Project done on behalf of

Mondi Ltd – Richards Bay Mill

Air Quality Impact Assessment for the Proposed Mondi Richards Bay Mill Upgrade

Report No.: APP/12/MBP- 01 Rev 0

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REPORT DETAILS

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EXECUTIVE SUMMARY

Airshed Planning Professionals (Pty) Ltd (Airshed) was appointed by Mondi Ltd – Richards Bay Mill to conduct a comprehensive air quality impact assessment for the proposed upgrade at the Mondi Richards Bay Mill. During this study all sources of air pollution have been identified and quantified with dispersion simulations undertaken to determine the potential impacts from the proposed operations on the surrounding environment. In addition, the latest ambient and meteorological monitoring data from the Richards Bay Clean Air Association (RBCAA) have been analysed and reported on.

Methodological Approach

In assessing atmospheric impacts from the proposed projects on sensitive receptors and the surrounding environment, emissions were quantified, atmospheric dispersion modelling conducted and predicted air pollutant concentrations evaluated.

The steps undertaken in the impact assessment include emissions quantification for all current and proposed sources the Mondi Richards Bay Mill, dispersion modelling and impact evaluation.

Baseline Assessment

To determine the current status of air quality and the prevailing meteorological conditions in the region, use was made of existing information. Baseline information from the latest 2011 RBCAA emissions, meteorological and ambient monitoring database and HAWK dispersion model was utilised to assist in the development of the baseline conditions of the area under assessment. Unfortunately, the current emissions inventory was incomplete for oxides of nitrogen (NO_x) and particulate emissions.

The main pollutants of concern associated with the current and proposed upgrade at Mondi are particulates (PM), sulphur dioxide (SO_2), NO_x and Total Reduced Sulphurs (TRS). Particulates are divided into different particle size categories with Total Suspended Particulates (TSP) associated with nuisance impacts and the finer fractions of PM_{10} (particulates with a diameter less than 10 µm) and $PM_{2.5}$ (diameter less than 2.5 µm) linked with potential health impacts. SO_2 and NO_x are gaseous pollutants with the potential for health impacts, whereas TRS is mainly considered for its odour nuisance value.

A comprehensive baseline assessment requires ambient monitoring data for a period of at least one year to account for seasonal variation. PM_{10} monitoring is being conducted by the RBCAA at four locations in and around Richards Bay. SO_2 is measured at five stations in Richards Bay while TRS is only measured at the CBD station. The data from these monitoring networks are reported on and used to evaluate the predicted baseline concentrations.

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The potential for impacts from the current operations at Mondi were simulated and used in addition to the monitored data. The simulated impacts reflect the contribution of particulates, NO_x, SO_2 and TRS (as hydrogen sulphide, H_2S) concentrations from Mondi operations compared with the other sources within Richards Bay.

Air Quality Impact Assessment

The anticipated air pollution emissions include particulates and gaseous emissions from stack releases. Dispersion modelling using the HAWK dispersion model was undertaken to predict maximum hourly, maximum daily and annual average concentrations of these pollutants.

Conclusions

The main objective for the study was to assess the significance of the contribution of the proposed Mondi Richards Bay Mill upgrade on ambient air quality.

Baseline

Meteorological Conditions

- The prevailing wind fields at the five RBCAA sites are north-northeast and south-west with highly infrequent winds from the east and west. The South African Weather Services (SAWS) airport station shows similar prevailing winds but with more dominant northerly winds. Low intensity winds are mainly associated with winds from the northerly to south-westerly sector with strong winds occurring from the north, north-easterly and south-westerly directions.

- During daytime, winds are in general stronger and more frequent from the south-west and south-southwest. Very few calm conditions were recorded at the various stations ranging between 0% and 1% with 11% recorded at the Airport.

- Dominant south-westerly airflow remains during the night but with an increase in the north-east and north-north-easterly airflow. Wind speeds are in general lower with increasing calm conditions of up to 5% at all the RBCAA stations and 12% at the SAWS Airport station.

- The highest wind speeds recorded during 2011 were at Harbour West at 20.1 m/s.

- Ambient temperatures recorded range between 9°C and 32°C.

- Long-term average total annual monthly rainfall is in the range of 57 mm to 172 mm. The study area falls within a summer rainfall region, with ~60 % of the annual rainfall occurring during the October to February period.

Existing Air Quality

- The main industries within the area include BHP Billiton's Bayside and Hillside Aluminium, Mondi Paper and Pulp Mills, Tata Steel, Foskor Fertilizer, Richards Bay Minerals, Mondi Felixton, Tongaat Hulett, Lafarge Cement and Exxaro.

- Annual PM_{10} concentrations measured at the CBD and Brackenham are within the current National Ambient Air Quality Standard (NAAQS) limit of 50 µg/m³, and only exceeded the 2015 limit at the CBD in 2007. Data recorded at Brackenham between 2008 and 2011 were below the current (50 µg/m³) and 2015 (40 µg/m³) limits. A slight decrease in ambient PM_{10} annual concentrations is evident at both the CBD and Brackenham during 2011.

- For the CBD, the current PM_{10} NAAQS daily limit was exceeded during 2007 with the following years slightly below the limit. When compared against the 2015 limit of 75 µg/m³, only the measurements for year 2011 were below the limit at the CBD. Although the other years exceeded the limit value, only years 2009 and 2010 were in non-compliance, i.e. exceeded the limit for more than 4 days in the year. At Brackenham all the years (2008 – 2011) exceeded the 2015 NAAQ limit with only year 2009 exceeding the current NAAQ limit. The years 2008 and 2009 resulted in non-compliance with the 2015 NAAQS. Measured PM_{10} concentrations are therefore in compliance with the current standard for all the years and with the 2015 NAAQSs during 2011.

- An increase in SO_2 concentrations was measured at all monitoring sites from the period 2003 to 2005. The measured SO_2 concentrations decreased from 2005 to 2009, but have shown an increase from 2009 to 2011 at some stations.

- The highest annual average SO_2 concentration (2005) was measured at the John Ross/Foskor intersection, which is located closest to major industry (Foskor, Hillside Aluminium and Bayside Aluminium). In 2011 the highest annual average SO_2 concentration was measured at the Harbour West and Scorpio stations, i.e. 42% of the NAAQS. No daily exceedances were reported for the year 2011, and six hourly exceedances were reported for 2011 at the Scorpio station.

- In 2011 the measured TRS 10-minute average concentration exceeded the H_2S odour threshold 409 times. The measured annual average TRS concentration was 1.1 ppb (1.52 µg/m³) while the measured highest hourly average concentration was 15.9 ppb (22.1 µg/m³).

Impact Assessment

- Main sources of emissions associated with the Mondi Richards Bay Mill include stack releases from the lime kiln, power boilers, recovery boilers and gas turbines.

- The proposed upgrade will result in an increase of 3.5% SO_2, 8.6% PM and 11.8% NO_x emissions relative to current Mondi Richards Bay Mill sources.

- The proposed upgrade will result in an increase of 0.4% SO_2, 1.8% PM and 10.7% NO_x [1] emissions relative to all current RBCAA sources.

- Due to the difficulty in estimating all TRS emissions (including stack, vent and fugitives) it is difficult to determine exactly what the increase in TRS emissions would be. With the upper estimated emissions (*Upper Current TRS Emission* scenario), the TRS emissions are projected to only increase by 0.6%, whereas with the lower estimated emissions (*Lower Current TRS Emission* scenario), the TRS emissions are projected to increase by 3.5 %.

- Both highest daily and annual average ground level PM_{10} and $PM_{2.5}$ concentrations are predicted to be slightly higher in the vicinity of the Mondi Richards Bay Mill due to the upgrade. Spatially however the areas where the SA daily and annual PM_{10} and $PM_{2.5}$ NAAQS are predicted to be exceeded remain unchanged after to the upgrade.

- Highest hourly, highest daily and annual average ground level SO_2 concentrations are predicted to remain nearly unchanged after the Mondi Richards Bay mill upgrade.

- Highest hourly NO_x concentrations are predicted to increase slightly, but the SA hourly NAAQSs are not predicted to be exceeded for the future scenario. Although future annual average NO_x concentrations are slightly higher than current concentrations, ground level NO_x concentrations are predicted to be well below the SA annual NAAQS.

