DEVELOPMENT OF AN INTEGRATED AIR QUALITY MANAGEMENT PLAN FOR THE DISTRICT

A PROJECT FOR THE FRANCES BAARD DISTRICT MUNICIPALITY

7 SEPTEMBER 2010

Document description

Client:	Frances Baard District Municipality
Report name:	Development of an Integrated Air Quality Management Plan for the District
Report type:	Status Quo Report
Project name:	AQMP FBDM
Project number:	E02.JNB.000652
Document number:	Doc1
Authority Reference:	BID 10/09
Version:	Rev 2

Compiled by:

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

The Frances Baard District Municipality in this report focuses on the outline of the status quo with respect to air quality within the district. The main aim with respect to the development of the Air Quality Management Plan for the District will also be outlined.

The Bill of Rights in the Constitution states that South Africans have the right to an environment that is not harmful to their health and well-being. The focus of air quality management in the District should be to characterise baseline air quality, and to ensure the management and operation of ambient monitoring networks (if required), the licensing of listed activities, and the development of emission reduction strategies. To fulfil these responsibilities, the District has initiated the development of an air quality management plan (AQMPs) which will form part of their overall Integrated Development Plan for the area. In developing this AQMP the main focus will be to ensure compliance with the National Air Quality Act.

The main objective of the Air Quality Act (AQA) is the protection of the environment and human health, in a sustainable (economic, social and ecological) development framework, through reasonable measures of air pollution control. The rationale for developing the Air Quality Management Plan for the Frances Baard District Municipality (FBDM) is due to the recognition of the growing severity of air pollution caused by domestic, industrial, agricultural and mining operations in South Africa, as well as due to the internal desire of the District to ensure that all is being done to certify that environmental considerations are being addressed within the District.

1.1 Purpose of this Air Quality Management Plan

As defined by the National Environmental Management: Air Quality Act of 2004, this air quality management plan aims, to:

- Give effect in respect of air quality to Chapter 3 of the National Environmental Management Act to the extent that this Chapter is applicable to it;
- Improve air quality;
- Identify and reduce the negative impact on human health and the environment of poor air quality;
- Address the effects of emissions from industrial sources;
- Address the effects of emissions from any point or non-point sources of air pollution;
- Assist the District to implement the Republic’s obligations in respect of international agreements; and
- Give effect to best practise in air quality management.

Furthermore, the AQMP must describe how the relevant entity will give effect to its air quality management plan.

The FBDM AQMP will initiate best practices in air quality management and ensure cost-effective and equitable reduction of emissions. This will aim to improve air quality at the FBDM and its surroundings and reduce environmental and health risks.

The main goals of the FBDM AQMP are to:

- Achieve and sustain acceptable air quality levels within the District;
- Minimise the negative impact of air pollution on people's health and well-being and on the environment;

Specific objectives of the FBDM AQMP include the following:

- Identify key pollutants of concern, its sources and impacts;
- Aid in the identification of sources of which the implementation of emission reduction measures in the short-term is justified;
- Identify measures to improve air quality;
- Identify and suggest measures to reduce the negative impact on human health and the environment due to poor air quality;
- Address the effects of emissions from industrial sources;
- Address the effects of emissions from any point or non-point source of air pollution other than those already contemplated above;
- Advise on the adherence to the Republic’s obligations in respect of international agreements;
- Give effect to best practice in air quality management;
- Describe how the FBDM will give effect to its air quality management plan (development of objectives, goals, action plans & strategies);
- The FBDM will outline an AQM framework including required organisational and functional structures to be established within the District, suitable AQM tools and an integrated air quality management system comprising of an emissions inventory, air quality and meteorological modelling, dispersion modelling and environmental reporting;

1.2 Legislative and Regulatory Framework of the Air Quality Management Plan

1.2.1 National Environmental Management: Air Quality Act

The Air Pollution Prevention Act regulates the control of noxious and offensive gases emitted by industrial processes, the control of smoke and wind borne dust pollution, and emissions from diesel vehicles.

The promulgation of the National Air Quality Act (2004) resulted in a shift from national air pollution control based on source based controls to decentralised air quality management through an effects-based approach. An effects based approach requires the meeting of ambient air quality standards. These ambient standards are to be set by the Local and District Municipalities which govern air quality management in the area. The local municipalities of concern here are Sol Plaatje, Dikgatlong, Magareng and Phokwane, plus a rural district management area. If these standards have not been set yet the National Ambient Air Quality Standards will need to be adhered to. Such standards provide the objectives for air quality management.

Multiple levels of standards provide the basis for both ‘continued improvements’ in air quality and for long term planning in air quality management. Although maximum levels of ambient concentrations should be set at a national level, more stringent ambient standards may be implemented by provincial and local authorities.

The control and management of all sources of air pollution relative to their contributions to ambient concentrations is required to ensure that improvements in air quality are secured in the most timely, even handed and cost-effective way. The need to regulate diverse source types reinforces the need for varied management approaches ranging from command and control methods to voluntary measures.

1.2.2 Enabling Legislation for Local Government

The decentralisation of AQM and associated new responsibilities for local government is made feasible given the promulgation of enabling legislation for local government. The Municipal Structures Act, together with the Local Government: Municipal Systems Act 32 of 2000, have firmly established Local Government as an autonomous sphere of government having specific functions defined by the Constitution.

The Access to Information Act, 95 of 2000 aims to promote transparency, accountability and effective governance of all public and private bodies through educating everyone to effectively scrutinize, and participate in, decision-making by public bodies that affect their rights. The Promotion of Administrative Justice Act, 96 of 2000 aims to give effect to section 33 of the Constitution. In terms of this Act, local government can be held responsible for its actions and decisions by the public and is required to act in an efficient and transparent manner. New responsibilities for local government arising due to recent legislative changes include facilitation of public participation, transparency, accountability and provision of access to information.

According to Section 156(1) of the Constitution a municipality has the executive authority in respect of air pollution, and has the right to administer the local government matters listed in, Part B of Schedule 4 of the constitution that deals with air pollution. Section 156(2) makes provision for a municipality to make and administer bylaws for the effective administration of the matters that it has the right to administer so long as such bylaws do not conflict with national or provincial legislation. The repealing of Local Government Transition Act, Act no. 209 of 1993 on 5 December 2000 removed legislative obstacles to the application of Section 156 of the Constitution by municipalities. In response to this, FBDM is able to pass bylaws dealing with local air pollution control.

1.2.3 Delineation of National, Provincial and Local Government Responsibilities

In accordance with the IP&WM Policy, the DEAT indicates that it will delegate the responsibility for air quality management strategy implementation and regulation enforcement to the 'appropriate sphere of government'.

The anticipated delineation of responsibilities between national, provincial and local government, as informed by the Air Quality Act, are outline in Table 1. National Government is tasked with the enforcement of the national AQM legislative framework with provincial and local government being required to operate within this framework. Provincial government is permitted to develop their own legislation and policies to meet their obligations in terms of the national policy. Local governments are permitted to develop and implement local AQM programmes, guidelines and bylaws in line with national and provincial policy and legislation.

Table 1: Anticipated delineation of responsibilities between National, Provincial and local government 1

NATIONAL Government Functions and Responsibilities	PROVINCIAL Government Functions and Responsibilities	LOCAL (District/Metro/Municipality) Government Functions and Responsibilities
Establish & review national framework	Air quality monitoring	Air quality monitoring
Identify priority pollutants	Monitor municipality performance	Emission monitoring
Establish national air quality standards	Identify priority pollutants	Identify priority pollutants
Establish national emission standards	Establish provincial air quality standards	Establish local emission standards
Appoint national AQ officer	Establish provincial emission standards	Appoint AQ officer
Integrate AQM plans into their Environmental Management Plans	Appoint provincial AQ officer	Develop and implement AQM plan as part of their Integrated Development Plan
Declare priority areas	Integrate AQM plans into their Environmental Management Plans	Collaborate with national & provincial government (within priority areas)
Prepare priority areas AQMP	Declare priority areas	Perform emission licensing authority functions (metros and district municipalities)
List activities	Prepare priority areas AQMP	
Declare controlled emitters	List activities	
Set requirements for pollution prevention plans	Declare controlled emitters	
Set regulations for dust, odour, noise	(Perform emission licensing authority functions if no capacity by local authorities)	
Declare and set requirements for controlled fuels Investigate & regulate trans-boundary pollution	Declare and set requirements for controlled fuel	
Investigate potential international agreement contraventions		

[1] Air Quality Act 2004

1.2.4 International Conventions to which South Africa is a Signatory and which may impact on air quality management in the Frances Baard District Municipality

1.2.5 United Nations Framework Convention on Climate Change (UNFCCC1)

The Convention entered into force on 21 March 1994. The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal membership, with 192 countries having ratified including South Africa.

Under the Convention, governments gather and share information on greenhouse gas emissions, national policies and best practices launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries and cooperate in preparing for adaptation to the impacts of climate change

1.2.6 Kyoto Protocol 2

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions .These amounts to an average of five per cent against 1990 levels over the five-year period 2008-2012.

The Kyoto Protocol is generally seen as an important first step towards a truly global emission reduction regime that will stabilize GHG emissions, and provides the essential architecture for any future international agreement on climate change. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. 180 nations including South Africa have ratified the treaty to date. Under the Treaty, countries must meet their targets primarily through national measures. However, the Kyoto Protocol offers them an additional means of meeting their targets by way of three market-based mechanisms.

The Kyoto mechanisms are:

- Emissions trading – known as “the carbon market"
- the clean development mechanism (CDM)
- joint implementation (JI).

These mechanisms help stimulate green investment and help Parties meet their emission targets in a cost-effective way.

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[1]www.UNFCCC.org
[2] http://unfccc.int/kyoto_protocol/items/2830.php

The last important summit of the UNFCCC was the Copenhagen Climate Conference in December 2009. During this conference South Africa announced it would cut its growth in carbon emissions by 34 % by 2020, and 52 by 2025, in case the developed countries provide financial aid. A majority of the countries have signed the Copenhagen Accord, saying an increase of below 2 degrees Celsius is required to prevent the worst effects of climate change. Developing countries like South Africa have agreed to communicate their efforts to limit GHG emissions every two years.

1.2.7 The Vienna Convention for the Protection of the Ozone Layer 3

The ultimate objective of the Convention is to protect human health and the environment against adverse effects resulting from human activities which modify or are likely to modify the ozone layer and urges the Parties to take appropriate measures in accordance with the provisions in the Convention and its Protocols which are in force for that party. To achieve the aforementioned objectives, the Parties, within their capabilities, are expected to: cooperate to better understand and assess the effects of human activities on the ozone layer and the effects of the modification of the ozone layer; adopt appropriate measures and cooperate in harmonizing appropriate policies to control the activities that are causing the modification of the ozone layer; cooperate in the formulation of agreed measures for the implementation of this Convention; and cooperate with competent international bodies to implement effectively this Convention and protocols to which they are party.

1.2.8 The Montreal Protocol on Substances that deplete the Ozone Layer 4

These protocol controls production of ozone depleting substances: The Montreal Protocol on Substances that Deplete Ozone Layer is a protocol under the Vienna Convention. The Protocol controls the production and consumption of the most commercially and environmentally significant ozone-depleting substances - those listed in the Annexes to the Protocol. One feature of the Montreal Protocol which makes it unique, is Article 6 that requires the control measures to be revised at least every four years (starting 1990), based on the review and assessment of latest available-information on scientific, environmental, technical and economic aspects of the depletion of the ozone layer. Based on reports of assessment panels appointed by the Parties and taking into consideration the needs and situation of the developing countries, the Protocol has already been adjusted and amended twice.

At present, 191 nations have become party to the Montreal Protocol. The Montreal Protocol on Substances that Deplete the Ozone Layer is an international treaty designed to protect the ozone layer by phasing out the production of a number of substances believed to be responsible for ozone depletion. The treaty was opened for signature on September 16, 1987 and entered into force on January 1, 1989 followed by a first meeting in Helsinki, May 1989. Since then, it has undergone seven

[3] www.unep.org/ozone/viennaconvention2002.pdf

4 www.unep.org/OZONE/pdfs/Montreal-Protocol2000.pdf

revisions, in 1990 (London), 1991 (Nairobi), 1992 (Copenhagen), 1993 (Bangkok), 1995 (Vienna), 1997 (Montreal), and 1999 (Beijing).

1.2.9 The Stockholm Convention on Persistent Organic Pollutants (POPs) 5

The Stockholm Convention is an international legally binding agreement on persistent organic pollutants (POPs). In 1995, the Governing Council of the United Nations Environment Programme (UNEP) called for global action to be taken on POPs, which it defined as “chemical substances that persist in the environment, bio-accumulate through the food web, and pose a risk of causing adverse effects to human health and the environment”.

Following this, the Intergovernmental Forum on Chemical Safety (IFCS) and the International Programme for Chemical Safety (IPCS) prepared an assessment of the 12 worst offenders. Known as the Dirty Dozen, this list includes eight organo-chlorine pesticides: aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex and toxaphene; two industrial chemicals: hexachlorobenzene (HCB) and the polychlorinated biphenyl (PCB) group; and two groups of industrial by-products: dioxins and furans.

The negotiations for the Stockholm Convention on Persistent Organic Pollutants were completed on May 23rd 2001 in Stockholm, Sweden. The convention entered into force on May 17th, 2004 with ratification by an initial 128 parties and 151 signatories. Co-signatories agreed to outlaw nine of the "dirty dozen" chemicals, limit the use of DDT to malaria control, and curtail inadvertent production of dioxins and furans. Parties to the convention have agreed to a process by which persistent toxic compounds can be reviewed and added to the convention, if they meet certain criteria for persistence and trans boundary threat. Several other substances are being considered for inclusion in the Convention. These are: hexabromobiphenyl, octaBDE, pentaBDE, pentachlorobenzene, short-chained chlorinated paraffin’s, lindane, α- and β-hexachlorocyclohexane, dicofol, endosulfan, chlordecone and PFOS.

The Convention sets out several objectives including:

- The elimination from commerce of identified POPs and others that may be identified in the future;
- encouraging the transition in commerce to safer alternatives;
- identifying additional POPs;
- the clean-up of old stockpiles and equipment containing POPs; and
- encouraging all stakeholders to work towards a POP-free environment.

[5] www.pops.int/

1.2.10 International Concerns Around mercury

There are international initiatives to address mercury but to date no international policy has been developed. A recent programme backed by the United Nations (UN) that aims to reduce the health and environmental impacts of mercury includes a two-year period of voluntary action to reduce emissions and an evaluation to determine whether an international treaty is necessary. It aims to develop partnerships between government, industry and other key groups to reduce emissions.

1.3 Vision and Mission Statement from the Frances Baard District As defined for Air Quality Management

1.3.1 Vision

- To ensure air Quality does not negatively affect the health and wellbeing of the social livelihoods of communities and ecosystems in the Frances Baard District.

1.3.2 Mission

- Stimulate economic growth while remaining compliant with legislative frameworks;
- Maintain infrastructure to continually improve on poor odour and health impacts in the District;
- To be in a position to monitor impacts related to air quality;
- To develop networks and allow for open transparency between key polluters and air quality managers;
- To facilitate the reduction in human health related impacts associated with air pollution;
- To ensure that the Frances Baard District continues to develop in a sustainable manner in line with air quality objectives;
- To ensure that all pollution sources of emissions to atmosphere are adequately managed to reduce their impacts on the surrounding ecosystems.

1.4 Report Layout

This report aims to outline the following key issues which need to be addressed by the FBDM in their Air Quality Management Plan:

- Baseline Condition;
    - Description of the Meteorological Condition;
    - Outline of Topographical Features;
    - Land Use in the Area;
    - Identification of Priority Pollutants of Concern;
    - Identification of Priority Sources of Concern;
    - Summary of Local Health-Related Standards;
    - Summary of Ambient Monitoring Taking Place in the District.
- Air Quality Management System Development;

  - Development of an emissions inventory;
  - Ambient and Meteorological Monitoring Requirements;
  - Dispersion Modelling requirements;
  - Approach to the development of intervention strategies;
  - Reporting Mechanisms;
  - Public Consultation Approach;
- Capacity Building;
- Plan Review;

2 BASELINE DESCRIPTION OF THE PLANNING AREA

2.1 Background

The Frances Baard District Municipality (FBDM) was named after Frances Baard, a woman who was born in Beaconsfield, Kimberley, and who played an important role in the struggle for democracy in South Africa. It is predominantly a mining and agricultural district. The climate is favourable for outdoor living with a great number of sunny days throughout the year. Two of the largest rivers, the Orange and the Vaal, flow through the district. FBDM covers an area 12 349 sq. km which accounts for 3,4% of the total area of 361 830 sq. km of the Northern Cape Province.

The Frances Baard District Municipality is the economic hub of the province. Although agriculture and mining (most notably the famous diamond mines in and around Kimberley) appear to be the district's main economic activities, they contribute relatively little to its annual income. The district's highest earnings come from community services, followed by finance, transport and trade. The FBDM has identified regional tourism, Agri-BEE, value adding and SSME procurement, as part of its objectives to regenerate the economy.

2.2 Demographics

The District comprises of four local municipalities namely, Sol Plaatje with a total population of 243 000, Dikgatlong with a total population of 40 617, Magareng with a total population of 20 485 and Phokwane which also comprises of a total population of 46 268, plus a rural district management area with a total population of 2 472 (Figure 1). Phokwane is situated at the heart of the Vaalharts Water Scheme, the largest of its kind in the southern hemisphere. Kimberley is located in the Sol Plaatje Municipality, it is the capital of the province, and is also the home of the head offices of a District Municipality. The total population of the whole district has been estimated at 353 198 people (Community Survey 2007). Based on the age breakdown of the population, approximately 234 523 (66.4%) of the population falls within the age group 15 to 64 years. Population composition by gender shows that 182 603 (51.7%) of the population is female whilst 170 594 (48.3% %) is male (Figure 2).

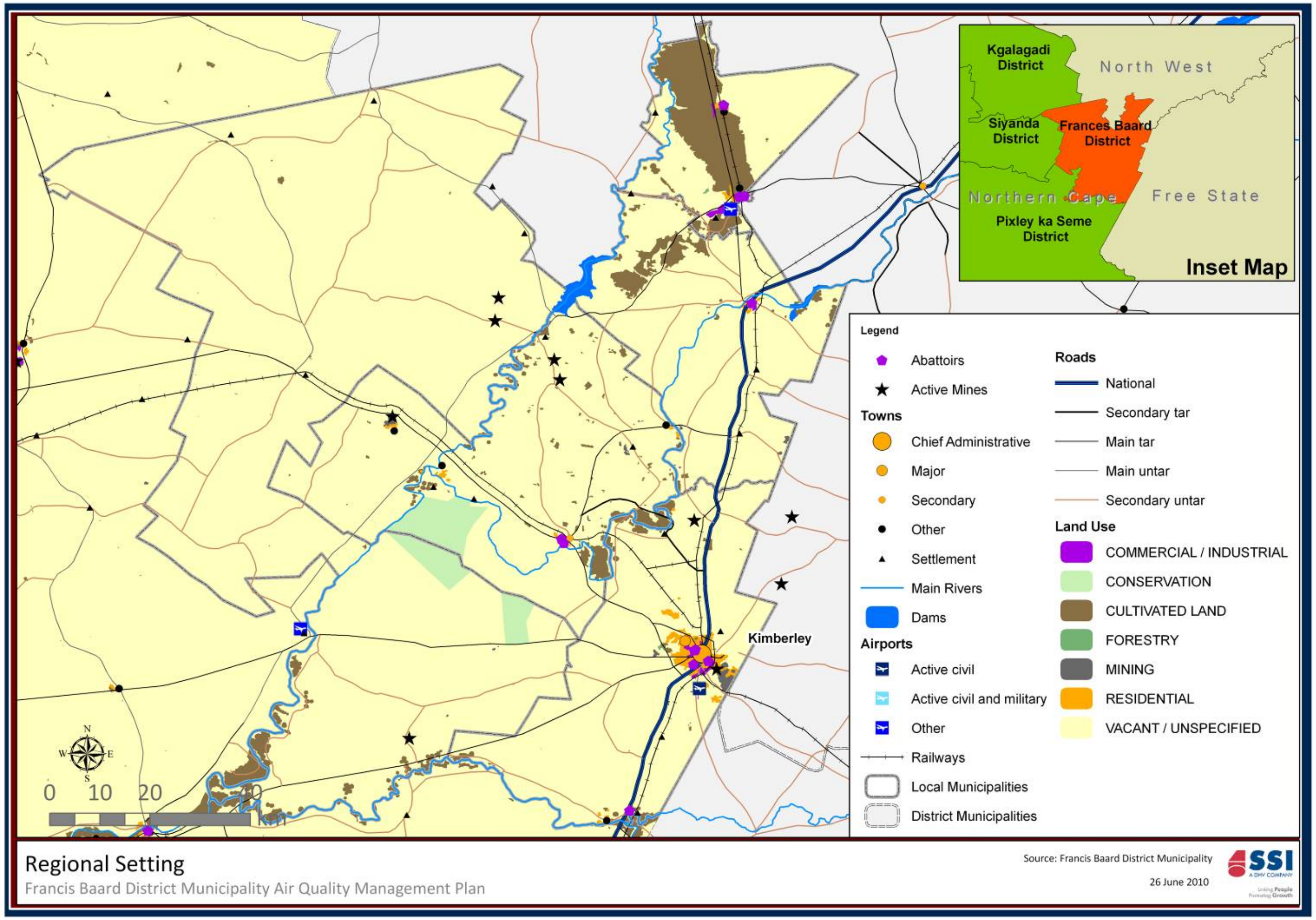


Figure 1: The Frances Baard District Municipality Locality Map

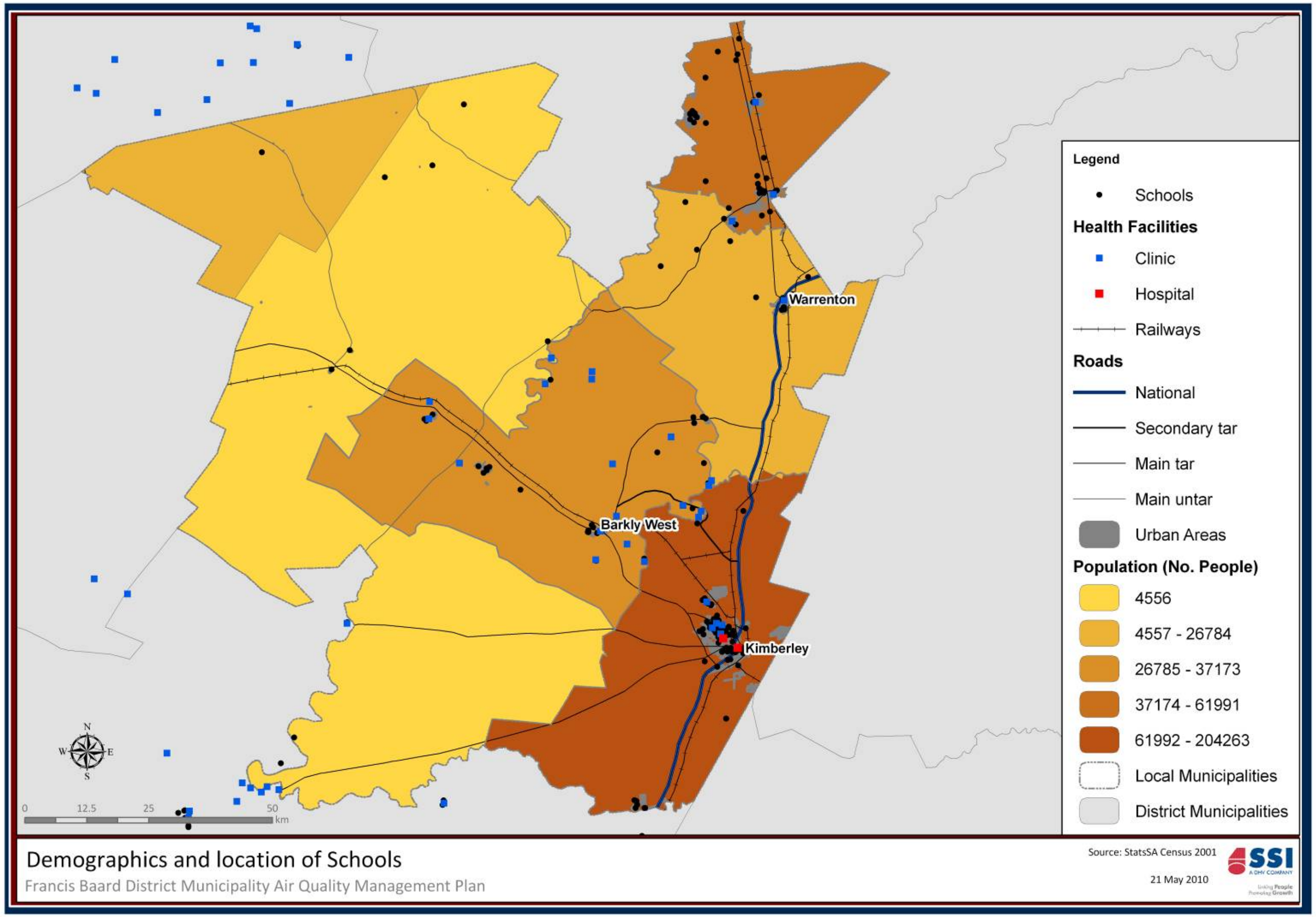


Figure 2: The Frances Baard District Municipality Population Distribution

2.3 Meteorological Setting

The climate around Kimberley is essentially a continental one - the weather provides hot wet summers (December to February) and mild dry winters (June to August). The infrequent summer rains tend to take the form of occasional severe thunderstorms rather than prolonged soft showers. It is not unusual for winter night-time temperatures to drop below freezing (Available at URL: http://www.bdb.co.za/kimberley/climate.htm). These general trends are however expected to change due to the impacts of climate change. The temperature in South Africa is projected to increase by between 1 and 3 degrees, and the country's rainfall is projected to decrease by 5-10%. However, arguably more important than these aggregate statistics, is the way in which these will be experienced. As well as average temperature increase, the daily maximum temperatures in summer and autumn in the western part of South Africa are likely to increase. That means more extremely hot days. With regards to rainfall, the east of the country is projected to become wetter, but the distribution of rainfall within the rainfall season (summer) will also change, with the rainfall season beginning later and the annual average falling over fewer days with an increase in extreme events (which has implications for the growing season). The west of the country - the winter rainfall region - will become drier (Available at URL: http://www.sealthedeal2009.org/climate-change-south-africa)

