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Air Quality Management Plan for eThekwini Municipality

Kwa-Zulu Natal

South Africa

Produced by eThekwini Health and Norwegian Institute for Air Research

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Preface

South Africa and eThekwini Municipality has for many years undergoing the process of fast urbanization and industrialization. As the further development of the urban areas ecology and environment are now facing greater pressure, with local and regional environmental pollution and ecological damage causing problems for the population in areas and by this reducing the possibilities for further development. Therefore, it is necessary to plan the use of the airshed to be able to take care of the possibilities and to repair the known problems connected to pollution. To do this it is necessary to understand what is happening. This is done through the use of systems that are able to explain what is causing the problem and is able to quantify what is happening.

eThekwini and the South Durban Basin occupies the most important harbour, industrial, manufacturing and refining capacity in South Africa. This means that the industrial production in the area is important to the development of South Africa as such and is therefore important to develop further. To be able to do this sustainably one of the problems that need to be planned is the emissions to air so that the effects of the emissions are minimized. In areas in South Durban there are nucleus of small and medium size industries that employ many people. The unemployment rate is large in eThekwini. This means that the Municipality needs to establish more employment in the area. This again means more emissions to air. South Africa have legislations for air quality in side the country. eThekwini is obliged to keep the air quality inside these limits. One of the tools that is used is to develop a master plan for the areas where there are problems. This is done through the Master plan.

To control the environmental pollution and improve the quality of environment, it is not enough only relying on a simple way of implementation and we have to seek some new models with latest ideas, advanced technique, strong management systems and effective monitoring strategies.

To develop the master plan it is necessary to have some understanding of the air quality in the area. If this does not exist it is necessary to make a plan on what is necessary to know before actions can be taken. In air quality as in many other areas the obvious answer might not be the wisest. All municipalities need to make a master plan for Air Quality. The complexity of this master plan does not have to be high but the goal is supposed to be achievable and implementable and agreed upon by most parties. The complexity of the master plan is dependent on the complexity of the area and the knowledge of the air pollution problems in the area.

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Funding and Contributions

Funding for the development of the Air Quality Management Plan was sourced from the Danida Urban Environmental Management (UEM) Programme and the eThekwini Municipality.

Technical guidance and knowledge transfer in the development of the AQMP was faciluated through the participation of the Norwegian Institute for Air Research. The AQMP was documented jointly between the Norwegian Institute for Air Research and the eThekwini Health Department with input from stakeholders.

Contents

Summary

The National Air Quality Management Act (2005) requires that each Municipality develops an air quality management plan with the objective to systematically address air quality concerns. The outcome of the AQMP will be to achieve compliance with air quality objectives and to ensure that the ambient air media is conducive to health and wellbeing of our people. The eThekwini Municipality had the advantage of having successfully implemented the Multi-point Plan since it received Cabinet endorsement in October 2000. Despite the unprecedented strides in reducing sulphur dioxide emission and improving the technical and regulatory foundation for air quality management, the need for an AQMP is still necessary.

The process of developing the AQMP started with stakeholder involvement in November 2005. The thematic topics selected for incorporation into an AQMP were sulphur dioxide, particulate matter, benzene, odours, Jacobs industrial complex, flaring and indoor air quality in informal settlements. The justification for this prioritisation was based on data emerging from the air quality monitoring network, health studies undertaken and record of public complaints.

The approach of taking forward this issue was firstly to describe each of the thematic areas in terms of the nature of the issue, its compliance status, possible causative factors and where necessary the need for additional work to be done. The development of the air quality management system (AQMS), institutional capacity and multi-stakeholder network under the MPP provided a powerful foundation to undertake this work.

The AQMP incorporates the issues to be addressed into a conceptual framework for scientific and objective evaluation so that the underlying problems get addressed.

The AQMP throws up a number of possibilities for abatement for each of the air quality concerns that have been prioritized. The next step is to synthesize the possibilities into concrete realizable actions that have political and management support. This set of realizable actions will be incorporated into the air quality master plan.

The AQMP is a guiding document and the master plan is a prescription for action which must get implemented to bring about a change in the air quality status. The whole process is subject to a monitoring and review exercise and the air quality monitoring network, stakeholder feedback and complaint statistics will be used in the evaluation process. The performance of the AQMS and further set of actions (master plan) will be reported annually in the annual reporting process.

The AQMP will undergo a comprehensive process of review every five years in line with the IDP review process for the eThekwini Municipality. The outcome of the AQMP will be incorporated into the IDP such that it has the political and financial endorsement for implementation.

eThekwini Municipality
South Africa

1. The basis for the Air Quality Management Plan

To get a good grip of the air quality situation in an area it is necessary to assess the problems get possible abatements and to implement some of these abatements. The Air quality management plan is a tool to achieve this in an scientific and logical way. An Air Quality management plan have to be developed for each municipality in South Africa.

1.1 Achieving the vision for an improved quality of life

As part of the democratic and institutional reform process in South Africa, the Integrated Development Planning (IDP) and Environmental Policy Development processes are informing a new approach to Air Quality Management Planning.

The IDP for the eThekwini Municipality seeks to improve quality of life for all its citizens. Air quality management as a sectoral issue will form part of the overall IDP implementation strategy.

1.2 Institutional basis for air quality management

a. Constitutional

The democratic Constitution of South Africa rules that all citizens have a right to clean and healthy environment. The constitution locates air quality as a local government function with the executive and oversight roles being played by the National and Provincial Government spheres of governance.

b. Policy reform

The National Environmental Management Act (NEMA) and the Air Quality Management Act (AQA, 2005) lays the legislative and regulatory framework for Air Quality Management.

c. Local Bylaws

The consolidated municipal bylaws will integrate the various policies and plans at a strategic level that will lay legal requirements for development at the Municipal level.

d. Policy directives

Policy directives will be more comprehensive statements of approaches to various themes and sub-themes in environmental management. The philosophy as to how permits are to be formulated and guidance on particulate matter, VOC or toxics management will be detailed in policy directives.

1.3 Overall aim of the AQMP

eThekwini municipality is obliged, by the National Environmental Air Quality Act of 2005(AQA), to develop an Air Quality Management Plan (short: AQMP used in the following). The provisions in the Air Quality Act regarding goals, objectives and consideration, as well as contents, are summarised as:

(i) to give effect, in respect of air quality, to Chapter 3 of the National Environmental Management Act

(ii) to improve air quality;

(iii) to identify and reduce the negative impact on human health and the environment of poor air quality;

(iv) to address the effects of emissions from the use of fossil fuels in residential applications;

(v) to address the effects of emissions from industrial sources;

(vi) to address the effects of emissions from any point or non-point source of air pollution

(vii) to implement the Republic's obligations in respect of international agreements;

(viii) to give effect to best practice in air quality management;

(ix) to ensure transparent and traceable processes in the AQMP

(x) to ensure use of science, policy, multi stakeholder involvement and enforcement for achieving better quality of life

1.4 Special Case Study :Multi-point Plan for the South Durban Basin

The existing Atmospheric Air Pollution Prevention Act of 1965 has proved to be inadequate in addressing air quality management. Its emphasis was on source based control without a clear plan for ambient air quality management. There has been an incoherent institutional response to the problem. All authorizations were issued by the national Department with poor and inadequate capacity at the local level. With the
advent of democracy and a new approach to environmental management under the ational Environmental Management Act, An inter-governmental structure proposed the Multi-point Plan (MPP) for the hot spot area of the South Durban Basin.

The South Durban Basin Multi-point Plan is an initiative of the three spheres of governance in South Africa with the eThekwini Municipality as the lead implementing agent. The initiative was in response to the high levels of industrial and vehicular pollution in the South Durban Basin. The Plan was conceptualised in May 2000 and received Cabinet endorsement in November 2000. In November 2000 former Minister of Environmental Affairs Valli Moosa remarked on the plan as "a comprehensive framework for promoting a partnership-based approach to developing a path for sustainable development".

The aim of the MPP is to provide an improved and integrated decision making framework for air pollution management at the local government level and to move towards reduction in air pollution to meet health based air quality standards. This will be achieved by the following objectives of the plan:

- Undertaking a health risk assessment and an epidemiological Study;
- To phasing out the use of dirty fuels;
- Establishing an Air Quality Management System;
- Controlling chemical and fugitive emissions;
- Strengthening the auditing and permitting system;
- Development of local legal framework;
- Reviewing of standards for priority pollutants;
- Reviewing standards for vehicles emissions.

The Multi-point plan has emerged as a learning centre for a contemporary approach to air quality management and will be instrumental in informing the development of the national framework for air quality management.

The establishment of the Air Quality Management System in eThekwini have integrated the different building blocks already existing for South Durban Basin and the multi point plan into a system for understanding and estimating the contributions to the different sources of air quality, The main building blocks are:

- Monitoring network (with defined quality of data)
- Emission inventories
- Meteorological measurements
- Dispersion modelling
    - Stacks
    - Roads
    - Area sources
- Exposure modelling
- Health effects

The System connects emissions through dispersion to air quality and measurements of air quality to exposure and effects. Exposure is again used to estimate health effects on the population affected. This is illustrated in the figure below.

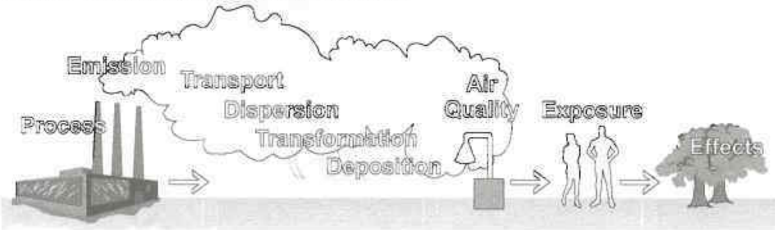


Figure 1: Chain of processes covered in the Air Quality Management System.

1.5 The monitoring network

Continuous measurements –designed to identify exceedances, evaluate models and be representative for different typical areas in SBD. Indicators measured are SO_2, NO_x, O_3, CO, PM_{10}, $PM_{2.5}$ and TRS

Background

The eThekwini Municipality now has a functioning Air Quality Monitoring Network as a concrete outcome of the MPP. The network has commenced generating data since December 2003. Since the first week of March 2004, it has been possible to access real time data in the eThekwini Health Department through the dedicated data lines and the Envidas data acquisition system. This development represents a four fold increase in monitoring capacity compared to what was operational in the past. Further the real time availability of the data within government is a significant achievement compared to the past where data was only made available a month or so later. Of particular note is the high data availability often exceeding the target value of 90 %. The raw data is subjected to two levels of quality control at the technical and at the logical level before the data is stored in a dedicated server. The Air Quality Information system (AirQUIS) is used to store the data. The integrated database is easily accessible for modelling, trending and reporting.

System Design

There are a total of 14 monitoring stations measuring a range of pollutant and meteorological parameters. Measurement indicators are for SO_2, NO_x, O_3, CO, PM_{10}, $PM_{2.5}$ and TRS. The continuous measurements are designed to evaluate models and be representative for different areas in SBD.

The following pollutants in terms of the health related priority pollutant listing are measured and indicates likely source.

Table 1: Priority Pollutant Listing.

Priority Pollutant	Representative of
Sulphur dioxide	Refinery, fuel based industry process emissions, traffic emissions
Nitrous Oxide and Nitrogen dioxide	Traffic and industry
Carbon Monoxide	Traffic
Particulate Matter (PM10)	Refinery, fuel based industry process emissions, traffic emissions, biomass combustion
Ozone	Industry and traffic
Benzene	Industry and traffic
Lead	Industry and traffic

In addition to pollutant monitoring, a range of meteorological parameters are measured. These are indicated in Table 2

Table 2: Meteorological Parameters Measured.

Met. Parameter	Measure of
Wind speed	State of ventilation/ atmospheric turbulence
Wind direction	Direction of pollutant transport
Net solar radiation and Vertical temperature gradient	Energy flux, stability of atmosphere
Humidity and rainfall	Washout effects and weather
Ambient temperature	Temperature and temperature developement
Barometric pressure	Broader weather patterns

Location of Air Quality Monitoring Stations

The 14 stations are sited according areas of representativity. These are industrial, hotspot, traffic, urban regional, residential and background.

