is a specialist air quality management consulting company that developed the Air Quality Status Quo Assessment for the Eastern Cape and the province's Air Quality Management Plan (AQMP) (uMoya-NILU, 2013).

2. TERMS OF REFERENCE

The terms of reference for the baseline assessment are to:

i. Undertake a baseline air quality assessment based on existing Mbizana LM air quality studies and any other relevant data (empirical or other);
ii. Describe the importance of air quality management and to flag any areas of concern;
iii. Describe the institutional and regulatory framework;
iv. Map the local air quality, depending on availability of data; and
v. Identify areas of future management for incorporation into Desired State and SEMP phases.

3. METHODOLOGY

The following methodology is applied to achieve the Terms of Reference:

i. The current state air quality in the Mbizana LM is assessed using existing data and information. This includes information on meteorology, emissions and ambient air quality. Sources of data may include the Mbizana LM, the Eastern Cape Department of Economic Development, Environmental Affairs and Tourism (DEDEAT) and the South African Weather Service (SAWS). An investigative visit to the Mbizana LM was also undertaken. If there is sufficient data, air quality will be presented on maps of the Mbizana LM.

ii. The institutional and regulatory framework was described based on the requirements of the National Framework for Air Quality Management (DEA, 2012) and the National Environmental Management: Air Quality Act (NEM: AQA) (Act No. 39 of 2004), highlighting the importance of air quality management in the Mbizana LM.

iii. Gaps, issues and challenges for air quality management in the Mbizana LM have been identified and these were evaluated to identify areas for future air quality management.

4. THE REGULATORY CONTEXT

4.1 Context of the NEM: AQA

The Bill of Rights contained in the Constitution of the Republic of South Africa enshrines the rights of all people in the country and affirms the democratic values of human dignity, equality and freedom. The state must respect, protect, promote and fulfil the requirements in the Bill of Rights. Section 24 of the Constitution states that everyone has the right:

a) To an environment that is not harmful to their health or well-being; and
b) To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that -
  i. Prevent pollution and ecological degradation;
  ii. Promote conservation; and
  iii. Secure ecologically sustainable development and the use of natural resources while promoting justifiable economic and social development

In order to give effect to this right in the context of air quality, it is necessary for government to ensure that levels of air pollution are not harmful to human health or well-being. The setting of ambient air quality standards is therefore necessary, as well as mechanisms to ensure that ambient air quality standards are achieved and maintained. Hence, the NEM: AQA provides an objectives-based approach to the management of air quality at different governance and operational levels and is the legislative means to ensuring that the rights pertaining to air quality are upheld.

4.2 Roles and responsibilities

The roles and responsibilities for the three spheres of government and inter-relationship between them are defined in the National Framework for Air Quality Management (DEA, 2007 and 2012a). The Department of Environmental Affairs (DEA) is the national Lead Agent for environmental management, and subsequently air quality management. Hence, DEA must provide national norms and standards to ensure coordinated, integrated and cohesive air quality governance for South Africa. The AQA provides DEA with governance responsibilities, and a number of exclusive powers for air quality management. These all have direct bearing on the implementation of the AQA by provinces and municipalities.

Provincial environmental departments are the Lead Agents for air quality management. Provinces must provide, where necessary, norms and standards to ensure coordinated, integrated and cohesive air quality governance in the province. As with the national department, provincial departments have governance responsibilities, and each provincial Member of the Executive Committee (MEC) responsible for the environment has a number of exclusive and discretionary air quality management powers. This includes the designation of the provincial Air Quality Officer (AQO) who is responsible for the coordination of all air quality related matters in the province and the preparation of a provincial Air Quality Management Plan (AQMP) as a component of the Environmental Implementation Plan. The provincial AQO must also review the AQMPs received from the municipalities.

Within provinces, municipalities also have air quality management governance responsibilities and exclusive air quality management powers. In this regard, municipalities must i) Designate a municipal AQO from its administration, ii) develop an AQMP for inclusion in its Integrated Development Plan (IDP) in, accordance with Chapter 5 of the Municipal Systems Act, and iii) prepare an annual report including progress regarding the implementation of the AQMP and compliance with the plan.