The change in temperature and rainfall will have implications for a number of sectors. Water resources are already under pressure in South Africa, and climate change will lead to a decline in the availability of surface water resources. This will happen at the same time as socio-economic development will increase the demand for water. Agriculture is an important source of livelihood for many rural South Africans, yet maize productivity will decrease under climate change, and the areas in which maize can feasibly be grown will decrease, forcing a shift to more drought-tolerant crops such as sorghum. Grassland pastures will also change to shrub land and risk invasion by alien plants. The change in range for plant growth will also affect biodiversity, threatening the high number of endemic species found in South Africa such as the fynbos of the Cape Floral Kingdom (Available at URL: http://www.sealthedeal2009.org/climate-change-south-africa).

Figure 3 provides an indication where various meteorological measurements have taken place within the district in the past. All sites with the exception of the Kimberley sites have however been discontinued since the early nineties so no recent data is available for presentation within the region. All the sites with the exception of Kimberley are agricultural stations and recorded measurements for temperature, humidity, rainfall as well as incidents of thunderstorms, hail and fog. A summary of this historical data collected is presented in the subsections which follow. Kimberley represents the South African Weather Services weather office, where over and above the variables listed above wind data is also recorded.

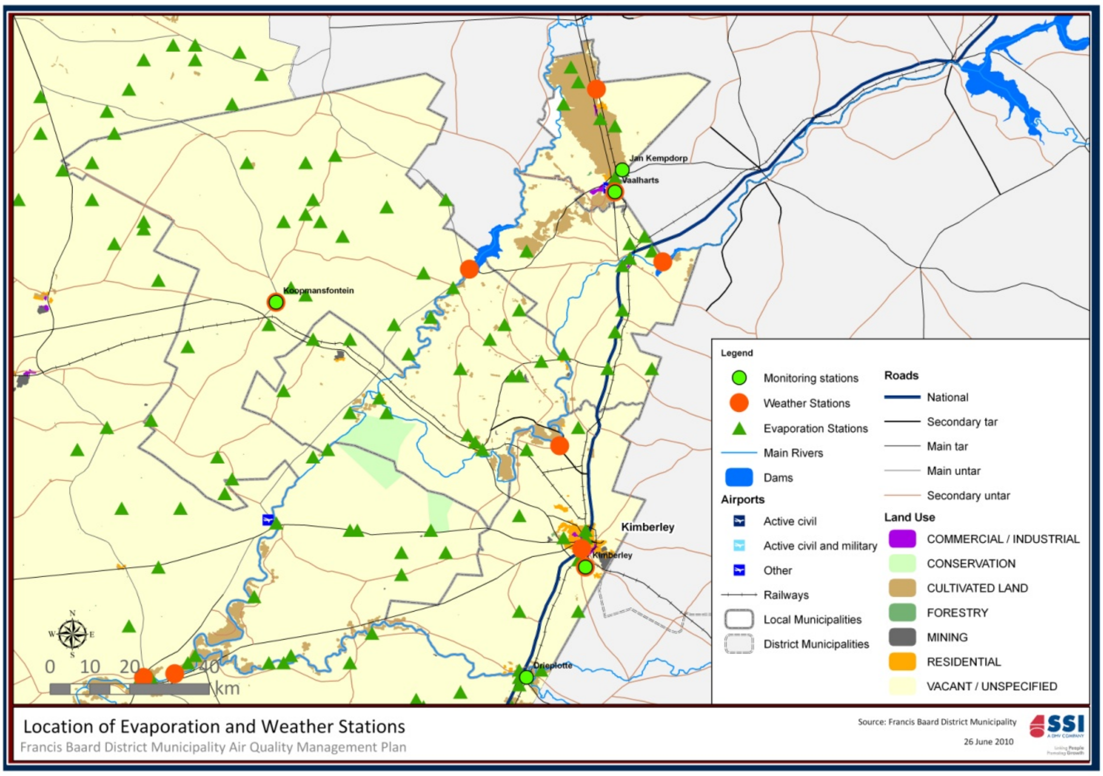


Figure 3: Location of meteorological sampling points within the FBDM.

2.3.1 Temperature

Temperature affects the formation, action, and interactions of pollutants in various ways (Kupchella & Hyland, 1993). Chemical reaction rates tend to increase with temperature and the warmer the air, the more water it can hold and hence the higher the humidity.

Temperature also provides an indication of the rate of development and dissipation of the mixing layer. This is the zone within the upper atmosphere where air movement takes place and where pollutants released can more easily be diluted by mixing with surrounding air before it reaches ground level.

Daily summer temperatures within the District range between ~18.5 °C and ~25.4°C with an average of ~21.3 °C. Winter temperatures range between ~8.7 °C and ~17.5 °C with an average of ~12.4 °C as is indicated in Figure 4.

Of the five sites assessed, the temperature profile differs very slightly. With marginally lower temperatures recorded at the Kimberley and Diepplotte sites located to the South of the District (Figure 4).

The highest maximums recorded in the District range from 39.9 °C to 41.2 °C respectively. With the lowest recorded temperature recorded at -10.6 °C at the Koopmansfontein site (Table 2).

2.3.2 Precipitation

Precipitation cleanses the air by washing out particles suspended in the atmosphere (Kupchella & Hyland, 1993). It is calculated that precipitation accounts for about 80-90% of the mass of particles removed from the atmosphere (CEPA/FPAC Working Group, 1999).

Total monthly rainfall figures for the five sites assessed are depicted in Figure 5. The area under investigation lies in the summer rainfall region of South Africa, receiving an average total annual rainfall of ~484 mm.

Of the data collected for the various regions of the District, no real variation in rainfall patterns could be observed (Figure 5). The number of rain days does however vary with more rain days noted at the Kimberly site to the southeast and at the Koopmansfontein site to the west, indicating that even though the same amount of rainfall fell in these areas this rainfall is distributed over a longer period (Table 3).

2.3.3 Relative Humidity

When relative humidity exceeds 70%, light scattering by suspended particles begins to increase, as a function of increased water uptake by the particles (CEPA/FPAC Working Group, 1999). This results in decreased visibility due to the resultant haze. Many pollutants may also dissolve in water to form acids.

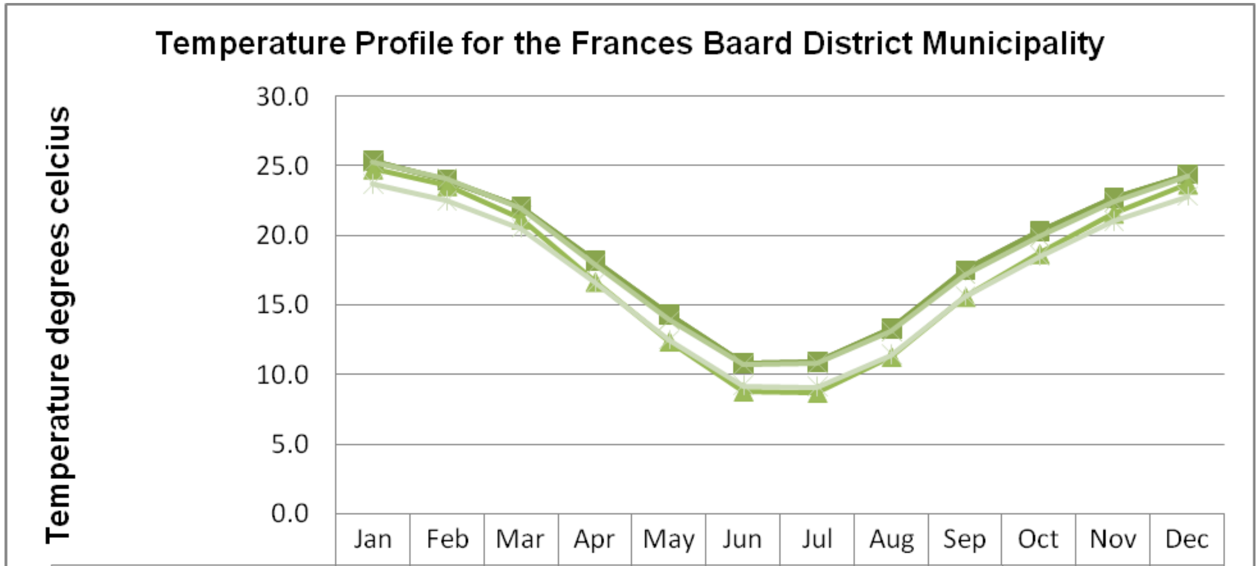
Within the Frances Baard District Municipality incidence of humidity above 70% occur quite often. This is illustrated in Figure 6, with a slightly lower level of maximum humidity recorded at Jan Kempdorp. Figure 7 similarly presents the lowest humidity figures recorded at these sites over the periods sampled, of significance is the marked difference in humidity between Jan Kempdorp and Vaalharts which are situated geographically quite closely to each other (Table 4, Figure 3).

2.3.4 Thunderstorms, Hail and Fog

The analysis of the occurrence of certain meteorological variables such as the development of thunderstorms, hail and fog, provides an indication of the severity and variability of climatic conditions in the area being investigated.

Incidents of thunderstorms, hail and fog were reported at four of the five sites. Thunderstorms were noted to occur more often at Kimberley with a total average of 55 days per year expected, this compared to only 25 days for Vaalharts, 47 days for Diepplotte and 39 days for Koopmansfontein. It appears that the southern and eastern portions of the District experience more thunderstorms than the north and west (Table 4).

A similar profile is presented with the comparison of hail and fog occurrences in the District. Both these phenomena however occur infrequently (Table 4)



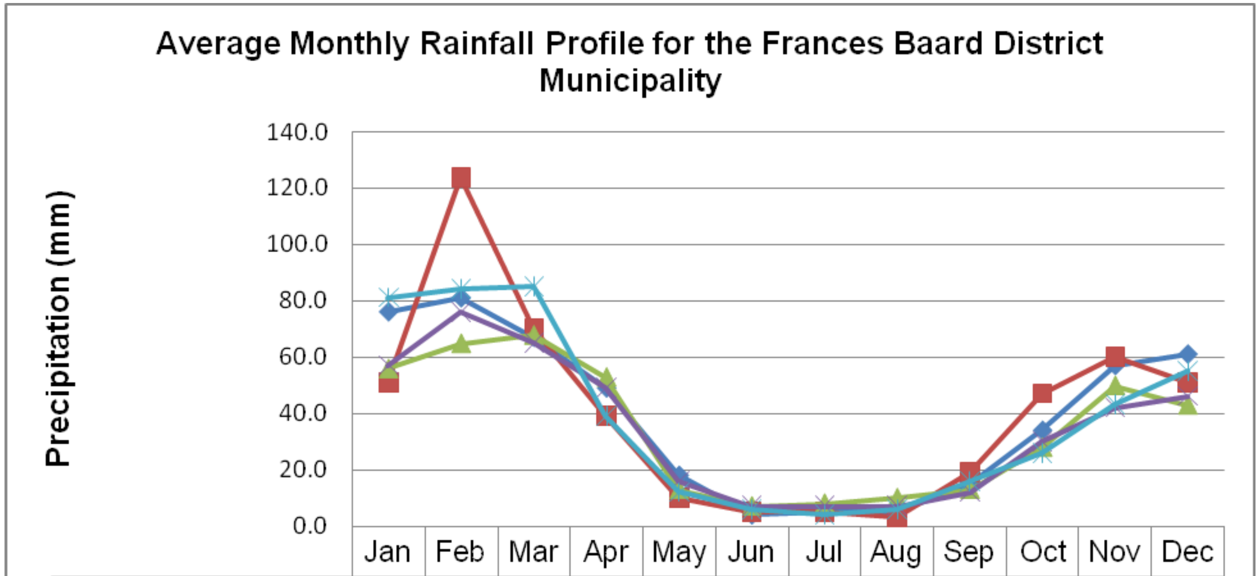
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Jan Kempdorp	25.4	24.0	22.1	18.2	14.3	10.8	10.9	13.3	17.5	20.3	22.7	24.4
Vaalharts	25.4	24.0	22.1	18.2	14.3	10.8	10.9	13.3	17.5	20.3	22.7	24.4
Diepplotte	24.8	23.6	21.2	16.7	12.4	8.8	8.7	11.3	15.6	18.7	21.6	23.7
Kimberley	25.3	24.1	22.0	17.9	13.9	10.7	10.8	13.1	17.2	19.9	22.4	24.3
Koopmansfontein	23.7	22.5	20.5	16.6	12.5	9.2	9.1	11.4	15.6	18.5	21.0	22.8

Figure 4: Mean Temperature Profile for five sample sites within the FBDM (Summary data from the South African Weather Services)

Table 2: Temperature Profile for the District (Summary data from the South African Weather Services)

Month	Vaalharts (1961-1990) Temperature - Agricultural Station (^oC)					Jan Kempdorp (1983-1990) Temperature - Agricultural Station (^oC)					Diepplotte (1961-1990) Temperature - Agricultural Station (^oC)				
	Min	Max	Mean	Highest	Lowest	Min	Max	Mean	Highest	Lowest	Min	Max	Mean	Highest	Lowest
January	17.7	33.0	25.4	41.2	8.5	16.9	32.7	24.8	40.5	10.0	16.4	33.2	24.8	41.0	6.3
February	17.0	30.9	24.0	38.7	6.1	16.6	30.8	23.8	38.0	4.5	15.8	31.5	23.6	40.5	3.3
March	15.0	29.1	22.1	37.1	1.5	14.2	29.2	21.8	37.0	3.0	13.4	29.0	21.2	38.0	1.0
April	10.7	25.7	18.2	35.0	0.1	10.0	26.3	18.1	34.5	-0.5	8.7	24.8	16.7	36.0	-2.5
May	6.0	22.5	14.3	31.6	-3.7	4.8	23.1	13.9	30.5	-3.4	3.1	21.7	12.4	33.0	-6.5
June	2.3	19.2	10.8	27.1	-6.4	0.8	19.4	10.1	26.5	-7.5	-0.8	18.2	8.8	27.5	-9.3
July	2.1	19.8	10.9	26.6	-7.2	0.1	19.7	9.9	26.0	-8.0	-1.5	18.8	8.7	27.1	-9.8
August	4.2	22.4	13.3	32.6	-6.8	3.1	22.8	12.9	30.5	-5.5	1.1	21.5	11.3	31.0	-9.3
September	8.5	26.4	17.5	35.5	-4.0	7.0	25.6	16.3	34.5	-3.5	5.6	25.6	15.6	36.0	-6.2
October	11.9	28.7	20.3	38.2	-2.0	11.2	27.9	19.6	36.5	-1.0	9.3	28.1	18.7	37.2	-2.7
November	14.5	30.8	22.7	39.0	4.0	13.8	30.3	22.0	37.3	5.1	12.6	30.5	21.6	38.5	3.8
December	16.5	32.3	24.4	39.9	4.5	15.7	31.8	23.7	39.0	3.5	14.9	32.5	23.7	40.6	4.6
Annual Avg	10.5	26.7	18.6	41.2	-7.2	9.5	26.6	18.1	40.5	-8.0	8.2	26.3	17.3	41.0	-9.8

Month	Kimberley (1961-1990) Temperature - Weather Office (^oC)					Koopmansfontein (1961-1990) Temperature - Agricultural Station (^oC)				
	Min	Max	Mean	Highest	Lowest	Min	Max	Mean	Highest	Lowest
January	17.9	32.8	25.3	40.4	7.1	15.7	31.6	23.7	39.9	5.6
February	17.3	31.0	24.1	39.9	5.6	15.1	30.0	22.5	39.0	3.4
March	15.2	28.8	22.0	36.2	2.0	13.1	27.9	20.5	36.1	-1.0
April	10.9	24.8	17.9	34.9	0.0	8.8	24.5	16.6	35.5	-3.0
May	6.5	21.4	13.9	31.1	-5.7	3.8	21.3	12.5	30.9	-6.8
June	3.2	18.2	10.7	26.6	-6.7	0.3	18.1	9.2	29.1	-9.5
July	2.8	18.8	10.8	26.8	-7.9	-0.3	18.6	9.1	26.0	-10.1
August	4.9	21.3	13.1	30.5	-6.7	1.7	21.1	11.4	29.9	-10.6
September	8.9	25.5	17.2	35.5	-5.5	6.0	25.2	15.6	34.9	-7.2
October	11.9	27.8	19.9	37.6	-0.5	9.4	27.6	18.5	36.4	-2.6
November	14.6	30.2	22.4	39.2	3.3	12.2	29.8	21.0	39.5	-1.5
December	16.6	32.1	24.3	39.7	4.8	14.2	31.4	22.8	39.3	3.6
Annual Avg	10.9	26.0	18.5	40.4	-7.9	8.3	25.6	16.9	39.9	-10.6



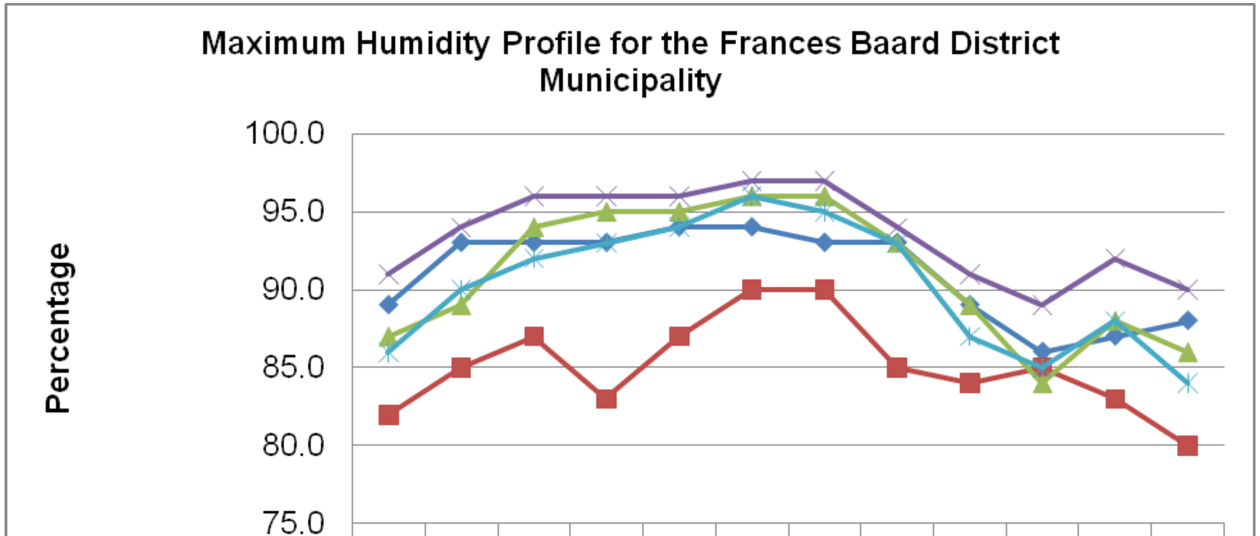
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vaalharts	76.0	81.0	67.0	49.0	18.0	4.0	5.0	5.0	15.0	34.0	57.0	61.0
Jan Kempdorp	51.0	124.0	70.0	39.0	10.0	5.0	5.0	3.0	19.0	47.0	60.0	51.0
Diepplotte	56.0	65.0	68.0	53.0	13.0	7.0	8.0	10.0	13.0	28.0	50.0	43.0
Kimberley	57.0	76.0	65.0	49.0	16.0	7.0	7.0	7.0	12.0	30.0	42.0	46.0
Koopmansfontein	81.0	84.0	85.0	39.0	12.0	6.0	4.0	6.0	16.0	26.0	43.0	55.0

Figure 5: Average Monthly Rainfall Profile for five sample sites within the FBDM (Summary data from the South African Weather Services)

Table 3: Rainfall Profile for the District (Summary data from the South African Weather Services)