- Ground level TRS concentrations were predicted to be slightly higher after the upgrade using both the *Lower* and *Upper TRS Emission* scenarios. Using the Lower Emission Estimate, the spatial extent is predicted to increase, with more of the industrial area and Acton experiencing exceedances of the H_2S 50% recognition odour threshold. However, with the Upper Emission Estimate, only small changes in the impact were predicted.

Impact on the City of uMhlathuze Air Quality Buffer Zones

- The proposed Mondi Richards Bay Mill upgrade is unlikely to have a noticeable impact on the current Air Quality Buffer Zones since the predicted increases in cumulative PM, SO_2 and NO_x impacts are very low. These Buffer Zones were based on the 2004 RBCAA database, with the health screening based on a set of international criteria. These buffer zones may need to be updated based on the latest RBCAA database and incorporating the NAAQSs for South

[1] This value is skewed significantly due to the incomplete NOx emissions inventory for the study area. The baseline air pollution emissions inventory for NOx is currently shown to be 91% from Mondi only.

Africa.

Recommendations

TRS emissions are only available for the Mondi Richards Bay mill sources. It is recommended that emissions from all RBCAA sources be quantified in order to establish an accurate baseline of TRS concentrations.

NO_x emissions are only available for the Mondi Richards Bay Mill and a few other industries, as there is no complete NO_x emissions inventory available for Richards Bay. It is recommended that NO_x emissions from all industries in Richards Bay be quantified in order to establish accurate baseline conditions.

Due to the relatively small increase in NOx, SO_2, TRS and particulate matter emissions due to the upgrade, and the insignificant changes to the ground level concentrations for TRS, SO_2 and particulate matter, no further mitigation measures are recommended.

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1 Introduction

The Mondi Richards Bay mill was commissioned in 1984. It produces two key products: Baycel, a premier grade bleached hardwood pulp made from 100-percent eucalyptus fibre and Baywhite, a white top kraft linerboard. In 2005, the Richards Bay mill underwent a major expansion project that increased its capacity to more than 720 000 tons/annum. The modernisation of the Richards Bay operation enabled the mill to significantly reduce its impact on every aspect of the environment, from air quality to water consumption through to solid waste reduction.

It is proposed that a further upgrade to the production facilities of the mill take place to increase the output to approximately 820 000 tons/annum. The current capacity of the mill is approximately 750 000 tons/annum.

Airshed Planning Professionals (Pty) Ltd (Airshed) was appointed by Mondi Ltd – Richards Bay Mill to conduct a comprehensive air quality impact assessment for the proposed upgrade at the Mondi Richards Bay Mill.

During this study all sources of air pollution have been identified and quantified with dispersion simulations undertaken to determine the potential impacts from the proposed upgrade on the surrounding environment. In addition, the latest ambient and meteorological monitoring data from the Richards Bay Clean Air Association (RBCAA) have been analysed and reported on.

1.1 Project Description

It is proposed to upgrade the production facilities at the Mondi Richards Bay Mill to increase the output from approximately 750 000 tons/annum to approximately 820 000 tons/annum.

The upgrade will involve changes to existing equipment in various parts of the plant including modifications to the existing Recovery Boiler 1 and increasing output from the pulp drying machine. The linerboard capacity will remain unchanged as will the unbleached softwood capacity.

Changes will take place in the hardwood screening and brown stock washing where new knot separation and washers will be installed. No changes will be made to the main equipment in the bleach plant, with only minor modifications to the wash presses. In order to produce the additional chlorine dioxide, the mill will revert to using the so-called R8 production process, which was previously in place in the mill and allows additional chlorine dioxide to be produced. The screening system of the pulp drying machine will be upgraded as well as the vacuum system and some felt cleaning equipment. Heat exchanges on the dryer will also be replaced.

A new washing system will be installed in the unbleached pulp line in order to allow for an increase in the black liquor solids. The black liquor evaporation capacity will remain unchanged.

The burning capacity for black liquor in the recovery boiler will be increased by modifications to the air system, super heaters, precipitators and cooling systems.

The changes that are proposed to the existing equipment will allow the mill to utilize the full capacity of installed equipment and thereby maximize the output from the mill. This will contribute to the improved competitiveness of the Richards Bay mill and add value to the local economy.

1.2 Site Description

The uMhlathuze Local Municipality (ULM) falls within the uThungulu District Municipality, and includes the towns of Richards Bay and Empangeni and its surrounding rural and tribal areas. The total area covered by the local municipality is approximately 796 km² (Liebenberg-Enslin & Petzer, 2006). The Mondi Richards Bay Mill is situated to the west of Richards Bay. The nearest residential areas are indicated in Figure 1-1.

The topography of greater Richards bay area is fairly flat comprising of hills, ridges and undulating plains. The relief ranges from sea level on the eastern side to 296 metres above mean sea level (mamsl) to the western side. The current land uses in the region include industrial and commercial processes, surface mining activities, agricultural activities (mainly sugar cane), forestry, and formal and small residential communities.

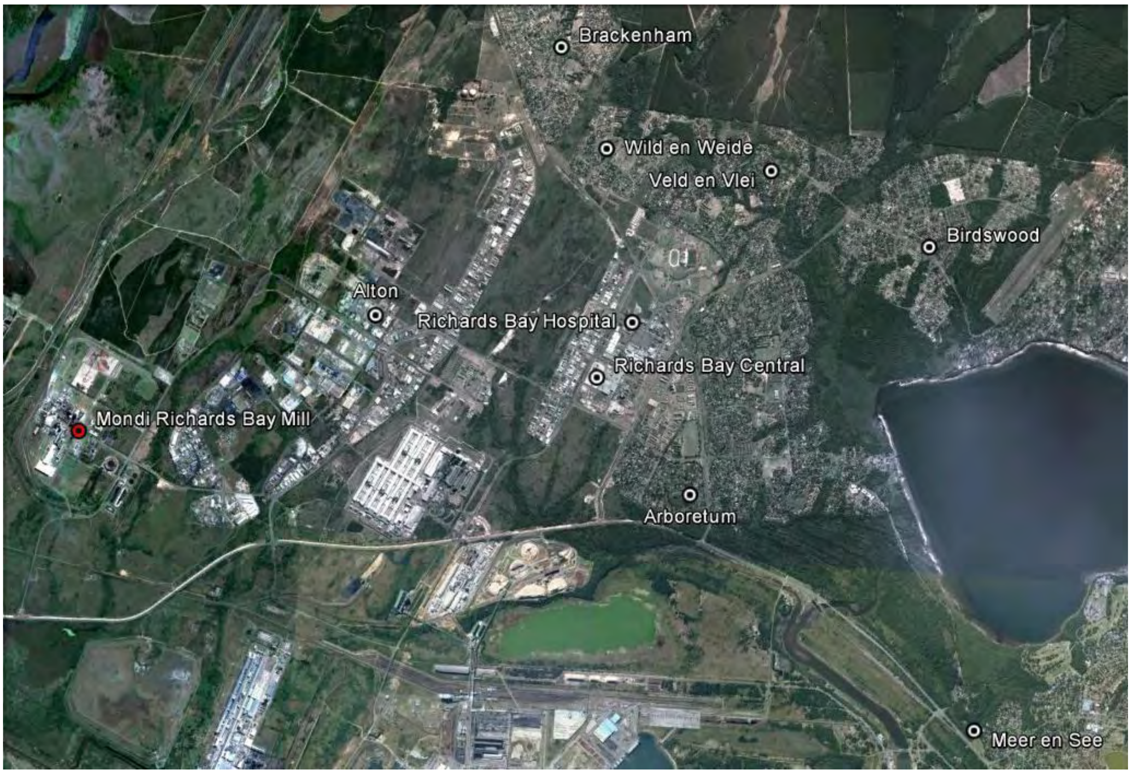

Figure 1-1: Location of Residential areas and sensitive receptors in the vicinity of the Mondi Richards Bay Mill

1.3 Project Scope

The scope of work was provided to include:

- The identification of current emission sources, the identification and mapping of all sensitive receptors, ambient air quality and relevant climatic conditions;
- Baseline information from the most recent RBCAA emissions and ambient monitoring database and HAWK model will be utilised to assist in the development of the baseline conditions of the area under assessment.
- The potential impacts for air quality associated with the proposed upgrade must be assessed through the use of the regional HAWK dispersion model.
- Identify potentially sensitive receptor sites and potential health impacts.
- Identify risks/impacts. Identify and predict the significance of potential impacts, direct, indirect and cumulative that may arise from the project. The assessment must include the potential risk to human health and the environment. The significance of potential impacts must be assessed without and after mitigation.