4.3 National ambient air quality standards

South Africa established health-based National Ambient Air Quality Standards (NAAQS) in 2009 for carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulate matter smaller than 10 microns (PM_{10}), ozone (O_3), lead (Pb) and benzene (C_6H_6) (DEA, 2009) and for $PM_{2.5}$ in 2012 (DEA, 2012b) (Table 4-1). The NAAQS consists of a *limit value* and a *tolerance* or 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 is the 99^{th} percentile and represents the tolerated exceedance of the limit value. It accounts for high concentrations due to process upsets and meteorological variations. Compliance with the ambient standard therefore implies the frequency of exceedance does not exceed the permitted tolerance.

Being health based, the implication is that ambient concentrations of pollutants that meet the NAAQS pose little or no risk to human health, while ambient concentrations that exceed that NAAQS may pose health risks.

Table 4-1: Ambient air quality standards for SO_2, NO_2, PM_{10}, O_3, benzene, ozone and lead (DEA, 2009) and $PM_{2.5}$ (DEA, 2012)

Pollutant	Averaging Period	Limit value (µg/m^3)	Number of 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
	1 year	40	0
$PM_{2.5}$	24 hour	65 40[1] 25[2]	0 0 0
	1 year	25 20[1] 15[2]	0 0 0
O_3	8 hours	120	11
Benzene	1year	5	0
Pb	1 year	5	0
CO	1 hour 8 hours	30 10	88 11
1: Effective date is 1 January 2016 2: Effective date is 1 January 2030			

4.4 Air Quality Management Plans

Section 15 of the NEM: AQA requires provinces to include an AQMP in their respective Environmental Implementation Plans (EIP) or Environmental Management Plans (EMP). Section 15 also requires municipalities to develop an AQMP as part of their Integrated Development Plan (IDP), in terms of Chapter 5 of the Local Government: Municipal Systems Act (Act 32 of 2000). An AQMP should provide definitive objectives, strategies, plans and procedures, for the relevant spheres of government to meet the requirements of the NEM: AQA with respect to air quality management planning and reporting.

Alfred Nzo DM has not yet developed an AQMP, but air quality is recognised in their 2014-15 IDP (Alfred Nzo DM, 2013). Similarly, Mbizana LM has also not yet developed and AQMP. However, as the lead agent for air quality management in the Eastern Cape, the DEDEAT developed the AQMP for the province in July 2013 (uMoya-NILU, 2013). The *Vision* that was developed for the provincial AQMP is that ***Air Quality Management in the Eastern Cape ensures clean, safe air for all***.

The *Mission* to achieve this vision states that ***DEDEAT leads Air Quality Management in the Eastern Cape to continually improve air quality while protecting human health and securing environmental sustainability.***

The AQMP includes six goals to achieve the overall objective. These are:

Goal 1: Intergovernmental relationships for Air Quality Management are streamlined and function effectively in the Eastern Cape, which refers to the need for co-operative air quality governance in the province, which in turn entails effective communication and interaction between National, Provincial and Municipal Departments, amongst others.

Goal 2: Air Quality Management is considered in planning in the Eastern Cape and is led by sound scientific research in order to achieve sustainable development, which recognises the importance of economic growth and development policies acknowledging the necessity to safe guard air quality for present and future generations through scientific research in planning and decision-making processes which facilitates an understanding of the linkages between air quality management and other disciplines.

Goal 3: Adequate and competent staff in all District and Metropolitan municipalities in the Eastern Cape to ensure successful implementation of the AQMP which hinges on municipalities being adequately capacitated to perform the air quality function effectively and efficiently. This goal aims to ensure that sufficient competent staff are deployed in all municipalities.

Goal 4: Adequate and effectively resourced Air Quality Management Systems support decision-making in the Eastern Cape, referring to the systems and tools required for informed decision-making including an emission inventory, dispersion modelling capability, ambient monitoring strategy and a mechanism to address complaints.

Goal 5: Awareness and knowledge of Air Quality is enhanced in the Eastern Cape to encourage the active engagement of a diverse group of stakeholders, who have a vested interest in improving air quality in the province.