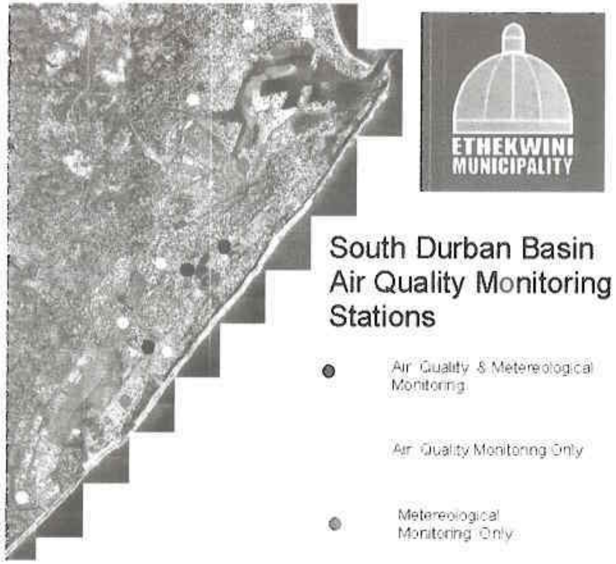


Figure 2: Location of Air Quality Monitoring Stations.

Note two out lying stations at Alverstone and Ferndale are not shown on this map due to scale.

The reader is invited to visit our air quality information site. The address for the site is:
www2.nilu.no/airquality/

Annual air quality reports have been generated since 2004.

A short summary of tends are presented below. The indicator with most information and that have been studied for a long time is SO_2. Generally there has been a 45 % reduction in SO_2 emissions from various sources in eThekwini from 1997-2006 .The trend in SO_2 concentrations from 1997 to 2006 is shown in Figure 3 . This figure show that there have been a significant reduction on all the different measurement stations in the period from 1999 to 2006. This means that the air quality impact from SO_2 have decreased dramatically in these years. There are however exceedance of the legislation for short term averages, this is located to the SDB.

The concentration of SO_2 is highest in the industrialised areas where emissions of SO_2 are highest (the Refinery corridor Engen, Sapref and Mondi, Mobeni and Jacobs).

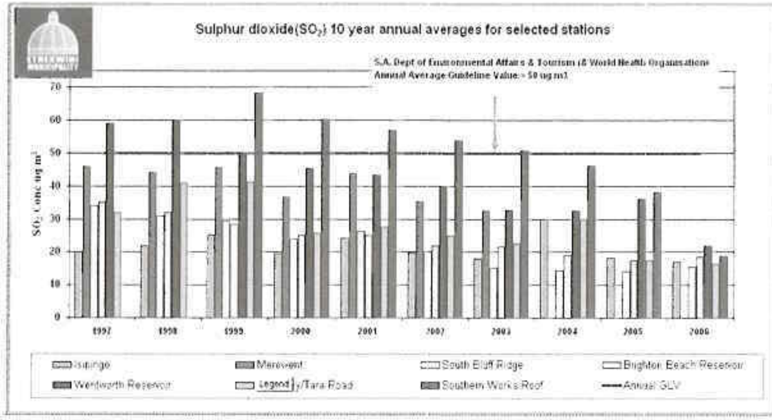


Figure 3: Ten year trend in annual average SO_2- concentration at key stations.

Sampling based on SO_2 bubbler methodology

Particulate matter tends to follow a regional scale and therefore some of the emissions causing the problem is located outside the municipality. The sources for PM are industry, sugar cane burning, biomass burning, and most notable emissions from diesel powered trucks, buses and older class of vehicles.

Benzene concentrations tends to dominate in traffic impacted sites (Warwick) and petroleum storage and processing (Island View, Settlers) and mixed land use areas (Isipingo).

Other types of Pollutants

There are a cocktail of chemicals also present in the local atmosphere which at times poses a nuisance effect in terms of odour and toxicity. These effects are more due to the state of abatement technology, operational integrity and housekeeping within the different sectors. Regulatory approaches to these nuisances are integrated into the permitting system and the public complaints management system.

1.6 The emission inventories

Several exercises of emission inventorying have been done in the area. These consists of the following inventories. The first comprehensive emission inventory of the CBD and SDB was ready in the late 1990s. As a reference point using SO_2, in there year 2000, the daily emission for SO_2 was 120 tons per day, of which 113 tons per day was from industrial sources. The original emission inventory was updated as industries reduced emissions due to fuel switching and scrubber installation. The results from these and the inventorying of done under the MMP projects have been used to put together an emission inventory and emission model to estimate the emissions from the SDB area hour by hour from industry, traffic and area sources. The whole emission system is embedded in the AOMS system AirQUIS containing a GIS system for presentation.

Emission Inventory for Sulphur dioxide (SO2) in South Durban Basin

Updated for the Year 2005

Company	Fuels utilised	Consumption rate	Sulphur content	SO_2 emissions (t/day)
Mondi	Coal	168 292 ton/year	0.9 %	3.78
	HFO	7 265 kl/year	3.5 %	0.41
	Sasol Gas	382 431 GJ/year	8 ppm	Nil
Engen	Fuel Gas	390 696 t/year	150 ppm	0.43
	(non-fuel based)			17.91
Sapref	Fuel gas	339 611 ton/year	0.0001 %	2.26
	Fuel oil	8962 ton/year	2.2 %	Nil
	(non-fuel based)			17.82
Heartland Leasing(UOS)	Coal	30 939 ton/year	0.5 %	0.72
Associated Additives	Paraffin	292 kl/year	0.06 %	0.004
Tongaat Hulett	Coal	108 000 ton/year	1.2 %	6.02
Illovo Sugar	Coal	28527 ton/year	0.6 %	0.49
Tiger Brands	Coal	5 306 ton/year	0.37 %	0.11
	Heavy fuel oil	147 ton/year	3.5 %	0.069
Chemical Initiatives	(non-fuel based)			0.88
Ineos Silicas	Coal tar fuel	6000 ton/year	0.6 %	0.018
	20/20 medium fuel oil	36 ton/year	0.492 %	0.001
Frame Textile Corporation	HFO	3 804 ton/year	3.5 %	0.36
Sub- total				52.12
Other industrial area sources				8.73
Total				**60.77**

Further work to be undertaken on the emission inventory

The emissions referred to above focus essentially on SO_2-emissions in the SDB. While activities in the SDB account for most of the SO_2-emissions, there is a need to look at other sources in the eThekwini Municipality. The emission of NO_x is also underrepresented as traffic is also a significant contributor. This needs to be updated. The same applies to particulate matter (PM_{10}) and VOCs.

The following list outlines the additional work to be undertaken:

- Emissions of SO_2 need to be updated for the whole of the eThekwini Municipality
- Emissions NO_x needs to be updated for traffic emissions
- Domestic emissions and emissions from small industrial enterprises

- Emissions of PM_{10} needs to be accounted for by the various sources: industry, traffic, biomass and background
- Island view emissions from handling of goods and storage

1.7 Special studies and screening studies

As part of the Multi-point Plan strategy to address air quality issues in the South Durban Basin, there is a focused strategy to look at the spatial patterns of pollutants such as SO_2 and NO_x and to investigate the management of toxic pollutants, in particular volatile organic compounds (VOCs) and fugitive emissions like benzene and hydrogen sulphide.

Measurement campaigns and screening studies SO_2, NO_x, H_2S, and BTEX.

Before the continuous monitoring network was established, a special passive screening study was conducted for SO_2 and NO_x during November 2002. The screening study results showed the elevated concentrations of SO_2 to be in the refinery-paper mill corridor and that concentrations for NO_x were dominant in the traffic corridors. Refer to Figure 4-Figure 7.

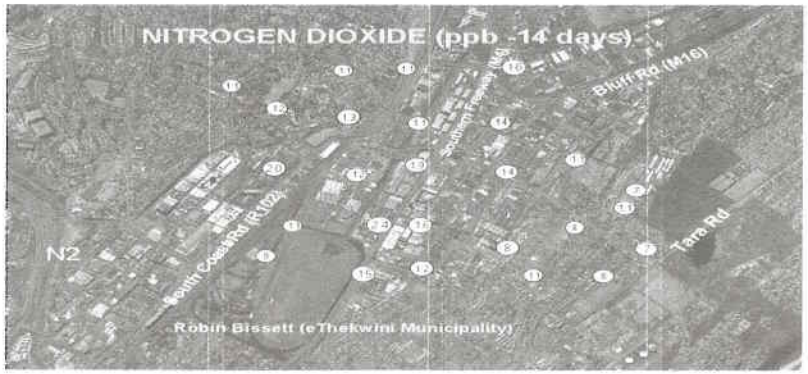


Figure 4: Spatial results of passive survey for NO_2, November 2002in the traffic corridor.

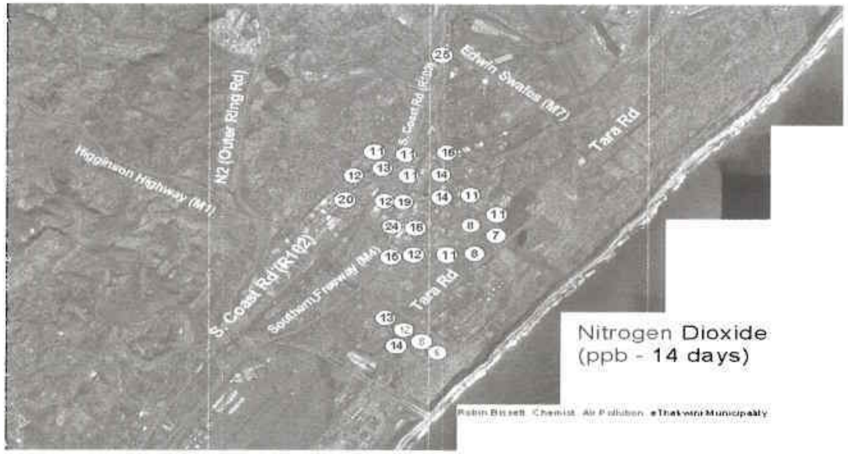


Figure 5: Spatial results of passive survey for NO_2, November 2002 in the refinery corridor.

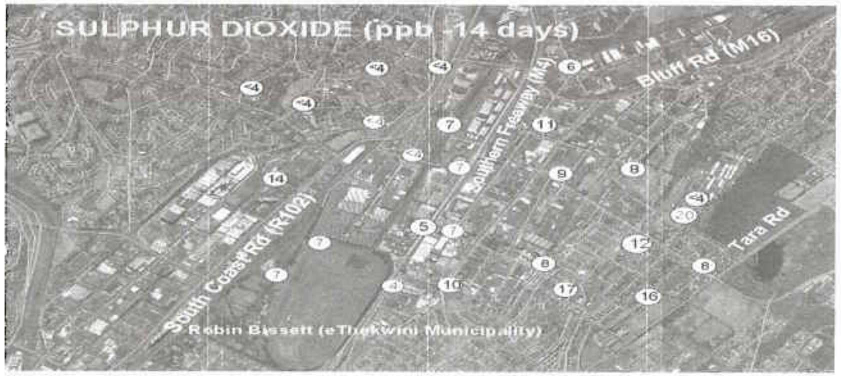


Figure 6: Spatial results of passive survey for SO_2, November 2002 in the refinery corridor.

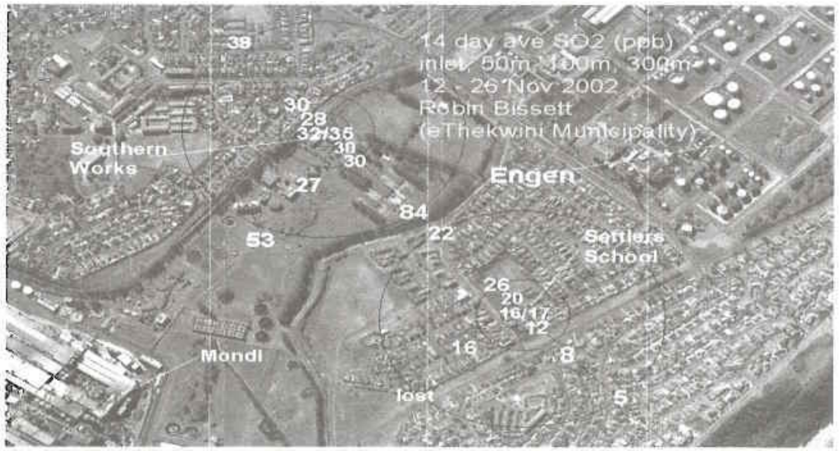


Figure 7: Spatial results of passive survey for SO_2, November 2002 in the Jacobs and Clairwood corridor.