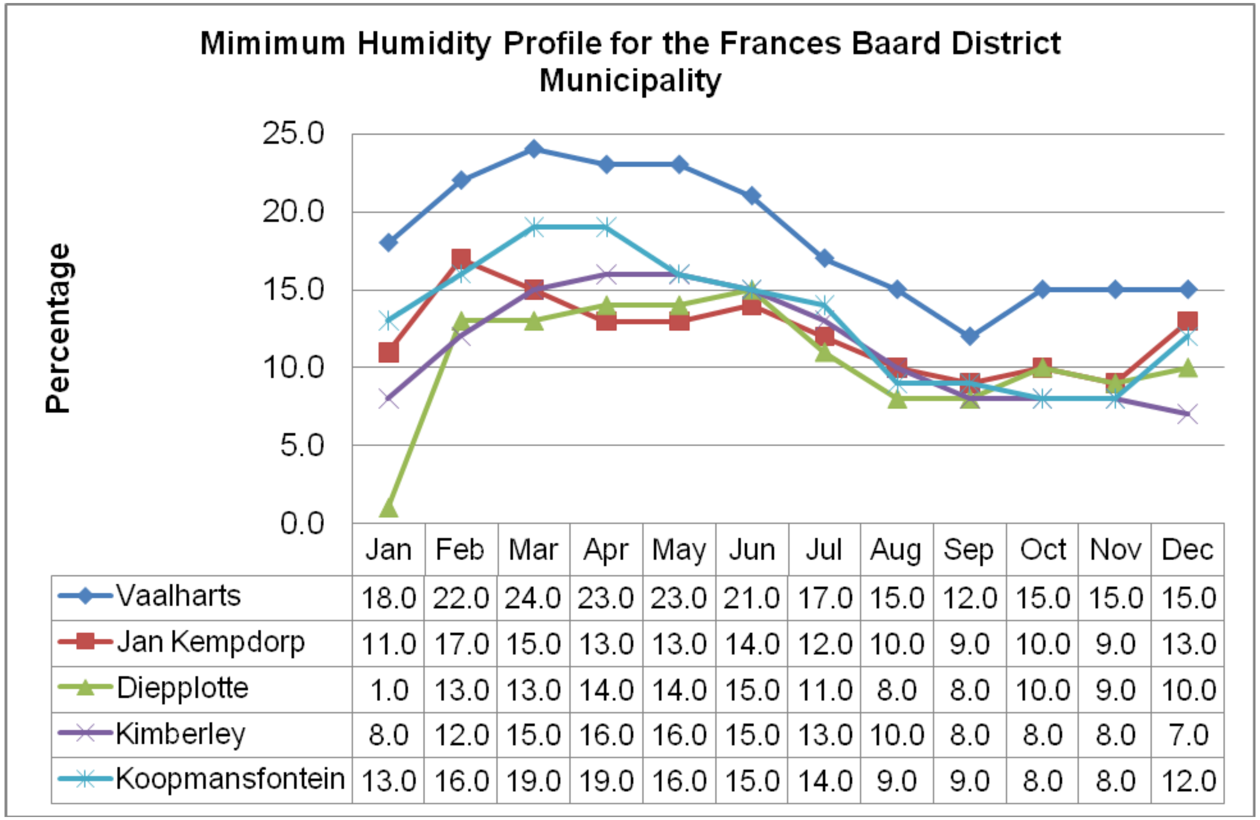
Month	Vaalharts (1961-1990) Precipitation - Agricultural Station (mm)					Jan Kempdorp (1983-1990) Precipitation - Agricultural Station (mm)					Diepplotte (1961-1990) Precipitation - Agricultural Station (mm)				
	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm
January	76.0	84.0	8.5	17.0	3.0	51.0	29.0	6.3	9.0	3.0	56.0	82.0	7.4	20.0	1.0
February	81.0	169.0	8.5	16.0	2.0	124.0	157.0	8.9	16.0	2.0	65.0	61.0	8.3	16.0	1.0
March	67.0	55.0	8.5	17.0	3.0	70.0	30.0	7.4	12.0	6.0	68.0	95.0	8.0	16.0	4.0
April	49.0	59.0	6.1	12.0	0.0	39.0	44.0	5.0	12.0	0.0	53.0	77.0	6.6	12.0	3.0
May	18.0	53.0	2.2	6.0	0.0	10.0	32.0	1.5	4.0	0.0	13.0	43.0	2.4	7.0	0.0
June	4.0	14.0	1.2	5.0	0.0	5.0	11.0	1.1	3.0	0.0	7.0	19.0	2.0	6.0	0.0
July	5.0	40.0	0.9	4.0	0.0	5.0	33.0	0.2	1.0	0.0	8.0	24.0	1.3	5.0	0.0
August	5.0	23.0	1.2	5.0	0.0	3.0	15.0	0.6	1.0	0.0	10.0	35.0	2.0	8.0	0.0
September	15.0	31.0	2.4	9.0	0.0	19.0	21.0	2.6	9.0	0.0	13.0	28.0	2.5	11.0	0.0
October	34.0	40.0	4.7	12.0	0.0	47.0	34.0	5.1	10.0	0.0	28.0	34.0	5.2	15.0	0.0
November	57.0	75.0	7.1	13.0	2.0	60.0	83.0	5.2	8.0	2.0	50.0	51.0	6.7	13.0	2.0
December	61.0	52.0	7.3	14.0	2.0	51.0	33.0	6.0	12.0	0.0	43.0	37.0	6.1	13.0	2.0
Annual Avg	472.0	169.0	59.0	76.0	46.0	484.0	157.0	50.0	64.0	37.0	414.0	95.0	58.0	89.0	40.0

Month	Kimberley (1961-1990) Precipitation - Weather Office (mm)					Koopmansfontein (1961-1990) Precipitation - Agricultural Station (mm)				
	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm	Avg Monthly Total	24 Hour Maximum	Avg Rain Days > 0.1 mm	Max Rain Days > 0.1 mm	Min Rain Days > 0.1 mm
January	57.0	45.0	9.8	21.0	2.0	81.0	109.0	9.5	21.0	2.0
February	76.0	88.0	9.8	19.0	2.0	84.0	77.0	10.3	21.0	3.0
March	65.0	54.0	10.2	16.0	3.0	85.0	90.0	10.4	17.0	4.0
April	49.0	51.0	7.6	14.0	3.0	39.0	48.0	7.0	12.0	3.0
May	16.0	55.0	3.3	8.0	0.0	12.0	41.0	2.6	7.0	0.0
June	7.0	18.0	2.5	7.0	0.0	6.0	23.0	1.3	5.0	0.0
July	7.0	22.0	1.5	5.0	0.0	4.0	28.0	0.9	4.0	0.0
August	7.0	26.0	1.8	8.0	0.0	6.0	32.0	1.4	7.0	0.0
September	12.0	44.0	3.1	12.0	0.0	16.0	57.0	2.0	9.0	0.0
October	30.0	35.0	6.1	13.0	0.0	26.0	25.0	5.4	12.0	1.0
November	42.0	60.0	7.7	16.0	3.0	43.0	98.0	7.0	16.0	2.0
December	46.0	60.0	7.9	13.0	3.0	55.0	51.0	8.4	16.0	1.0
Annual Avg	414.0	88.0	71.0	98.0	49.0	457.0	109.0	66.0	88.0	50.0



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vaalharts	89.0	93.0	93.0	93.0	94.0	94.0	93.0	93.0	89.0	86.0	87.0	88.0
Jan Kempdorp	82.0	85.0	87.0	83.0	87.0	90.0	90.0	85.0	84.0	85.0	83.0	80.0
Diepplotte	87.0	89.0	94.0	95.0	95.0	96.0	96.0	93.0	89.0	84.0	88.0	86.0
Kimberley	91.0	94.0	96.0	96.0	96.0	97.0	97.0	94.0	91.0	89.0	92.0	90.0
Koopmansfontein	86.0	90.0	92.0	93.0	94.0	96.0	95.0	93.0	87.0	85.0	88.0	84.0

Figure 6: Maximum Monthly Humidity Profile for five sample sites within the FBDM (Summary data from the South African Weather Services)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vaalharts	18.0	22.0	24.0	23.0	23.0	21.0	17.0	15.0	12.0	15.0	15.0	15.0
Jan Kempdorp	11.0	17.0	15.0	13.0	13.0	14.0	12.0	10.0	9.0	10.0	9.0	13.0
Diepplotte	1.0	13.0	13.0	14.0	14.0	15.0	11.0	8.0	8.0	10.0	9.0	10.0
Kimberley	8.0	12.0	15.0	16.0	16.0	15.0	13.0	10.0	8.0	8.0	8.0	7.0
Koopmansfontein	13.0	16.0	19.0	19.0	16.0	15.0	14.0	9.0	9.0	8.0	8.0	12.0

Figure 7: Minimum Monthly Humidity Profile for five sample sites within the FBDM (Summary data from the South African Weather Services)

Table 4: Thunder-storms, Hail, Fog and Humidity for the District (Summary data from the South African Weather Services)

Month	Vaalharts (1961-1990) Other - Agricultural Station					Jan Kempdorp (1983-1990) Other - Agricultural Station					Diepplotte (1961-1990) Other - Agricultural Station				
	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %
January	3.7	0.2	0.0	89.0	18.0				82.0	11.0	7.9	0.1	0.1	87.0	1.0
February	4.0	0.1	0.0	93.0	22.0				85.0	17.0	5.8	0.0	0.1	89.0	13.0
March	2.9	0.0	0.0	93.0	24.0				87.0	15.0	6.2	0.1	0.2	94.0	13.0
April	1.7	0.2	0.0	93.0	23.0				83.0	13.0	4.4	0.2	0.3	95.0	14.0
May	0.6	0.2	0.0	94.0	23.0				87.0	13.0	1.6	0.0	0.2	95.0	14.0
June	0.2	0.0	0.2	94.0	21.0				90.0	14.0	1.2	0.0	0.6	96.0	15.0
July	0.3	0.1	0.1	93.0	17.0				90.0	12.0	1.2	0.0	0.5	96.0	11.0
August	0.3	0.0	0.1	93.0	15.0				85.0	10.0	1.5	0.0	0.2	93.0	8.0
September	1.5	0.1	0.1	89.0	12.0				84.0	9.0	1.9	0.0	0.1	89.0	8.0
October	2.7	0.1	0.0	86.0	15.0				85.0	10.0	4.6	0.2	0.0	84.0	10.0
November	3.6	0.4	0.0	87.0	15.0				83.0	9.0	5.9	0.3	0.0	88.0	9.0
December	3.5	0.1	0.0	88.0	15.0				80.0	13.0	5.3	0.2	0.0	86.0	10.0
Annual Avg	25.0	2.0	1.0	98.0	10.0				93.0	5.0	47.0	1.0	2.0	98.0	5.0

Month	Kimberley (1961-1990) Other - Weather Office					Koopmansfontein (1961-1990) Other - Agricultural Station				
	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %	No of Days Thunder-storms	No of Days Hail	No of Days Fog	Max Humid %	Mini Humid %
January	8.4	0.3	0.0	91.0	8.0	8.1	0.0	0.0	86.0	13.0
February	7.7	0.4	0.3	94.0	12.0	6.4	0.2	0.3	90.0	16.0
March	6.7	0.3	0.3	96.0	15.0	6.1	0.2	0.3	92.0	19.0
April	4.8	0.2	0.7	96.0	16.0	3.7	0.2	0.1	93.0	19.0
May	1.7	0.0	0.4	96.0	16.0	1.0	0.1	0.1	94.0	16.0
June	0.7	0.1	0.4	97.0	15.0	0.2	0.1	0.0	96.0	15.0
July	0.8	0.1	0.7	97.0	13.0	0.4	0.0	0.0	95.0	14.0
August	1.3	0.1	0.5	94.0	10.0	0.5	0.0	0.0	93.0	9.0
September	2.5	0.1	0.2	91.0	8.0	1.4	0.1	0.0	87.0	9.0
October	5.7	0.3	0.1	89.0	8.0	2.9	0.2	0.0	85.0	8.0
November	6.4	0.5	0.0	92.0	8.0	3.8	0.1	0.0	88.0	8.0
December	8.0	0.3	0.1	90.0	7.0	4.6	0.4	0.1	84.0	12.0
Annual Avg	55.0	3.0	4.0	98.0	5.0	39.0	2.0	1.0	97.0	6.0

2.3.5 Wind Field

Wind is important in that it cleans by diluting and dispersing pollutants but it can also transport pollutants over large distances. Wind roses comprise 16 spokes which represent the directions from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories.

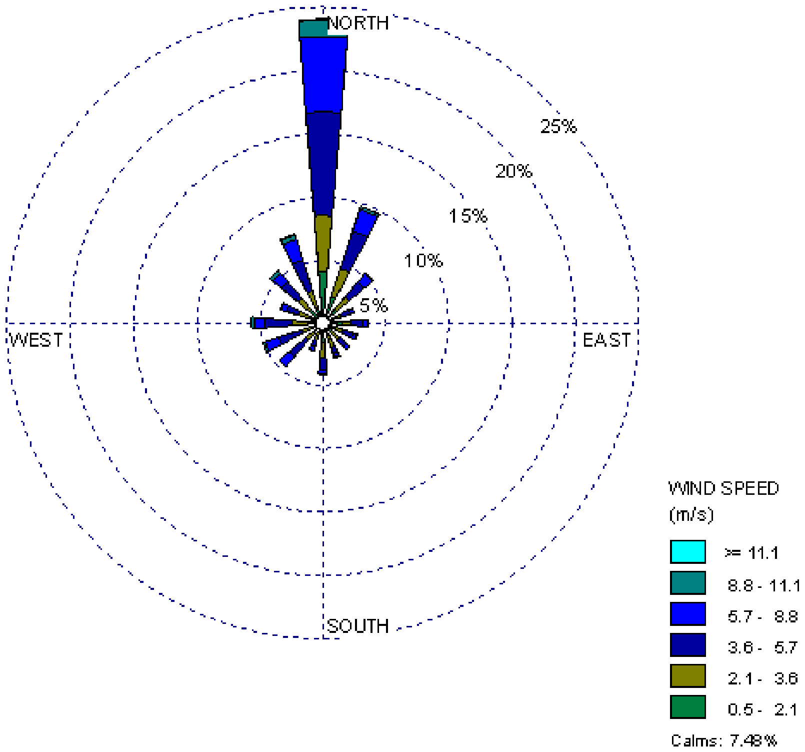
Period, day-time and night-time average wind roses for the South African Weather Service's Kimberley Airport station are depicted in Figures 8 a), b) and c) for the period January 2001 to December 2001 respectively. Similarly, period, day-time and night-time average wind speed frequency distribution graphs are presented in Figures 9 a), b) and c).

From the period wind rose (Figure 8a) it is note that winds predominate from the north for 23% of the time. Wind speeds in the range of 3.6 - 5.7 m/s occurred for 29.1% of the time, with higher wind speeds in the range of 5.7 – 8.8 m/s and from 8.8 - 11.1 m/s noted to occur for 16.8% and 3.1% of the time respectively (Figure 9a). These higher wind speeds are noted to occur from the north.

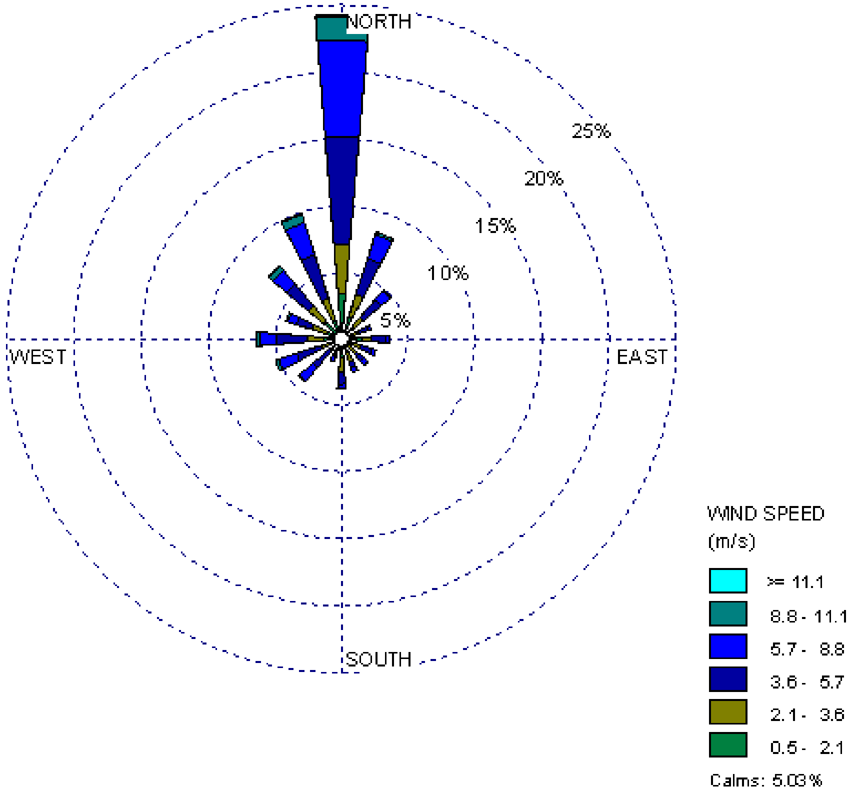
When comparing day-time and night-time wind profiles a higher incidence of southwesterly winds are noted during night-times (Figure 8c). Southwesterly winds increase in frequency from 5% to 7% of the time when comparing day-time and night-time conditions. North-northeasterly and southerly winds also increase in frequency during night-time from 8-11 % and 4-6 % respectively. As is to be expected during night-time wind speeds are noted to be lower when compared to day-time conditions, predominating in the range of 0.5 – 5.7 m/s.

From this wind profile it is noted that sources impacting on air quality would most likely impact more significantly on sensitive areas to the south of these activities. With wind speeds in the calm (0.5 – 5.7) to moderate (5.7 – 8.8) range predominating indicates that the dispersion potential for the area can be considered to be poor to moderately good.

(a)


NORTH
WEST
EAST
SOUTH
5%
10%
15%
20%
25%
WIND SPEED
(m/s)
>= 11.1
8.8 - 11.1
5.7 - 8.8
3.6 - 5.7
2.1 - 3.6
0.5 - 2.1
Calms: 7.48%

(b)



(c)

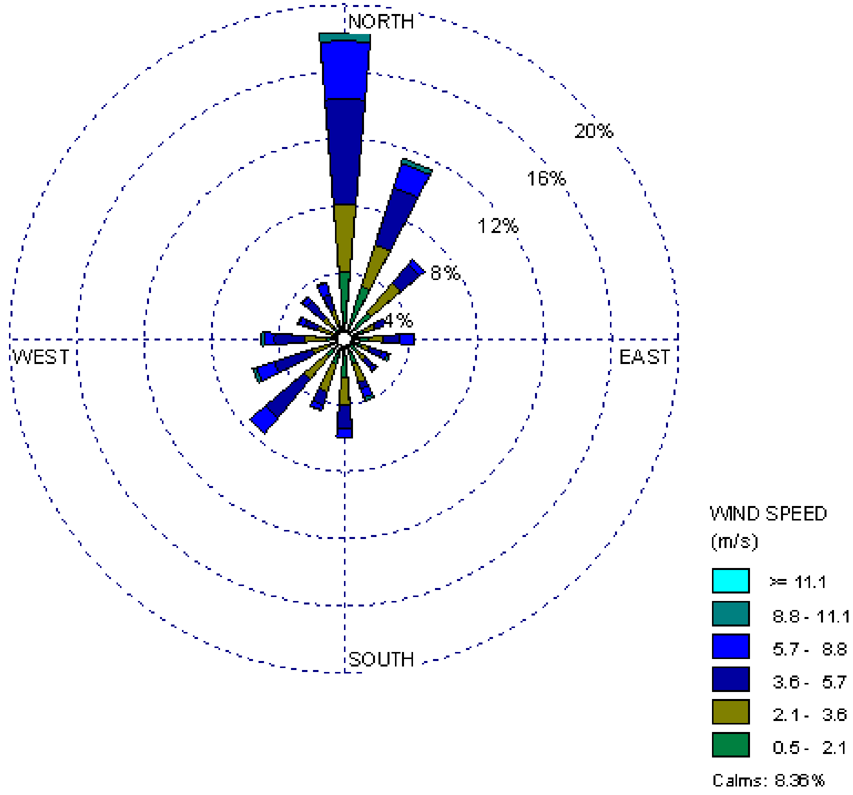
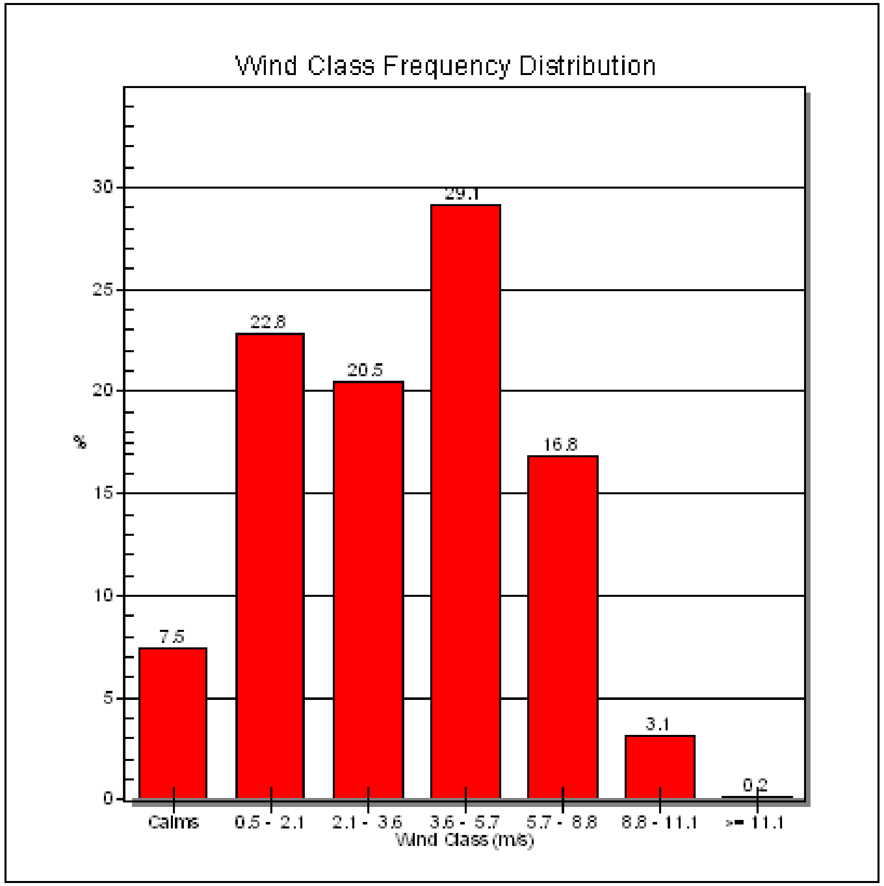
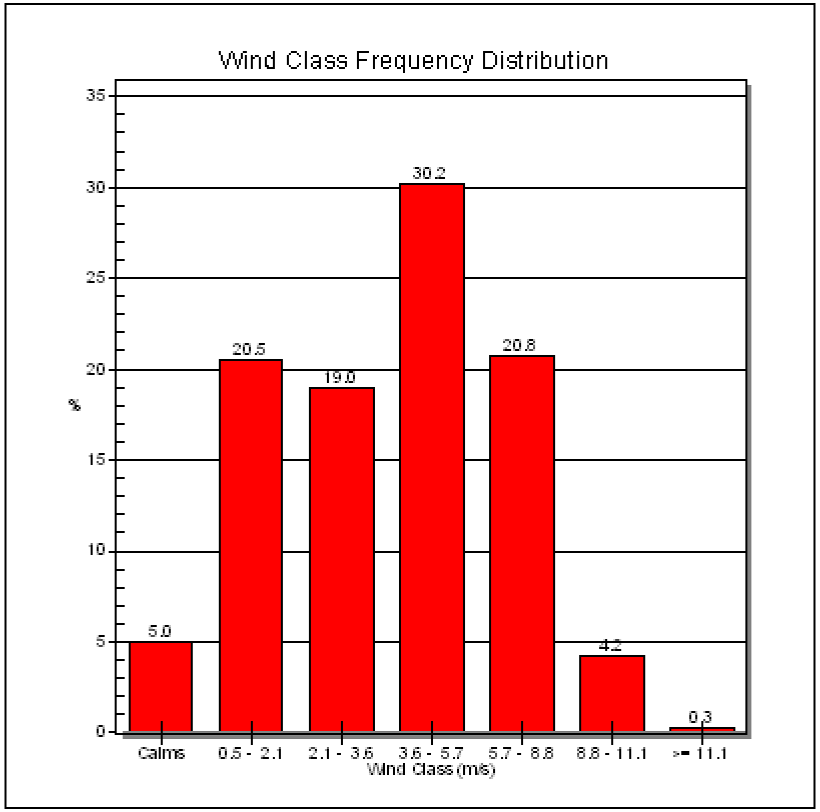