Goal 6: Compliance and enforcement initiatives in the Eastern Cape are visible and effective to ensure that Provinces and Municipalities, and industries comply with air quality legislation. The visibility of compliance and enforcement initiatives is also considered.

4.5 Listed Activities and Controlled Emitters

In accordance with Section 21 of the NEM: AQA, the Minister published the first list of Listed Activities and associated Minimum Emission Standards in 2010 (DEA, 2010), and updated these in 2012 (DEA, 2012c). Listed activities are those that the Minister reasonably believes have or may have a significant detrimental effect on the environment, including health.

There are 68 such activities listed in the revised regulations with minimum emissions standard and special conditions for compliance. Section 22 of the NEM: AQA states that no person may operate a Listed Activity without a provisional Atmospheric Emission

License (AEL) or without an AEL. Chapter 5 of the NEM: AQA details the licensing procedures and requirements. The designated District Municipal AQA is the AEL Authority in municipalities where capacity and competence exists. In the case of Alfred Nzo DM, the Provincial AQO is the AEL Authority.

Boilers with a design capacity of more than 10 MW, but less than 50 MW net heat input are classed as Controlled Emitters in terms of the NEM: AQA, and are regulated by the local authority (DEAT, 2013).

5 AIR QUALITY BASELINE

The assessment of baseline air quality consists of three components. These are discussed in the following sections and include the climate and meteorology of the area, emissions to the atmosphere, ambient air quality and air quality management capacity.

5.1 Climate and meteorology

The Mbizana LM experiences a sub-tropical climate with predominantly summer rainfall, warm humid summers and mild winters. There are no SAWS weather stations in the Bizana LM, but inference regarding the rainfall and temperature can be drawn from the SAWS stations at Port St Johns, Mount Ayliff and Mount Frere.

More rainfall occurs along the coast than in the interior of the Mbizana LM. The annual average rainfall at Port St Johns is 1 031 mm and at Mount Frere it is 795 mm. The rain results mainly from convective storms in summer and the passage of cold frontal systems in winter. As a result, most rainfall occurs in the summer from October and March, although rainfall is experienced in the winter months (Figure 5-1).

The temperatures along the coast are temperate with a smaller range between the average maximum and minimum temperatures at Port St Johns than over the interior (Figure 5-1). This is a result of the moderating effect of the warm Indian Ocean on air temperature along the adjacent coast line. Over the interior of the Mbizana LM the maximum temperatures are higher and the minimums are colder minimum than along the coast (Figure 5-1).

There are no measurements of wind in the Mbizana LM. Inference regarding wind along the coast can be drawn from the wind measured at Port St Johns. Wind is best described in a windrose. Windroses simultaneously depict the frequency of occurrence of hourly winds from the 16 cardinal wind directions and in different 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 in the windrose represents a percentage frequency of occurrence (5% in this case).

The windrose at Port St Johns for the 3-year period 1 January 2010 to 31 December 2012 and is shown in Figure 5-2. The predominant winds are associated with the Indian Ocean high pressure system and its location relative to the coast, with influence also from coastal lows and the passage of frontal systems. The winds are generally aligned with the coastline and occur predominantly in the sector north to north-northeast (about 50% of all winds) and in the sector southwest to west-southwest (about 33%). They are

strong at times and exceed 8.5 m/s, mostly from the northeast. These strong winds are usually associated with an advancing coastal lows ahead of cold frontal systems.

Winds over the interior of the Mbizana LM will certainly be lighter than along the coast as a result of the frictional effect of the underlying land surface. It is also likely that a relative high frequency of northerly to northeasterly winds will occur, with southwesterly winds less frequent.

