VEHICLE EMISSION CONTROL AND TESTING STRATEGY

Compiled by: L. Mahlaule - Assistant Manager: Environmental Management and Compliance

Reviewed by: E.J Nkabinde - Manager: Environmental Management and Compliance

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CHAPTER 1

1.1. Introduction and Background

Air pollution has become synonymous with the modern urban environment. Such is the current scale of human activity in production, processing and transport that globally any industrialized city will be prone to some form of air pollution. Air pollution is often insidious and disperses quickly from the site of contamination to offer a potential threat to the health and quality of life of people over a wide area. So called mobile source emissions or emissions from vehicles are recognized as a significant source of pollution in urban environments and legislation of ever increasing severity has been implemented in Europe, the United States and Japan to limit the emissions from vehicles. South African cities are no exception to this trend with pollution levels having at times been measured as exceeding World Health Organization (WHO) Guidelines. Greenhouses (GHG) gases are amongst the highest pollutants emitted from vehicles. The dominant pollutants from vehicular emissions are CO, NOx, SO2, VOCs, CO2 and PM (especially in diesel vehicles). While the likes of SF6, CH4 are not emitted from vehicles and have negligible health impacts Research studies reveal that developing countries have the fastest growing source of GHG emissions due to the rapid expansion of road networks in these countries. Vehicle emissions in South Africa have been identified as a growing concern, with increased emissions due to the number of vehicles on the roads, the age of these vehicles and the lack of emission control devices.

The South African transport sector contributes 8.8% of South Africa's total GHG emissions with the road transport sector contributing 91.2% of these emissions. According to Posada (2017), South Africa's vehicle fleet produces 21% more CO2 emissions than their European counterpart. The number of self-propelled vehicles has increased by 15% in South Africa and by 21% in Mpumalanga Province between 28 February 2013 and 28 February 2018 (eNatis, 2018). As per the AQMP, particulate matter and SO2 emissions are among the biggest contributors to poor air quality in Emalahleni.

A number of initiatives from the South African government emanate from concerns about air quality in South Africa most notable perhaps being the Brown Haze Study and the Vehicle Emissions Project (VEP) commissioned by the Department of Minerals and Energy and the then Department of Environment and Tourism. To this effect, the National Framework for Air Quality Management in the Republic of South Africa (NFAQM) was published with an attempt to achieve the objectives of the NEM: Air Quality Act (NEMAQA) (Act No. 39 of 2004). The aim of the

framework is to provide mechanisms, systems and procedures to promote holistic and integrated air quality management through pollution prevention and minimization at source (point and non-point sources), and through impact management with respect to the receiving environment from local scale to international issues.

Vehicle Emissions have been known to be a growing challenge in South Africa because of steady increase in the number of vehicles on the roads and an increase in the annual distance driven. Owing to the absence of vehicle emissions legislation, most vehicles are not equipped with emissions control devices and can thus emit more than ten times the emissions of equivalent vehicles in emissions regulated markets. Combined with the fact that a significant proportion of the vehicles are old and often in poor condition, it has become prudent for Emalahleni Local Municipality (ELM) to make an intervention by formalizing vehicle emissions strategy applicable to vehicles being driven within its area of Jurisdiction. The contribution by the coal transporting trucks is of great concern as the area is experiencing a huge number of trucks driving to and from mining activities. There is also a huge number of vehicles passing through Emalahleni to the other neighboring province and municipalities. Their contribution to air pollution cannot be overlooked.

Coordinated revision of vehicle emissions legislation together with the revision of fuel specification are accepted practices internationally and they have facilitated significant improvement of air quality. ELM was, amongst other municipalities, declared by then Minister of Environmental Affairs as a Highveld priority area (HPA), which signifies the importance of the management and improvement of the quality of the air in the region. Consequently, the ELM designated a local air quality officer (LAQO) in terms of section 14 of the NEMAQA to be responsible for the coordination of matters pertaining to air quality in the municipality and exercising of delegated powers and functions, amongst others. In addition, the Municipality has also developed and adopted an Air Quality Management Plan (AQMP) and Air Quality Management By-laws (AQMBL) for the management and control of air pollution in the municipality.

1.2. Purpose and Objective of the vehicle emission control and testing strategy

- To contribute to the management and improvement of the quality of air within ELM through conducting vehicle emission testing thereby ascertaining whether such vehicles driven within the municipal Jurisdiction comply with the acceptable standards on vehicle emission. The strategy will focus mainly of diesel-powered engines (mostly coal

transporting trucks and other mining related vehicles), as they are the most polluting instruments.