Figure 8: Kimberley Wind Rose (a) Period (b) Daytime (c) nighttime

(a)


Wind Class Frequency Distribution
%
0
5
10
15
20
25
30
7.5
22.8
20.5
29.1
16.8
3.1
0.2
Calms
0.5 - 2.1
2.1 - 3.6
3.6 - 5.7
5.7 - 8.8
8.8 - 11.1
>= 11.1
Wind Class (m/s)

(b)



(c)

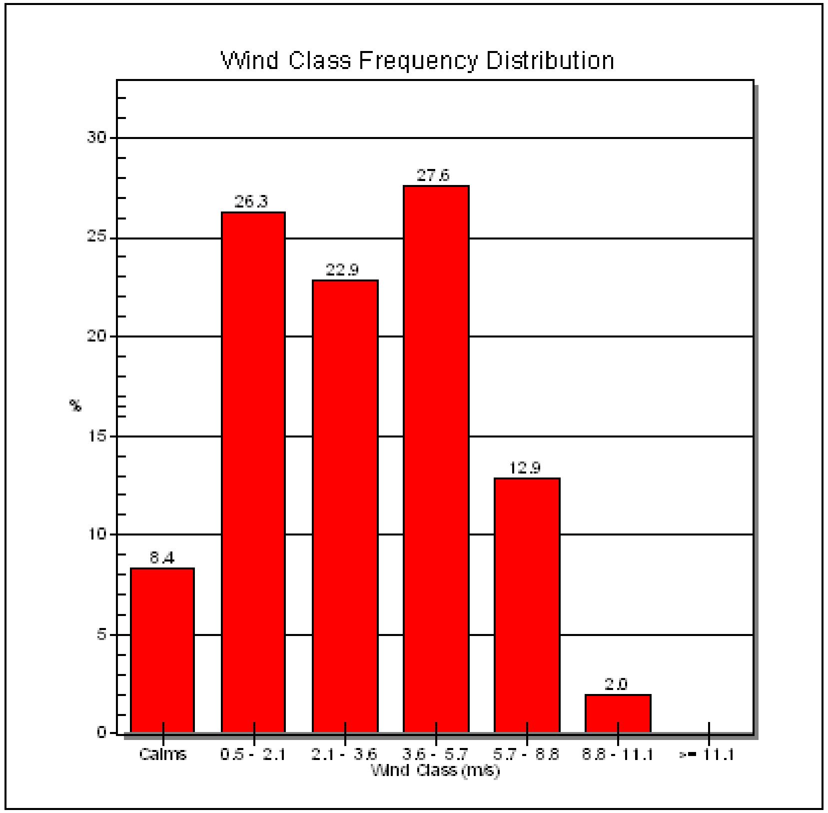


Figure 9: Kimberley Wind Class Frequency Distribution (a) Period (b) Daytime (c) nighttime

2.3.6 Atmospheric Stability

Atmospheric stability (indication of the amount of mixing and movement of air possible in an area) is commonly categorised into one of six stability classes. These are briefly described in Table 5.

The atmospheric boundary layer is usually unstable during the day due to turbulence caused by the sun's heating effect on the earth's surface. The depth of this mixing layer depends mainly on the amount of solar radiation, increasing in size gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. The degree of thermal turbulence is increased on clear warm days with light winds. During the night a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral.

Figure 10 depicts the estimated atmospheric stability for the Kimberley area in the form of a rose. The rose indicates how the atmospheric stability differs from different wind directions. It can be noted however that there is not a marked difference in the variability of stability class types with wind direction. Figure 11 indicating that a neutral stability class occurs for 24.3% of the time, stable atmospheric conditions can be expected to occur for 18.2% of the time with very stable conditions noted for 22.5 % of the time. The predominance of atmospheric stability for the region in the neutral to very stable range, suggests that very little movement and potential for mixing of pollutants and the consequent dilution of a pollution plume exists. Thus when pollutants are released they will tend not to dissipate quickly from source.

Table 5: Stability Class

A	Very unstable	calm wind, clear skies, hot daytime conditions
B	Moderately unstable	clear skies, daytime conditions
C	Unstable	moderate wind, slightly overcast daytime conditions
D	Neutral	high winds or cloudy days and nights
E	Stable	moderate wind, slightly overcast night-time conditions
F	Very stable	low winds, clear skies, cold night-time conditions

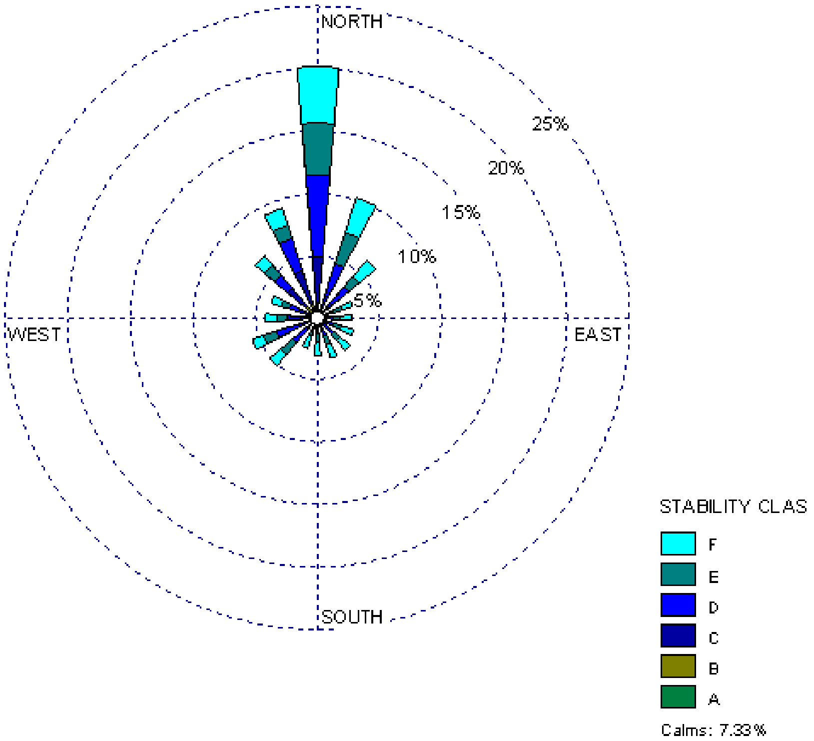


Figure 10: Kimberley Stability Class Frequency Distribution by wind direction.

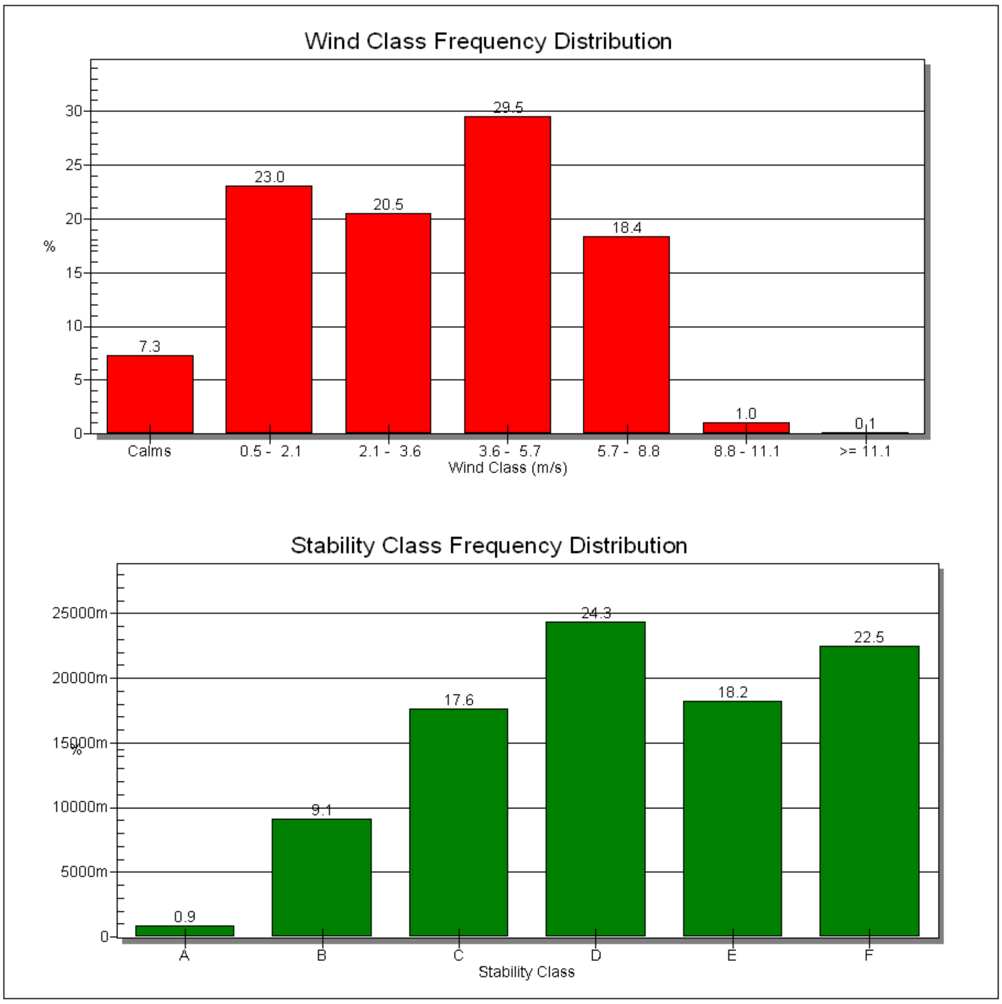


Figure 11: Kimberley Stability Class Frequency Distribution by wind speed.

2.4 Topographical Features in the Frances Baard District Municipality

Topographical features such as hills, mountains and valleys can influence the distribution of pollution once released, with obstacles such as mountains and hills acting as barriers to the distribution of pollution and valleys helping to channel pollutants also trapping pollution released.

From Figure 12 it can be seen that the Frances Baard District Municipality is relatively flat, with a maximum elevation of 254 m above mean sea level. These slight rises occur in the form of koppies, dotted around the District. Activities taking place in close proximity to these elevated areas, and which release particulates and gases to atmosphere could be influenced by these topographical features, however on the whole there are no significant topographical features which would influence regional wind profiles in the area.

2.5 Land Use in the Frances Baard District Municipality

The analysis of the land use in the area provides an indication of where potential sources of air pollution can be found, or where polluting sources could develop in the future. Significant areas of urban development or open grassland in turn can influence micro scale meteorological conditions in an area, with large amounts of concrete resulting in the formation of heat islands and large amounts of vegetation having a cooling effect on surrounding air.

Most of the Frances Baard District can be classified as natural areas, however agriculture dominates the northern most reaches of the district, with areas in the centre and along the southern border of the district also classified as agricultural (Figure 13). To the central and eastern reaches of the District, areas of degraded land are noted, mining also occurs in these areas. The rural district management area is predominated by wetlands, with nodes of urban areas distributed throughout the region, the most significant urban area being Kimberley on the eastern most border of the District (Figure 13).

2.6 Vegetation in the Frances Baard District Municipality

An analysis of the type of vegetation in the area provides an indication of potential sensitive areas with respect to natural biomes which may need to be protected (Figure 14).

The Frances Baard District Municipality is almost treeless, consisting mainly of grass veldt with some Karoo vegetation in the south. The central and eastern areas of the FBDM are dominated by Themeda Veldt Grass. The decrease in rainfall westwards is reflected by vegetation that changes from grassland to Kalahari Thorn veldt under Karoo conditions. These conditions are however favourable for the growing of maize, hence the regions high importance nationally.

In addition to these, there are some very scarce vegetation species and potential for further development around game farming activities.

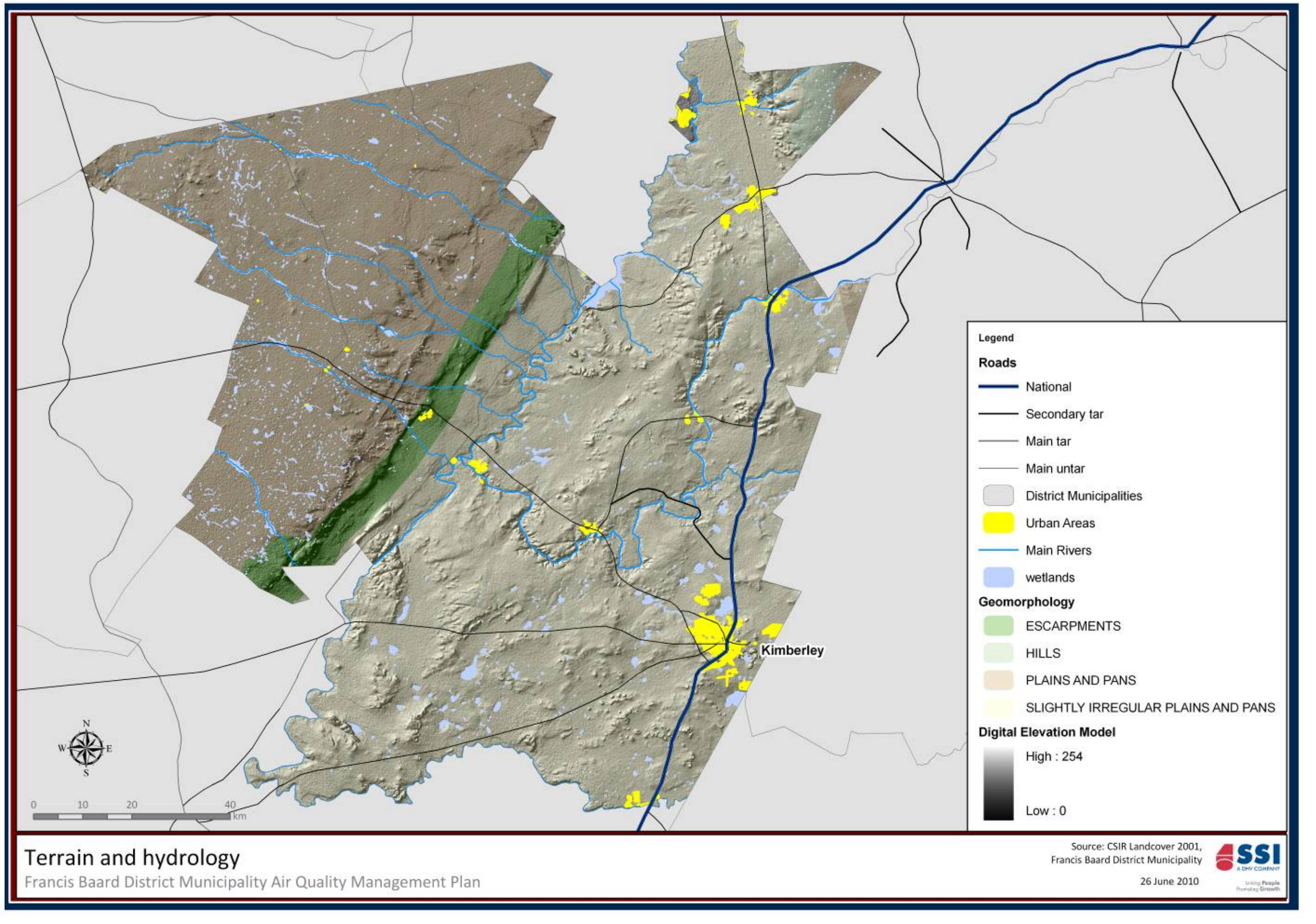


Figure 12: Frances Baard District Municipality Topographical Features

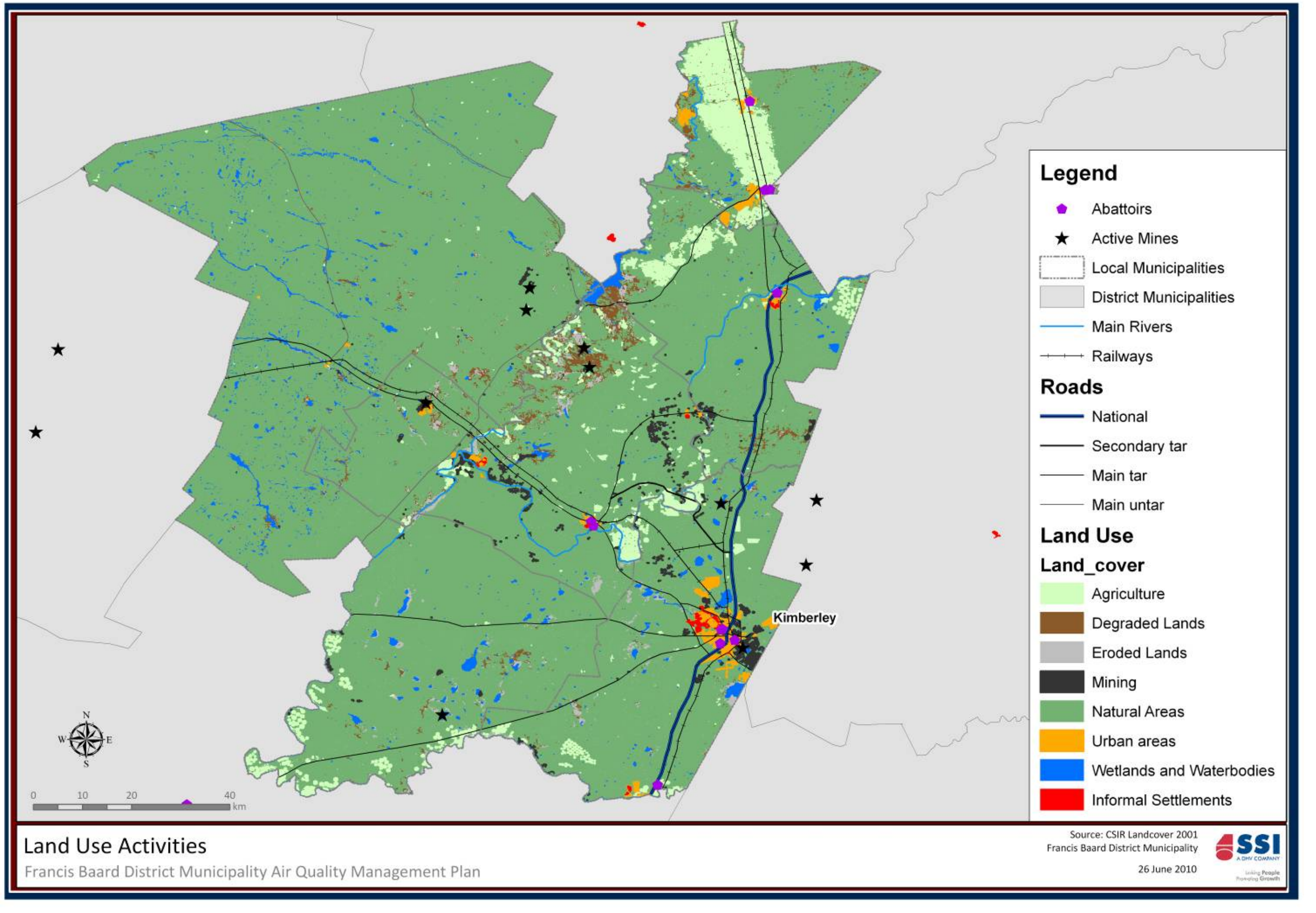


Figure 13: Frances Baard District Municipality Land Use

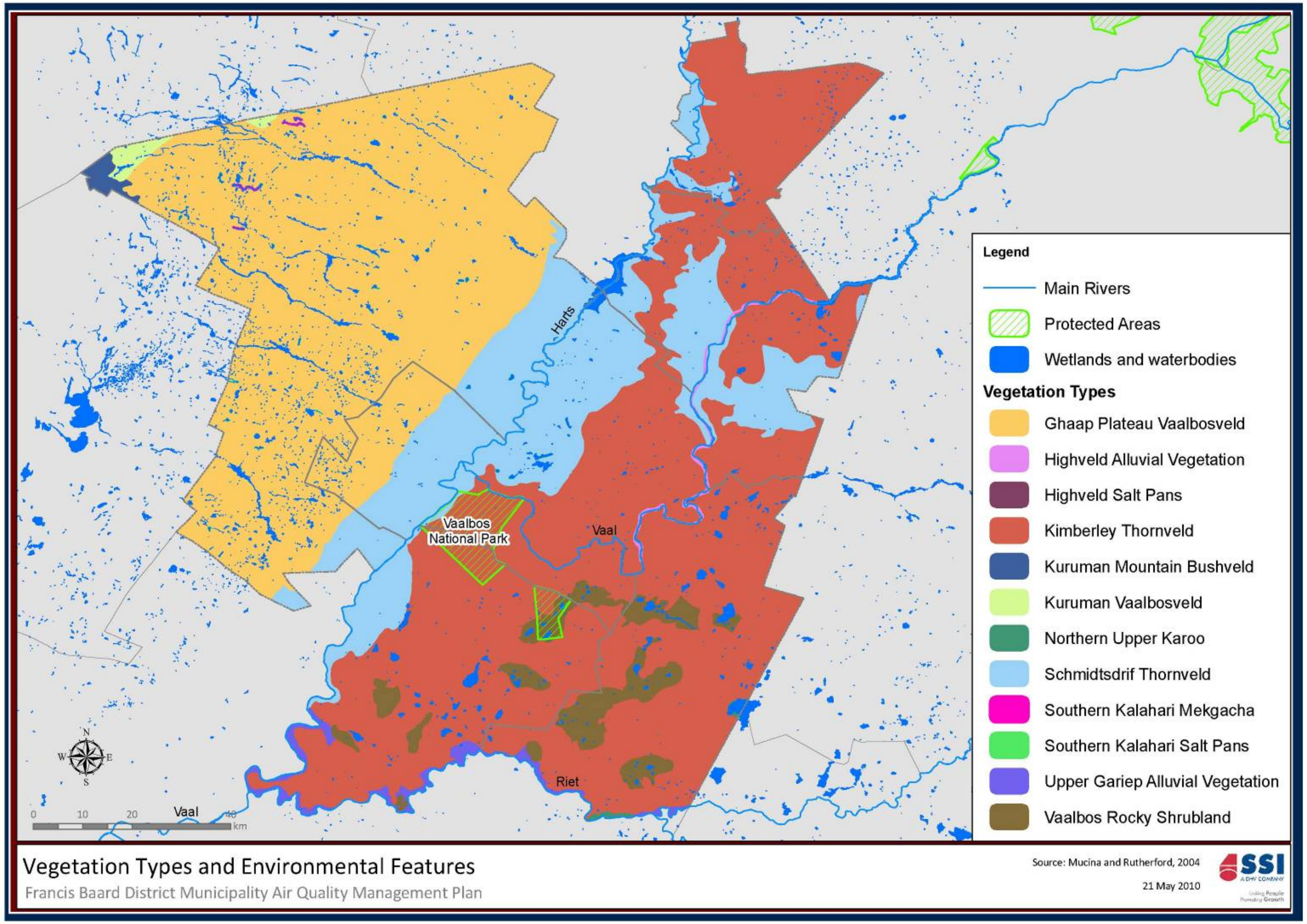


Figure 14: Frances Baard District Municipality Vegetation Types and Environmental Features

2.7 Identification of Priority Pollutants

2.7.1 Selection of Priority Pollutants for which Guidelines are to be established

In the selection of pollutants for which the FBDM needs to comply with, attention was paid to the following:

- Commonly occurring pollutants within FBDM which occur in relatively widespread exposures;
- Pollutants for which national air quality guidelines currently exist and for which national air quality standards are in the process of being established; and
- Pollutants for which guidelines/standards/goals are issued by other countries.