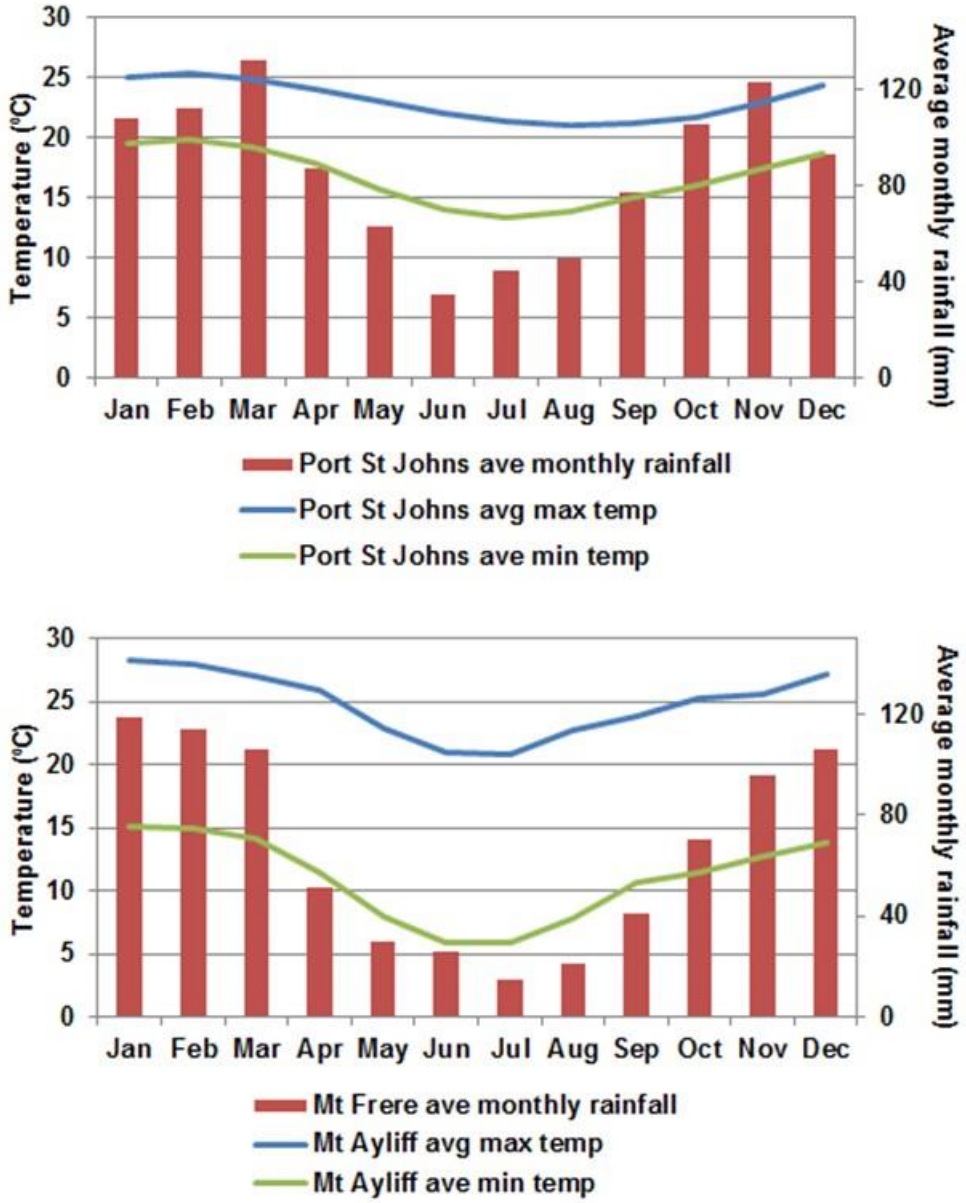

Figure 5-1: Average monthly rainfall at Port St Johns and Mount Frere, and average monthly maximum and minimum temperatures at Port St Johns and Mount Ayliff (SAWS, 1998)

The atmospheric dispersion potential of an area relates to the stability (or instability) of the atmosphere, which in turn, is a function of wind speed and insolation (solar radiation). Stable conditions relate to poor atmospheric dispersion and generally coincide with low wind speeds and no insolation (night) or weak insolation due to

overcast conditions which limits dilution of pollutants. Conversely, unstable conditions are conducive to good dispersion potential and occur with moderate winds and strong insolation. The wind disperses pollutants horizontally and unstable conditions dilute pollutants in a deeper layer of the atmosphere. The relationship between stability and wind speed and insolation is commonly conveyed through the Pasquill-Gifford stability classes from A to F, shown in Table 5-1.