- The strategy seeks to address the constitution right of the residents of ELM to be in an environment, which is not harmful to their health and wellbeing.
- To encourage motorist to service and maintain their vehicles regularly to reduce particulate matter and SO2 emission and other pollutants.

1.3. Rationale, limitations and setbacks on vehicle emission testing

Despite the tightening of requirements for the regulatory approval of new vehicles, air quality remains a problem in many cities, particularly in the HPA. Vehicle emission concentration vary according to vehicle age and the abatement technology installed in the vehicle. It is well known that even the most severe emission control legislation of today for newly developed vehicles cannot provide major reduction solutions in air pollution, without appropriate control of the vehicles technical conditions by inspection and air pollution reduction technology methods. Vehicle emissions, counting amongst others vehicle exhaust fumes of carbon dioxide have negative consequences on climate change and health.

While vehicle emission testing is commonly practiced in many developed countries following various international reference and testing methods, it is however less practiced in developing countries like South Africa. South Africa has been progressively developing norms and standards that seeks to address air pollution from various sources since the advent of the NEMAQA. The then Minister of Environmental Affairs published minimum emissions standards (MES) in 2013 for a large number of listed activities which came with specific monitoring and analytical procedures for various chemical substances or mixture of substance in both point sources and non-point sources or mobile sources. Recognizing the challenges of poor air quality in some parts of South Africa due to vehicular emissions, it is almost unthinkable that the NEMAQA does not provide specific norms and standards or specific reference methods for vehicular emissions. .

Many research studies have proven that vehicle emissions have a devastating impacts on the environment and public health. Prior to the coming into effect of the new air pollution management regime, vehicular emissions in South Africa was regulated under the now defunct Atmospheric Pollution Prevention Act (APPA) (No. 45 of 1965). The APPA was very specific in terms of how authorities needed to deal with vehicular emissions and how authorities can set their own standards in terms of the Ringlemanns chart. The APPA has since been repealed by the NEMAQA and currently authorities do not have an adopted reference method for vehicular

emissions testing which can be used. The current state of affairs poses a serious challenge for municipalities in the execution of their legislative mandate in terms of air pollution control.

The agglomeration of mines and power generation plants in the ELM has resulted in a large number of coal haulage diesel driven vehicles crisscrossing the length and breadth of the municipality. These heavy vehicles which are transporting coal from various mines destined for power generation plants are immensely contributing to the poor quality of air in the HPA. Cognizance should also be given to the fact that the N12, N4 and various other regional roads transverse through Emalahleni and into other locations as depicted in the map below (figure 1):

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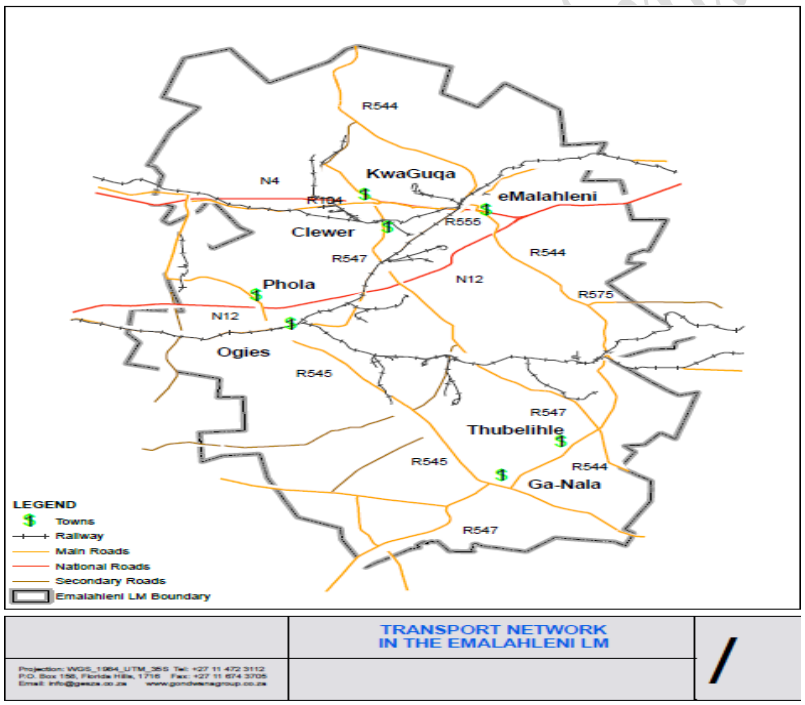
Figure 1: Major Road network in ELM



The ELM AQMP identified vehicle emission as the third largest source of air pollution in the municipality. This state of affairs is a serious setback on the efforts of the municipality to address

other hotspots air pollution, hence the need to develop a strategy that will deal specifically with vehicular emission within the municipality.