Based on the above considerations the following pollutants were selected as priority pollutants of concern and they are shown in Table 6, with an indication provided as to their associated sources:

- Particulate Matter – PM (Particulate matter less than 10 micro meters in diameter, and particulate matter less than 2.5 micro meters in diameter, total suspended particulates and diesel particulates);
- Sulphur Dioxide – SO_2;
- Oxides of Nitrogen – NO_x;
- Carbon Monoxide – CO;
- Carbon Dioxide – CO_2;
- Methane – CH_4;
- Ozone – O_3;
- Mercury – Hg;
- Lead – Pb;
- Volatile Organic Compounds – VOCs;
- Organophosphates and other pesticides and constituents identified for use by the agricultural industry.

Table 6: Priority Pollutants for assessment at the Frances Baard District Municipality

Source	PM	SO_2	NO_X	CO	CO_2	CH_4	O_3	Hg	Pb	VOCs
Traffic emissions	x	x	x	x	x	x	x	x	x	x
Domestic Fuel Burning	x	x	x	x	x	x	x	x	x	x
Commercial Fuel Burning Appliances	x	x	x	x	x	x	x	x	x	x
Waste (Incineration, Landfills and Sewage)	x	x	x	x	x	x		x	x	x
Mining	x					x				x
Veldt Fires	x	x	x	x	x	x	x	x	x	x
Agricultural Activities	x									
Cement Manufacture	x	x	x	x	x		x	x	x	x
Asphalt production (Road Building)	x	x	x	x			x	x	x	x
Petrol Stations	x	x	x	x	x		x	x	x	x
Aviation emissions	x	x	x	x	x	x	x	x	x	x
Rail	x	x	x	x	x		x	x	x	x
Brick Making	x	x	x	x	x	x	x	x	x	x
Other Industrial Activities (e.g. Spray Painting)									x	x

2.8 Identification of Priority Sources

The characterisation of baseline air quality and the identification of priority sources, polluting the area, represent the basis of effective air quality management and planning. Sources of emissions identified as occurring within the FBDM and which need to be addressed from an air quality perspective are summarized as follows:

- Transportation and Traffic (aircraft, motor vehicles and railway);
- Domestic Fuel Burning;
- Commercial Fuel Burning Appliances;
- Waste (Incineration, Landfills and Sewage);
- Mining and related activities;
- Biomass Burning (Veldt fires);
- Agricultural Activities;
- Asphalt production (Road Building);
- Cement Manufacture;
- Petrol Stations (Fuel Storage); and
- Other Industrial Activities (e.g. Spray Painting).

The characterisation of baseline air quality and the identification of priority sources, polluting the area, represent the basis of effective air quality management and planning. Sources of emissions identified as occurring within the FBDM and which need to be addressed from an air quality perspective are summarized as follows:

2.8.1 Aircraft

The Frances Baard District Municipality has one airport and an additional landing strip. The airport is located in Kimberley, and aids in the movement of passengers into and out of the District, there is also a small landing strip in the Hartswater area to the north of the region, used during agricultural crop spraying activities. An airport is anticipated to contribute to NO_2 health threshold exceedances in its vicinity. The other most significant emissions released include CO_2 and CO. Smaller quantities of VOCs, SO_2, non-methane volatile organic compounds, methane, lead, and particulate matter are also associated with these activities.

2.8.2 Motor Vehicles and Rail

Motor vehicle related impacts are associates with gaseous tailpipe emission releases as well as dust generated due to the movement of vehicles along dirt roads. The road network of FBDM is extensive and well developed. Primary air pollutants emitted by vehicles may include NOx, CO_2, HCs, SO_2, particulate matter and lead. Secondary pollutants associated with vehicle emissions include nitrogen dioxide, photochemical oxidants (e.g. ozone) and sulphuric or nitric acids, and sulphate and nitrate aerosols. Nitrogen dioxide is formed through the oxidation of nitric oxide which is formed at high combustion temperatures and emitted by vehicles. Ozone is formed from the reaction of NOx and reactive hydrocarbons (HCs) in the presence of sunlight. Toxic hydrocarbons emitted include benzene, 1.2-butadiene, aldehydes and polycyclic aromatics hydrocarbons (PAH). Benzene represents an aromatic HC present in petrol, with 85% to 90% of benzene emissions emanating from the exhaust and the remainder from evaporative losses. Light-duty petrol vehicles not equipped with pollution control devices have the highest exhaust emissions during acceleration, followed by deceleration, cruising and idling cycles. Frequent cycle changes characteristic of congested urban traffic patterns thus tend to increase pollutant emissions. At higher cruise speeds HC and CO emissions decrease, while NO_x and CO_2 emissions increase.

Emissions from diesel-fuelled vehicles including diesel rail locomotives include particulate matter, NO_x, SO_2, CO and HC, the majority of which occurs from the exhaust. Operating at higher air-fuel ratios (about 30:1 as opposed to 15:1 characteristic of petrol-fuelled vehicles with electronic fuel injection engines), diesel-powered vehicles tend to have low HC and CO emissions, despite having considerably higher particulate emissions.

Various site-specific factors influence the extent of emissions, including ambient temperatures and altitudes. Higher temperatures promote evaporative emissions but result in lower emissions of HC and NOx from vehicle exhausts. CO emissions tend to be higher at lower temperatures. At higher altitudes, air densities are lower and the fuel-air ratio thus becomes larger, resulting in a lowering of the engine power output and an increase in CO and HC emissions from petrol-fuelled cars. Vehicles equipped with electronic fuel injection systems are able to automatically compensate for altitude changes.

Particulate emissions from petrol-driven vehicles are usually negligible. Such emissions when they do occur would result from unburned lubricating oil, and ash-forming fuel and oil additives. Higher particulate emissions are associated with diesel-powered vehicles. Particulates emitted from diesel vehicles consist of soot formed during combustion, heavy HC condensed or adsorbed on the soot and sulphates. In older diesel-fuelled vehicles the contribution of soot to particulate emissions is between 40% to 80%. The black smoke observed to emanate from poorly maintained diesel-fuelled vehicles is caused by oxygen deficiency during the fuel combustion or expansion phase. The force of the wheels of vehicles travelling on unpaved roadways also causes the pulverisation of surface material. Particles are lifted and dropped from the rotating wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. The quantity of dust emissions from unpaved roads especially varies linearly with the volume of traffic (USEPA, 1996).

2.8.3 Domestic Fuel Burning

It is anticipated that certain low income households in the area are likely to use coal and wood for space heating and/ or cooking purpose. The problems facing African countries around the impact of air pollution generated indoors as a result of the use of coal and wood are not unique. Similar problems are reported around the world in poor communities which either lack access to electricity or lack the means to fully utilise the available supply of electricity (Van Horen et al. 1992).

Globally, almost 3 billion people rely on biomass (wood, charcoal, crop residues, and dung) and coal as their primary source of domestic energy. Exposure to indoor air pollution (IAP) from the combustion of solid fuels is an important cause of morbidity and mortality in developing countries. Biomass and coal smoke contain a large number of pollutants and known health hazards, including particulate matter, carbon monoxide, nitrogen dioxide, sulphur oxides (mainly from coal), formaldehyde, and polycyclic organic matter, including carcinogens such as benzo[a]pyrene (Ezzati and Kammen, 2002). Pollutants arising due to the combustion of wood include respirable particulates, nitrogen dioxide, carbon monoxide, polycyclic aromatic hydrocarbons, particulate benzo(a)pyrene and formaldehyde. Particulate emissions from wood burning within South Africa have been found to contain about 50% elemental carbon and about 50% condensed hydrocarbons. The main pollutants emitted from the combustion of paraffin are NO2, particulates, carbon monoxide and polycyclic aromatic hydrocarbons.

Exposure to indoor air pollution (IAP) from the combustion of solid fuels has been implicated, with varying degrees of evidence, as a causal agent of several diseases in developing countries, including acute respiratory infections (ARI) and otitis media (middle ear infection), chronic obstructive pulmonary disease (COPD), lung cancer (from coal smoke), asthma, cancer of the nasopharynx and larynx, tuberculosis, perinatal conditions and low birth weight, and diseases of the eye such as cataract and blindness (Ezzati and Kammen, 2002).

Monitoring of pollution and personal exposures in biomass-burning households has shown concentrations are many times higher than those in industrialized countries. The latest South African National Ambient Air Quality Standards, for instance, required the daily average concentration of PM10 (particulate matter < 10µm in diameter) to be < 180 µg/m3 (annual average < 60 µg/m3). In contrast, a typical 24-hr average concentration of PM10 in homes using bio fuels may range from 200 to 5000 µg/m3 or more throughout the year, depending on the type of fuel, stove, and housing. Concentration levels, of course, depend on where and when monitoring takes place, because significant temporal and spatial variations may occur within a house. Field measurements, for example, recorded peak concentrations of ≥5000 µg/m3 in the immediate vicinity of the fire, with concentrations falling significantly with increasing distance from the fire. Overall, it has been estimated that approximately 80 % of total global exposure to airborne particulate matter occurs indoors in developing nations. Levels of CO and other pollutants also often exceed international guidelines (Ezzati and Kammen, 2002).

2.8.4 Commercial Fuel Burning Appliances

Industrial and commercial fuel burning, particularly coal fired boilers used by a drycleaner, the technical high school, the bone meal factory (Jan Kempdorp) and the abattoir in Kimberley can be of concern in FBDM. These small scale operations are not usually licensed as they do not generate sufficient energy to be classified under the listed activities detailed as part of the Air Quality Act.

Emissions from many of these boilers remain poorly controlled. Due to their relatively low stacks and frequent proximity to residential areas, poorly controlled small-scale boiler operations have the potential to have a significant negative impact on the health and well-being of local residents. The pollutants associated with these devices are related to the fuel type used. Generally however it can be expected that PM10, SO_2, NOx, CO and CO_2 are produced, however the quantities of each may vary.

2.8.5 Waste Management (Incineration)

The FBDM has 2 areas where waste incinerators can take place. The first site is at the Kimberley hospital, it is noted however that the hospital has an incinerator, but the unit is not in use, medical waste is collected and disposed of to a registered landfill site outside of the Province. The second site is the crematorium located at the central cemetery in Kimberley. Cremations are reported to take place twice weekly.

The emission rates of incinerator operations are a function of fuel usage, waste composition, incinerator design characteristics and operating conditions. Emissions from incinerators may be grouped into:

- Criteria pollutants (sulphur dioxide, oxides of nitrogen, carbon monoxide, lead, particulates and benzene)
- Acid gases (hydrogen chloride, hydrogen bromide, hydrogen fluoride)
- Metal gases (chromium, arsenic, cadmium, mercury, manganese, etc.)
- Dioxins and furans - (such as polychlorinated dibenzo-p-dioxins and dibenzo furans) (Data on PCDD and PCDF is currently scarce and incomplete).

Given the range of pollutants emitted from incinerator operations and the toxic nature of such pollutants, areas within which incinerator operations are located are frequently labelled as potential "toxic hotspots" for air quality management needs purposes. Incinerator emissions have a potentially greater sphere of influence than do landfills and waste water treatment plants due to the elevated nature of the emission and the larger quantities being released.

2.8.6 Waste Management (Landfills)

Various landfill sites are distributed throughout the District. Only domestic waste is disposed of at these site. About 99% of landfill gas is comprised of methane and carbon dioxide which are primarily of concern due to them being greenhouse gases. The remaining 1% is comprised of a range of odoriferous and toxic gases. Studies indicate that over 200 compounds can be encountered in a landfill site6.

Of significance with respect to the landfill sites located within the district is that fires are being lit on these sites by local residents in an attempt to reclaim wire from discarded cabling and tyres. These fires have a significant impact on air quality in the immediate vicinities of these sites.

2.8.7 Waste Management (Sewage Works)

Various sewage works are distributed throughout the District. The potential for emissions of volatile organic compounds (VOCs) during wastewater treatment is a cause for concern when industrial type effluent also lands up in the sewage system. This will be of particular concern in the Kimberley area. It should be noted here though that most of the sewage works in the District are poorly maintained this is resulting in significant odour and health impacts.

Species measured at Local Municipal waste water treatment works in South Africa have included: hydrogen sulphide, mercaptans, ammonia, acetone, toluene, and ethyl benzene. Species which represent the most important odorants include: hydrogen sulphide, mercaptans and ammonia. Odour impacts may however be a serious source of annoyance to the local communities of Frances Baard District Municipality, and have been shown in various cases to affect property values and development.

2.8.8 Mining Operations

Mining and quarrying are primary economic activities within the District, predominantly in the Sol Plaatje Local Municipality. It should be noted however that mining operations are generally associated with significant sources of fugitive dust emissions which occur due to wind erosion of extensive, poorly controlled tailings impoundments or other large material storage piles.

Such sources are frequently associated with localised nuisance dust that contribute to the concentration of fine particulate matter in the atmosphere. Whereas high dust fallout rates have been measured to occur in close proximity to poorly controlled tailings impoundments, the contribution of such impoundments to airborne fine

[6] Extract from the Department of Environment and Tourism(DEAT) report 3957

particulate concentrations is lower. The potential effects are significantly increased in areas where residential settlements occur in close proximity to tailings impoundments.

Other emissions generated due to mining operations are generally associated with surface mining activity. Dust fallout and inhalable particulate emissions are generated due to aeolian action on exposed storage piles, material transfer activity, vehicle entrainment on both paved and unpaved road networks, drilling and blasting operations, as well as due to various process related emissions (crushing, screening and milling of ore and ore products). Dust generated during these processes at the FBDM are generally captured and sent to atmosphere via a dust plant.

Subsurface mining operations result in small quantities of particulates, sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and carbon monoxide (CO), released from shaft vents primarily as a result of blasting and drilling operations, and diesel powered vehicles working underground.

2.8.9 Biomass Burning (Veldt Fires)

Veldt fires are widespread across the country and in the District, occur in autumn, winter and early spring. In addition to controlled burning for fire-breaks and veldt management, many fires are set deliberately for mischievous reasons. Some are accidental, notably those started by motorists throwing cigarettes out of car windows. Emissions from veldt fires are similar to those generated by coal and wood combustion. Whilst veldt fire smoke primarily impacts visibility decreasing the landscape aesthetic quality, it also contributes to the degradation of regional scale air quality.

Dry combustible material is consumed first when a fire starts. Surrounding live, green material is dried by the large amount of heat that is released when there are veldt fires, sometimes this material can also burn. Factors that affect the rate of fire spread include:

- Weather(wind velocity, ambient temperature and relative humidity);
- Fuels (fuel type, fuel bed array, moisture content and fuel size);
- Topography (slope and profile); and
- Logistical problems (size of the burning area).

The major pollutants from veldt burning are particulate matter, CO, and VOCs. NOx are emitted at rates from 1 to 4 g/kg burned, depending on combustion temperatures. Emissions of SO2 can usually be considered negligible (USEPA, 1996).

2.8.10 Agricultural Activities

Agricultural activities can be considered a significant contributor to particulate emissions, although tilling, harvesting and other activities associated with field preparation are seasonally based.

The main focus internationally with respect to emissions generated due to agricultural activity is related to animal husbandry, with special reference to malodours generated as a result of the feeding and cleaning of animals. The types of livestock assessed included pigs, sheep, goats and chickens. Emissions assessed include ammonia and hydrogen sulphide (USEPA, 1996).

Little information is available with respect to the emissions generated due to the growing of crops. The activities responsible for the release of particulates and gasses to the atmosphere would however include:

- Particulate emissions generated due to wind erosion from exposed areas;
- Particulate emissions generated due to the mechanical action of equipment used for tilling and harvesting operations;
- Vehicle entrained dust on paved and unpaved road surfaces;
- Gaseous and particulate emissions due to fertilizer treatment; and
- Gaseous emissions due to the application of herbicides and pesticides.

2.8.11 Asphalt Mixing – Road Building

Asphalt is important in road building, and it consists mainly of heavy organic compounds. Hazardous air pollutants (HAP) are volatilised from asphalt as it is heated and agitated during processing and roofing manufacturing operations. The HAP emitted from asphalt processing is associated with a variety of adverse health effects. An asphalt plant is located to the south of Kimberley in the Sol Plaatjes Local Municipality.

2.8.12 Cement Manufacture

Particulate matter (PM and PM10), nitrogen oxides (NOx), sulphur dioxide (SO_2), carbon monoxide (CO), and CO_2 are the primary emissions in the manufacture of cement. Small quantities of volatile organic compounds (VOC), ammonia (NH_3), chlorine, and hydrogen chloride (HCl), also may be emitted. Emissions may also include residual materials from the fuel and raw materials or products of incomplete combustion that are considered to be hazardous.

2.8.13 Petrol Stations

The storage and the distribution of motor fuels in service stations cause a number of environmental impacts. The main environmental key issue still concerns the emissions of volatile organic compounds (VOC) released during the filling of the petrol storage tanks and petrol car tanks. These compounds contribute to the creation of ozone in the lower layers of the atmosphere, cause odour pollution and can present a danger to human health.

Volatile organic compounds (VOC) constitute a wide-ranging category of products found in gaseous state and are easily evaporated under normal temperature and pressure conditions (20°C and 105 Pa), these compound include pollutants such as benzene, acetone, perchloroethylene etc. some of them are considered human carcinogens.

2.8.14 Other Small Industrial Activities

Other Industrial Sources, particularly activities associated with spray painting, welding etc, in the area result in emissions released to atmosphere. Although these processes are short in duration, and can be seen as batch type processes, if located close to residential settlements, venting of harmful fumes can result in health risks to surrounding communities. The main air emission from these processes include, particulate matter, as well as greenhouse gases (CO_2, CH_4 and N_2O) and volatile organic compounds.

2.9 Local Health-Related Standards which need to be adhered to

The exceedance of such thresholds necessitates immediate steps. The limit values and associated averaging periods which need to be adhered to by activities taking place within the FBDM are primarily based on human health effect data given for specific averaging periods. South African Ambient Standards at local government level have not been set yet, thus National Ambient Standards will apply to the site. These are summarised in Table 7.

Table 7: FBDM Ambient Standards which Need to be Adhered to

Pollutant	**Averaging Period**	**Guideline (ppb)**	**Guideline ($\mu g/m^3$)**	**Number of Allowable Exceedances**
Sulphur dioxide	10 minute running average (1)	191	500	526
	1hr(1)	134	350	88
	24hr(1)	48	125	4
	annual(1)	19	50	0
Nitrogen Dioxide	1-hour(1)	106	200	88
	annual(1)	22	40	0
PM 10	24hr		120 (2) 75 (3)	4 4
	annual(1)		50 (2) 40 (3)	0 0
Carbon monoxide	1hr(1)	25 800	30 000	88
	8hr running average calculated on 1 hourly averages(1)	8 600	10 000	11
Lead	annual(1)		0.5	0
Ozone	8hr running average	61	120	11

Pollutant	Averaging Period	Guideline (ppb)	Guideline ($\mu g/m^3$)	Number of Allowable Exceedances
	calculated on 1 hourly averages[(1)]			
Benzene	Annual average[(1)]	3.2 1.6	10 [(2)] 5 [(3)]	0 0

Note: [(1)] Comes into immediate effect
[(2)] Come into effect immediately until 31 December 2014
[(3)] Comes into effect 1 January 2015

The four-band scale to be used in the evaluation of dust fallout is outlined below and target, alert and action levels indicated. Dust fallout rates shall be expressed in units of $mg/m^2/day$, averaged over 30-days. An enterprise may submit a request to the authorities to operate within the Band 3 ACTION band for a limited period, providing that this is essential in terms of the practical operation of the enterprise (for example the final removal of a tailings deposit) and provided that the best available control technology is applied for the duration. No allowance will be made for operations that result in dust fallout rates in the Band 4 ALERT.

Table 8: Four band scale evaluation criteria for dust deposition (SANS, 2005)

Band Number	Band Description	Dustfall rate, D ($mg/m^2/day$, 30-day average)	Comment
1	Residential	D < 600	Permissible for residential and light commercial
2	Industrial	600 < D < 1200	Permissible for heavy commercial and industrial
3	Action	1200 < D < 2400	Requires investigation and remediation if two sequential months lie in this band, or more than three occur in a year
4	Alert	2400 < D	Immediate action and remediation required following the first incidence of the dustfall rate being exceeded. Incidence reported to be submitted to the relevant authority.

Table 9: Target, action and alert thresholds for dust deposition (SANS, 2009)

Level	Dustfall rate, D ($mg/m^2/day$, 30-day average)	Averaging Period	Permitted Frequency of Exceeding dustfall rate
Target	300	Annual	
Action residential	600	30 days	Three within any year no two sequential months
Action industrial	1200	30 days	Three within any year not sequential months

Alert threshold	2400	30 days	None. First incidence of dustfall rate being exceeded requires remediation and compulsory report to the relevant authorities.

Dust fallout that exceed these specified levels but that can be shown to be the result of some extreme weather or geological event shall be discounted for the purpose of enforcement and control. Such event might typically result in excessive dust fallout rates across an entire metropolitan region, and not be localised to a particular operation. Natural seasonal variations, such as dry windy periods during the Highveld spring season will not be considered extreme events for this definition.

3 AMBIENT MONITORING TAKING PLACE IN THE DISTRICT

The only sampling noted to be taking place within the district is dust fallout monitoring. This has taken place at OMV Crushers, Petra Diamonds, the DeBeers Kimberley Mine, Afrisam Cement (Ulco Plant) and by the Northern Cape Province.

Dust fallout monitoring is available at the OMV crushers for the year 2005 for a single bucket sample. Additional sampling points are proposed for implementation at the site in 2010, when sampling is proposed to recommence.

The Petra Diamonds and DeBeers Kimberley Mine currently monitors at various sites within the mine lease boundary, with extensive data available for the site spanning over a decade.

Afrisam Cement currently manages 8 dust fallout buckets 4 on site and 4 outside of the plant boundary.

The Province operates 2 dust buckets one in Kimberley and one at Jan Kempdorp.