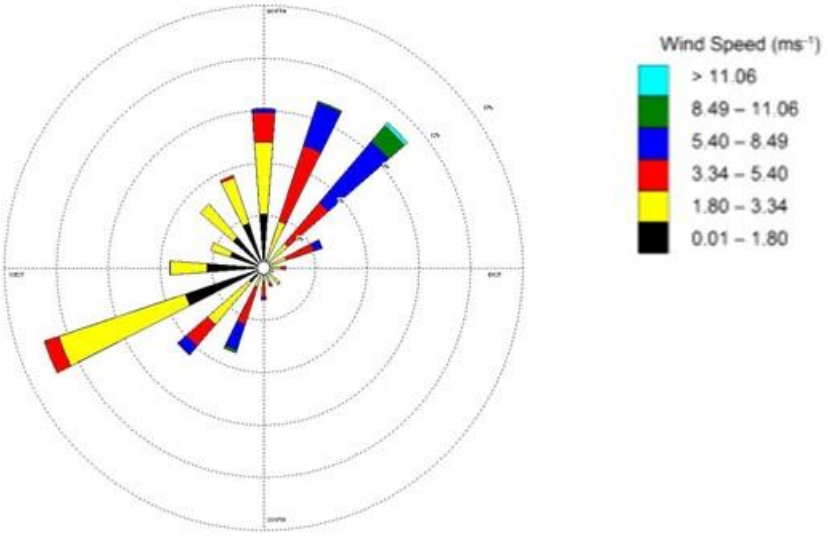

Figure 5-2: Wind rose at Port St Johns for the 3-year period 2010 to 2012

Table 5-1: Pasquill-Gifford stability classification

Stability classification	*Stability class*	*Atmospheric conditions*
A	Very stable	Calm wind, clear and hot daytime conditions
B	Moderately stable	Light wind, clear and hot daytime conditions
C	Unstable	Moderate wind, cloudy daytime conditions
D	Neutral	Strong wind, cloudy skies and at night
E	Stable	Moderate wind, cloudy and at night
F	Very stable	Low wind, clear skies, cold night time conditions

The atmospheric dispersion potential along the Mbizana LM coast is expected to be effective for a lot of the time due to the high frequency of moderate and sometimes strong winds. Poor dispersion conditions are most likely to occur at night particularly over the interior of the Mbizana LM when cool temperatures coincide with light or calm winds and surface temperature inversion manifest. The poorest dispersion conditions are likely to occur between May and August when the coldest night time temperatures occur. At this time strongest temperature inversion occur.

5.2 Sources of air pollution

For air quality management objectives sources of air pollution are typically presented in an emission inventory which details source characteristics and quantifies emissions of

different pollutants. Emissions for the respective metropolitan and district municipalities in the Eastern Cape are presented in the provincial AQMP (uMoya-NILU, 2013).
The emission information for Alfred Nzo DM (uMoya-NILU, 2013) is used as a basis to describe sources of air pollution for Mbizana LM. This information has been updated following a telephonic interview with the Eastern Cape's Air Quality Officer (AQO) (personal communication, Lyndon Mardon, DEDEAT, March 2016). The information was further augmented with observations during a site visit to Mbizana LM on 7 April 2016. Emissions from different sources are discussed in the following paragraphs.

Residential energy use

Domestic fuel burning for cooking, heating and lighting is perceived to be the largest source of air pollution in Mbizana LM (personal communication, Lyndon Mardon, DEDEAT, March 2016).

Emissions from domestic fuel burning in Mbizana LM are estimated using energy use data from Census 2011 (StatsSA, 2011) and assuming the average household fuel use (FRIDGE, 2006). The StatsSA data delineate the number of households utilising different energy modes fuels for cooking, lighting, space heating. The 2011 census recorded 48 447 dwellings in Mbizana LM.

Electricity is the predominant source of energy for lighting with nearly 30 000 of the total number of dwellings using this mode (Figure 5-3). As might be expected in a rural area, there is strong reliance on wood as the energy source for cooking and heating. Wood is a relatively dirty fuel and domestic wood burning is a source of air pollutants. Paraffin and electricity which are clean fuels is used in some homes.