1.4 Methodological Approach

In assessing atmospheric impacts from the proposed upgrade on sensitive receptors and the surrounding environment, emissions need to be quantified, atmospheric dispersion modelling conducted and predicted air pollutant concentrations evaluated.

The steps undertaken in the impact assessment include emissions quantification for all current and proposed sources at Mondi Paper Mill in Richards Bay, dispersion modelling and impact evaluation.

1.4.1 Baseline Assessment

To determine the current status of air quality and the prevailing meteorological conditions in the region, use was made of existing information. Baseline information from the latest 2011 RBCAA emissions, meteorological and ambient monitoring database and HAWK dispersion model was utilised to assist in the development of the baseline conditions of the area under assessment.

The main pollutants of concern associated with the current and proposed upgrade at Mondi are particulates (PM), sulphur dioxide (SO_2), oxides of nitrogen (NO_x) and total reduced sulphur (TRS). Particulates are divided into different particle size categories with Total Suspended Particulates (TSP) associated with nuisance impacts and the finer fractions of PM_{10} (particulates with a diameter less than 10 µm) and $PM_{2.5}$ (diameter less than 2.5 µm) linked with potential health impacts. SO_2 and NO_x are gaseous pollutants with the potential for health impacts, whereas TRS is mainly considered for its odour nuisance value.

A comprehensive baseline assessment requires ambient monitoring data for a period of at least one year to account for seasonal variation. PM_{10} monitoring is being conducted by the RBCAA at four locations in and around Richards Bay. SO_2 is measured at five stations in Richards Bay while TRS is only measured at the CBD station. The data from these monitoring networks are reported on and used to evaluate the predicted baseline concentrations.

The potential for impacts from the current operations at Mondi were simulated and used in addition to the monitored data. The simulated impacts reflect the contribution to particulates, NO_x, SO_2 and TRS concentrations from Mondi operations compared with the other sources within Richards Bay.

1.4.2 Air Quality Impact Assessment

In order to assess the potential impacts, the predicted air quality assessment includes the following tasks:

- Preparation of topographical, meteorological, land use, source and emissions data required for input to the dispersion model;
- Evaluation of predicted air pollutant concentrations based on local and international air quality guidelines and standards, dose-response relationships and odour thresholds.

The Hawk atmospheric dispersion model was used in the current study since it is used for all projects within Richards Bay.

Exposure predictions are provided for hourly, daily and annual average gaseous and particulate concentrations. The results from the analysis will be used to evaluate (a) magnitude, frequency of occurrence, duration and probability of impacts, (b) the local, regional, national and international significance of predicted impacts and (c) the level of confidence in findings relating to potential emission impacts.

1.5 Assumptions and Limitations

In interpreting the study findings it is important to note the limitation and assumptions on which the assessment was based. The most important assumptions and limitations of the air quality impact assessment are summarised as follows:

- Emissions from all the baseline sources are based on the information in the RBCAA database as provided by SGS. Only Mondi’s source parameters and emission rates were updated as part of this study.
- Information regarding NO_x emission rates for the RBCAA sources is very limited and NO_x

impacts were only evaluated incrementally.

- Only routine emissions for the current and proposed operations were simulated, no information is available regarding upset emissions.
- Dispersion models don't contain all the features of a real system but contain the feature of interest for the management issue or scientific problem to be solved (MFE, 2004). Gaussian plume and puff models are regarded to have an uncertainty range of between -50% to 200%. It has generally been found that the accuracy of off-the-shelf dispersion models improve with increased averaging periods.
- The impact assessment is limited to the pollutants associated with the current and future operations at Mondi. Thus not all pollutants as reported on by the RBCAA were addressed in this study.
- Due to the difficulty in accurately estimating all TRS emissions (including stack, vent and fugitives) a range of for these emissions were included in the study, *viz.* the upper estimated emissions (*Upper Current* and *Future TRS Emission* scenarios) and the lower estimated emissions (*Lower Current* and *Future TRS Emission* scenarios). The latter estimate is the most likely representation of the routine TRS emissions whereas the upper estimate also includes upset and unconfined TRS emissions.

1.6 Report outline

The overall structure of the document reflects this approach:

Section 2 of the report provides a discussion on the legislation and regulatory requirements, with specific reference to the National Environmental Management: Air Quality Act.

Section 3 includes the baseline evaluation of the current meteorological conditions and air quality in Richards Bay.

Section 4 provides the impact assessment of the proposed Mondi Richards Bay Mill upgrade, including the identification and quantification of all sources of emissions associated with the project and the dispersion modelling results.

Section 5 concludes and provides recommendations.

Section 6 lists the references.

2 Policy and Regulatory Requirements

The Mondi Richards Bay Mill, together with the proposed upgrade, will have to comply with the requirements of the National Environmental Management: Air Quality Act (Act No. 39 of 2004). The Air Quality Act (AQA) commenced on the 11th of September 2005[2] with the exclusion of the sections pertaining to the listing of activities and the issuing of atmospheric emissions licences. Listed Activities and associated Minimum Emission Standards were published in the Government Gazette on the 31st of March 2010 (No. 33064) as Section 21 of the Air Quality Act. The Atmospheric Pollution Prevention Act (APPA) of 1965 was repealed on the 1st of April 2010 bringing the Air Quality Act into full force.

According to the Air Quality Act, air quality management control and enforcement is in the hands of local government with District and Metropolitan Municipalities as the licensing authorities. Provincial government is primarily responsible for ambient monitoring and ensuring municipalities fulfil their legal obligations, with national government primarily a policy maker and co-ordinator. Each sphere of government must appoint an Air Quality Officer responsible for co-ordinating matters pertaining to air quality management.

The National Framework states that aside from the various spheres of government responsibility towards good air quality, industry too has a responsibility not to impinge on everyone's right to air that is not harmful to health and well-being. Industries therefore should take reasonable measures to prevent such pollution order degradation from occurring, continuing or recurring.

2.1 Ambient Air Quality Standards

The National Framework provided a stepped approach in setting ambient air quality standards. Based on this the standard for a specific pollutant must include limit values for specific exposures, the number of allowed exceedances and a timetable for compliance. The limit values (concentrations) are based on scientific evidence. National Ambient Air Quality Standards (NAAQS) were determined based on international best practice for particulate matter less than 10 and 2.5 µm in aerodynamic diameter (PM_{10} and $PM_{2.5}$), dust fall, sulphur dioxide, nitrogen dioxide, ozone, carbon monoxide, lead and benzene. These standards were published for comment in the Government Gazette on 9 June 2007 with the new standards, which include frequency of exceedance and implementation timeframes, published on the 24th of December 2009 (*Government Gazette 32816*)**.** $PM_{2.5}$ standards were gazetted and passed in June 2012 (*Government Gazette 35463*).

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[2] The National Environmental Management: Air Quality Act (Act no.39 of 2004) commenced with on the 11th of September 2005 as published in the Government Gazette on the 9th of September 2005. Sections omitted from the implementation are Sections 21, 22, 36 to 49, 51(1)(e),51(1)(f), 51(3),60 and 61.

The main pollutants of concern for this study are NO_x (SA NAAQS are given for NO_2, if predicted NO_x concentrations exceed the ambient standard, further investigation will be required as to the NO_2 percentage), SO_2, PM_{10} and $PM_{2.5}$, all of which have South African standards, these are listed in Table 2-1

Table 2-1: National ambient air quality standards for PM_{10}, $PM_{2.5}$, NO_2 and SO_2

Pollutant	Averaging Period	Limit Value (µg/m³)	Frequency of Exceedance	Compliance Date
PM_{10}	24 hours	120	4	Immediate – 31 Dec 2014
		75	4	1 Jan 2015
	1 year	50	0	Immediate – 31 Dec 2014
		40	0	1 Jan 2015
$PM_{2.5}$	24 hours	65	4	Immediate – 31 Dec 2015
		40	4	1 Jan 2016 – 31 Dec 2029
		25	4	1 Jan 2030
	1 year	25	0	Immediate – 31 Dec 2015
		20	0	1 Jan 2016 – 31 Dec 2029
		15	0	1 Jan 2030
NO_2	1 hour	200	88	Immediate
	1 year	40	0	Immediate
SO_2	1 hour	350	88	Immediate
	24 hours	125	4	Immediate
	1 year	50	0	Immediate

The 2016 to 2029 standards will be used to evaluate the impact of particulate matter.