The Constitution of the Republic of South Africa (CRSA) provides that municipalities have exclusive executive and administrative authority for the administration of air pollution by, amongst others, passing by-laws that can be enforced for the administration of this function. Furthermore, section 151 (4) provides that the National and Provincial Governments may not impede or compromise a municipality's ability or right to exercise its powers and perform its functions.

This strategy is therefore developed in the context of the CRSA amidst the non-availability of regulations that regulate emissions from motor vehicles.

CHAPTER 2: LEGAL FRAMEWORK AND MANADATE TO CONTROL AIR POLLUTION FROM VEHICLE EMISSIONS

2.1. The Constitution of the Republic of South Africa (CRSA) (Act 108 of 1996).

Air pollution is a mandatory function of local government in terms of Part B of schedule 4 and Part B of schedule 5 of the Constitution. Furthermore, section 152 of the Constitution encapsulates the object of local government, which amongst others include; 'To promote a safe and healthy environment for the inhabitants of the municipality'. The need to managed air pollution, is also pivoted on the Bill of Rights contained in the Constitution of South Africa (1996). The Bill 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 rights in the Bill of Rights. Section 24 of the Constitution states that everyone has the right:

2.1.1. To an environment that is not harmful to their health or well-being; and

2.1.2. To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –

(a) prevent pollution and ecological degradation;

(b) promote conservation; and

(c) secure ecologically sustainable development and the use of natural resources while promoting justifiable economic and social development.

In order to uphold the provisions of the Constitution and the environmental right in the context of air quality, it is necessary for local government, municipalities in particular, to ensure that it

takes all reasonable measures that are justifiable to ensure that levels of air pollution are not harmful to human health and the environment.

2.2. The National Environmental Management Act (NEMA) (Act No. 107 of 1998).

Section 2 of the Act sets out principles that must be observed and promoted by all organs of state, amongst others;

2.2.1 placing the people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably.

2.2.2 that pollution and degradation of the environment are avoided, or where it cannot be altogether avoided, are minimized and remedied.

Section 28 of the Act imposes an obligation on every person the "Duty of care and remediation of environmental damage", specifically with regard to taking reasonable measures to prevent the occurrence of pollution and degradation of the environment.

To this end, the Emalahleni Local Municipality Vehicle Emission Control and Testing Strategy (ELM- VECTS) is aimed at enforcing the provisions of the NEMA and the CRSA.

2.3. The National Environmental Management: Air Quality Act (NEMAQA) (Act No. 39 of 2004).

The Act put in place various measures for the prevention of pollution in the country. Section 11 of the Act provides a mandate for municipalities in terms of the bylaws to identify substances in the ambient air which through their concentration, bioaccumulation and deposition or in any other way present a threat to the environment and human health or which the municipality believes present such threat. To this effect, the municipality can set local standards for any particular substance or mixture of substances in terms of section 11 of the Act if national or provincial standards are not available. Section 8 (a) read with paragraph 4.2 table 4 of the NFAQRSA mandate municipalities to (a) monitor ambient quality on point and non-point and mobile sources emissions and (b) the collection and management of data necessary for the assessment of compliance with the Act, the AQMP and ambient air quality and emission standards. Further, section 16 of the Act provides that air quality management plans must seek to address, amongst others; (a) improving the quality of air, (b) identification and reduction of the negative impact on human health and the environment and (c) effects of emissions from point and non-point sources.

Annexure B of the NEMAQA provides a Ringlemann smoke chart. It a scale that has been used for many centuries and continue to be used for measuring apparent density or opacity of smoke. It gives different shades of grey by which smoke may be compared. The chart was also used

during the era of APPA to detect levels of industrial, domestic and vehicular emissions. It is a visual method of identifying concentrations of smoke and thus providing a baseline for the visible threats to the air. This Ringlesmann smoke chart shall also be used as a baseline reference method in conjunction with Hartridge smoke units.