As might be expected from the abundant use of wood, the largest emissions of all pollutants result from this fuel, followed by paraffin (Table 5-2). CO and PM_{10} from wood constitute more than 99% of the total emission for the DM. For the NO_X emission, 81% results from wood combustion and 17% from paraffin. For the SO_2 emission, wood combustion results in 48% of the total emission with paraffin contributing 28% and coal 23%.

Table 5-2: Emissions of SO_2, NO_X, CO and PM_{10} for different domestic fuels in the Mbizana LM in tons/year

	SO_2	NO_X	CO	PM_{10}
LPG	0.0	0.01	0.001	0.0
Paraffin	0.6	1.6	0.4	0.09
Wood	1.1	7.5	614	81
Coal	0.5	0.08	2.3	0.05
Total	**2.2**	**9.1**	**617**	**81.6**

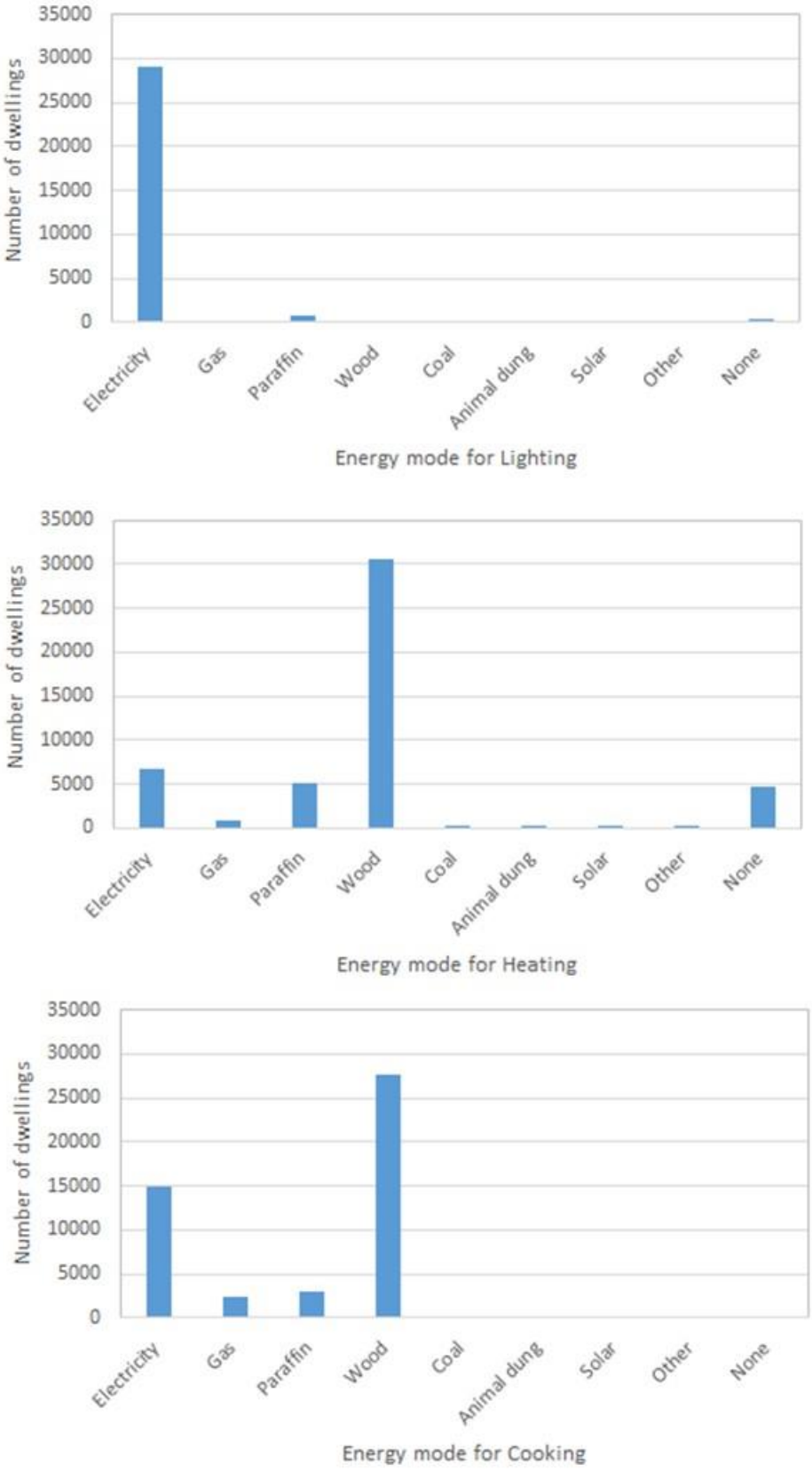

Figure 5-3: ***Household energy use for heating (top), lighting (middle) and cooking (bottom) in the Mbizana LM***

Motor vehicle emissions

Emissions from motor vehicles were estimated in all municipalities in the *Integrated Strategy for the Control of Motor Vehicle Emissions: Motor Vehicle Emission Inventory* (DEA, 2013b). Emissions were estimated for passenger cars, light-duty vehicles (LDVs) (< 3.5 ton), heavy-duty vehicles (HDVs) (> 3.5 ton) and buses, and motorcycles using emission factors for diesel (500 and 50 ppm) and gasoline for the different vehicle classes and fuel sales data from the Department of Energy (DoE).

Estimated emissions from motor vehicles in the Mbizana LM in tons per annum is shown in Table 5-3. It should be noted that the emission refer to vehicle emissions (tail pipe, evaporative losses, tyre wear). They do not include the entrainment of dust as vehicles move on unpaved and roads.

Table 5-3: Emissions of SO_2, NO_X, CO, PM_{10}, NMVOC and CO_2 from motor vehicles in the Mbizana LM in kg/year

SO_2	NO_X	CO	PM_{10}	NMVOC	CO_2
3.8	168	779	5.8	105	28 029

Industrial and manufacturing