2.2 Odour Impact Assessments

Odour thresholds are defined in several ways including absolute perception thresholds, recognition thresholds and objectionable thresholds. At the perception threshold one is barely certain that an odour is detected and it is too faint to identify further. For the purposes of this investigation, it was therefore decided to use the 50% recognition threshold for the listed pollutants. The 50% recognition threshold is the concentration at which 50% of an odour panel defined the odour as being representative of the odorant being studied.

The mean recognition threshold odour concentrations (TOC's) published by Haug (1993) (Table 2-2) were used in the investigation.

Table 2-2: 50% Recognition odour threshold concentrations (Haug, 1993)

Compound	50% Recognition odour threshold concentrations [µg/m³]		
	Median	Mean	Standard Deviation
Dimethyldisulphide	21.9	29.7	25.02
Dimethylsulphide	5.16	6.45	5.68
Dimethyltrisulphide	6.29	7.33	6.81
Ethylmercaptan	0.83	1.03	0.67
Hydrogen Sulphide	5.82	6.39	4.12
Methylmercaptan	1.64	2.03	1.46

The detectability of an odour is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. This point is called the odour thresholds and defines one odour unit per cubic metre (OU/m³), i.e. the odour unit is the concentration of a substance divided by the odour threshold for that substance or the number of dilutions required for the sample to reach the threshold. Therefore, an odour criterion of less than 1 OU/m³ would theoretically result in no odour impact being experienced.

In practice, the character of a particular odour can only be judged by the receiver's reaction to it, and preferably only compared to another odour under similar social and regional conditions. The New South Wales Environmental Protection Agency (NSW EPA) in Australia, having referred to the literature in its determining the level at which an odour is perceived to be of nuisance, gives this level as ranging from 2 OU/m³ to 10 OU/m³ depending on a combination of the following factors:

- **Odour quality** – i.e. whether the odour results from a pure compound or from a mixture of compounds. Pure compounds tend to have a higher threshold, lower offensiveness, than a mixture of compounds

- **Population sensitivity** – any given population contains individuals with a range of sensitivities to odour. The larger the population, generally the greater the number of sensitive individuals contained.

- **Background level** – refers to the likelihood of cumulative odour impacts due to the co-location of sources emitting odours

- **Public expectation** – whether a given community is tolerant of a particular type of odour and does not find it offensive. Background agricultural odours may, for example, not be considered offensive until a higher threshold is reached whereas odours from a waste disposal site or chemical facility may be considered offensive at lower thresholds.

- **Source characteristics** – emissions from point sources are more easily controlled that are diffuse sources, e.g. waste disposal sites

- **Health effects** – whether a particular odour is likely to be associated with adverse health effects. In general, odour from an agricultural operation is less likely to present a health risk than emissions from a waste disposal or chemical facility

Experience gained in NSW through odour assessments for proposed and existing facilities has indicated that an odour performance criterion of 7 OU/m³ is likely to represent the level below which "offensive" odours should not occur for an individual with a "standard sensitivity"[3] to odours. The NSW EPA policy therefore recommends that, as a design criterion, no individual is exposed to ambient odour levels of greater than 7 OU/m^3. Where a number of the factors listed above simultaneously contribute to making an odour 'offensive', odour criteria of 2 OU/m^3 at the nearest sensitive receptor (existing or any likely future receptor) is appropriate. This is given as generally occurring for affected populations equal to or above 2000 people.

The odour performance criteria specified by the NSW EPA is compared to that used in other jurisdictions in Table 2-3. It is evident that the odour performance criteria range specified by the NSW EPA includes the criteria stipulated in various other jurisdictions, the exception being the South Coast Air Quality Management District in the US which permits odour units of up to 10 OU in certain instances.

Table 2-3: Odour performance criteria used in various jurisdictions in the US and Australia

Jurisdiction	Odour Performance Criteria (given for application to odour units) (OU)
New South Wales EPA (NSW EPA, 2001a, 2001b)	2 to 7
California Air Resources Board (Amoore, 1999)	5
South Coast Air Quality Management District (SCAQMD) (CEQA, 1993)	5 to 10
Massachusetts (Leonardos, 1995)	5
Connecticut (Warren Spring Laboratory, 1990)	7
Queensland (Queensland Department of Environment and Heritage, 1994)	5

So, for the purposes of this assessment, an OU/m³ of 2 was used. If we assume that the TRS can be assessed as H_2S, then 2OU/m³ is approximately 12 µg/m³ (based on the median value in Table 2-2).

[3] "Standard Sensitivity" is defined by the Draft Australian and European CEN Standards, which require that the geometric mean of individual odour thresholds estimates, must fall between 20 ppb and 80 ppb for n-butanol (the reference compound).

3 Baseline Characterisation

The baseline evaluation primarily comprises the assessment of near-site surface meteorology and available ambient concentrations.

3.1 Influencing Meteorological Conditions

Meteorological mechanisms govern the dispersion, transformation, and eventual removal of pollutants from the atmosphere. The analysis of hourly average meteorological data is necessary to facilitate a comprehensive understanding of the ventilation potential of the site.

Dispersion comprises vertical and horizontal components of motion. The wind field largely determines the horizontal dispersion of pollution in the atmospheric boundary layer. The wind speed determines both the distance of downwind transport and the rate of dilution as a result of plume 'stretching'. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness. The wind direction and the variability in wind direction, determine the general path pollutants will follow, and the extent of cross-wind spreading (Shaw and Munn, 1971; Pasquill and Smith, 1983; Oke, 1990).

In characterising the meso-scale dispersion potential of the site reference is made to the RBCAA's five meteorological and ambient monitoring stations data (managed by SGS Consulting). Ambient monitoring stations equipped with meteorological stations measure wind speed, wind direction, temperature and humidity. Meteorological data for the year 2011 was used in this study and reported on in the subsequent sections. In addition, data from the South African Weather Services weather station at the Airport is reported on for the same year. The locations of these stations are provided in Figure 3-1.

Parameters that need to be taken into account in the characterisation of meso-scale ventilation potentials include wind speed, wind direction, extent of atmospheric turbulence, ambient air temperature and mixing depth.

Data availability of parameters recorded at these monitoring stations between January and December 2011 are summarised in Table 3-1. The HAWK dispersion model utilises meteorological data from all the stations. The RBCAA Scorpio station is located nearest to the Mondi Richards Bay Mill.