Table 1: Ringlemanns chart

0	1	2	3	4	5
0%	20%	40%	60%	80%	100%

To achieve cleaner air, the AQA also 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 environmental rights above are upheld.

2.4. 2012 National Framework for Air Quality Management in the Republic of South Africa (NFAMPRSA)

The AQA is largely based on the use of the application of the NFAMPRSA. This is a framework which outlines the governance functions in relation to air quality management between the three spheres of government. The framework highlights the following key principle responsibilities for municipalities:

Table 2: A synopsis of principle responsibilities of municipalities as denoted from the NFAMPRSA

Type of municipality	Principle responsibility
Local municipality and District municipality	Monitor ambient air quality and point, non-point and mobile sources, and Appoint a local air quality officer
Local municipality and District municipality	Development of air quality management plans as a component of integrated development plan (IDP)
Local municipality and District municipality	Monitoring compliance in respect to reasonable steps to prevent the emission of any offensive odour caused by any activity
Local municipality and District municipality	Monitoring compliance with directives to submit an atmospheric impact report
District	Monitoring compliance with conditions or requirements of an atmospheric emission license (AEL) or any other matter relating to AEL.

The table above clearly shows that air quality management function is a shared function between local municipalities and the district.

Notably, the framework also rates Victor Khanye, Emalahleni and Steve Tshwete Local Municipalities as one of the municipalities that have poor air quality in the country and thus given the highest rating of class 5 in terms of the Air Quality Areas.

2.5. Emalahleni Local Municipality Air Quality Management Plan

According to the ELM-AQMP, vehicles contributes the highest levels of lead at 99.21%; PM10 at 11.59%, whilst the other pollutants have been found to be insignificantly low. The total contribution of air emissions resulting from traffic in the ELM were quantified using total fuel sales statistics. Fuel sales statistics for eMalahleni and Kriel Magisterial Districts (MD) were obtained from the Department of Energy (DoE) fuel sales for 2016. Fuel statistics from the DoE were provided in liters for petrol and diesel. A total of 418.25 metric tons of fuel was sold in the MD in one year (2016). CO is the main criteria pollutant emitted from the usage of petrol at 21% of the total fuel used, whilst NOx from the usage of diesel at 77% of the total fuel used within the municipality. Therefore, the main assumption of the total fuel usage is that all fuel sold in the Emalahleni MD and Kriel MD is combusted within the ELM Airshed.

The plan also recommended that the municipality must undertake monitoring, data analysis and reporting on ambient air quality as per its mandate. It further recommended the following

(a) that emission monitoring of heavy vehicles tail pipes be undertaken
(b) that updated fleet data (vehicle type, age, fuel usage, etc) should be collected in order to improve the vehicle emission inventory.

2.6. Emalahleni Local Municipality Air Quality Management By-laws, 2016 (ELM-AQMBL)

The objectives of these bylaws are to give effect to the right contained in section 24 of the CRSA by regulating air pollution within the municipality. Section 4 of the bylaws provides for the 'Duty of Care'. Part 3 section 14 give a full account of motor vehicles emission testing including the testing procedure and the procedure to be followed in the event that there is noncompliance on the vehicle tested.

CHAPTER 3: VEHICLE TESTING INSTRUMENT TO BE USED

3.1. Background to the smoke measuring instrument

Smoke Meters are widely used instrument for measuring smoke density in diesel or gas powered engine vehicles based on optical property measurements. There's a variety of smoke meters,

namely Hartridge Smoke Meter, Bosch Smoke Meter and United States Public Health Smoke Meter. All of these instruments come with manufactures operational manual and the units of measurements or number scales. Smoke number scales have been developed to relate different instrument measurements to the assumed amount of soot being measured. The common reporting scales include Hartridge Smoke Units (HSU), Bosch Smoke Unit (BSU), and Filter Smoke Number (FSN).

Many of these instruments measure opacity directly through the smoke column while others measure opacity through a sampled fraction of the column. Opacity is a measure of light reduction/loss over a smoke column path usually expressed as a percentage. A wide variety of approaches to such instruments exists. An underlying assumption for such reporting is that soot is the majority or at least the most important constituent of the smoke to be measured.