4 PRIORITY SOURCES IDENTIFIED PER LOCAL MUNICIPALITY

4.1 Sol Plaatjes Local Municipality

4.1.1 Listed Activities identified in the Sol Plaatjes Local Municipality which need to be licensed

- Category 2: Petroleum Industry
  - Subcategory 2.2: Storage and Handling of Petroleum Products
    - Fuel storage depots managed by Sasol, Caltex, Engen, Chevron, Shell, ACSA.
- Category 4: Metallurgical Industry
  - Subcategory 4.10: Foundries
    - KEW foundry
- Category 5: Mineral Processing, Storage and Handling
  - Subcategory 5.1: Storage and Handling of Ore and Coal
    - Kimberley Coal cc (Coal Distributors)

- Subcategory 5.8: Macadam Preparation
    - Roadspan Asphalt Plant
- Category 7: Inorganic Chemicals Industry
    - Subcategory 7.3: Primary production of chemical fertilizer
        - Sasol Nitro (liquid fertiliser producer)
- Category 8: Disposal of hazardous and general waste
    - Potential for Medical Waste Incineration at the Kimberley Hospital
    - Potential for Medical Waste Incineration at the Department of Agriculture
    - Crematorium at the Central Cemetery Kimberley

4.1.2 Other Sources of Concern in the Sol Plaatje Local Municipality which need to be managed

- Combustion instillations
    - Boiler at the Technical High School;
    - Coal fired boiler at the Kimberley Dry Cleaner;
    - Coal fired boiler at the Beefmaster's Abattoir.
- Airport
    - Kimberley Airport;
- Motor vehicles
    - National Roads;
    - Provincial Roads;
    - Local paved Roads;
    - Local unpaved Roads.
- Rail
    - Passenger Rail Spoornet;
    - Goods Rail Spoornet.
- Domestic fuel burning
    - Informal housing.
- Landfills
    - Kimberley;
    - Richie.
- Sewage works
    - Kimberley – Greenpoint;
    - Kimberley – Galeshewe (pump station);
    - Kimberley – Homevale (pump station);
    - Richie.
- Mining
    - DeBeers;
    - PetraDiamonds.
- Veldt fires
- Agricultural activities
- Petrol Stations
- Other

- Casino (Pesticide usage)
- Golf Course (Pesticide usage)
- Alucon - Furniture and Fabric Construction (dye, lacquer and varnish usage)
- Spray painting
- Blackbear Taxidermy

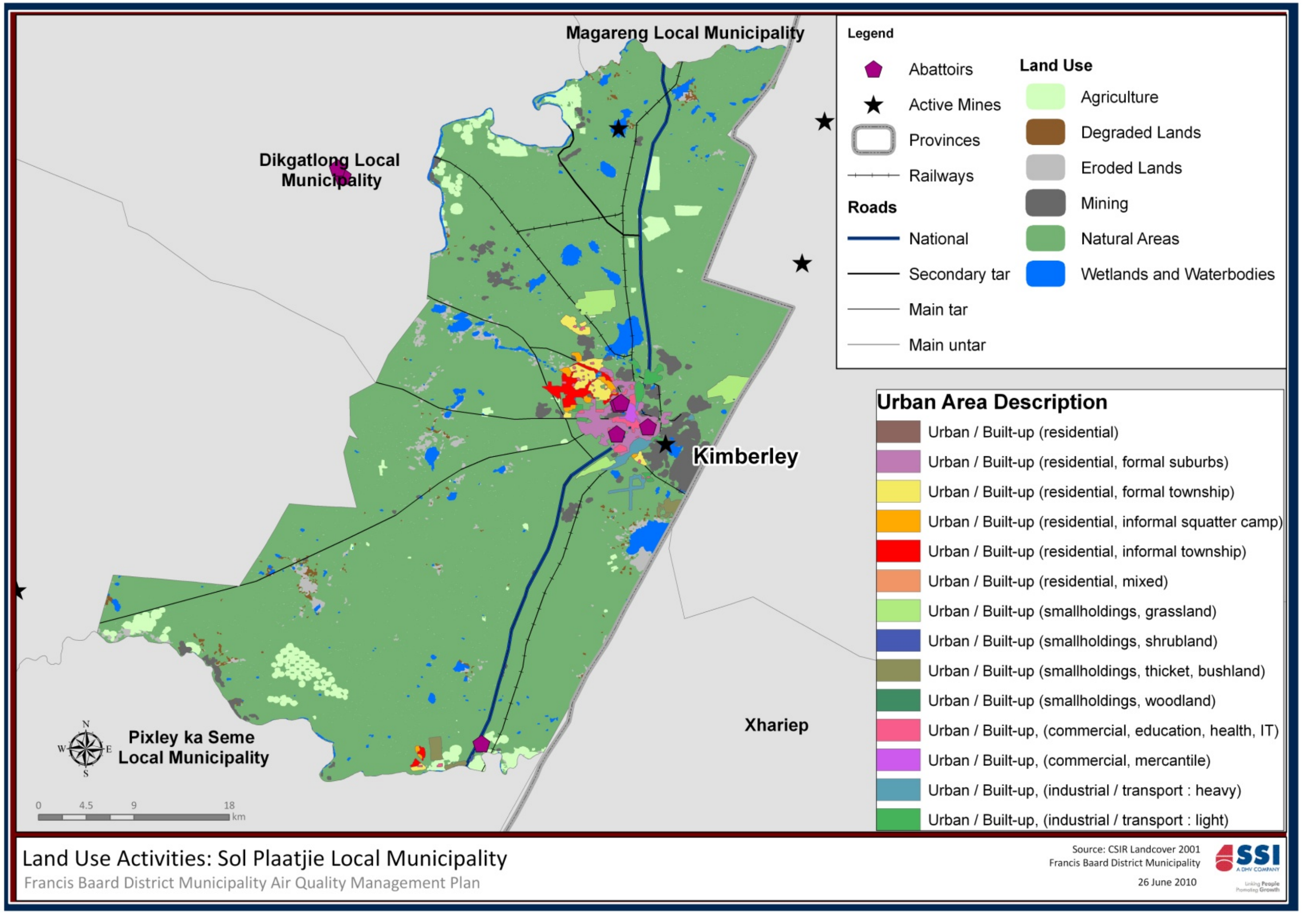


Figure 15: Land use Activities in the Sol Plaatje Local Municipality

4.2 Dikgatlong Local Municipality

4.2.1 Listed Activities identified in the Dikgatlong Local Municipality which need to be licensed

- Category 5: Mineral Processing, Storage and Handling
  - Subcategory 5.3: Cement production (using conventional fuels and raw materials).
  - Subcategory 5.4: Cement production (using alternative fuels and/or resources)
    - Afrisam (Ulco Cement Factory)

4.2.2 Other Sources of Concern in the Dikgatlong Local Municipality which need to be managed

- Motor vehicles
  - National Roads;
  - Provincial Roads;
  - Local paved Roads;
  - Local unpaved Roads.
- Rail
  - Passenger Rail Spoornet;
  - Goods Rail Spoornet.
- Domestic fuel burning
  - Informal housing.
- Landfills
  - Barkley West
  - Delportshoop
- Sewage works
  - Barkley West
  - Delportshoop
- Mining
- Veldt fires
- Agricultural activities
- Petrol Stations

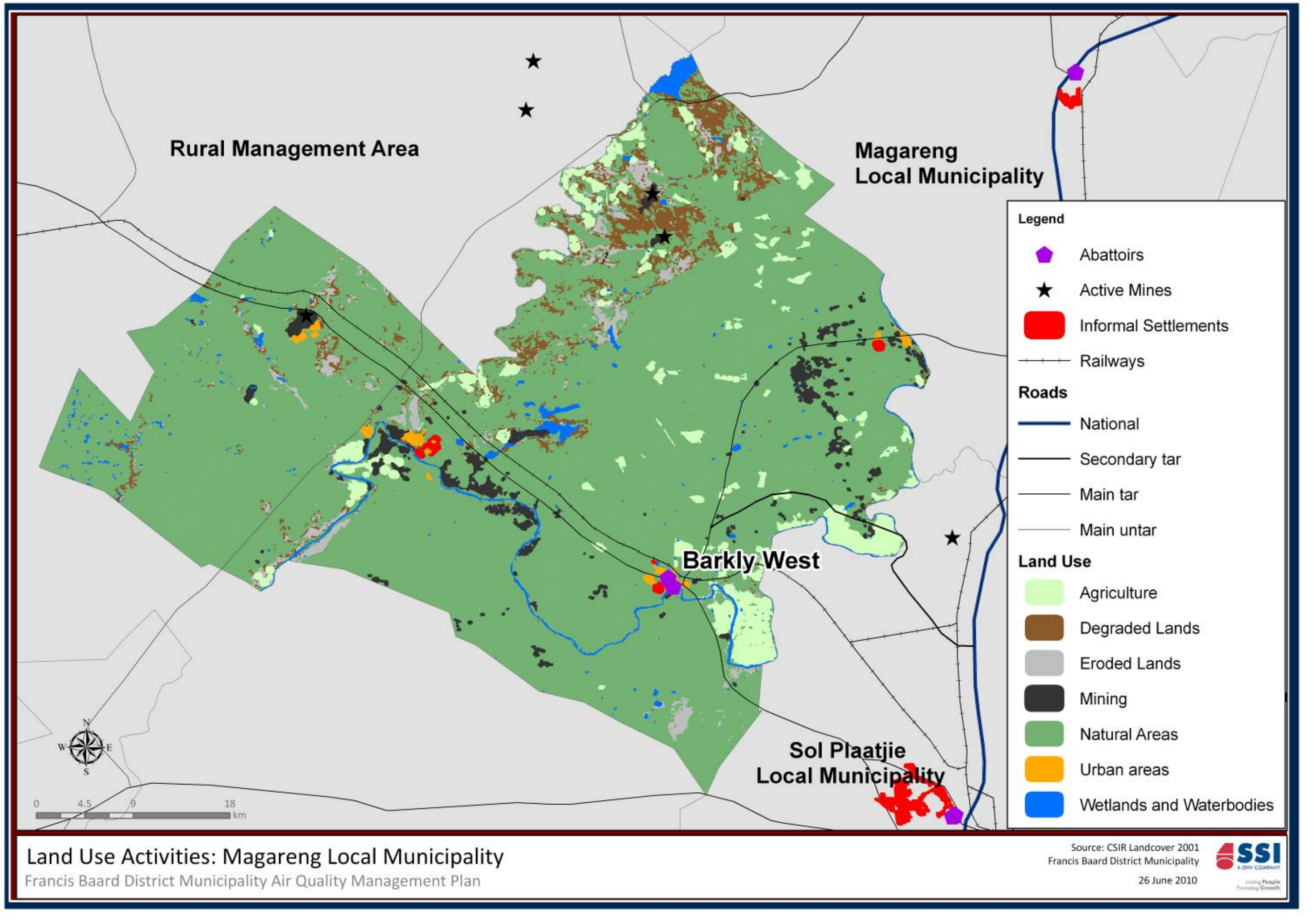


Figure 16: Land use Activities in the Dikgatlong Local Municipality

4.3 Magareng Local Municipality

4.3.1 Listed Activities identified in the Magareng Local Municipality which need to be licensed

None

4.3.2 Other Sources of Concern in the Magareng Local Municipality which need to be managed

- Combustion instillations
  - Bone Meal Factory;
- Motor vehicles
  - National Roads;
  - Provincial Roads;
  - Local paved Roads;
  - Local unpaved Roads.
- Rail
  - Passenger Rail Spoornet;
  - Goods Rail Spoornet.
- Domestic fuel burning
  - Informal housing.
- Landfills
  - Winsorton
  - Warrenton
- Sewage works
  - Winsorton
  - Warrenton
- Mining
  - Informal Mining Operations (Diamond Mining)
  - SONOP (Sand Cleaning)
  - Elandslogte Mining (Diamond Mining)
  - Combrink (Diamond Mining)
- Veldt fires
- Agricultural activities
  - Tswharaganang (Hydroponics)
  - Obaru produsente (Grain Production)
- Petrol Stations

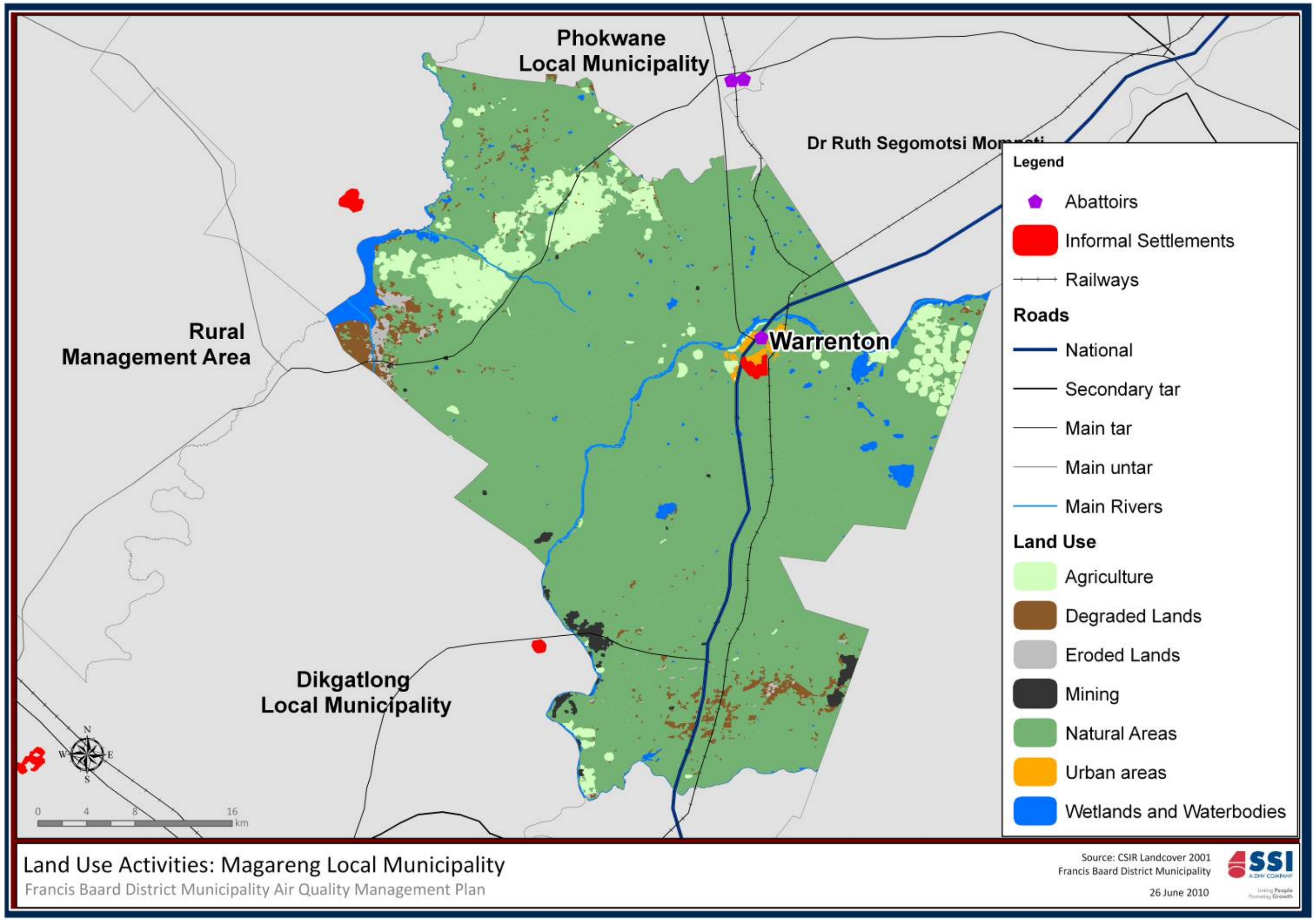


Figure 17: Land use Activities in the Magareng Local Municipality

4.4 Phokwane Local Municipality

4.4.1 Listed Activities identified in the Phokwane Local Municipality which need to be licensed

- Category 2: Petroleum Industry
    - Subcategory 2.2: Storage and Handling of Petroleum Products
        - Fuel Storage Deport at Hartswater
- Category 5: Mineral Processing, Storage and Handling
    - Subcategory 5.2: Clamp Kilns for brick production
        - Magogong Bricks

4.4.2 Other Sources of Concern in the Phokwane Local Municipality which need to be managed

- Airport
    - Landing strip to cater for crop spraying
- Motor vehicles
    - National Roads;
    - Provincial Roads;
    - Local paved Roads;
    - Local unpaved Roads.
- Rail
    - Passenger Rail Spoornet;
    - Goods Rail Spoornet.
- Domestic fuel burning
    - Informal housing.
- Landfills
    - Waste Burning Hartswater
    - Landfill Pampierstadt
    - Landfill Jan Kempdorp
- Sewage works
    - Hartswater
    - Pampierstadt
    - Jan Kempdorp
- Mining
    - Bucker Crushers (Quarry)
    - Magogong Quarry
- Veldt fires
- Agricultural activities
    - P-farms Snacks (Peanut Production)
    - Olives South Africa (Olive Production)
    - Citrus
    - Hartswater Wijnkelder (Wine Production)
    - Senwes grainlink

    - Olam (Peanut and Peacan nut factory)
    - Feedlots (Tristar Feeders, Pieter van Wyk)
    - Lucerne mills x12
- Petrol Stations
- Other
    - Ammunition Depot (Jan Kempdorp)

4.5 Rural District Management Area

4.5.1 Listed Activities identified in the Rural District Management Area which need to be licensed

None

4.5.2 Other Sources of Concern in the Rural District Management Area which need to be managed

- Motor vehicles
    - National Roads;
    - Provincial Roads;
    - Local paved Roads;
    - Local unpaved Roads.
- Rail
    - Passenger Rail Spoornet;
    - Goods Rail Spoornet.
- Domestic fuel burning
    - Informal housing.
- Veldt fires
- Petrol Stations

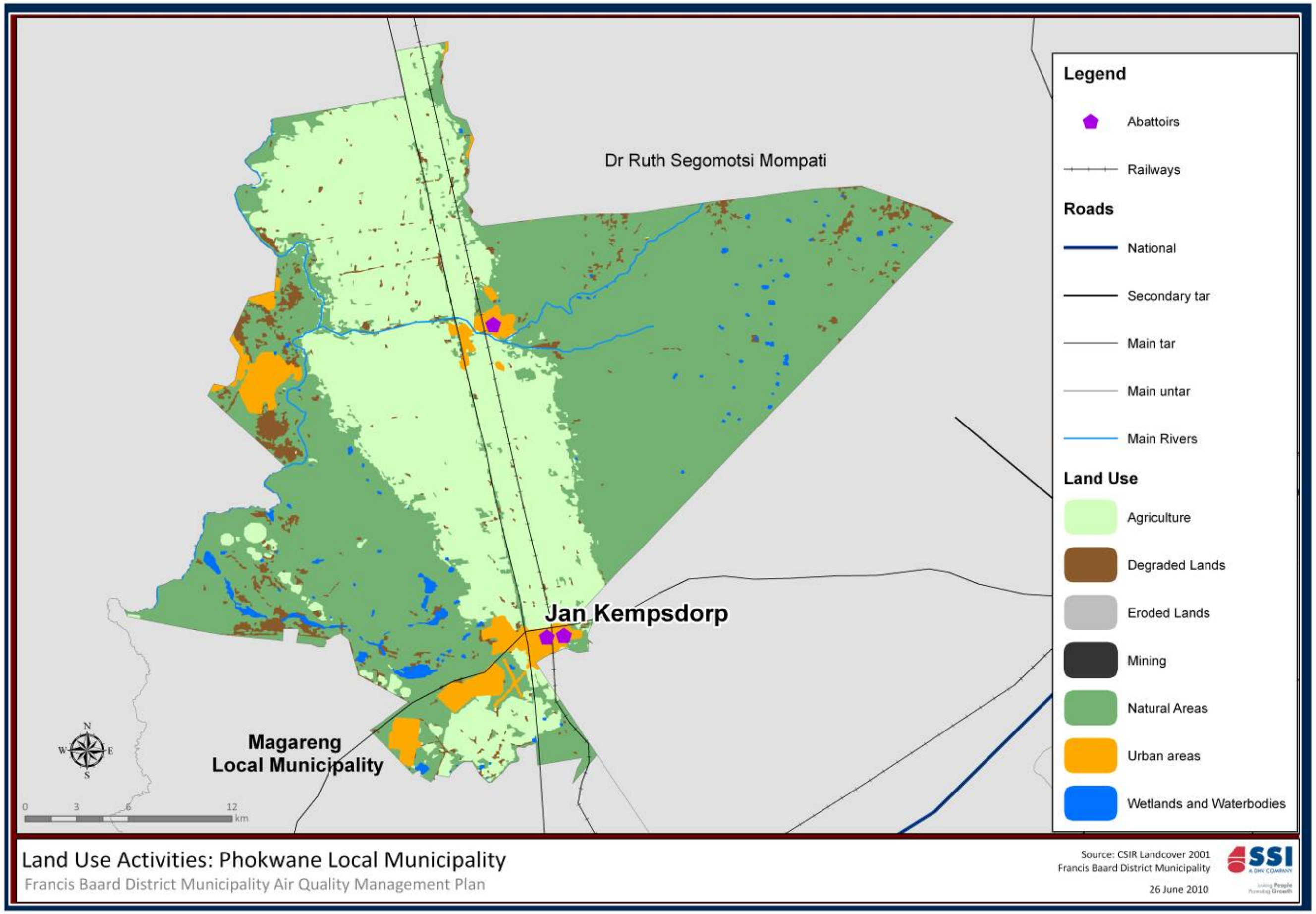


Figure 18: Land use Activities in the Phokwane Local Municipality

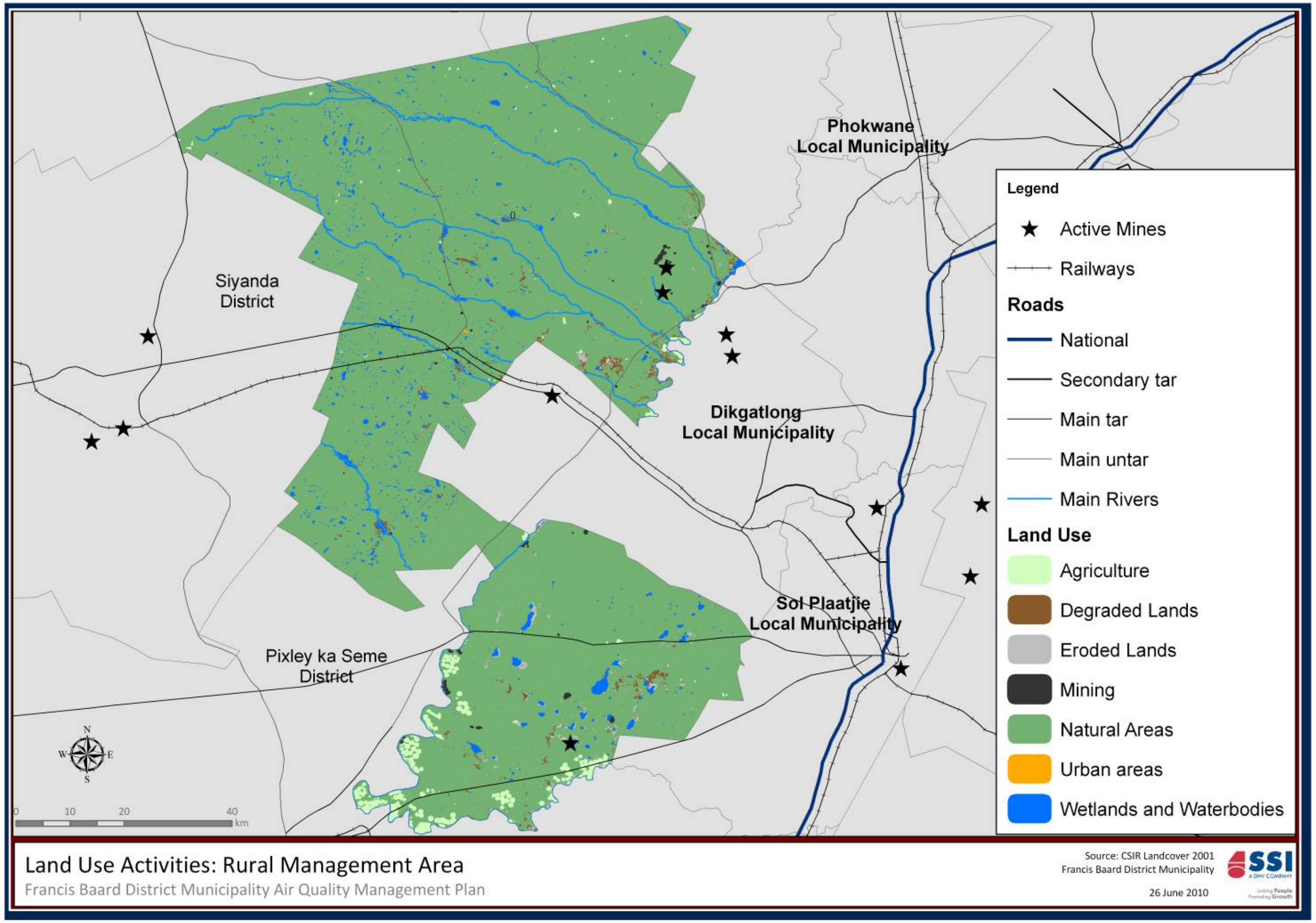


Figure 19: Land use Activities in the Rural Management Area

5 AIR QUALITY MANAGEMENT SYSTEM

An Air Quality Management Plan cannot be successfully implemented and revised in the absence of an effective air quality management system (AQMS). FBDM will implement an AQMS in a two phased approach, namely on the short term essential tools will be acquired to manage air quality, this will be followed by the implementation of health and damage assessments which will inform the cost of air quality impacts and the savings which could be realised with the implementation of intervention strategies.