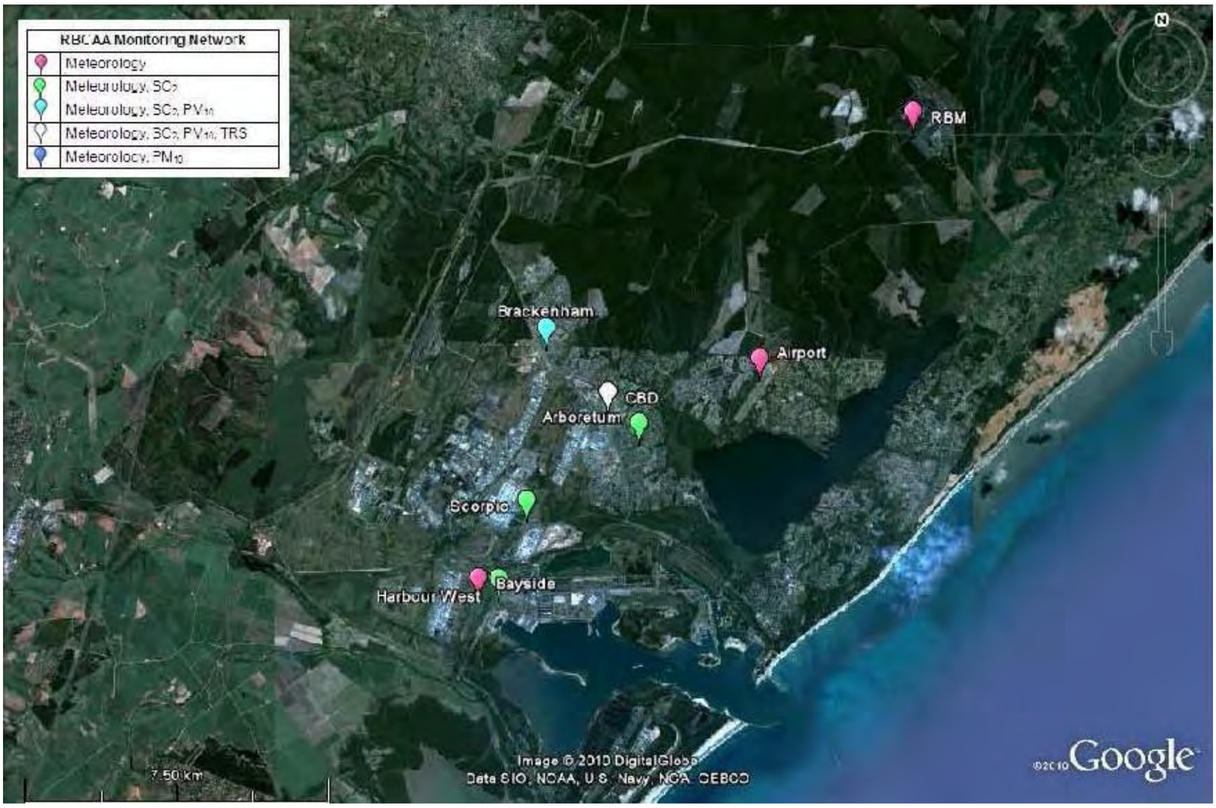

Figure 3-1: Location of the RBCAA monitoring network (after SGS, 2011)

Table 3-1: Meteorological parameters and data availability for the period January to December 2011

Location	Wind Speed	Wind Direction	Ambient Temp.	Relative Humidity
Bayside	98.42%	98.42%	98.42%	N/M
Harbour West	98.92%	98.92%	98.92%	N/M
Brackenham	99.89%	99.89%	99.89%	N/M
Arboretum	98.77%	99.99%	99.99%	N/M
Scorpio	99.97%	99.97%	99.97%	N/M
Airport(a)	99.16%	99.16%	99.16%	99.16%

Notes: NM – not measured

(a) South African Weather Services station.

(b) Wind speed availability at Arboretum is less than the wind direction due to the removal of extreme wind speeds (>15m/s) not recorded at any of the other stations.

3.1.1 Wind field

Period, day-time and night-time wind roses are provided in Figures 3-2, 3-3 and 3-4, respectively.

Wind roses comprise 16 spokes, which represent the directions from which winds blew during the period. The colours used in the wind roses below, reflect the different categories of wind speeds; the grey area, for example, representing winds of 1 m/s to 2 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. For the current wind roses, each dotted circle represents a 5% frequency of occurrence. The value given in the label describes the frequency with which calms occur, i.e. periods during which the wind speed was below 1 m/s.

The prevailing wind field at the five RBCAA sites is north-northeast to south-west with highly infrequent winds from the east and west (Figure 3-2). The SAWS Airport station shows similar prevailing winds but with more dominant northerly winds. Low intensity winds are mainly associated with winds from the northerly to south-westerly sector with strong winds occurring from the north, north-easterly and south-westerly directions. Scorpio, the closest station to Mondi, mirrors the dominant regional north-north-easterly and south-westerly winds with limited airflow from the south-east and west. This station also records lower wind speeds from the north-northeast than the other stations.

During daytime, winds are in general stronger and more frequent from the south-west and south-southwest. Very few calm conditions were recorded at the various stations ranging between 0% and 1% with 11% recorded at the Airport. This station also reflects more dominant wind flow from the north during day-time.

Dominant south-westerly airflow remains during the night but with an increase in the north-east and north-north-easterly airflow. Wind speeds are in general lower with increasing calm conditions of up to 5% at all the RBCAA stations and 12% at the SAWS Airport station.

The highest wind speeds recorded during 2011 were at Harbour West at 20.1 m/s, with the second highest of 18.4 m/s recorded at Bayside. Scorpio recorded a maximum wind speed of 11.2 m/s with Brackenham 12.6 m/s and the Airport station 13.4 m/s. Extreme wind speeds of up to 60.1 m/s were reported at Arboretum during the last week of December 2011. These records were disregarded leaving the maximum wind speed to be 13.1 m/s.