Screening study for volatile organic compounds (VOCs)

In pursuance of the MPP objective to investigate volatile emissions it was first necessary to identify spatial dominance of VOC concentrations in the form of benzene, ethyl benzene, toluene and xylene (BTEX). The key elements of this strategy involved:

- Identification of key source contributors to VOC emissions
- The specific focus on VOCs was limited to benzene, toluene, ethyl benzene and xylene (BTEX) as these compounds are priority toxics and have established guideline values
- Establishing areas where concentrations are likely to be high
- Undertaking of a VOC screening study
- Identification of major VOC sources in the South Durban Area
- Planning for a BTEX passive sampling study (Refer to Figure 8 and 9)
- Deployment of regular BTEX sampling programme
- Capacity building and information exchange
- Special modifications to the permitting process

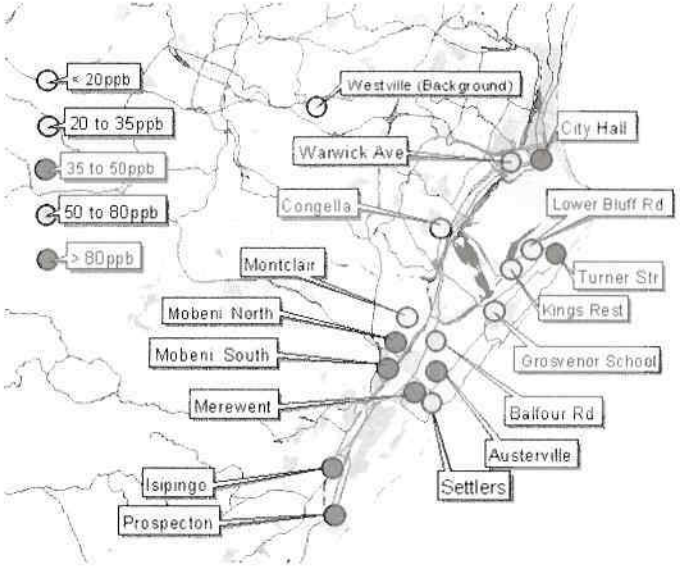


Figure 8: Results of a 2 week BTEX sampling study, August 2003.

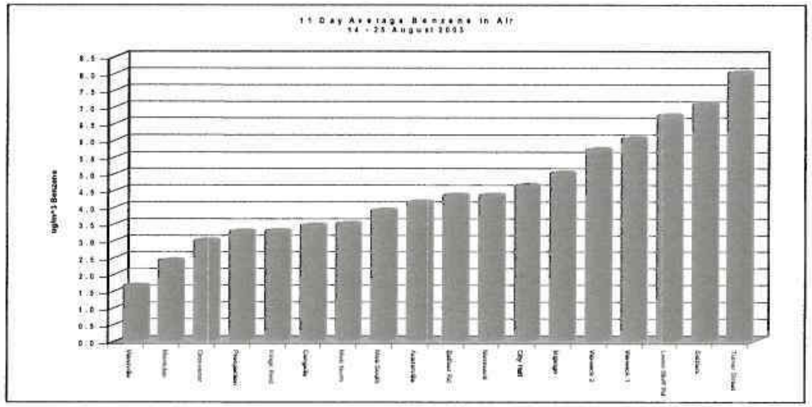


Figure 9: Graphical results of benzene concentration, 2 week sampling study, August 2003.

Screening study for hydrogen sulphide

Some of the compounds contributing to odors in the SDB relate to reduced sulphides such as hydrogen sulphide and mercaptons. The continuous measurement for these compounds is total reduced sulphides (TRS). Correlation between hydrogen sulphide and TRS showed that hydrogen sulphide make up about 60

% of TRS. Based on this relationship a passive survey using Radiello samplers for H_2S was undertaken in the SDB. The obvious sources such as the Soiuthern wastewater treatment works, Mondi and the refineries were focused on. The map of the study area for the screening study for hydrogen sulphide is shown in Figure 10, the results for the two week passive sampling exercise is depicted in Figure 11 and also represented as a pollution rose in Figure 12.

Figure 10: Measurement points for hydrogen sulphide passive sampling.

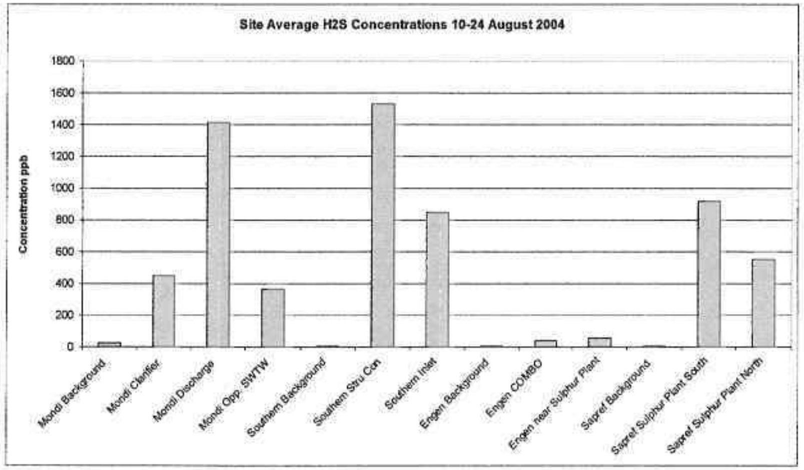


Figure 11: Results of the 2 week passive sampling study for hydrogen sulphide.

Figure 12: Pollution rose for TRS with data from continuous analysers.

1.8 The Health study for eThekwini

The objective of the health study undertaken under the MPP was to describe the prevalence of chronic respiratory symptoms and conditions, including asthma, among children at selected schools in an area with large scale industrial activity, compared with suitable populations in the metropolitan area with presumed lower pollution.

The study was conducted among seven communities in two geographic regions of the a large metropolitan city in South Africa: the southern communities, located within a highly industrialised area were compared to the northern communities. In each of these communities, a single primary school was selected according to specific criteria. At these schools, all the students from within one or two randomly selected grade four classrooms (Type A classrooms), together with all those from grades 3-5 (Type B classrooms), identified through a screening questionnaire as being persistent asthmatics, were invited to participate in the study. Standardised interviews of child participants and their caregivers were conducted, together with baseline spirometry, methacholine challenge testing and skin prick testing for common aero-allergens. At each of the schools key conventional pollutants, including particulate matter (10 microns in diameter), sulphur dioxide, oxides of nitrogen and carbon monoxide were monitored over a period of a year.

The prevalence of reported symptoms consistent with persistent asthma was 32%, of whom 4% was of marked severity. Over 25% were reported to have had symptoms of wheezing, with 10.4% reporting an attack of wheezing, and 3.8% having had to be hospitalised.. Predicted prevalence of symptom-defined persistent asthma, adjusted for age, gender, race, caregiver education, and annual household income, was higher among schools in the south (12.2 vs. 9.6 %). Marked airway hyper-reactivity was substantially more elevated among schools in the south as compared to schools in the north (8.0 vs. 2.8 %). Living in south Durban presented a statistically significantly higher risk for the presence of persistent asthma (Odds Ratio=1.82) and bronchial hyper responsiveness (Odds Ratio=2.55).

The health study concluded that prevalence of symptoms defined asthma and non-specific bronchial hyper responsiveness that are at the higher end of the ranges described in the published

literature. Substantial differences in the prevalence of grades of asthma and bronchial hyper responsiveness were found between populations of schoolchildren from industrially exposed and non-exposed communities. The findings are strongly suggestive of industrial pollution having a negative impact on the respiratory health of these schoolchildren.

1.9 The major plan tool

eThekwini have several units that binds into the planning that effects air quality in the municipality. This means that the planning of the air quality involves many governmental institutions and many stakeholders both from private enterprises, organizations and individuals. To make the Air Quality management plan work all these persons will have to participate and buy into the process.

1.10 The concept of the Air Quality Management System (AQMS)

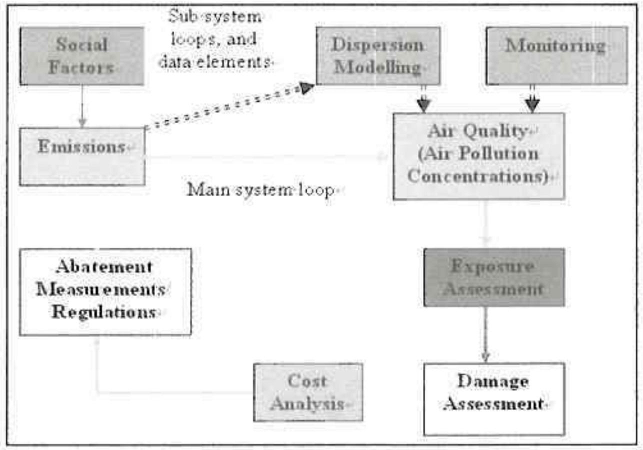


Figure 13:The illustration concept for the air quality control based on the analysis of the cost.

The modern Air Quality Management System has made it possible to combine latest monitoring technique with information technique, data collecting, the development and application of the data bank, quality control, statistic, model calculation and the data handling. It can also illustrate and announce the results of the data and model calculations. It can be used to process the evaluation for the air quality, the evaluation of effects on the environment, the evaluation for the individual abatements that is proposed, the measures for control and reduction, the analysis of the best control strategy of the air quality. The AQMS will give the framework that needs to be used to get to a scientifically and practical analysis of the Air Quality.

Figure 13 shows the concept for the air quality control based on the analysis of the cost as well as the relations between the various functional models used for the study of the air quality control strategy. This kinds of relations and construction are the frame work used in the AirQUIS system for this project and they are also the technical methods used in the project.

The AQMS include the collection the very detailed data about the emission of pollution source, about the geographical locations, about the conditions for the air quality, about the weather, the establishment of the dispersion model. The modelled distribution of concentrations the modelled effects of the abatement actions together with the estimates of cost effectiveness will provide a tool to support the decision making.

1.10.1 The major plan tool: AirQUIS

AirQUIS 2003 (Air Quality Information System), developed by Norwegian Institute for Air Research (NILU), is a software system with multiple functions to be used in the air pollution control. The main goal of building up a modern system platform as AirQUIS, which can be used in the environmental monitoring and implementation plan, is to realize the direct transmission and application of data and information, telecommuting of the data collection and quality control and effective determination of the implementation for the pollution control.

This system is designed as an integrated system with multiple functions including environmental monitoring, data collection and transmission, emission modelling, modelling of wind patterns, dispersion modelling and exposure modelling. The system can analyse historical situations as well as the current situation. The system can also be used as a forecasting system if meteorological forecasts exist. The system can also be used for analysis of future emission scenarios for planning purposes, by manipulation emissions. The GIS system platform enables the users to collect and use these information very conveniently, and it is easy to operate the data transmission system.

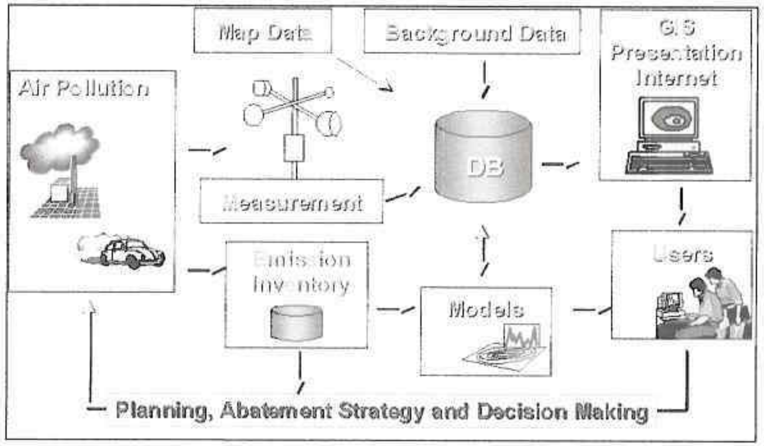


Figure 14: The diagram of the construction of the AirQUIS.