Air quality goals or objectives represent an important air quality management 'tool'. Other essential tools in any air quality management system are: emissions inventory, air quality and meteorological monitoring and atmospheric dispersion modelling (Figure 20).

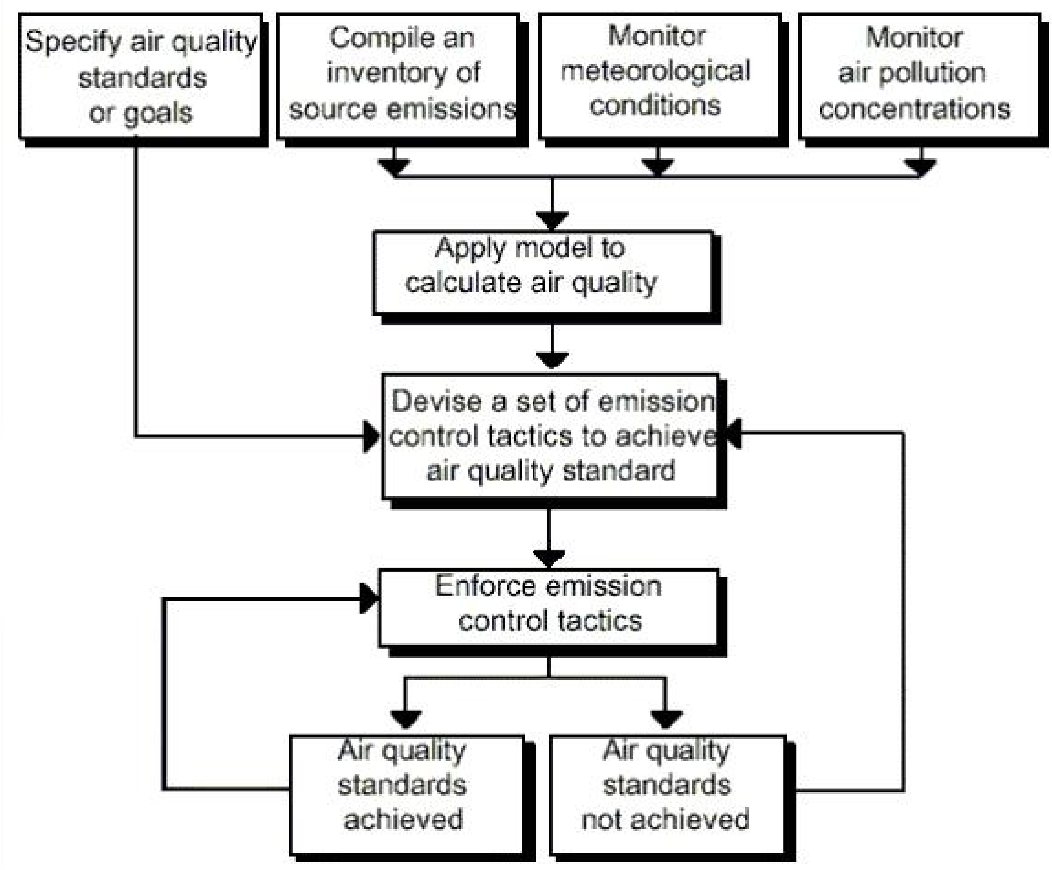


Figure 20: Development of an air quality management strategy through the implementation of select air quality management tools (after WHO, 2000).

On the basis of a comprehensive emissions inventory, the application of monitoring, in combination with modelling, facilitates the effective characterisation of spatial and temporal variations in air pollutant concentrations[7]. Such concentrations are evaluated based on existing ambient standards[8] to determine the need for devising emission control strategies. Dispersion modelling is used to predict ambient air pollutant reductions possible through the implementation of specific emission control strategies. Emission control strategies may then be selected which are able to ensure compliance with the local guideline values. It should be noted however that the socioeconomic acceptability and technological feasibility of such strategies would need to be assessed, and the implementation of the strategies would need continued enforcement. If the standards are not achieved within the permissible timeframe stipulated, the emission control measures would need to be revised.

An integrated air quality management system, which includes components such as an emissions inventory and air quality monitoring and modelling, forms the basis of effective air pollution control and air quality management. The configuration of the management system to be implemented by FBDM is illustrated in Figure 21. System components proposed for implementation in the short-term are indicated by solid lines, with components to be added at a later stage indicated by dashed lines.

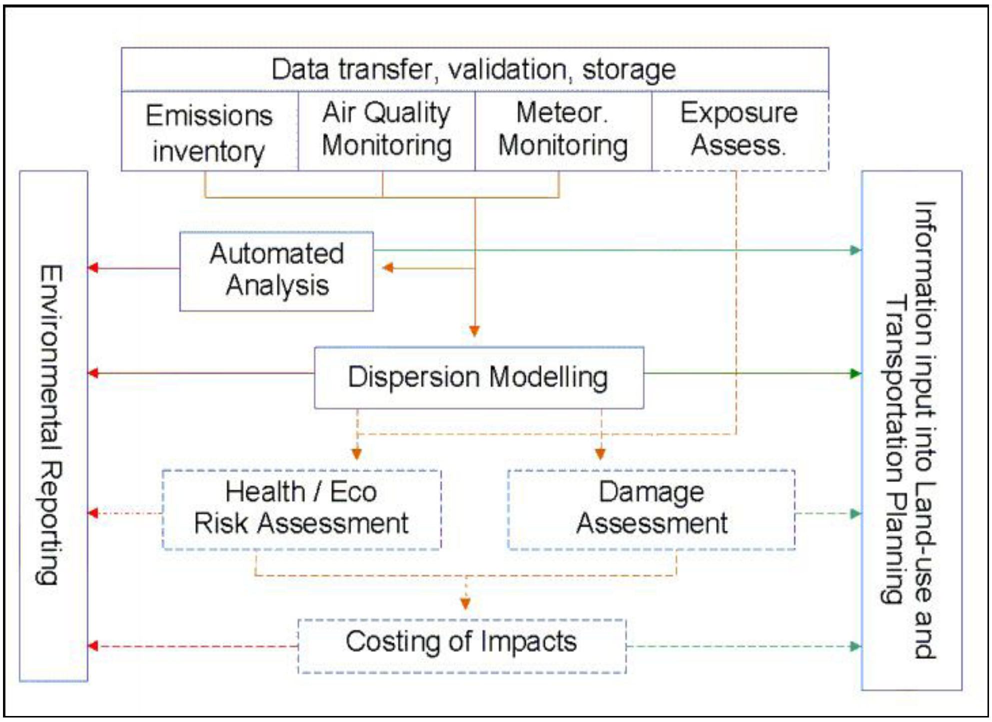


Figure 21: Air Quality Management System to be implemented by the Frances Baard District Municipality

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7 Extract from the City of Johannesburg Air Quality Management Plan.

8 Ambient standards are defined as National Ambient Air Quality Standards or any stricter standards as defined by the Northern Cape Province or the Frances Baard District Municipality.

Components of the Basic Air Quality Management System proposed for implementation by the FBDM and which are to be put in place within the short-term, in the next 1-2 years, include the following:

- An emissions inventory is to be developed;
- An air quality and meteorological monitoring network is to be designed and implemented;
- Atmospheric dispersion modelling is to be undertaken;
- Routine reporting mechanisms are to be designed and implemented;
- Public liaison and consultation mechanisms are to be put into place.

Health risk assessments and damage assessments can be undertaken, and the resultant impacts cost within a 3-5 years time frame. This assessment will be based on the outputs of the basic air quality management system. Such an assessment may be undertaken in the following ways:

- the selection and acquisition of suitable models and acquisition and preparation of locally derived input data;
- the application of manual calculations based on locally derived data; or
- the appointment of consultants on a project by project basis.

5.1 The Development of an Emissions Inventory

ACTION: FBDM has to establish an emissions inventory data base, with associated software, training and modelling capabilities.

An emission inventory is a list of air pollutant emissions released from activities undertaken by different types of sources. Source and emission data need to be collected for routine, upset and accidental emissions to provide an accurate description of the potential for impacts to occur. In addition to collecting information on present sources of emissions, an emission inventory should also indicate future emissions for long-term planning purposes. The first step in the establishment of an emissions inventory is the identification of sources of emissions this has been done and is presented in Sections 2 and 3 of this report.

The next step is to establish each sources contribution to ambient air quality. The District aims to undertaken the following with respect to estimating individual source impacts:

5.1 Transportation

- Develop a database to house:
    - o A log of diurnal (24 hour variation) vehicle movements along major arterial routes, a differentiation is to be made between heavy duty and passenger vehicles;
    - o A log is to be kept of rail movements along rail networks in the District;
    - o A log is to be kept of air traffic listed by aircraft type from the local airport(s);
- Set up reporting protocols to ensure information is received from stakeholders to populate the database created;
- Make use of emission factors to estimate the release of criteria pollutants to atmosphere from these sources (inhalable particulates, carbon monoxide, sulphur dioxide, nitrogen dioxide, benzene, lead).
- Make use of emission factors to estimate the release of non criteria pollutants such as diesel particulates from these sources.

5.1.2 Domestic Fuel Burning:

- Information related to coal sales, wood sales/collections from the veldt and paraffin sales used in household cooking and heating need to be assimilated into a central database;
- Emission rates need to be estimated for these activities with the use of applicable emission factors for both criteria and non criteria pollutants of significance;
- Questionnaires will be formulated and issued to communities to establish the extent of wood collection from the veldt, as well as coal and paraffin usage in the home.

5.1.3 Listed Activities and Commercial Fuel Burning Appliances:

- Information related to the following key listed activities and fuel burning appliances need to be collected and stored in a central database:
    - o Incineration (including crematoria);
    - o Brick making;
    - o Asphalt production (macadam processes);
    - o Fuel Storage Facilities;
    - o Cement Manufacture;
    - o Boilers at schools and hospitals; and
    - o Restaurant trade (pizza ovens, fast food restaurants etc.).
- Information related to Point Source emission releases must include:
    - o Stack height and inner diameter of the stack;

  - Stack gas exit temperature, exit velocity and flow rate;
  - List of permit specifications;
  - Emission rates monitored from these sources;
  - Production rate/or operating capacity of facilities; and
  - Fuel usage at the facility per operation is required.
- Information related to non Point Source emission releases must include:
  - Type of release to atmosphere;
  - Duration of operations; and
  - In the case of vehicle movements, the number of road trips per day.

5.1.4 Waste Sector Impacts

- The waste sector is comprised of landfill and sewage works. Incineration of waste will be dealt with under listed activities;
- As part of the development of an integrated waste management plan, the District is in the process of developing an inventory of all registered and non registered landfill sites. When this information is available this needs to inform the development of an emissions inventory for this source group;
- Likewise a number of sewage works are in operation in the District. A comprehensive list of their status needs to be compiled by the District. Reference can be made to existing documentation such as the Green Drop Report. Once this information is assimilated, this information needs to be used to inform the develop an emissions inventory for this source group;
- It should be noted however that due to the diffuse nature with which the gasses are released from landfill sites and sewage works, the estimation of emissions released from these sources can only be done with the use of monitoring equipment and emission models;
- Typical models and equipment which would need to be deployed for this purpose would include:
  - Gassim (Model)
  - Landgem (Model)
  - Tedlar bags (Sampling method)
  - Adsorbent tubes (Sampling method)
  - Etc.
- Emissions released from these sources vary as the amount of waste stored or treated on site changes, and because of the degree to which the waste at landfills have decomposed. In order to manage the impacts from these types of sources, the level of emissions released need to be modelled to estimate effective buffer zones (areas were certain activities are excluded adjacent to the site);

- In the absence of this modelling exercise various standard exclusion zones are proposed. For the District and for implementation by the Local Municipalities, it is suggested that the buffer zones as prescribed by the Gauteng Province be used. These are set as:
  - A best case buffer of 400m and a worse case buffer of 200m for landfill sites;
  - A best case buffer of 800m and a worse case buffer of 500m for sewage works.
- The District will however still strive to evaluate the applicability of these standard buffer zones by developing an emissions inventory for each site. In estimating emissions released from these sources the following information will need to be collected from each landfill sites and stored in a central database:
  - Layout map of the site, to be electronically available and geo-referenced;
  - Design capacity of the landfill site;
  - Amount of waste disposed of at the site annually;
  - Total amount of waste already stored on site;
  - Type of waste received at the landfill site;
  - Monitored data from gas probes used to measure as a minimum, methane and carbon dioxide levels;
  - Monitored data from gas probes indicating levels of odorous and health risk pollutants released from typical landfill sites.
- In estimating emissions released from each sewage works the following information will need to be collected and stored in a central database:
  - Layout map of the works, to be electronically available and geo-referenced;
  - Design Capacity of the works;
  - Amount of waste treated at the site daily;
  - Monitored data indicating water quality at the works inlet and outlet.

5.1.5 Mining

Mining operations in the District need to be separated into two groups, firstly air quality impacts resulting due to closed, abandoned and derelict mines, and secondly those areas which are still actively being mined in the area. A large amount of detail regarding the activities taking place or which took place at these sites needs to be collected in order for the District to develop an emissions inventory for this group of sources. The list that follows details the information which needs to be collected and stored in a central database.

- Historical legacy of mining – closed, abandoned and derelict mines;
  - From discard dumps;

        - Particle size distribution of material deposited on site;
        - Dimensions and height of impoundments;
        - Bulk density of material stored on site;
        - Particle density of material stored on site;
        - Type of rehabilitation methods deployed; and
        - Efficacy of the types of rehabilitation methods deployed.
    - Un-rehabilitated mine works;
        - Electronic and geographically referenced site layout plan of the mine works;
        - Description of the type of mining activities which took place in the area;
        - List of the type of rehabilitation procedures deployed on site; and
        - A description of the efficacy of the rehabilitation procedures deployed.
- From still actively mined areas;
    - General Information on the Site;
        - Electronic and geographically referenced site layout plan of the mine works;
        - Process description of the activities taking place on site; and
        - Mine plan for the site.
    - Storage Piles and Discard Dumps;
        - Particle size distribution of material deposited on site;
        - Dimensions and height of impoundments;
        - Bulk density of material stored on site; and
        - Particle density of material stored on site
    - Open case mining activities;
        - Vehicle activity;
            - Number of truck trips per day from the site;
            - Route taken by trucks leaving the site.
        - Temporary storage piles;
            - Potential location of piles and description of the type of material being stored;
            - Particle size distribution of material deposited on site;
            - Standard dimensions and height of piles;
            - Bulk density of material stored; and
            - Particle density of material stored.
        - Crushing and screening activities;
            - Rate at which material is processed per hour;
            - Number of hours per day that crushing and screening takes place.

        - Blasting;
            - Type of explosives used;

            - Standard size of the blast area;
            - Drill spacing for overburden;
            - Drill spacing for in-situ ore body.
            - Number of blasts per week or per month.
    - Underground mining activities;
        - Vehicle activity;
            - Number of truck trips per day from the site;
            - Route taken by trucks leaving the site.
        - Location of temporary storage piles;
            - Particle size distribution of material deposited on site;
            - Dimensions and height of impoundments;
            - Bulk density of material stored on site; and
            - Particle density of material stored on site
        - Crushing and screening activities;
            - Do these activities take place underground or above ground;
            - Rate at which material is processed per hour;
            - Number of hours per day that crushing and screening takes place.
        - Blasting;
            - Location of ventilation shafts, to be provided electronically and geographically referenced.

5.1.6 Agricultural activities

- Agricultural activates involve the cultivation of land as well as activities related to or associated with the processing of crops such as a peanut, olive, citrus, vine, grain and lucerne. Processes associated with animal husbandry, such as abattoirs, feed lots, bone meal processing also need to be managed;
- Land preparation for harvesting purposes can generate significant quantities of dust. This is of particular concern when these activities take place close to schools and clinics. Emission factors cited by the United States Environmental Protection Agency for these activities indicates that approximately 0.6 tonnes of inhalable particulate matter (PM10) is generated for every acre of land worked (per activity per year). Land preparation operations are in this example said to

include root cutting, disking, tilling, chiselling, ripping, sub-soiling, land planning and floating as well as weeding.

- In order to estimate the impacts from harvesting activity the following information needs to be assimilated for all agricultural activity taking place in the District:
  - Acreage of land under cultivation per annum;
  - Number of harvesting operations undertaken per annum;
  - Nature of the harvesting operations;
    - Watering of fields takes place prior to harvesting;
    - Harvesting taking place directly after significant rain events;
    - Degree to which the harvesting process is mechanised etc.
- In order to estimate the impacts from crop processing the following information needs to be assimilated from these operations:
  - A description of the process to be undertaken;
  - The type of dust extraction processes in place;
  - The type of chemicals stored on site which could vent emissions to atmosphere;
    - The nature in which these substances are being stored e.g. ethanol for the production of wine, may be stored in vessels/tanks, thus tanks specifications would thus need to be collected.
  - The nature in which waste material is disposed of needs to be detailed.
  - If boilers are used on site, details specific to these facilities need to be provided, this will include:
    - Purpose of use;
    - Type of fuel used;
    - Amount of fuel used per day;
    - Operating hours per day;
    - Chimney height (m);
    - Chimney diameter (m);
    - Gas exit temperature (°C);
    - Gas exit velocity (m/s).
- Animal husbandry is often associated with foul odour. The estimation of odour emanating from feedlot operations are not possible, rather ambient air quality sampling needs to be undertaken to establish the nature and extent of these air quality impacts. The pollutants usually of concern include hydrogen sulphide (H_2S) and ammonia (NH_3). These impacts need to be assessed on a case by case basis, with the District responding to complaints received from communities. The emissions inventory database should thus be able to accommodate a complaints register.

- When estimating emissions released from operations like abattoirs and bone meal factories the follow information needs to be sourced in order to estimate the emissions released:
    - A description of the processes being undertaken;
    - The quantities of material being processed;
    - The specifications related to boilers being used;
        - Type of fuel used;
        - Amount of fuel used per day;
        - Operating hours per day;
        - Chimney height (m);
        - Chimney diameter (m);
        - Gas exit temperature (°C);
        - Gas exit velocity (m/s).

5.1.7 Adherence to International Conventions

United Nations Framework Convention on Climate Change (UNFCCC)

The United Nations Framework Convention on Climate Change (UNFCCC) provides the framework for addressing climate change as a global issue. It provides a broad consensus for establishing institutions and practices to address climate change by introducing processes of ongoing review, discussion and information exchange. The UNFCCC also differentiated between the responsibilities of developed and developing countries, by designating Annex 1 and Non-Annex 1 status, respectively, to parties to the convention. Developed countries have greater commitments as stated in Annex 4 of the Convention. The framework convention is expanded on through protocols, of which the Kyoto Protocol is the most recent and well recognised. South Africa ratified the UNFCCC in August 1997, and is classified as a non-Annex 1 Party, or a developing country. South Africa has obligations as stated in Article 4 Paragraph 1 of the UNFCCC, including the preparation of the National Communication, which incorporates an inventory of greenhouse gases (GHGs) not covered by the Montreal Protocol.

Although this initiative is driven on National Government level, the National DEA will require feedback from the individual provinces and local municipalities in order to develop their greenhouse gasses inventory. Pollutants which need to be reported on to the National DEA will include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), Perfluorocarbons (PFCs), Hydrofluorocarbons (HFCs), Sulphur hexafluoride (SF_6) as well as indirect greenhouse gasses like sulphur dioxide (SO_2), Oxides of Nitrogen (NO_x), Carbon Monoxide (CO) and non methane volatile organic compounds (NMVOC). The key sources of these pollutants in the Frances Baard District Municipality include:

- Landfill Sites;
- Sewage works;
- Combustion sources used in industrial processes;
- Domestic fuel burning activities; and
- Veldt Fires.

During the estimation of emissions from the above mentioned sources, these greenhouse gasses need to be included in the list of pollutants which need to be assessed.

Kyoto Protocol

The Kyoto Protocol was adopted in December 1997 at the meeting of the Conference of the Parties to the UNFCCC, and came into force in February 2005. The protocol establishes the commitment of developed (Annex 1) countries to reduce GHG emissions by 5.2%, compared to 1990 levels, for the period 2008 - 2012. There are three principle mechanisms used to facilitate GHG emission reduction, including, the clean development mechanism (CDM), joint implementation, and international emissions trading. The purpose of the clean development mechanism is to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments. South Africa acceded to the protocol in 2002 and it came into force in 2005. However, South Africa’s status as a non- Annex 1 country implies no binding commitment to cap or reduce GHG emissions. South Africa, as a developing country, is in a position to benefit from the CDM.

The District Municipality thus has a responsibility to determine areas where greenhouse gasses could be reduced if cleaner technologies were introduced at a site. The development of an emissions inventory of sources in the district will identify the sources to target for CDM type projects.

The Vienna Convention for the Protection of the Ozone Layer

The Vienna Convention was agreed upon in 1985, with countries expressing commitment to conduct research and share information on stratospheric ozone depletion. The convention focused on the protection of human health and the environment from adverse effects resulting from anthropogenic influences on ozone destruction. Chemicals responsible for ozone destruction were also identified and monitored. The convention provided the framework for a binding agreement on addressing ozone depletion. The convention is also viewed as significant as it demonstrates the cooperation of international governments to address a global environmental issue. South Africa acceded to the convention in January 1990 with the aim to research and reduce all potential pollutants which may reduce ozone within the atmosphere.