The Provincial AQO (personal communication, Lyndon Mardon, DEDEAT, March 2016) confirmed that there are no industrial or manufacturing activities in Mbizana LM. Bizana is the only urbanised area in the municipality which is otherwise rural (uMoya-NILU, 2013).

Hospitals

There are two hospitals in Mbizana LM, the St Patrick's Hospital and the Greenville Hospital. St. Patrick's Hospital also operates a diesel-fuelled medical waste incinerator (Figure 5-4) (site visit 7 April 2016). The incineration of hazardous and non-hazardous waste is a Listed Activity, if more than 10 kg of waste are processed daily (Sub-category 8.1, DEA, 2012c). Emissions from this source have not been quantified.

Figure 5-4: Medical waste incinerator at St Patrick Hospital in Bizana. It was not in operation at the time of the site visit on 7 April 2016 (photo by M Zunckel)

Refuse burning

Waste burning on formal and informal landfill sites was shown to be a source of air pollution throughout the Eastern Cape and air quality management challenge (uMoya-NILU, 2013a). This practice is also prevalent in Mbizana LM (personal communication, Lyndon Mardon, DEDEAT, March 2016) and are illustrated in Figure 5-6, a photo taken during the site visit on 7 April 2016. Emissions from waste burning in the Mbizana LM are not estimated in this assessment.

Figure 5-5: Informal refuse burning in Bizana, photo taken by M Zunckel on 7 April 2016

Vegetation burning

Vegetation burning is practiced for land clearing and other agricultural needs. This includes controlled burning in forestry areas, sugar cane burning and burning to clear veld. Biomass burning is considered a potential air quality issue (personal communication, Lyndon Mardon, DEAET, March 2016). Emissions from biomass burning in the Mbizana LM are not estimated in this assessment. Examples of biomass fires are illustrated in the Google Earth image in Figure 5-5.