2 Goals and objectives of the eThekwini Air Quality Management Plan

2.1 The goal of the Air Quality Management Plan

The goals for the environmental quality can been divided into three categories for improving the air quality of in eThekwini. These are:

The first short term goals cover plans already developed and implementation of these action plans to improve air quality. These plans give the roadmap to achieve compliance with the laws and by-laws currently in place. Where there is lack of problem identification, then a plan to identify and quantify this will be made.

The next category involves more long term goals involving more indicators not included in the legislation. Where the air quality falls within current legislation but out of other reasons it is desirable further lower the exposure limit or the legislation does not cover the pollutant.

The next is to make sure that the environmental management is strengthened and that the angle of air quality is covered for the other processes such as area planning, planning of industrial emissions and emissions from traffic, in such a way as to avoid problems in the future.

2.2 The near-future goals for environmental quality

The near-future goals for environmental quality is that :

- The air quality of the urban areas conforms to the standards set out in AQA
- Document that the air quality conforms to the standards
- Provide possible abatement strategies and possibilities for implementation of these abatement strategies, when the pollution does not conform with the standards set out in AQA
- Assess and document problems/problem areas for the population as such and the environment in general such as
    - To solve the SO_2 problem in SDB
    - Quantify and understand the BTEX and VOC problem
    - To establish the pollution impact of flaring from refineries
    - To establish the pollution impact from the Jacobs industrial complex
    - To establish the extent of indoor air pollution in informal settlements using fossil fuels (paraffin, wood and coal)
    - To characterise the sources contributing towards PM_{10}
    - To establish various point and non point sources contributing towards odour nuisance

2.3 The long-term goals for environmental quality

The more longer term goals will be to quantify the levels of concentrations in the air of other types of pollutants that is not covered in the short term goals and ensure that the population on eThekwini have a healthy air quality that causes minimum effects to human health and to the environment. This means that potential problems have been quantified and that plans to reduce the effects have been made and implemented. Some of the problems that needs to be investigated are listed below:

- Pesticides
- Dioxins
- BTEX
- POPs
- Heavy metals
- Particulates less than PM_{10}
- "New pollutants"

2.4 Modernization of environment management

Environmental planning is crosscutting in the different areas of administration. This means that to include this into the planning process a administrative system have to be established. This is done for large planning structures such as the moving of eThekwini international airport. This is also taken care of in the EIA structure for new activities. These structures are already in place in South Africa and thereby in eThekwini. This process is however strongly dependent on the participation of the different stakeholders and that the process is run properly. This is dependent on skills and information on the system in the different structures in government and society as such. The goal is to ensure that the planning procedures in eThekwini includes air quality and that the planning process is good enough to avoid air quality problems in the future.

2.5 The special characteristics of the industrial distribution

EThekwini can be classified into different areas, The north where the industry and the population nuclei are separated. The Central Business District where the main activities with emissions to air are road traffic. In South Durban Basin (SBD) industrial sources are dominating and the population is living close to the sources and therefore have a high exposure to air pollution. The main large emissions are located to the two refineries, Mondi, and Tongaat. These are all located in the SDB. The harbour activities are also connected to the SDB and have significant emissions with different characteristics than the main industries. In addition to this the Southern works waste water treatment plant is located in the centre of SDB. The different areas of eThekwini must therefore be treated differently.

2.6 The industrial distribution

The main industrial nucleus is in SDB this contains the large refineries, Tongaat and Mondi. In addition to this a variety of medium size and small industries are located in various areas. The Southern works waste water treatment plant also have emissions to air. One such area where the industrial density is high is Jacobs. The Jacobs area is analysed separately to understand the dynamics of such a complex air quality problem.

3 Approach and overall strategy for the eThekwini AQMP

The main goal is that the air quality management plan shall have an impact on the air quality in eThekwini. This will be achieved by an integrated approach. This includes the following building blocks:

1. An integrated air quality management system
2. Partnership with stakeholders
3. An active information dissemination strategy, containing push and pull possibilities, such as the internet, SMS, e-mail, reports, presentations, news bulletins.
4. An approach to Air quality management based upon health aspects and criteria
5. The AQMP will provide an air quality management strategy, the strategy will provide and action plan and the action plan will provide possible actions to reach the objectives and goals. The action plans will contain different solutions and the multi stakeholder group will decide on the way forward.

3.1 Integrated Air quality management system

The approach for AQ Management in eThekwini is an integrated approach where AQ Management is based upon:

- an integrated model for assessing and managing the air quality,
- by utilising information and data from many activities, such as air pollution monitoring, data on emissions, dispersion modelling based upon appropriate meteorological and relevant data, assessment of the exposure to air pollutants of the population, ecosystems, materials.
- such as listing and evaluation of control options and abatement measures,
- and considering the cost effectiveness of introducing control and abatement by comparing control costs with the reduction potential for the measure in terms of air pollution concentrations and exposure of the population, ecosystems, materials.

3.2 Partnership with stakeholders

To establish the partnership with the stake holders the flow of information (pull and push, infrastructure) to the stakeholder is important, but the partnership involves participation and dedication from the stakeholders to put the strategies and solutions into life. This will be done through possibilities of the stakeholders to put forward their views and influence the decisions. This means that a process where the possibilities are discussed and put out for comments and that the comments are treated professionally and documented for the sake of the information flow and understanding of the problem discussed

To take the Air Quality management strategy and plan into actions the buy in of the stakeholders is crucial. This means that a variety of organizations and individuals both in government, communities and industry must be active to get a good result.

The main active partners will be:

Government: Pollution control support, environmental health practioners and their management and environmental, planning and transport branches. Other spheres of government will be involved depending on the scale of the problem. When it is a matter of national legislation of setting or tightening of the standard the Provincial or National department will be involved.

Industry: All relevant industry targeted for intervention. This will be sector based on specific issues and broad based on general air quality problems.

Community: All affected parties close to the problem including organised formations of civil society, relevant CBOs and NGOs, labour, local ward councillor, ward committees and the media.

3.3 An active information dissemination strategy, using the internet (etc., such as active dissemination methods to persons, using SMS, e-mail,…. ('push' methods)

The strategy involves many stakeholders and that they work together towards a common goal. This means that the flow of information should be one of the main activities. This means that the identified stakeholders and others that is interested in getting information should have this readily available. There should be different information channels that the stakeholders could choose from. This should be possible to subscribe to different services according to interest and needs. The information should contain both pull and push services.

3.4 An approach to Air quality management based upon health aspects and criteria

Exposure to air pollution will affect the health of the persons exposed. Through the dispersion modelling exposure estimates are to be made. These exposure over specified levels can be made in different ways. As a personal dosage where a person accumulates a dose according to where this person is at all times, or as a general dose for all the persons in areas with an exposure over the specified level. This dose (exposure times time) can be linked to health effects through dose response functions. These dose response functions are available internationally, they will however not be specially designed from the population in eThekwini. These international dose response functions will be applied to the exposure estimates and the effects on health will be estimated. This will be expressed as number of days of hospitalization, number of sick days, and number of pre mature deaths. From this an cost estimate will be made. The dose response functions used are for the following pollutants such as: SO2, NO_2 and PM_{10}.

In addition to the exposure of these pollutants there are other types of pollutants present in the air in eThekwini. This means that the estimate that is produced through the parameters above is an under estimation.

5.7 Exposure models

The spatial resolution possible in the model calculations is rather high. The built-in dispersion model system is typically run on a 1 km-size grid system.

However, the sub grid models incorporated in the system, calculation of dispersion from point sources and streets, allow for calculation of concentrations in freely specified "receptor points", allowing a resolution of 10 meters or better. Thus, concentrations can be, and typically are, calculated e.g. at individual houses/residences. The accuracy of the calculated concentration values is subject to the accuracy of a number of parameters: emission data, wind field and dispersion parameters, model inaccuracies, etc., as is typical for all such model calculations. The time resolution is typically 1 hour.

Population exposure

The AirQUIS models enable estimates of population exposure to air pollutants. The indoor pollution module is being planned but is still not incorporated in AirQUIS. The input for performing exposure indoors will require data on indoor/outdoor ratio and indoor sources. Techniques for estimating indoor concentrations may also be implemented.

The micro environment approach used by NILU in epidemiological studies has not been implemented in AirQUIS. Thus, the population exposure calculated is a "potential" exposure, related to the place in the city where each individual spends most of his time. A possibility to develop this towards better exposure estimates is to define population groups of individuals with similar patterns of daily movements.

AirQUIS has been used extensively to calculate potential population exposure distributions in Oslo. Calculations have been carried out for NO_2, PM_{10} and benzene. The model is run on an hourly basis for entire years, and statistics then calculated to give, for example, the number of people potentially exposed to exceedance of AQ limit values at their home address.

6 Air Pollution damage assessment

6.1 Structure, tasks, phases and time line

The process of developing the AQMP began soon after the promulgation of the National Air Quality Act of 2004. Contents of air quality management plans (Chapter 16 of AQA) must cover plans to improve air quality;

to identify and reduce the negative impact on human health and the environment of poor air quality

to address the effects of emissions from the use of fossil fuels;

to address the effects of emissions from industrial sources and to give effect to best practice in air quality management;

The process of assessing the present air pollution problems began with the implementation of the MPP (2000). Through the directives of the MPP and the process of monitoring and measuring air quality, there has been a 45 % reduction in sulphur dioxide emissions. This was largely attained via fuel switching measures.

The current air quality data set provides the technical basis for next cycle of intervention. This is largely confined to management of residual sulphur dioxide emissions that are causing short term ambient concentration exceedances. Through a process of initiating the development of the need for

a structured approach to an AQMP during November 2005, government, community and industry stakeholders have prioritized a range of air pollution issues to focus on. These have been informed by their local knowledge and experiences such as odors and visual impacts to assessment of air quality data sets.

Phase 1: Prioritized areas for intervention

The current Phase 1 shall consider already obviously needed abatement actions, which are feasible. The tasks will cover the following areas of priority

- Sulphur dioxide
- PM_{10}
- Flaring from refineries
- Odors (from wastewater treatment plants and industrial formation such as Jacobs)
- Benzene (VOCs)
- Indoor air quality with an initial focus on informal settlements in the eThekwini Municipality
- The Jacobs area

Phase 2: Comprehensive Plan of Action

This phase will generate a fully elaborated plan involving stepwise activities to analyse the data, develop source contributions, exposure determination, development of control options and abatement strategies, cost benefit analysis and a prioritised set of actions.

The actions will be put up against a realistic time for implementation.

Phase 3: An Air Quality Master Plan

The report will document the assessments of present and future air pollution, and presenting the prioritized actions needed to obtain an acceptable air quality within a given time frame, based upon cost analysis.

The present assessment will be informed by the work in Phase 1 and 2 under the existing development scenario. The assessment work will initially focus on the South Durban Basin. and City centre and over time will extend to another areas of priority in the eThekwini Municipality.

The future air pollution potential will be informed by natural growth and by specific development projects such as Dube Trade Port (North), Development in the West (Hammarsdale and cato Ridge)

The Timeline

The AQM Plan has main Tasks and phases. The main Tasks of Phase 1 (present project) will cover the following:

- ***Task 1*** Specify the goals and objectives
- ***Task 2*** Documentation of Air Pollution problems
- ***Task 3*** Abatement (control) options
- ***Task 4*** The AQ Management Plan specification
- ***Task 5*** Workshops and Seminars for AQMP presentation and discussion
- ***Task 6*** Set up the Framework for the contents of the Master Plan

Stakeholder Involvement

The initial round of stakeholder involvement in November 2005 was to highlight the prioritised air pollution problems that needed to be addressed in the AQMP. The goals and objectives were also specified at this point. Task groups within eThekwini Health were formed to investigate the prioritised air pollution problem areas (SO_2, PM_{10}, benzene, odours etc.) The documentation of the problems was shared at a second round of stakeholder engagement in May 2006. During this period the conceptual process of rolling out the AQMP was elaborated and potential abatement scenarios were explored.