3.2. Preferred Testing Method and Testing Procedure

The Hartridge smoke meter is the accepted instrument for the local municipality as it will afford the municipality with adequate result and further enhance the goals of the Emalahleni local municipality's Air quality management plan. The Hartridge smoke meter is a smoke measuring instrument which consists of two optically identical tubes, one containing clean air whilst the other containing a moving sample of the smoke, the clean air tube being used as reference to the experiment. On the apparatus, there is also light source and photo-electric cell mounted which face each other on swinging arms.

Movement of the change-over knob alters their position from 0-100, indicating the light absorbed by the smoke in Hartridge units. The air flow through the open ends of the tube across the surfaces of the light source and the photo-electric cell to provide cooling and to protect them against sooting by the smoke.

The sampling probe is connected either to a tapping on the exhaust pipe. The smoke meter is switched on and control lever set to bring the clean air tube between light and cell. The smoke meter dial should read zero otherwise the meter needs to be adjusted to read zero. The meter gives continuous and direct reading of the smoke density.

The Hartridge Smokemeter-4 has new features that improve and simplify operation and ensure that it meets all existing and anticipated international exhaust smoke regulation standards. The Smokemeter-4 is designed for simple one man operation either from alongside a vehicle or from the driver's seat, either free acceleration or steady state test procedures. The control is through

a compact and rugged handset with a digital LCD. Any out of range parameters are automatically flagged to the operator.

The standard printer data entry pack uses a full size easy to use QWERTY style keypad which enables operator and vehicle details to be entered, stored and then printed out together with the smoke density results from the vehicle being tested. Operators can also set up several different operating sequences for their personal convenience providing extra flexibility in use. The length of the smoke sample and the operating principles of the Smokemeter-4 are the same as earlier Hartridge Smoke meters ensuring continued compliance with relevant international exhaust smoke measurement regulations. The main limitation of the Hartridge smoke meter is that it is applicable to Diesel powered engines. The apparatus will be used for only trucks and other diesel powered engines.

3.3. Testing procedure and Implication for non-compliance

The testing procedure and implications in the event of non-compliance are detailed in the ELM AQMBL.

CHAPTER 4: IMPLEMENTATION PROCESS

4.1. The following instruments and tools shall be used in the execution of the VECTS:

(a) Hartridge smoke meter for the reading of exhaust emissions from the tailpipes
(b) Manual for the operation of the Hartridge smoke meter
(c) Emalahleni Local Municipality Air Quality Management By-laws which prescribes the testing procedure
(d) Smartphone with applications that will show the temperature and weather conditions at the time of testing as well as the location where the testing was conducted.
(e) The NEM: Air Quality Management Act
(f) Repair notice book to be used in relation to noncompliance for first test conducted
(g) Section 56 (Criminal Procedure Act) fine book to be used in the event that there is noncompliance with the repair notice
(h) Relevant PPE

4.2. Factors to be taken into account during testing

(a) Weather conditions which must be recorded for every test
(b) Exact location where tests were conducted
(c) Recording of all tests conducted in a particular date

4.3. Roles and responsibilities

(a) **Traffic officer** –
(i) stopping the vehicle to be tested
(ii) ensure that the vehicles is stopped at a safe and convenient place for conducting the test.
(iii) Direct the driver of the vehicle to oblige to the instructions of the testing office
(iii) direct the tested vehicle to proceed once the testing has been completed.

(b) **Testing officer/ Compliance officer**
(i) Conduct the prescribed vehicular emission testing in accordance with Part 3, section 14 of the Air Quality Management By-laws.
(ii) Record all relevant information for every individual test conducted.

4.4. Standards for vehicular emission testing

The municipality is in the process of procuring a Hartridge smoke meter. Minimum emission standards for vehicular emission testing in the ELM shall be developed in terms of sections 11 of

the NEMAQA and published in the Provincial Gazette. The development of the standards should be guided by the manufacturer's instruction and manual for the Hartridge smoke meter.

CHAPTER 5: CONCLUSION

The Emalahleni Local Municipality acknowledges the fact that there are no established norms and standards for vehicular emissions. The municipality also acknowledges that it needs to make every effort within reasonable and justifiable means to ensure the protection of the environment and upholding the constitutional rights of its citizens. To this end, this strategy is aimed at ensuring the control and effective testing of vehicular emissions within the ELM. A consultative process shall be followed prior to the implementation of the strategy.

ANNEXURE 1 – REPAIR NOTICE FORM TO BE USED FOR NONCOMPLIANCE