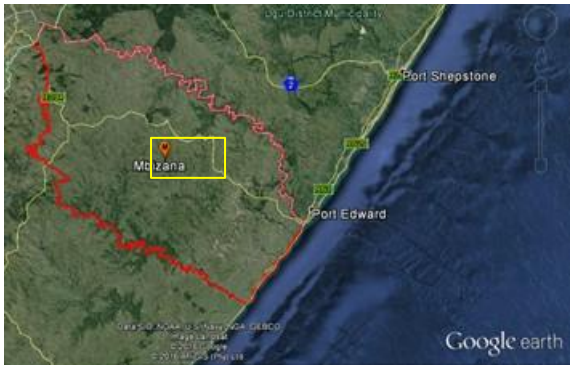

Figure 5-6: Evidence of largescale biomass burning in the Mbizana LM from Google Earth imagery. The smoke plumes are highlighted in the bottom panel on 1 July 2014

Road construction

Extensive upgrade work is being undertaken on the R61 between Port Edward in the Ugu DM and Bizana. This includes resurfacing of the existing road and the construction of new sections with bush clearing, grading and blasting as well as the operation of an extensive quarry and stone crushing facility (Figure 5-7), and ultimately asphalting the surface. Road construction is a relatively temporary activity, lasting possibly months in a single location before progressing to the next section. All road construction activities are sources of dust and the emission depends on the nature of the activity, its duration and the of dust control measures that are applied. Emissions from the R61 upgrades have not been quantified.

Figure 5-7: The stone quarry and crushing facility supporting the R61 upgrade in Mbizana LM, photo taken by M Zunckel on 7 April 2016

Transboundary transport

The potential exists for the transport of air pollutants into the Mbizana LM from activities, such as timber processing and sugarcane burning in the Ugu DM in KwaZulu-Natal. However, these are isolated sources with local scale impacts (uMoya-NILU, 2013b).

5.3 Ambient air quality

There are no ambient air quality measurements in the Mbizana LM (personal communication, Lyndon Mardon, DEDEAT, March 2016). Even so, ambient air quality is expected to be very good as the air dispersion potential of the area is good, particularly along the coast, and the there are no significant sources of air pollution. Generally the air quality in the Mbizana LM can be expected to be well within the limits of the NAAQS (Table 4-1) and not harmful to health and wellbeing.

Air quality may become relatively poor at times close to local sources of air pollution when exceedances of NAAQS (Table 4-1) may occur. These areas include close to waste sites, at peak traffic times in Bizana, and adjacent to busy unpaved roads. In residential areas where wood is the primary source of energy for cooking and heating air quality may also become poor, particularly during winter when more fuel is used and the atmospheric dispersion potential is not as effective as in summer.

5.4 Air quality management capacity

The capacity to carry out the air quality management function in the Alfred Nzo DM was benchmarked in 2013 as part of the Eastern Cape's status quo assessment (uMoya-

NILU, 2013). At the time ANDM did not have an AQO but planned to designate an officer to fulfil the role in terms of an oversight function and a point of communication for the municipality. It was also noted that as might be expected without an AQO, intergovernmental governance roles and responsibilities between ANDM and the local municipalities are not yet defined. However, the provincial DEDEAT fulfils the AEL function on behalf of the ANDM through means of a Council Resolution. A further finding was that the competence and technical capacity for AQM function in ANDM needed to be strengthened.

Since the review by uMoya-NILU (2013), the capacity for air quality management has reduced in Alfred Nzo DM. The incumbent Environmental Officer is Mr F. Nyembezi (personal communication, Thulani Gweje, IKAMVA Consulting, March 2016). He is responsible for air quality management as part of his functions, but has not been designated as the Air Quality Officer.

6 CONCLUSION: THE IMPORTANCE OF AIR QUALITY MANAGEMENT

Air quality that is not harmful to health and wellbeing is provided for in Section 24 of the Constitution. The National Framework for Air Quality Management defines roles and responsibilities for all levels of government to ensure that this right is upheld.

There are no major sources of air pollution in the Mbizana LM and air quality has been shown to be relatively good. It is important to ensure that the current state of air quality in Mbizana is maintained. The sources include the possibility of Listed Activities at the hospitals, domestic fuel burning and agricultural burning.

As such, air quality management in Mbizana LM does not warrant dedicated resources. Listed Activities are a provincial function. Similarly, domestic fuel burning and agricultural burning are regional issues that should be dealt with at a provincial level. It would be more prudent for Alfred Nzo DM to provide the function with the DEDEAT regional staff fulfilling an oversight role. Despite this, it is necessary that air quality and the agreed management function is recognised in Mbizana LM's IDP.

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