7 Assessment of the present Air Pollution in eThekwini, Phase 1

The Multi Point Plan and the monitoring network for SDB together with the complaint register at the eThekwini health department have established an overview of the air quality situation in the area. The following 7 problem areas have been identified under the different initiatives:

- SO_2 concentrations
- Concentrations of VOC including benzene
- Indoor air quality
- Flaring
- Odours
- Problem area of Jacobs
- Particulate matter

Each of these problems are described in more detail in the following text.

7.1 VOC (Benzene)

Objective

Find and characterize the main sources for benzene in the eThekwini Municipality.

What is the nature/character of the problem?

The annual averages of benzene for year 2004 and 2005 shows that benzene are below the world health organisation guideline value of 10 $\mu g/m^3$ in all sites, but most sites are above the world health

organisation 2010 target of 5 $\mu g/m^3$, (refer to Figure 1). WHO states that no level of exposure of benzene is safe but target limits have been put forward. This means that although the recorded concentrations are in compliance with the WHO guidlines, intervention is needed to address the potential effects on health in the future (2010). There are no guidelines for the other VOC concentrations in South Africa.

Measurements in SDB show that the annual averages of benzene for year 2004 and 2005 are below the guideline of 10 $\mu g/m^3$ in all sites. Most sites are above the target of 5 $\mu g/m^3$. There is no safe limit for benzene and further work is needed to get the concentrations down. The WHO guideline is also likely to be lowered in the future to 5 $\mu g/m^3$ and internationally this might be lowered to 1 $\mu g/m^3$. Because the time resolution of the data is as weekly averages the sources of benzene are not easily identified. From international studies and experience there are several hot spots for benzene. These are filling stations for cars and trucks, industrial complexes that have benzene as part of their process, and along roads. The emission from cars is strongly dependent on the amount of volatile compounds that the petrol contains. The emissions from cars have two sources, evaporation from the petrol tank and tail pipe emissions. The evaporation from the petrol tank increases when the temperature is high and with the content of volatile organic compounds in the petrol. The effects of benzene is long term and therefore the long term average is used to quantify the problem.

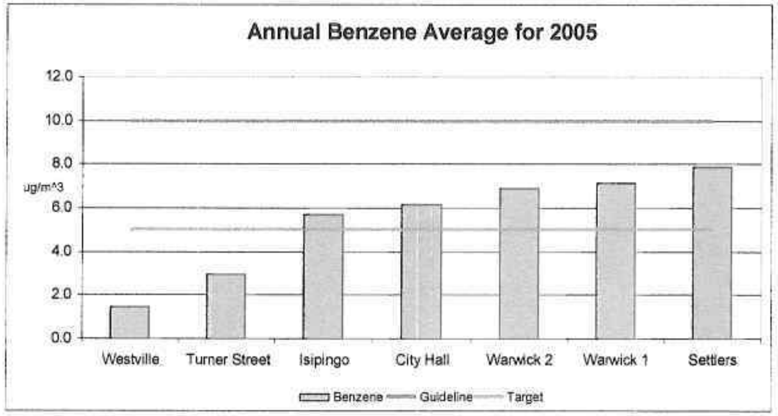


Figure 28: Annual benzene average for 2005.

Potential sources of benzene

The typical sources for benzene are crude tanker off-loading zones, oil refinery, vehicular tailpipe emissions, evaporation from petroleum storage tanks, solvent processing industry, paint manufacturers, petrol stations and from tankers transporting the petrol. Volatile hydrocarbons will also evaporate from the tank of the car.

Major sources of VOC and benzene in the South Durban Basin are the refineries, the Island view tank farms and petrol stations. Because of the relative high temperature especially in summer the evaporation from the tank of cars are also considered a major source of exposure of benzene.

Location of hotspots

In general potential hotspots are located close to the above-mentioned sources. This means close to the refineries, gas stations, premises that handle products that contain benzene and close to activities involving a high density of traffic. The following hotspots are identified and measurements of VOC and benzene have been carried out. This is not meant to be a full list and with more knowledge the list will probably change.

1. Island View (Tank farms/harbour activity)
2. Settlers School (refineries)
3. Busy Road Intersection (Warwick Junction)(traffic)
4. Isipingo (small industries/traffic)
5. Jacobs(industry/traffic)

In the above areas the major sources of volatile organic compounds are known, and the challenge that the municipality face is in the apportioning of the contribution from the various sources. A possibility of making this apportionment can be done by measuring the different concentration profiles from the different sources and by doing so identifying the contribution from one source using these profiles. An emission inventory for VOC for the area have been carried out these show that gasoline cars have the highest emissions with 15 085-ton pr annum. The refineries are next with 4441 at Sapref and 3291 at Engen. The Island View tank farms have approximately the same amount as Engen. The main emission estimates from 2004 are given in table 1.

When estimating the contribution to the concentrations car traffic will have high concentrations close to the road. The concentrations are however expected to be highest close to the refineries and the tank farms because the emissions are concentrated to a smaller area. The traffic is distributed more evenly through the area and hotspots are therefore expected to be lower.

By studying the benzene annual averages it clearly shown that traffic is the main source. When comparing the benzene with the current guidelines, it is noted that Settler's School and Warwick junction are the areas that need special attention. The main sources for Settler's school are the refineries, and at Warwick junction is traffic. There are other places in eThekwini that probably have the same traffic density and similar activities these places should be identified and the concentration of benzene quantified. The annual average benzene results show that almost all areas are above the 5 $\mu g/m^3$ level but below the 10 $\mu g/m^3$ level. The following table shows the major emitters of volatile organic compounds in the above areas.

Table 3:Table 1: Major sources of VOC emissions in eThekwini, 2004 data. Unit: t/y.

SOURCE	VOC EMISSIONS (t/y)	% OF TOTAL	CUMULATIV E %
1. Gasoline vehicles	**15085**	**48**	**48**
2. Sapref	**4441**	**14.1**	**62.1**
3. Engen	**3291**	**10.5**	**72.7**
4. Island View Tank Farm	**3284**	**10.5**	**83.1**
5. NCP Isipingo	**1630**	**5.2**	**88.3**
6. Diesel vehicles	**1304**	**4.2**	**92.5**
7. Service stations	**783**	**2.5**	**95**
8. Bevcan	**398**	**1.3**	**96.2**
9. Ships	**339**	**1.1**	**97.3**
10.Plascon	**292**	**.9**	**98.2**
11. Divpac	**215**	**0.7**	**98.9**
12. Cray Valley Products	**72**	**0.2**	**99.1**

Next course of action

To be able to get a good grip with the emissions of benzene a emission inventory is needed as input to dispersion modeling. This can be used to look at the general concentrations in the area. The hot spot areas must have measurements to verify the concentration level. The first approach is to find emission factors for benzene and run this through the emission model of AirQUIS. This will give an estimate for emissions from traffic. These industrial emissions can be done through an evaluation of the VOC emissions that have been done in 2004. For the evaporation of car tanks a temperature dependent emission factors are available. From the amount of gasoline handled, emissions from filling stations can be obtained. This will give enough information for the dispersion model to give an estimate for the annual average concentration and en estimate of the exposure of the population.

Then a rough exposure estimate can be developed for each source and an abatement strategy can be developed.

Possible abatements

- Vapor recovery for tankers that fill gas stations
- Lower the volatile content in the petrol
- Vapor recovery for tankers that is on loading or loading goods (harbor area)
- Increased maintenance of cars
- Increased and enforced emission limits for cars and trucks
- Better sealing of floating roof tanks

7.2 Sulphur dioxide

Objective

To comply with the legislated concentrations of SO_2 in the eThekwini Municipality.

Background to SO_2 concentrations and exceedances

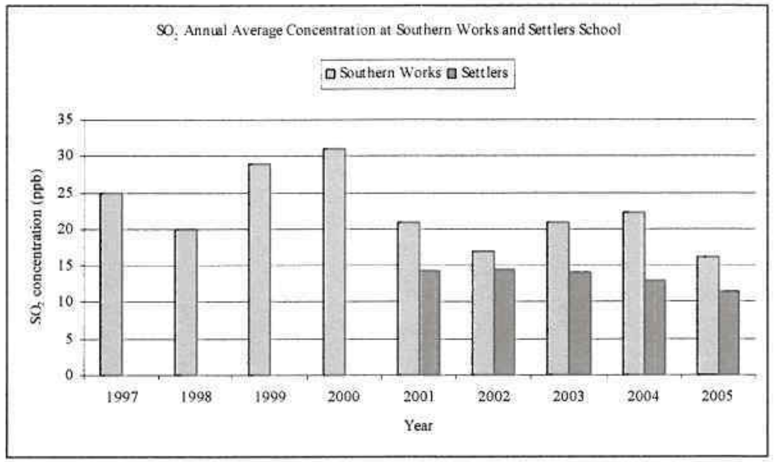
Continuous SO_2 measurements are performed at nine locations, mostly in and around South Durban. All monitors have USEPA designations as reference methods for the measurement of SO_2. The hot spot stations are Southern Works, Wentworth and Settlers, located in the vicinity of the refineries and Mondi. Over the last ten years there has been a year to year reduction in concentrations largely due replacing high sulphur heavy fuel oil with gas at the refineries, installation of the SO_2 scrubber at Mondi and substitution of coal with Sasol gas at some industries. Southern Works has made the transition to achieving compliance in 2005 with respect to the annual limit value of 19 ppb. The low value of 1.8 ppb measured at Ferndale is indicative of the absence of large scale industrial activity in the northern areas of the municipality.

Southern Works also recorded the highest number of daily exceedances of 14 compared to the 34 that were recorded for 2004. The overall picture with respect to SO_2 exceedances looks positive, with a 54% total reduction in the number of 10-minute exceedances and a 56% total reduction in the number of daily exceedances from 2004 to 2005. Table 4 reports the number of 10-minute exceedances and number of daily exceedances for 2005.

Table 4: SO_2 number of exceedances for 2005.

Station Name	10-minute exceedances	24-hour exceedances
Prospecton	0	0
Southern Works	240	14
Settlers	170	8
Ganges	0	0
Grosvenor	3	0
Wentworth	48	2
Balfour	6	0
Ferndale	0	0
TOTAL	**467**	**24**

Figure 29 shows the concentration of sulphur dioxide using continuous measurement at Southern works and Settlers School.



Southern Works station has been moved to three different locations.
SSW1-(1997-1998)
SSW2-(1999-2003)
SSW3-(2004-2005)

Figure 29: SO_2 Annual Average Concentration at Southern Works and Settlers School.

The bubbler network allows SO_2 to be measured using a less sophisticated method than continuous monitors, but at a substantially lower cost. The bubbler network is located over a vast area in the eThekwini Municipality. Bubbler stations are not just located in South Durban, but also in the North and West. It is clear from the results of monitoring that the highest recorded SO_2 concentrations are in the South Durban area. This is in line with expectations. Furthermore, all previous exceedances of the SO_2 guideline value of 19 ppb have occurred in South Durban. Figure 30 shows the annual average for sulphur dioxide concentrations measured at various stations based on the bubbler sampling method.