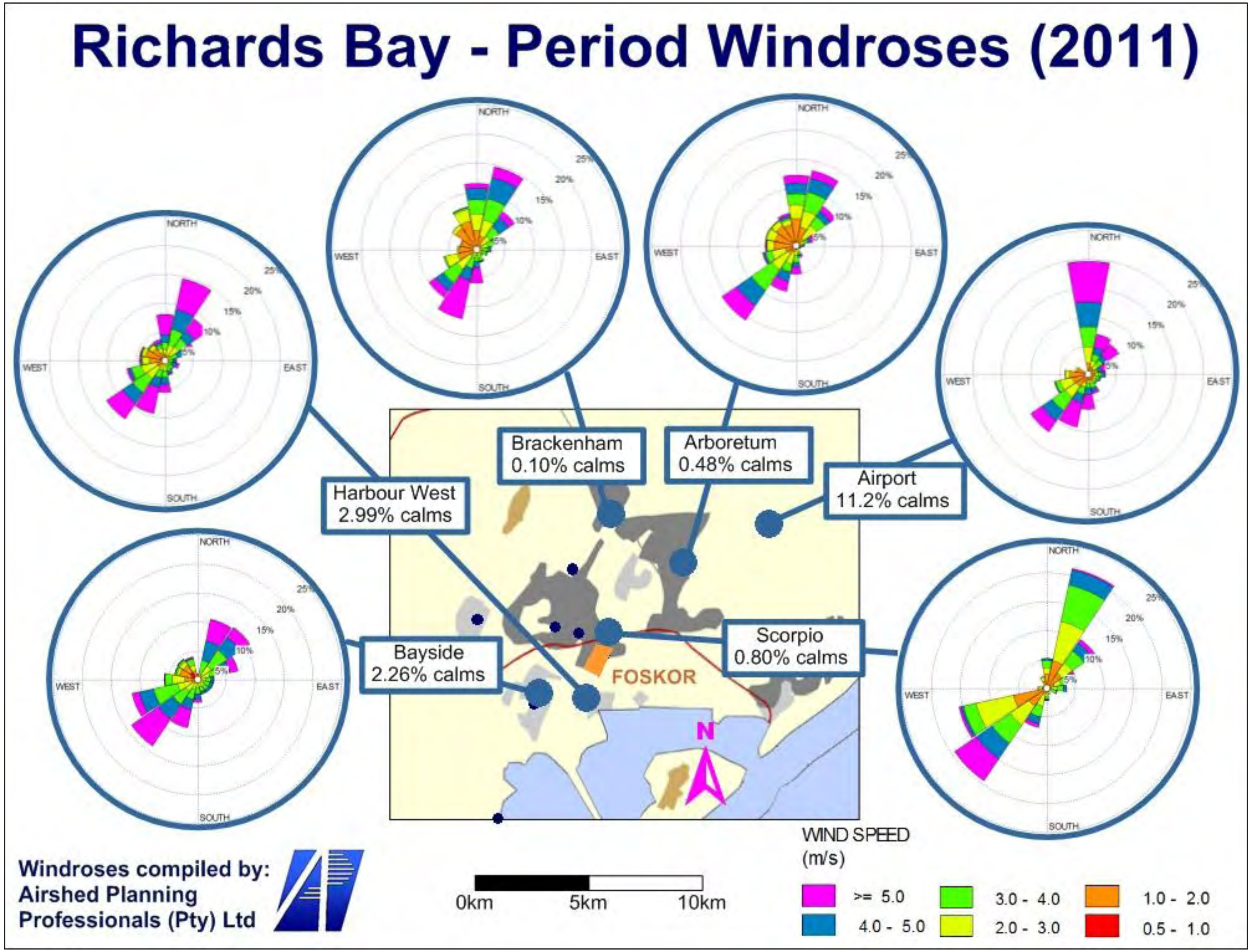

Figure 3-2: Period wind roses for the six stations in Richards Bay for 2011

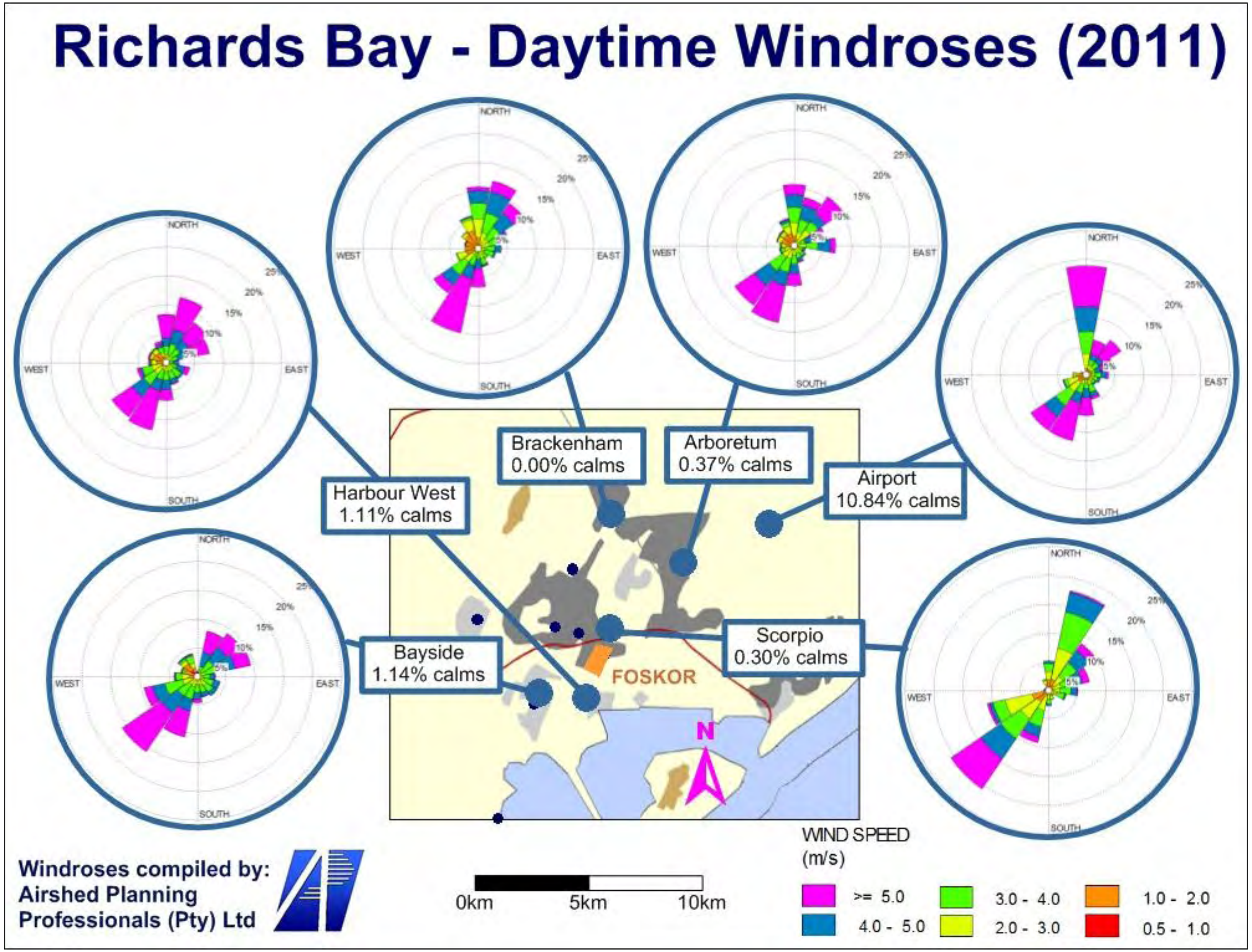

Figure 3-3: Day-time wind roses for the six stations in Richards Bay for 2011

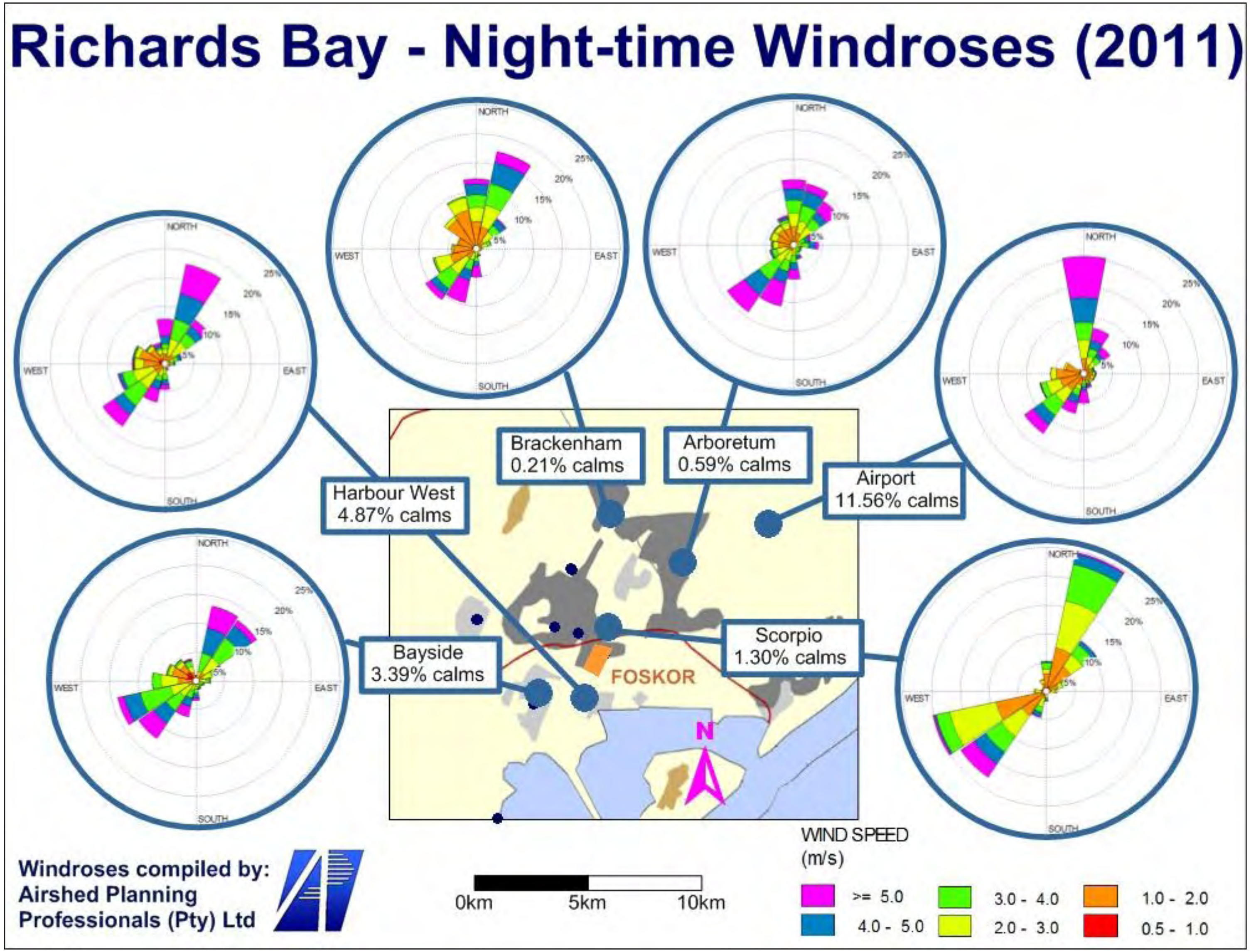

Figure 3-4: Night-time wind roses for the six stations in Richards Bay for 2011

3.1.2 Temperature

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher the plume is able to rise), and determining the development of the mixing and inversion layers. The diurnal temperature profile for the Richards Bay stations is given in Figure 3-5 with the minimum, maximum and average temperatures provided in Table 3-2. Ambient temperatures recorded range between 9°C and 32°C.

Long-term average maximum, mean and minimum temperatures for Richards Bay (1951-1984) are shown in Table 3-3 (Schulze, 1986). An annual mean temperature for Richards Bay is given as 21.8°C, based on the long-term record.