The District needs to assist National DEA with the collection of information required for South Africa to evaluate if their obligations as outlined under the Vienna Convention are being met. This information will be assimilated through the development of a detailed emissions inventory for the District. The format in which this information needs to be relayed to National DEA needs to be provided by the Department.

The Montreal Protocol on Substances that deplete the Ozone Layer

The Montreal Protocol was signed in September 1987 as a means of addressing the production, supply and use of ozone-depleting substances. It puts in place procedures for the phasing out of chlorofluorocarbons and halons. The schedules for phase-out and obligations take cognisance of developed and developing country status, designated as Article 5 and non-Article 5 parties respectively. The protocol was significantly amended in 1990 (London Amendment) and 1992 (Copenhagen Amendment), with further amendments made in 1997 (Montreal Amendment) and 1999 (Beijing Amendment). The amendments served to include additional obligations and additional ozone-depleting substances, such as methyl bromide, hydro chlorofluorocarbons and methyl chloroform, and also to tighten schedules of compliance. South Africa ratified the protocol in January 1990, the London Amendment in May 1992, and ratification of the Copenhagen Amendment is in process. South Africa is currently in full compliance with the conditions of the protocol.

The Frances Baard District Municipality in the process of compiling information for their emissions inventory need to monitor that all major sources of listed ozone depleting substances continue to no longer be in use.

The Stockholm Convention on Persistent Organic Pollutants (POPs)

The Stockholm Convention was signed in May 2001, and came into force in May 2004. The Convention is intended to address the production and use, or banning, of POPs for the protection of human health and the environment. Twelve pollutants are considered in the convention, including pesticides such as dichlorodiphenyltrichloroethane (DDT), industrial chemicals like hexachlorobenzene and polychlorinated biphenyls, and unintended by-products of industrial process like dioxins and furans. Intentionally produced POPs are targeted for reduction and elimination, and unintentional production requires feasible elimination. The management and disposal of stockpiles of obsolete chemicals are addressed, with trade restrictions also included in the convention. South Africa ratified the convention in 2002, and it came into force in 2004. South Africa is however the only country that as signatories to the convention are permitted to use DDT for the control of malaria vectors.

The use of the 12 dirty dozen chemical as listed under the convention are monitored through a reporting structure. An implementation plan for the convention also needs to be developed by each Country. To this end all industry types with the potential for POP's production will be identified by the Implementation Plan, and a monitoring programme will be set out to guide the reduction in use and production of these pollutants.

Due to the costs associated with the monitoring of POP's, emission factors and mass balance calculations are likely to be recommended for the regular reporting of results by industry, with monitoring only being used to validate these results. Key source types in the District which need to be considered for assessment of the release of POPs include:

- Intentionally produced and used POPs
    - Pesticides listed under the convention and used during agricultural applications need to be stopped, all stockpiles of these pesticides need to be recorded and reported to the National DEA;
    - Transformer oils contaminated with PCB's need to be recorded and their locations reported to the National DEA (power generation applications).

- Unintentionally produced POPs
    - Dioxins and furans released from incineration processes need to estimated and reported on (including crematoria);
    - Dioxins and furans released from boiler operations (power generation) need to estimated and reported on;
    - Dioxins and furans released from brick making need to estimated and reported on;
    - Dioxins and furans released from domestic fuel burning need to estimated and reported on;
    - Dioxins and furans released from landfill sites (flaring and leachate) need to estimated and reported on;
    - Dioxins and furans released from veldt fires (landfill fires, savannah fires etc.) need to estimated and reported on;
    - Dioxins and furans released from vehicle activity need to estimated and reported on;
    - Dioxins and furans released from thermal wire reclamation operations need to estimated and reported on;
    - Dioxins and furans released from cement manufacturing need to estimated and reported on;
    - Dioxins and furans released from asphalt production processes need to estimated and reported on;
    - Dioxins and furans released from smoke houses (meat smoking) need to estimated and reported on;
    - Dioxins and furans released from tobacco smoking need to estimated and reported on;

- o Dioxins and furans released from sewage works need to estimated and reported on;
- o Dioxins and furans released from waste oil disposal need to estimated and reported on;
- o Dioxins and furans released from composting need to estimated and reported on.

Information collected on each of these sources need to be stored in a central database which can be used to provide the National DEA with input to the development of their National POPs Emissions Inventory.

International concerns around mercury

There are international initiatives to address mercury but to date no international policy has been developed. A recent programme backed by the United Nations (UN) that aims to reduce the health and environmental impacts of mercury includes a two-year period of voluntary action to reduce emissions and an evaluation to determine whether an international treaty is necessary. It aims to develop partnerships between government, industry and other key groups to reduce emissions. The 1979 Convention on Long-Range Trans-boundary Air Pollution on Heavy Metals provides a detailed list of actions based on the category of industry or activity. These activities each have guidelines and recommendations on reducing the emissions as well as ideas for Best Available Techniques (BAT) including low-waste technologies and recovery options. Based on the listed activity, specific mitigation measures are recommended, as well as an indication of the design control efficiency of each measure, along with a cost guide in order to determine the financial implications of implementation. Emission limits have also been provided, with the current Air Quality Framework recommending the inclusion of these during the next round of updates.

The sources of most significance to the District with respect to these developments are:

- Boiler Operations, and
- Domestic fuel burning, as mercury is one of the metals released during the combustion of coal.

It is recognised though that the main issue of concern with respect to mercury contamination in the District will not be air quality related but will rather be associated with soil and water contamination.

5.2 Ambient Air Quality and Meteorological Monitoring

ACTION: FBDM should establish a comprehensive air quality and meteorological and monitoring network.

In the design of a monitoring network for the FBDM the following have to be undertaken:

- monitoring objectives need to be defined;
- priority pollutants should be selected;
- suitable numbers of stations need to be determined for pollutants to be measured;
- stations are to remain secure;
- standard periods for data reporting should be determined;
- the accreditation of the sampling technique needs to be ensured; and
- suitable mechanisms and protocols for data transfer and storage are to be identified.

5.2.1 Monitoring Objectives adopted by FBDM

The following air quality monitoring objectives are to be adopted by the FBDM:

- to assess exposure of people, addressing both the highest levels and the levels in other areas which will provide a better understanding of the spatial distribution of impacts;
- monitor in areas where the general population is exposed;
- make adequate information available to the public;
- collect information which will enable the establishment of source contributions and trend analysis;
- monitoring should enable the assessment of exposure of vegetation and ecosystems;
- stack monitoring will be undertaken;
- focus on monitoring of near ground pollution in areas where maximum pollution concentrations coincide with high rates of exposure;
- focus on the quantification of 'air toxins', dust fallout and odoriferous pollutants which are typically localised and traceable to a specific source.

5.2.2 Parameters to be Monitored

In the identification of pollutants to be monitored, reference was made to the priority pollutants identified for the purpose of establishing local air quality guidelines. It was determined that the following pollutants be monitored by the District:

- Particulate Matter – PM (Particulate matter less than 10 micro meters in diameter, and particulate matter less than 2.5 micro meters in diameter, total suspended particulates and diesel particulates);
- Sulphur Dioxide – SO_2;
- Oxides of Nitrogen – NO_x;
- Carbon Monoxide – CO;
- Carbon Dioxide – CO_2;
- Methane – CH_4;
- Ozone – O_3;
- Mercury – Hg;
- Lead – Pb;
- Volatile Organic Compounds – VOCs;
- Organophosphates and other pesticides and constituents identified for use by the agricultural industry.

Meteorological parameter required to be monitored are wind speed and direction, ambient temperature, relative humidity, barometric pressure and rainfall. The only Weather Services Station currently operated in the District is located at the Kimberley airport.

5.2.3 Areas to be Monitored

ACTION: The FBDM will facilitate the monitoring of sources of pollution as well as the impacts the release of pollutants have on ambient air quality within the District. Key focus areas include:

- Domestic fuel burning – With the aid of the emissions inventory development for this source type as well as dispersion modelling undertaken, areas of maximum impact will be identified. Results from this modelling exercise will then be supported by passive sampling in key areas expected to be impacted by domestic fuel burning. Seasonal variations in these impacts will need to be assessed. It is envisaged that this passive sampling exercise will be undertaken through the collaboration with a University or similar type of institution, which will facilitate the District to overcoming its capacity and time constraints in implementing this phase of the project. Once this information is available, an automated monitoring station will need to be set up in the area which is best representative of this type of ambient impact. This will allow for trends in ambient air quality impacts to be monitored, as well as the successes and failures of any intervention strategies which are rolled out.

- Mining Operations – A key focus will be to address the historical legacy of mining in the District. Discard dumps, those in operation and those not, need to be monitored to establish their impacts on local communities and adjacent commercial concerns. Initially residential and commercial zones which are situated within 500m of a discard dump will be targeted for assessment[9]. This assessment will take the form of dust fallout bucket monitoring[10] and active pump sampling over a 24 hour period at individual households or commercial concerns. Dust fallout sampling needs to be done on a continuous basis with active pump sampling undertaken to obtain representative seasonal variations of impacts. The monitoring methods to be deployed should conform to the SANS 69 guidelines.

  The District will as far as possible assist the owners of these facilities to monitor their own impacts. With respect to ownerless mine dumps, the District in association with the DME will take responsibility for the assessment of impacts.

  Where dust fallout sampling has been prescribed by the DME at actively mined areas, and where mines have undertaken sampling voluntarily, this information needs to be reported to the District for inclusion in a centralised database of monitored information for the District.

- Transportation related impacts. – the key focus areas her includes the monitoring of ambient air quality impacts in close proximity to petrol stations and the testing of diesel vehicles through spot checks of diesel exhaust fumes.

- Industrial and commercial operations – If stack monitoring has been prescribed by the licensing authority for the industry concerned this information needs to be provided to the District for inclusion in their central database.

  The District is tasked to ensure that all activities which need an air pollution licence are in possession of such a valid licence. In high density areas where these activities are noted to occur, ambient monitoring within the maximum area of impact should be undertaken. This maximum area of impact can be ascertained through dispersion modelling of source emissions from these activities.

  Where significant impacts (repeated exceedance of ambient standards and limits) are noted to occur the polluter should take responsibility for continued monitoring

[9] Representative of a worse case buffer zone for tailing facilities (GDACE Buffer Zone Study).
[10] ASTM Method D 1739-98

of these impacts. This monitoring is necessitated in order to demonstrate a reduction in ambient air quality impacts, as a result of measures implemented to bring the activities concerned into compliance with National, Provincial and Local Authority ambient air quality standards and limits.

The methods used to measure ambient air quality should comply with the guidelines presented in the SANS 69 Standard, and the results obtained should allow for the assessment of season trends in ambient impacts.

- Waste Treatment Facilities - Sewage and landfill sites situated close to residential and commercial facilities need to be assessed due to their potential to contribute to both nuisance and health risk impacts. The Frances Baard District Municipality will work closely with the current service providers in order to set up a monitoring protocol for these facilities. Those facilities which will be prioritised will include sewage works with residential and commercial facilities within 500m of their fence line, and landfill sites with activities within 200m of their fence line. Active sampling needs to be undertaken in these areas to ascertain the levels of exposure to these pollutants over a time interval applicable to the pollutant being assessed.

5.3 Recommended Atmospheric Dispersion Modelling Approach

ACTION: FBDM will acquire and implement a suitable atmospheric dispersion model.

Recommended criteria to be met by the dispersion model to be implemented by FBDM include the following:

- the software should be able to undertake urban-scale dispersion modelling;
- as a minimum, first order chemical transformation (ozone formation) should be possible;
- the model should be Microsoft Windows based;
- the model should be compatibility with the local LAN;
- the model should be compatible with any emissions inventory software used;
- the model should be GIS based;
- the model should demonstrate strong data base tools.

The most widely used commercially available package suited for the application and which are endorsed for use by DEA include:

- ISC-Aermod View (incorporates U.S.EPA models, ISCTS3, ISC-PRIME and AERMOD into one interface); and

- The Calpuff View Model.

5.4 Approach to the Development of Intervention Strategies

ACTION: The FBDM will implement and monitor the effectiveness of intervention strategies deployed to reduce impacts related to key polluting sources. Key focus areas include:

- Domestic fuel burning;
- Mining; and
- Industrial and commercial operations

To curb the impacts related to **domestic fuel burning** in the district various initiatives can be adopted, which have already successfully been implemented in other Districts. These may include:

- The introduction of the Basa njenga Mgogo method of lighting fires (top down ignition method as demonstrated by the programme rolled out by DME);
- The use of solar cookers in more remote areas,
- The introduction of solar geysers in homes;
- The roll out of education programmes related to the health risks associated with household fuel burning, and better use of current resources;
- The prescription of how new RDP houses are build, to ensure better energy efficiency. For example, ensure they are north facing, solar geysers are installed, and that these homes are on the whole better insulated;
- The encouragement of the use of alternative fuels for household cooking and heating, i.e. the substitution of the use of wood and coal for paraffin and gas.

The key focus for assessing **mining operations** will be to address the historical legacy of mining in the District. The source which impacts the most on ambient air quality are discard dumps. Various methods are available to limit the impacts due to these sources, these have varying cost implications and should be evaluated for implementation based on the risk these impacts pose, with specific reference to the proximity of these sources to surrounding residential settlements. The methods which can be deployed could include:

- Vegetation of closed impoundments, and the vegetation of side slopes at actively used material storage piles. If properly maintained, vegetation of the dams can reduce the impacts at these sites by up to 60%;
- The set up of automated hoses which are triggered to spray open areas of the impoundment when the wind speed reaches a certain threshold, can be deployed which will result in an expected reduction in impacts of 70%-80% (depending on

material type, other climatic variables and the initial moisture content of the material being sprayed);

- In highly problematic areas rock cladding can be used, however this method of mitigating side slopes is expensive. If deployed however a control efficiency of up to 90% can be achieved at the source;
- At newly erected impoundments or at derelict and abandoned impoundments chemical can be sprayed on the slopes which aid in stabilising the area. Many of these chemicals are biodegradable and can be deployed in conjunction with methods like vegetation. This is often a temporary measure to be used in areas which need immediate action to be taken to prevent unnecessary health risk to neighbouring communities; and
- The reclamation of material results in reducing or completely removing the impoundment from the area. Although this is not always a viable option to be deployed, and the process of reclamation also generates air quality impact, the partial or total removal of the impoundment, helps to remove the problem of wind blown dust completely from the impacted area.

Industrial and commercial operations need to all be registration on a central database held by the District. On the database a distinction can then be made between those entities which require an air emission license and those not. Those who are required to obtain an air emission license will then be monitored to ensure that full compliance is achieved with the stipulations outlined in the license provided.

5.5 Reporting Mechanism

ACTION: The FBDM will implement a comprehensive reporting mechanism. This mechanism will include the following:

- All monitoring information will report to a central data base including: air quality and meteorological data (automatic transfer or other depending on station), source and emissions data, diesel vehicle test results, soiling index monitoring results (etc.).
- The air quality management data base (comprising air pollution monitoring data, meteorological monitoring data and source and emissions data) will be archived on a monthly basis. Copies will be made: (i) one to be retained by the Air Quality Management department, and (ii) one to be sent to the Province for archiving.
- Source and emissions data and air pollution and meteorological monitoring results will be made available to Province in an electronic format compatible with their in-house data bases.

5.6 Public Consultation Approach

ACTION: FBDM will undertake a public consultation process.

5.6.1 Aims and Objectives

- Inform Interested and Affected Parties (I&AP's) of the monitored pollution levels in the FBDM on a regular basis;
- Allow I&AP's an opportunity to comment on the progress of the AQMP implementation;
- Allow I&AP's an opportunity to voice their concerns.

5.6.2 Media to be used

- Newspapers;
- Newsletters;
- Website;
- Public Meetings.

5.6.3 Designation of an Air Quality Information Liaison Officer

- The duties of an Air Quality Information Liaison Officer are to:
    - Coordinate responses to air quality related complaints;
    - Gather and distribute information to newspapers and radio stations;
    - Ensure the information is reported for display;
    - Organise and facilitate public meetings; and
    - Assist in the design and implementation of awareness raising campaigns.
- It is noted that this function may be fulfilled by an existing line function and does not need to be a stand alone individual.

5.6.4 Reporting Air Quality Information

Air quality information could be made available in local newspapers, libraries, post offices, public information centres and on the Districts website.

5.6.5 Public Meetings

Public meetings can be held every 3 months at a venue central to the majority of the I&AP's. Two meetings could be held on the same day to allow I&AP's who are working to attend. The first meeting is to be held during working hours and the second in the evening, allowing I&AP's enough opportunity to get to the venue after work. There are five Municipal areas and it is recommended the meeting be rotated between these Municipalities i.e. one meeting per Municipality every three months.

The meetings will where possible include:

- Welcome, Apologies and Introduction;
- Conduct of Meeting;
- Purpose of meeting;
- Presentation of issues that will be raised at the meeting;
- Presentation of monitoring results, progress against key indicators, and proposed developments for the next six months;
- Questions related to the presentation;
- Discussion;
- General;
- Date for next meeting; and
- Closure.

Meetings should be advertised four weeks in advance to allow I&AP's to submit topics for discussion.

6 CAPACITY BUILDING WITHIN THE FBDM

It is intended that air quality management capacity and tools be development by the Frances Baard Environmental Management Department, to ensure efficient and cost-effective service delivery with respect to air quality management and planning. These capacities and tools typically include human resources (staff availability, expertise and experience), facilities, source and ambient monitoring equipment, emission and calculation methodologies.

The resources and tools required are informed by national regulatory requirements, international good practice and the current availability and local resources and competence.

Action: staff will be trained and more additional staff could be hired if necessary to provide the human resources necessary for effective air quality management, including AQM Plan implementation, review and revision.

6.1 Capacity Required on the District Municipality Level

Environmental Health Practitioners are responsible for air quality related functions at local level within the FBDM, specifically within the Magareng, Phokwane and Dikgatlong Local Municipalities. Figure 22 outlines the department's desired organogram. The specific air quality functions which are to be fulfilled are outlined as follows:

- The issuing of air quality licenses;
- The development of an emissions inventory;
- Undertaking dispersion modelling;
- Developing and rolling out of intervention strategies;
- Monitoring of air quality;
- Management of information databases;
- Compilation of complaints response database;
- The periodic inspection of fuel burning appliances in the area; and
- Setting of local emission and ambient air quality standards.

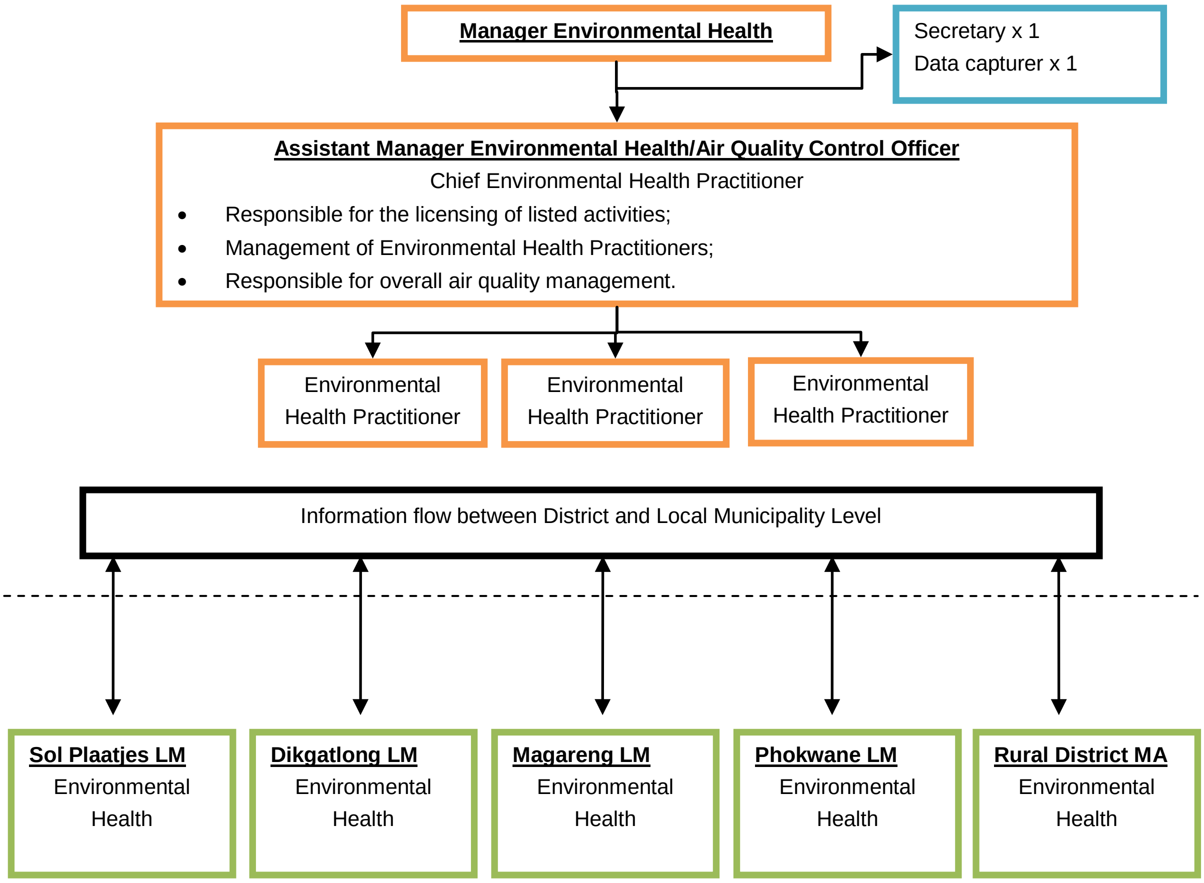

Figure 22: Proposed Organogram for the Environmental Management Division.

7 IMPLEMENTATION AND REVIEW OF THE FRANCES BAARD DISTRICT MUNICIPALITY AIR QUALITY MANAGEMENT PLAN

7.1 Plan Implementation

Effective air quality management has as its basis a comprehensive management framework including the required organisational and functional structures and an integrated air quality management system comprising of an emissions inventory, air quality and meteorological monitoring, dispersion modelling and environmental reporting (etc.), the details of which are outlined in Section 5 of this report.

In the short-term emphasis needs to be placed on establishment of an air quality management framework, including organisational and functional structures and AQM system tools. These system tools are clearly outlined in Section 5 of this report and can be briefly summarised as follows:

- Establishment of an emissions inventory database;
- Development of a monitoring network;
- Undertake Dispersion Modelling;
- Develop Intervention Strategies;
- Develop Reporting Mechanism; and
- Consult with the Public.

The key focus of the implementation plan is to reduce air quality impacts where possible. Once significant information pertaining to each source type has been assimilated emission reduction strategies can be implemented for key polluting source. During this phase of the assessment emphasis will be placed on the following:

- Major Sources impacting on air quality;
- Sources where short term intervention strategies are justified;

- Sources for which further assessment are required to determine the need for and/or most suitable type of emission reduction measures implementable;
- Need to facilitate inter-departmental co-operation in the identification and implementation of emission reduction measures for certain sources; and
- The implementation of air quality management planning approaches by specific sources rather than on isolated individual emission reduction measures.

7.2 Air Quality Management Plan Review

Once the plan is approved by the Frances Baard District Municipality and relevant organisations, the plan will be reviewed on a regular basis to ensure continuing stability and effectiveness. The air quality management plan should be reviewed based on the following:

- Any revisions made to the National Air Quality Act and its supporting documentation;
- Progress made on the AQM Plan implementation; and
- The introduction of large scale developments into the area.

The Air Quality Management Plan should be reviewed every two years.