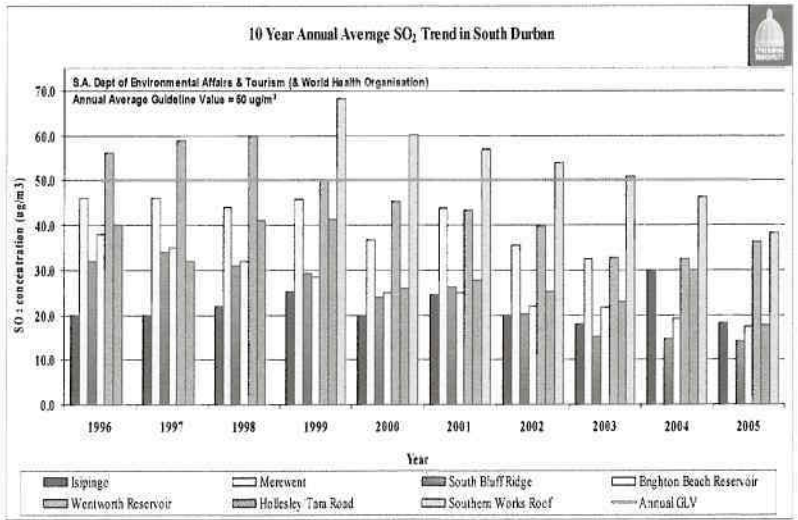


Figure 30: Graph showing long term trends in annual sulphur dioxide concentration using the bubbler sampling method.

Legislation (criteria for evaluation)
The AQMP aims to address the sulphur dioxide pollution problem in the eThekwini Municipality. This is in line with the requirements of Section 15 (2) of the National Environmental Management: Air Quality Act which states that each municipality must include in its integrated development plan an air quality management plan. It is envisaged that this pollutant specific management plan will be incorporated into a larger management plan for the Municipality.

Air pollution is not specifically covered by the bylaws of the eThekwini Municipality, but several sections have been used in the past to address air pollution.

The Atmospheric Pollution Prevention Act (APPA) has for years represented national legislation for air quality management in South Africa. The act was recently replaced by the National Environmental Management: Air Quality Act (AQA). It is expected that APPA will only be repealed by the end of 2007 to allow for the phasing in of AQA.

Table 5: Proposed Guideline Values for Sulphur dioxide.

SO_2	Averaging time	Legislation GLV
	10 min	191 ppb
	24 h	48 ppb
	12 months	19 ppb

Effects
Sulphur dioxide is a dense colourless gas. Effects of Acute exposure to sulphur dioxide will cause irritation (burning, stinging, watering) of the eyes, nose, mouth and other parts of the respiratory tract. Extremely high concentrations can cause damage to the respiratory tract or even respiratory paralysis and death. People with asthma or other respiratory allergies are more sensitive to sulphur dioxide.

Location
The sulphur dioxide problem in the eThekwini Municipality is confined primarily to South Durban. This is confirmed primarily by the results of monitoring with the bubbler network. Sulphur dioxide ambient air quality measurements show that the legislation is breached for short time levels such as 24 hour and 10 minutes averages.

Sources
In the eThekwini Municipality, industry has been identified as the major contributor to SO_2 emissions. Point source industries contribute in excess of 96 % (61 t/day) to the total industrial SO_2 emission load in South Durban. The emissions have gone down from industrial sources since 1999. South Durban is still justifiably the focus of attention with respect to SO_2 monitoring and reduction initiatives. The extent of information available on the status of SO_2 emissions outside of South Durban is currently limited. The lower level of heavy industrial activity in the West and North of Durban is substantially less than the South and this points to SO_2 being less of a problem in the North and West. However, this gap in information needs to be addressed in the not too distant future.

Area source industries contribute the remaining 4 % (2.25 t/day) to the total industrial SO_2 emission load in South Durban. An update of the data is needed to incorporate all the many industries that did not fall within the scope of the original study in 2003, including the Northern, Southern and Western areas of the municipality.

Line sources also contribute to SO_2 emissions, but it is at a lower level than point sources.

Future Work
Work need to focus on reducing the ten minute exceedances at Settlers which is primarily due to emissions form the Engen refinery.

There are ongoing ten minute and 24 hour exceedances at Wentworth. The sources here are more complex due to the refinery corrider form the south, the Jacobs-Mobeni industrial corridor form the west and Tongaat Hulett sugar refinery from the north-west as demonstrated the annual SO_2 pollution roses at Wentworth for the year 2005 in Figure 31.

Figure 31: Figure 3. Annual SO_2 pollution roses at Wentworth for the year 2005.

Using modeling to determine the causes for the exceedances and actions to take to resolve the problem.

Determining the sulphur dioxide impact from future development scenarios.

The EThekwini health study reported that the sample school population had a two fold increased chance of persistent asthma in the South than in the North after having accounted for confounding factors. The question that needs to be explored is that what is the extent to which sulphur dioxide emissions must further reduce to have an optimal cost benefit outcome.

Remaining activities

The legislation in South Africa states that the problems should be solved after the polluters pay principle. This means that within certain limits the contribution to exceedances from each industry have to be made. The connection between Emissions and concentrations can only to a limited amount be established through measurements. To establish a direct connection between sources and concentrations a dispersion model evaluated with measurements needs to be established. This model will be able to make estimates on the blame matrix. This must however not be the only source of information.

A workshop should be set up where the contributions from the different emissions should be discussed and agreed upon. This could be divided according to:

1. Emissions
2. Over exposure from models
3. Estimated from statistics (breuer diagrams and exceedances and wind directions)

It is necessary to agree to a set of criteria for the division of funds and how to put forward the blame matrix.

Engage with industry to challenge them on which possibilities they got and the different costs to make these changes.

The SO_2 emission inventory needs updating. The sources that are in the dispersion model is at the moment average emissions. It is reason to believe that some of the exceedances are connected to elevated emissions over a period of time. The modeling exercise will estimate the contributions under average emissions. The measurements on actual emissions. Therefore the variation on emissions should be available as well.

Possible abatements

1. reduction of sulphur in the crude that is used
2. introduction of gas instead of coal as energy source
3. more efficient cleaning devices
4. targeting the sources that have the highest exposure to the population
5. Engen have done an abatement plan for reducing the exceedances at Settlers this plan have to be put forward and the effects of the different abatements quantified.
6. Mondi have to reduce their downtime on the scrubber- reliable backup or switch to gas instead of coal,
7. Ban heavy fuel oil use in the basin
8. Report the impacts from Sapref.
9. Assess the impacts from Tongaat
10. Assess the impact from Jacobs
11. Improve maintenance plans to reduce exceedances
    a. Review of maintenance plans and implementation
    b. Pro active plans
    c. Assess contribution from fugitive emissions and upset conditions in production
12. Review startup and shutdown procedures, and implementation of these.
13. Formation plans for operators to avoid emissions
14. Fines to the municipality for causing exceedances
15. Further improvement on cleaner production and efficiency

7.3 Indoor air pollution in informal settlements

Objective

To minimize the exposure to poor indoor air quality in informal settlements in the eThekwini Municipality.

Definition of the problem

In the eThekwini Municipality there are over 150 000 informal homes that are yet to be formally housed. The time horizon for the housing delivery programme is 5-10 years. A majority of informal households in the urban and peri-urban context use paraffin as an energy source. The review of indoor air pollution and health impacts literature in South Africa confirms that indoor air pollution is a major problem affecting mostly the poverty stricken members of society. The time the population spends inside the house is also long and is therefore important for the exposure. There are informal settlements in every part of eThekwini. The majority is however in the north of the city.

Sources to indoor air pollution

The indoor air pollution will normally not be lower than the concentration in outdoor air. Every type of combustion with outlets to the indoor environment will contribute to the indoor concentrations. In informal settlement the main source is the use of paraffin for cooking and light. The level of emissions from this combustion is strongly dependent on the technology that is used for combustion.

Attributes and effects of poor indoor air quality

- Especially in households using fossil fuels inside the house levels of certain pollutants like particulate matter, oxides of nitrogen and aerosols can be far greater indoors than outdoors,
- Indoor air quality is linked to different health effects, such as acute lower respiratory infections in children less than five years old
- Accounts for a significant proportion of death and illness in developing countries.
- Women and children carry the biggest risks to their health because of the length of time spent in door and the direct exposure from use of energy for cooking.
- Accounts for as much as 4-6% of the burden of diseases in developing countries.
- Solution to poor indoor air quality needs to be resolved as an integrated response to other service delivery challenges such as housing backlog, poor water, poor sanitation and supply of electricity for lighting and heating.
- Majority of households that are not electrified use biomass fuels for cooking and heating.
- Despite electrification, over half the households are still primarily dependent on solid fuels for cooking and heating.

Evaluation criteria

Some preliminary work undertaken by the eThekwini Health Unit during 2006 showed the exposure potential of people living in informal settlements to varying levels of NO_2 levels in indoor air.

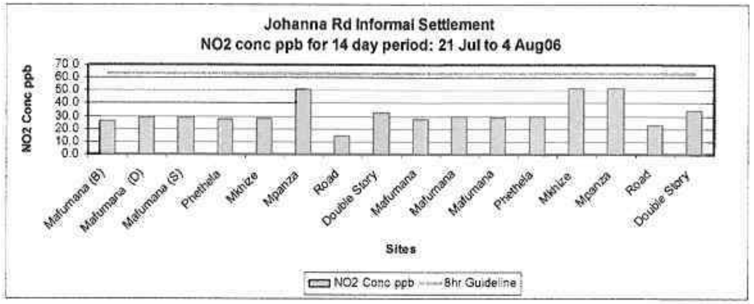


Figure 32: *NO_2 passive survey at Johanna Rd informal settlement.*

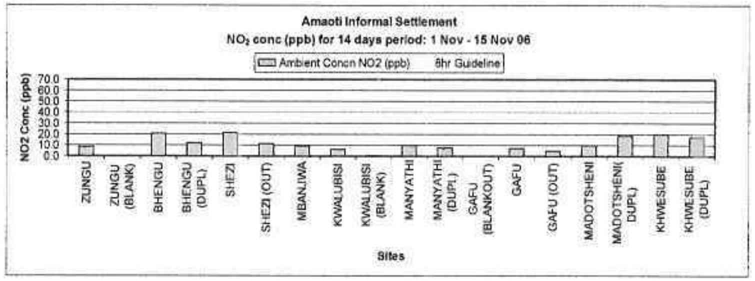


Figure 33: *NO_2 passive survey at Amoati informal settlement.*

The NO_2 passive survey for the Johanna Rd informal settlement in Figure 1 shows 14 day average concentrations close to the limit value of 63 ppb. So it is likely that the 8 hour and 24 hour health based guideline values may be breached on many occasions. The analysis is different for Amoati in Figure 2 which generally shows lower averages that Joanna Rd. There are some differences: The Johanna Rd passive survey was conducted over winter whereas than in Amoati was conducted in summer. Johanna Rd. informal settlement has widespread use of paraffin with typical widespread use of a low pressure inexpensive paraffin stove application as shown in figure 3. . Amaoti informal settlement has mixed energy use: electricity and paraffin.

Figure 34: *Low pressure paraffin stove application in eThekwini.*

Potential sources

Paraffin is primarily used in informal settlements the urban eThekwini area. Wood, crop residue and, charcoal, cow dung and other fuels incl. paraffin are used in the rural areas. High cost and low accessibility of paraffin and liquid petroleum gas (LPG), forces the communities in these areas, to utilise biomass/ fuel wood, as it is a much cheaper and readily available resource.

Existing documentation

Literature review undertaken within the eThekwini Health Department cited the Durban Kerosene study (Ref 1) which showed that at the time seventy percent households in informal areas rely on kerosene for domestic purposes, leading to widespread problems of poor indoor air quality. The study aimed to quantify the health risk for people living in a densely populated informal settlement known as Cato Crest within the eThekwini Municipality. The pollutants investigated included nitrogen dioxide, benzene and toluene. The work showed positive outcomes in terms of exposure to both NO_2 and benzene.

Data gaps

Particulate matter such and PM_{10} and $PM_{2.5}$ needs to be measured including benzene and carbon monoxide. The problem with PM measurement is the need to have electrical power supply. The possibility of using a generator or battery powered samplers needs to be considered.

Establish the current situation in eThekwini

The current situation can be quantified through a screening study with passive samplers and measurements of the emissions for the most used energy.

Research in all sectors, especially energy, is being undertaken by both the government and the private sector. Various types of research projects exist:

- Policy analysis and development – which is the identification of problems requiring policy attention.
- Technology-oriented research – involves the use of applied research methods such as pilot plant investigations
- Demonstration projects – the application of new technologies.

This information should be assessed and information spread to the stakeholders to get maximum impact of the information available.