Table 3-2: Monthly average temperatures recorded at Scorpio Station during January to December 2011

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum	35.7	33.1	38.3	32.0	32.1	28.7	25.5	30.0	39.2	34.4	36.5	35.8
Minimum	19.6	19.1	20.0	14.9	11.4	8.9	9.0	10.4	13.7	13.9	15.5	17.5
Average	24.8	24.9	25.9	21.8	20.6	17.8	16.5	17.9	20.7	21.1	22.2	23.8

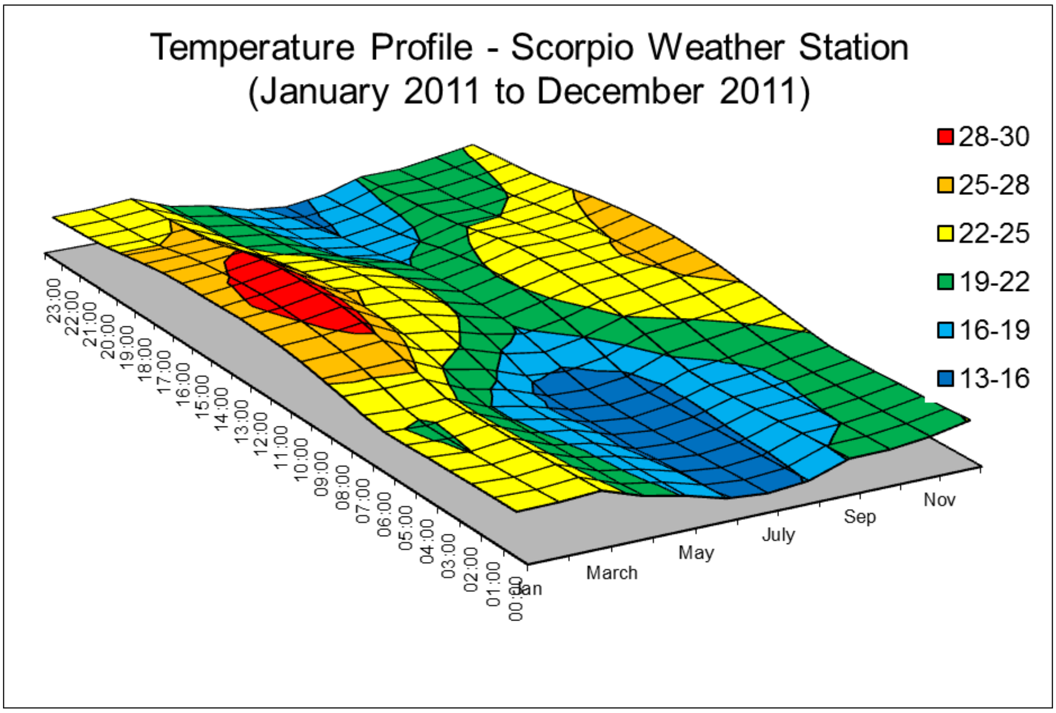

Figure 3-5 Diurnal temperature profile for Scorpio Station for the period January to December 2011

Table 3-3: Long-term minimum, maximum and mean temperature (°C) for Richards Bay for the period 1951-1984 (Schulze, 1986), and for 1970-1990 (SAWS, 1990)

	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
1951 -1984												
Max	30	29.6	29.3	27.3	25.1	23.4	23.4	24.0	25.4	26.1	27.6	29.5
Min	21.1	21.0	20.3	17.9	14.7	11.7	11.4	13.5	15.7	16.9	18.3	20.3
Mean	25.5	25.3	24.8	22.6	20.0	17.6	17.4	18.8	20.5	21.5	23.0	24.9
1970 -1990												
Max	29.2	28.9	28.9	27.0	24.8	23.1	23.0	24.0	24.9	25.4	26.7	28.7
Min	21.2	21.2	20.4	18.1	15.2	12.3	12.3	14.1	16.0	17.3	18.6	20.4
Mean	25.2	25.0	24.6	22.5	20.0	17.7	17.6	19.0	20.3	21.3	22.7	24.5

3.1.3 Precipitation

Rainfall represents an effective removal mechanism of atmospheric pollutants and is therefore frequently considered during air pollution studies. Evaporation is a function of ambient temperature, wind and the saturation deficit of the air. Evaporation rates have important implications for the design and implementation of effective dust control programmes. The average rainfall for the Richards Bay area is shown in Table 3-4. Long-term average total annual monthly rainfall is in the range of 57 mm to 172 mm. The study area falls within a summer rainfall region, with ~60 % of the annual rainfall occurring during the October to February period.

Table 3-4: Long term monthly rainfall over the period 1970 – 1990 (SAWS, 1990)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ave rainfall (mm)	172	167	107	109	109	57	60	65	77	105	114	86	1228
Ave no. of rain days	12.4	11.5	9.9	8.4	7.2	5.8	5.9	7.1	9.3	12.0	13.1	11.3	113

3.1.4 Atmospheric Stability

The vertical component of dispersion is a function of the extent of thermal turbulence and the depth of the surface mixing layer. Unfortunately, the mixing layer is not easily measured, and must therefore often be estimated using prognostic models that derive the depth from some of the other parameters that are routinely measured, e.g. solar radiation and temperature. During the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface and the extension of the *mixing layer* to the lowest elevated inversion. Radiative flux divergence during the night usually results in the establishment of ground based inversions and the erosion of the mixing layer. The mixing layer ranges in depth from ground level (i.e. only a stable or neutral layer exists) during night-times to the base of the lowest-level elevated inversion during unstable, day-time conditions.

Atmospheric stability is frequently categorised into one of six stability classes. These are briefly described in Table 3-5.

The atmospheric boundary layer is normally unstable during the day as a result of the turbulence due to the sun's heating effect on the earth's surface. The thickness of this mixing layer depends predominantly on the extent of solar radiation, growing gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. This situation is more pronounced during the winter months due to strong night-time inversions and a slower developing mixing layer. During the night a stable layer, with limited vertical mixing, exists. During windy and/or cloudy conditions, the atmosphere is normally neutral.

Table 3-5: Atmospheric stability classes

A	very unstable	calm wind, clear skies, hot daytime conditions
B	moderately unstable	clear skies, daytime conditions
C	unstable	moderate wind, slightly overcast daytime conditions
D	neutral	high winds or cloudy days and nights
E	stable	moderate wind, slightly overcast night-time conditions
F	very stable	low winds, clear skies, cold night-time conditions

For low level releases, such as due to vehicle entrainment from unpaved roads, the highest ground level concentrations will occur during weak wind speeds and stable (night-time) atmospheric conditions. Wind erosion, on the other hand, requires strong winds together with fairly stable conditions to result in high ground level concentrations i.e. neutral conditions.

3.2 Existing Air Quality

The identification of existing sources of emission in the region and the characterisation of existing ambient pollutant concentrations is fundamental to the assessment of the potential for cumulative impacts and synergistic effects given the proposed operation and its associated emissions.

3.2.1 Existing sources of Air Pollution

Most of the main industrial role-players within the study area are members of the Richards Bay Clean Air Association (RBCAA). Emissions are reported to the RBCAA on a regular basis and included into a dispersion model (Hawk Model) managed by SGS Consultants (previously Ecoserv Consultants).

The emissions inventory compiled by SGS on behalf of the RBCAA is largely limited to particulate and sulphur dioxide emission data and mainly includes the larger industrial operations. Furthermore, the particulate emissions data set is considered incomplete since fugitive dust sources are mainly omitted from the database. Some of the omitted fugitive sources such as the Richards Bay Coal Terminal have been quantified as part of the City of uMhlathuze Spatial Development Framework project which included an Air Quality Study. The main description of the baseline characterisation was taken from this study (Liebenberg-Enslin & Petzer, 2006).

Sources of emission may be categorised in various ways, with distinctions most frequently being made between industrial versus non-industrial sources, point versus area sources, mobile versus stationary sources, and regulated versus un-regulated sources. Existing sources of emissions are discussed in the subsequent sections.

Source types present in the area and the pollutants associated with such source types are noted with the aim of identifying pollutants which may be of importance in terms of cumulative impact potentials.

- Stack, vent and fugitive emissions from industrial operations;
- Fugitive emissions from industrial, mining, commercial and miscellaneous operations;
- Vehicle tailpipe emissions;
- Household fuel combustion;
- Biomass burning (veld fires, forest fires and sugar cane burning);
- Waste treatment facilities (i.e. water treatment plants, landfills, incinerators etc.); and
- Various miscellaneous fugitive dust sources (agricultural activities, wind erosion of open areas, vehicle-entrainment of dust along paved and unpaved roads).