Change in any society is difficult to achieve, hence there would be a gap in the attempt to change peoples/societies perceptions of the causes, effects and possible solutions to indoor air pollution. The most crucial gap that exists with regard to Indoor Air Pollution and the ordinary man on the street is the lack of adequate knowledge of the impact of Indoor Air Pollution on human health. For years, the excuse for not dealing with indoor air pollution has been that there is not enough evidence. This is no longer the case. Just as it took years of medical research to prove smoking kills, the same is true of indoor air pollution. The number of cancer cases in South Africa has risen and thus medical researchers are making an attempt to find crucial evidence that indoor air pollution is directly related to these medical problems that society faces.

There are uncertainties on the level of exposure hat is causing an adverse effect on health the Air Quality standards and guidelines take care of these uncertainties by applying safety factors. The indoor air pollution needs to be evaluated according to SA or international standards when SA standards are not available.

Possible abatements

- Use of fossil cooking outside, give information to the population on the effects of cooking inside
- Give out information on the effects of the different types of technologies for fossil fuel use

- South Africa as a country in a transition stage lacks the necessary expertise in the research field of indoor air pollution and furthermore, funding in this field is limited as this is a new area of study.
- Encourage chimneys or ventilation to avoid the high concentrations, give advise on the rate of ventilation
- Avoid children in the room that is polluted.

7.4 PM10 – Problem Description

Objective of the study

The objective is to understand the sources and impact of PM_{10} in the eThekwini Municipality

Background information

The analysis of PM_{10} concentration trends across the city shows a regional profile. From the highly industrialised SDB, heavy traffic flow in the city centre to the less developed northern area of Ferndale, PM_{10} concentrations show similar trends. Lisa et al demonstrated that PM_{10} is responsive to a wider synoptic pattern. By studying the arrival of cold front, the prefrontal conditions experienced by coastal town in East London, eThekwini, Richards bay and Maputo demonstrate the regional nature and the concentration generally decrease as the cold front passes through.

The paper also demonstrated that PM_{10} does not correlate well with NO_x suggesting that local traffic activity is not a proportionately large contributor to PM_{10} concentrations and that there may be other sources.

Problem Description

Regional Character
The regional character of PM demonstrates that PM_{10} cannot be solely characterised by localised obvious industry or traffic emissions- that there must be sources beyond the city that is contributing to the background concentrations. The eThekwini Health Study has also confirmed this trend.

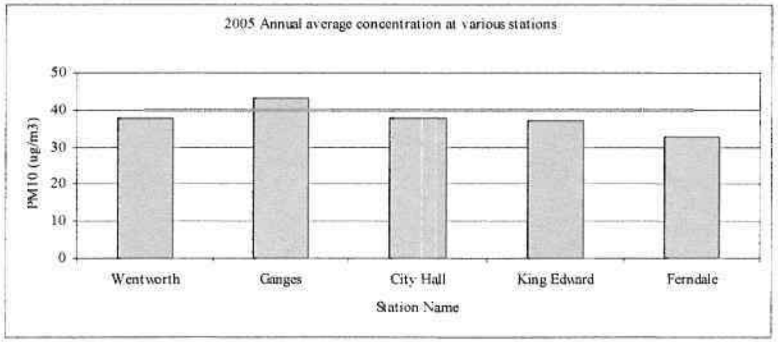


Figure 35: PM_{10} annual average concentration for 2005 at various stations.

Table 6: PM_{10} number of exceedances for 2005.

Station Name	24-hour exceedances
Wentworth	24
Ganges	32
City Hall	17
King Edward	22
Ferndale	8
TOTAL	**103**

Since PM_{10} is a regional pollutant, it may be more appropriate to allocate the number of exceedances to areas of representatives, eg. Traffic impacted sites in the SDB will have the highest, followed by Wentworth which is an urban background site and Ferndale which is characterized at peri-urban devoid of industrial and traffic activity has a relatively lower no. of exceedances. All stations measuring PM_{10} in the monitoring network have exceedances of the 24 hour standard. The traffic station Ganges also exceeds the annual average standard.

Seasonal Variations
In additional to the regional character, there is a season trend in PM_{10} concentrations coinciding with the winter inversion conditions. Typically most of the 24 hour PM_{10} exceedances occur during the winter months.

Local effects
Local contributions from traffic are easily observed at kerbside station as in Warwick Junction and Ganges Secondary school on the Southern freeway. These higher concentrations occur as an excess to the regional background concentrations. Other local effects has its origins in upset conditions from local industry (Jacobs, Clairwood), sugar cane burning (eThekwini north) etc.

Next Steps

The following work is envisaged as the next step towards determining the source of PM_{10} and then to assess its social and environmental impact

1. PM_{10} physical characterisation
   - organic/inorganic content (dust)
   - salt content (sea - salt influence)
   - $PM_{2.5}$ -PM_{10} distribution (combustion vs mechanical source)
   - Screening of chemical content in the particulates

2. PM chemical characterisation

   - Heavy metals analysis
   - Toxics analysis - ex EThekwini Health Study
   - Semi-volatile organic carbon (SVOC) fraction
   - Data from aircraft sampling study over SDB (DEAT)

3. PM emission inventory synchronisation with concentrations

- conduct modelling, traffic emission modelling
- traffic forecasting model - future predictions and significance determination.

Other issues

1. Legislative context: variable GLVs (DEAT/SANS)
2. Emerging issue of $PM_{2.5}$ concentrations

7.5 Odors in eThekwini Municipality

Objective

To minimize the odour problem in eThekwini

Definition of the problem

Odours is a very complex matter to qualify and quantify. It varies from person to person when smell is detected and what is considered smelly. In the eThekwini Municipality odours is one amongst the air pollution problems that has caused most complaints from the population and general level of discomfort when inhaling. The problems are normally cased by accidental or non normal emissions connected to different specific sources. For some sources the occurrence of emissions causing smell are high and should be given priority.

Evaluation criteria

The odour varies with operational sources. The complaints that are received are the indicator of the seriousness and impact that the odours have in the environment and the quality of life. The main effect is nuisance for the persons that are exposed. Some of the odour producing substances might be toxic. Odours is connected to peak concentrations. The areas where the odour related complaints are most common is listed below. Passive samples have been deployed to quantify odours and revealed that hydrogen sulphide and formaldehyde are one of the main contributors to odours. The Hydrogen sulphides are normally connected to the refineries, Mondi and the Southern works waste water treatment plant. Formaldehyde from industries using formaldehyde in the process. This will typically be in Jacobs.

Potential sources

The following are the area where odour related complaint come from:

- Landfill sites
- Southern Waste Treatment Works and others
- Mondi paper mill
- Point Road pump station
- Tank farms
- Sewage Package plants
- Jacobs
- Refinery effluent treatment plants

Documentation

The number of complaints are recorded and classified according to the main potential sources. The table below have sorted the complaints according to location in the Municipality, but does not say anything about the reason of complaint.

The state of pollution status 2005 (complaints report) reveals the following:

Table 7: State of Pollution Status 2005 : Hydrogen Sulphide.

Total	N/S central	Outer West	South local council	STWs total	N/S central sewer	Odour residentail total	N/S central
155	148	-	-	62	50	154	103

In general the incidents where odours are observed in the Municipality needs to be documented and described. This information must be readily available. The odour should be regulated according to internationally published odours threshold or exposure limits. To determine the impact at real time interval the continuous monitoring stations have been set up at Southern Works and Settlers school to record 60% hydrogen sulphide gas as a fraction of TRS to record impact from refineries and Southern treatment works. This shows that the concentration levels are above the odour threshold level which is 4.7 ppb averaged over 30 minutes.

The permits need to include odours in the permits. The problem here is to identify the source and the amount that is causing problems. This means that problem areas have a monitoring network where the level of emissions are measured and where the level where there is a problem is included and that when and if this level is breached an action plan is made for improving the conditions . This action plan must be agreed upon by the regulatory authorities. There have to be a timeframe on the implementation.

Hotspot areas must be documented and reported. Two of the main areas of concern is acrylates from pumping acrylates from unloading ships in the harbour. Hydrogen sulphide and other reduced sulphides is also a problem that may have several emissions sources such as refineries, Mondi, and Southern sewage works. Description of suggestions for the five potential problems mentioned above is provided below:

Landfill sites

Landfill sites have a large potential for producing odours in the surrounding areas and this can also spread over rather large areas. This have however been a problem in many places in the world and different technologies have been developed for reducing the emissions to water and air. These technologies have been put to use for some landfills in eThekwini. This is probably a national problem and should be done through the national management plan. The following actions are suggested:

- Make the technology already in use in eThekwini readily available to other users
- Establish a workshop and training course for the personnel that is responsible for the landfills
- Make it more profitable to get the act together. Local government normally owns landfills. This means that the local government can put into place BAT technologies and initiate the use of the products that come from the landfills such as gas, compost, metal, plastic and other renewable products.
- Information dissemination

- Monitoring program
- Strengthening the professional association

Mondi

Production of paper is connected to H_2S and other smelling substances. The smelling substances come from the process. Emissions to air can come from many points and sources. Such as diffuse emissions from the plant, stack emissions and the sewer system. The human nose is a good indicator of what and where the smell comes from. If the human nose is not able to smell the substance close to the source it wont be a problem further from the source either. This means that a representative from the Department of Health and a representative from Mondi should walk around the premises and the sewer systems and use the nose to establish the emission points or areas. This should include a rough distance down wind where smell could be identified. The source of the smell should be located and documented. When there is a smelling incident in the area one should have a dedicated person at Mondi that walks around the factory to try and identify if this is coming from special sources. If the sources can cause a problem this can be solved in various ways either by destruction through combustion or by dilution. The costs of solving these problems might be minimal.

- Document geographical location of sources
- Evaluate the possibilities for abatements for each source
- Analysis of monitoring network
- Put the air from the covered parts to the furnaces for destruction

Southern Works waste water treatment plant

The sewage works is treating a variety of different fluids from industry and other sources. It is known that the activity can produce smells. The first to notice the smells are the workers in the premises. The following activities are proposed. Control the sewage from Mondi.

- Get an overview of the things that are dumped in the tanks.
- Get an expert to evaluate mixtures that are to be avoided
- Interview the workers on which discharges that produce this problem
- Ask them for possible solutions
- Analyse the different types of effluents and see if they are smelling to verify if this is a synergetic effect where two non smelling effluents smell when mixed.
- Decide when (under which meteorology that the smell is a problem. This means that the smelling effluents is better discharged under certain conditions).
- Mix the effluents that are smelling slowly into the mainstream to avoid strong emissions from the mainstream(Dilute the substance).
- Avoid secondary smell (products of chemical reactions)

Flaring from the refineries

Flaring from refineries are connected to upsets in the refinery or gas that needs to be destructed. The main odour problem from flaring comes from the flaring of small amounts of gas where the combustion is poor and the H_2S is not combusted. The reason for the poor combustion is that the flares are not designed to destruct small amounts of gas but that they have the capacity to destruct large amounts. This means that a minimum amount where the flare have a good combustion must be set as a minimum allowed amount or that the refineries finds a better flare or another way of destructing the gas.

- Put a minimum amount of VOC to the flare when flaring
- Evaluate the height of the flare and technology

- Go through the reported flaring incidents and link these to the different conditions at the refinery and see if there are some connections with load and production rate.

Diffuse emissions from the refineries

Diffuse emissions are normally linked to leaks in the refinery. This means that the emissions are there until the leak is sealed. The smelling parts normally come from the H_2S side of the refinery. The maintenance procedures of the refineries should be gone through by an external expert on refineries and suggest improvements. These have to be investigated.

The refineries are the experts and therefore the best to deal with these problems. The refineries have plans for maintenance, finding and sealing leaks in the refinery. The recommendation is that the refineries put forward a draft plan for decreasing the diffuse emissions from the refineries. This should include a detection plan and a preventive maintenance plan. This plan should be discussed and evaluated and should be as close to BAT for this type of technology as possible. The main goal is to seal leaks, but also give more understanding and trust in the community. Therefore the plan should be publicly available and approved.

- Maintenance plans
- VOC study

Recommended steps for abatement

Some of the abatements that are proposed are listed under the description of the problem above. The abatements listed below are of a more general kind and summarizes the abatements above.

Most of the sources for the complaints of odours in the area are known. Some of the sources can be pinpointed to direct point sources. Others like landfills are connected to the activity itself and is covering a larger area.

- Each point source must be analysed and a plan of reduction must be made.
- Landfills and odours is a problem all over the world. However the severe ness is closely connected to how the landfill is constructed and how it is run. An overview of how these landfills are constructed and run should be made and a study trip to landfills with an advanced use of technology and reuse of energy should be done and a system for improving the treatment at the landfills should be put into place. The Shongweni landfill site in eThekwini can be an example.

- The harbour activities are connected to smelling substances. Smell in the surroundings are and indication of lost substance. Solutions to these problems should be sought, and international expertise should be consulted to avoid emitting substances to air.
- H_2S is causing a substantial impact on the population in SDB. There are several potential sources of H_2S in the area. A preliminary list is below:
-
    - Mondi
    - Southern Works waste water treatment plant
    - Flaring from the refineries
    - Diffuse emissions from the refineries
    - Refinery treatment plants
    - Sewage pumping stations

These potential sources should be investigated, reported and assessed and if connected to smell an abatement plan should be elaborated and put into action.

7.7 Flaring from oil refineries

Objective of the study

The objective is to understand and reduce the impact and frequency of flaring from oil refineries in the eThekwini Municipality

Background information and definition

Flaring is the process whereby refineries combust waste gas streams, usually arising out of systems designed to protect equipment during abnormal or emergency events, before discharge into the atmosphere. In international best practice, flaring is to be used strictly as a means of safely venting flammable gases arising out of uncontrolled or emergency events on the refinery, not to handle normal venting operations.

There are different types of flares and these flares have a different problems attached:

- H_2S from Sapref and Engen
- VOC flares from Sapref and Engen

Different types of quantities are also flared and they are connected to the amount flared:

- Total shutdown (power failure)
- Plant upset flaring
- Planned startup and shutdown
- Planned gas destruction

Problem Description

Over the last few years there have been numerous complaints of excessive flaring emissions from the two Durban refineries (Sapref and Engen, 60 % of national capacity). Flaring accounts for a significant proportion of air pollution complaints. For example, in the South Durban Basin (SDB), flaring accounts for 10 % of pollution related complaints. At present, flaring emissions are poorly monitored or not monitored at all. Flaring pollutant emission rates and composition (toxicity) are essentially unknown, hence the environmental and health impact of these emissions are unknown.

What is known is that the flares of VOCs have emissions of soot in the form of particles, NO_x, SO_2, PAH and other substances. The flaring is also connected to odours down wind of the flares. This is especially when the flare is low and H_2S is in the gas that is flared. The concentration of H_2S is important. If the energy that of the flare is low the plume rise low. If this gas contains smelling substances odours are likely to arise because of poor combustion and that the flare is not designed for the low flowrate that is used. If the amount of flared gas is high the exhaust gas will have a substantial plume rise and the impact from the flaring will be quite some distance from the SDB. The air pollution will rise but this may be caused by recirculation or other sources to air pollution than flaring. This means that it is the small flares that are causing the largest air quality problem in SDB. To improve the impact to Air Quality from flaring focus should be kept on these incidents and not the large and famous incidents.

A second major concern is that the frequent flaring of emergency vent gases (from, for example, relief valves) reflects poor operation and stability (or possibly design flows) in the refinery, and may be a precursor to a major hazard incident such as a fire, explosion and/or large scale release of toxic chemicals. Hence the need and importance of assessing current refinery practice and designs against international best practice, and instituting regulatory and technology measures to achieve monitoring and control of flaring emissions.

Due to current lack of detailed oversight of refinery operations, it is possible that certain relief valves and process vents do not discharge to the flare systems. These would constitute a further source of unregulated emissions that should be assessed and regulated.

The further concerns with flaring relate to:

- the frequency of flaring,
- the environmental and health impact of the emissions from the flaring process,
- unreported emissions and percentage of this to reported emissions,
- the linkages between a flaring incident and the state of operation and stability in a refinery complex,
- evaluation against international best practice and regulatory and technology measures to achieve control.

Future Work

Refinery process configuration, monitoring and regulatory options

The assessment of flaring practices as well as venting and relief systems that discharge directly to atmosphere at refineries in eThekwini and benchmarking against international best practices. Developing and instituting specific monitoring and regulatory measures to bring SA refineries in line with international best practice. Development of an integrated response to flaring with respect to refinery process safety management.

Impact on Air Quality

Data from the new air quality monitoring network before, during and after notable flaring incidents did not show significant shift in concentration trends. One must be mindful that the air quality monitoring network is largely focused on measuring the priority pollutants such as sulphur and nitrogen oxides. What is of concern from the flaring system is the release of un-combusted hydro-carbons (toxic pollutants).

However the incidents where the flare is barely burning is a potential problem, firstly because of odours but also other problems may occur. The problem will be dependent on the gas that is flared and the amount flared. If the flare is running at a minimum or only a small amount is directed to the flare the combustion may not be good and the gas such as H_2S is not transformed to SO_2 in the combustion. This has the potential of causing problems with odours in the vicinity of the flares. To avoid this problem a minimum amount of energy should be advised for the gasses to be better destructed in the flare and that the exhaust gas is transported to a height where the gasses are diluted sufficiently to be below the odour threshold and thereby not produce this problem in the basin.

Nuisance local community

The visual impact, smoke, noise and frequency of occurance are the main factors drawing local community attention to the flaring system. Communities living next to refineries have cited flaring as a key issue. An investigation into this issue will address stakeholder concerns

Recommendation to address the issue at a public level

- Evaluate backup energy supply.
- Provide background to the flaring system, and include stakeholders in the process
- Establish an information dissemination system
- Provide regulatory options in licenses to address problem of flaring
- Stricter licensing and reporting procedures included in the licences in collaboration with the stakeholders
- Putting restrictions to production rates.
- Procedures to avoid flaring

- Make sure that the technology of the flares are designed to treat the amounts that it is used for
- Make sure that the technology of the flares are adequate for the substance flared.
- Define a minimum amount of gas going to the flare when flaring
- Reporting procedures relating to submitted plans for start up and shutdown of refinery.
- Removal the liquid going to the flare to reduce fallout.
- Quantify the emission factors flares
- Find the BAT for flaring

8 Summary of the assessments

The assessments are largely informed by the evaluation of the air quality data that has been generated over the last few years. The assessment pick the key topics for further work to be undertaken or directly make recommendations for actions.

- SO_2 in South Durban
    - Short term SO_2 impacts at Settlers School
    - Contributions of SO_2 from Jacobs industrial complex
    - Urban background annual average at Wentworth suggests that further base load reduction is required for all industries
    - Health study shows evidence for SO_2 linkages with respiratory health effects
    - Development of a SO_2 emission reduction plan
- PM in Durban
    - The City is approaching its carrying capacity for PM
    - There are over 30 days of non complaint in a year of the 24 hr GLV for PM_{10}
    - PM qualitative characterisation study
    - PM source apportionment study
- BTEX in Durban
    - Annual average for benzene is above the proposed DEAT GLV
    - Intervention required in the refinery and traffic corridors
    - BTEX source apportionment study
    - Development of emission inventory for BTEX
- Jacobs Industrial Complex
    - The existence of a multitude of chemical process operations results in a cocktail of emissions that have a toxic and odour potential
    - The top 10 industries in this area have been prioritised for intervention
    - Development of regulatory instruments for resolving odour complaints
    - Application of operational and process methods to resolve emissions
- Odours in South Durban
    - Odours account for a significant no of air pollution complaints which affects the quality of life of South Durban residents
    - Hydrogen sulphide emissions from the Southern treatment work
    - Hydrogen sulphide emissions from the Engen effluent treatment plant and from Flaring system
    - Hydrogen sulphide emissions from Mondi
    - Hydrogen sulphide emissions from Sapref
    - Hydrogen sulphide emissions from the Sewage pumping station in Merebank

- Flaring
    - Flaring responsible for a proportional no of pollution complaints
    - Flaring is a medium throught which pollutants like SO2, H2S, PM is released
    - Understand air pollution impact from flaring
    - Relate flaring to refinery process to identify root causes
    - Develop a protocol for flaring: regulatory and operational
- Indoor air quality in informal settlements
    - Over 70 % of informal settlements in the urban context use paraffin for heating with concomitant indoor air pollution.
    - Acute health effects established
    - Measurement of PM in indoor air
    - Measurement of Benzene in indoor air
    - Development of intervention measures

9 Options for control and abatement of air pollution in eThekwini

The process towards developing options for control will be varied in terms of stakeholder engagement, technology and process assessment, timing the abatement measures, integration into the permitting and enforcement system and a cost benefit analysis to improve the decision making.

Stakeholders will be engaged to come up with possible options and ideas for abatement. This will be discussed at workshops as to their ability to bring about the reduction in pollution as desired. Ultimately it will be up to the enterprise that is responsible for the emissions to come up with the most feasible solution.

Generally the approach for considering control and abatement option will be timed into short, medium and long term measures. The short term measure relate to what can be done almost immediately to improve the situation such as reduction in throughput or inducing higher operating costs to reduce pollution. For example the short term choice to use low sulphur heavy fuel oil while there are long terms option to install a gas network. The medium terms plans (2-4 years) normally will require board level decision, capital commitment, tender, construction and commissioning as in the case of a scrubber installation.

The need to have a proper assessment of the process including all inputs and outputs may generate options for control that may not require large investments. For example improved process control or giving consideration to cleaner production concepts may solve the undesirable emissions problems.

To strengthen the plan to improve air quality, the targets for reduction will be written into the permit documents such that they are enforceable after a reasonable time for construction and commissioning.

There may be a need to undertake a cost benefit analysis between options. This will be an effective tool to enable choices to be made between different control options.

Ultimately the eThekwini Municipality will have a list of control and abatement options categorised into short medium and long term. It is this list that will be managed to ensure what has been declared as a pollution abatement option does actually get implemented.

10 Information dissemination to stakeholders, public and media

The air quality management plan has as one of its fire engines the centrality of stakeholder involvement. Stakeholders map the way forward and ensure there is continual improvement. For meaningful stakeholder participation there has to be an effective communication strategy. Existing means of conveying information and knowledge on air quality to stakeholders has brought some results but this has a very narrow focus. The idea is to reach out to the broader society as air quality affects all citizens in the eThekwini. So the strategy with have two approaches.

The first approach is to ensure existing strategies involving information dissemination and reporting (push and pull factors) are made more effective. This strategy must also overcome the challenges to successful information communication by:

(i) broadening the dissemination of the results of data collection and processing,
(ii) the data generated must be transformed into information that can be directly used by decision-makers, and
(iii) the information must be easy to understand and act upon.
(iv) The information must be readily available in the adequate form

The second long range approach aims to have a societal level impact. First this would have to overcome some of the challenges in communicating information to society. There is a need to reach out by breaking the barriers: the barrier is two fold: information (technical) and psychological. People are receptive to change when they have a problem. Problems are understood when there is good information to explain the nature of the problem and its root cause. An example of this could be when mothers are informed that children are more vulnerable if exposed in a polluted area and they are more vulnerable due to their higher metabolic rate than adults.

The goal is push out information to encourage participation and engagement and to seek the information that flows from them. The feedback processes will inform governmental plans to improve the environment.

The first approach will ensure information gets out to key stakeholders. The first approach will include the following:

- Putting information on the world wide web,
- Regular reporting of air quality (weekly and monthly reports),
- Comprehensive annual oral presentation and reporting of air quality trends, observations and challenges,
- Putting our regular media statements on key topics,
- Presentations at conferences and symposia.

The second approach will include an awareness component and an information dissemination plan. The second approach will include the following:

- Develop education awareness and integrate with school curricular,
- Seek practical ways to get information out to womens' group, clinics and health practioners,
- To school children, schools, universities, local community newspaper, eThekwini newspaper and radio stations,
- Use churches and religious foundation.