3.2.1.1 Industrial sources

The main industries within the area include BHP Billiton's Bayside and Hillside Aluminium, Mondi Paper and Pulp Mills in Richards Bay and Felixton, Foskor, Tongaat Hulett, Lafarge Cement, Exxaro and Richards Bay Minerals (Figure 3-6). A synopsis of all the industrial and commercial processes identified within the study area is listed in Table 3-6 including the associated pollutants for each process (Liebenberg-Enslin & Petzer, 2006).

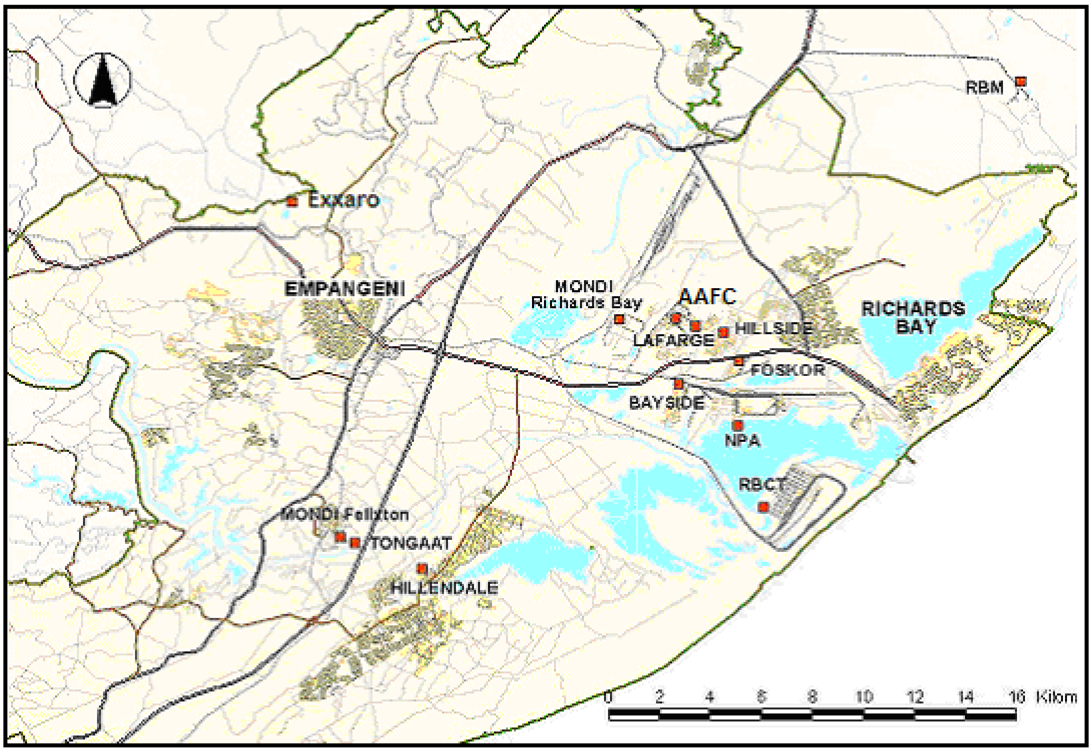

Figure 3-6: Location of all the main industries within the area (after Liebenberg-Enslin & Petzer, 2006)

Table 3-6: All industrial sources within the study area and associated air pollutants

SOURCES	POLLUTANT										
	PM	SO_2	NO_x	HF	NH_3	H_2S	VOC	CO	CO_2	SO_3	Other
Hillside Aluminium	✓	✓		✓			✓	✓	✓		✓
Bayside Aluminium	✓	✓		✓			✓	✓	✓		✓
Mondi Richards Bay	✓	✓	✓			✓	✓	✓	✓		✓
Mondi Felixton		✓					✓	✓	✓		✓
Exxaro	✓	✓	✓					✓			✓
Foskor	✓	✓		✓	✓					✓	
Richards Bay Minerals	✓	✓									
Richards Bay Coal Terminal	✓										
Lafarge Cement	✓										
AAFC (AECI)		✓									
National Ports Authority	✓										
Tongaat-Hullet		✓									
Richards Bay Bulk Storage	✓										
Tata Steel	✓	✓	✓				✓	✓	✓		✓
Pulp United	✓	✓	✓					✓	✓		✓

3.2.1.2 Mining sources

Mining operations within the ULM almost exclusively include mineral sand mining activities. Only two mines are operational within the municipal boundaries namely Ticor Hillendale, and Hlanganani Sandwork Operations. There might be other smaller sandwork operations within the municipality that was not listed. Ticor Fairbreeze and Richards Bay Minerals fall outside the area of impact considered for this study.

3.2.1.3 Transport related emissions

Vehicles, railroad, shipping and the airport are included in this category. The main source of concern around the Richards Bay area is vehicle tailpipe emissions. The main national and provincial highways and roads within the Richards Bay area include the N2 from Durban in the south to north of Empangeni and the R34 (John Ross Highway) between Richards bay and Empangeni. Various main and secondary roads link the rural and urban areas within the municipality.

The main vehicle emissions close to the Mondi Mill are from the John Ross highway (R34) (Liebenberg-Enslin & Petzer, 2006).

3.2.1.4 Biomass burning

Crop-residue burning and general wild fires (veld fires) represent significant sources of combustion-related emissions associated with agricultural areas and forestry. Major pollutants from veld fires are particulates, CO and VOCs. The extent of NO_x emissions depend on combustion temperatures, with minor sulphur oxides being released. Emissions are greater from sugar cane burning than for savannas due to sugar cane areas being associated with a greater availability of existing material to be burned.

3.2.1.5 Waste treatment facilities

Water treatment facilities are most commonly associated with odour emissions. There are currently two water treatment facilities and three landfill sites in the City of uMhlathuzi. Mondi Richards Bay and Mondi Felixton operates their own landfill site and Bayside Aluminium operates an ash disposal facility.

3.2.1.6 Miscellaneous sources

Various miscellaneous fugitive dust sources, including: agricultural activities, wind erosion of open areas, vehicle-entrainment of dust along paved and unpaved roads are found in the area.

3.2.2 Ambient monitored data

3.2.2.1 Inhalable Particulates (PM_{10})

The monitoring network was expanded during 2004 to include the measurement of particulate matter (PM_{10}) at the Civic Centre (CBD) and in 2008 to include Brackenham. The Civic Centre station was relocated to the Central Sports Complex in December 2008. Two additional PM_{10} monitoring stations were installed in 2010, one at Mtunzini and one at St Lucia. Data from the CBD and Brackenham stations are reported on for the period up to the end of 2011 with the other two stations regarded not representative of the area near the Mondi Richards Bay Mill.

The percentage data captured at each station and for the various years are provided in Table 3-7. Given the poor data availability of less than 80% for the years 2007 to 2008 at the CBD and during 2009 at Brackenham, these years are not regarded representative.

The SA NAAQ limit for PM_{10} concentrations is given as 120 µg/m³ for a daily averaging period (not to be exceeded for more than four days per calendar year) and 50 µg/m³ for an annual averaging period (immediate compliance). The standards will become more stringent form the 1st of January 2015 when the limits will reduce to 75 µg/m³ for a daily averaging period (not to be exceeded for more than four days per calendar year), and 40 µg/m³ for an annual averaging period.

Table 3-7: Percentage PM_{10} data capture and annual average concentrations for 2007 – 2010

Monitoring Station	Year	Annual Average Concentration (µg/m³)	Highest Daily Concentration (µg/m³)	Frequency of Exceedance of 75 µg/m³ (days)	Data Availability
2015 NAAQS:		**40 µg/m³**	**75 µg/m³**	**4 days per year**	**>80%[(a)]**
CBD	2007	41	142	N/A	66%
	2008	34	105	3	29%
	2009	29	111	5	93%
	2010	29	99	10	98%
	2011	23	68	0	98%
Brackenham	2008	32	108	9	68%
	2009	35	172	10	78%
	2010	35	80	3	99%
	2011	27	100	1	99%

Notes: N/D – No Data

(a) Based on the US.EPA requirements for compliance monitoring.

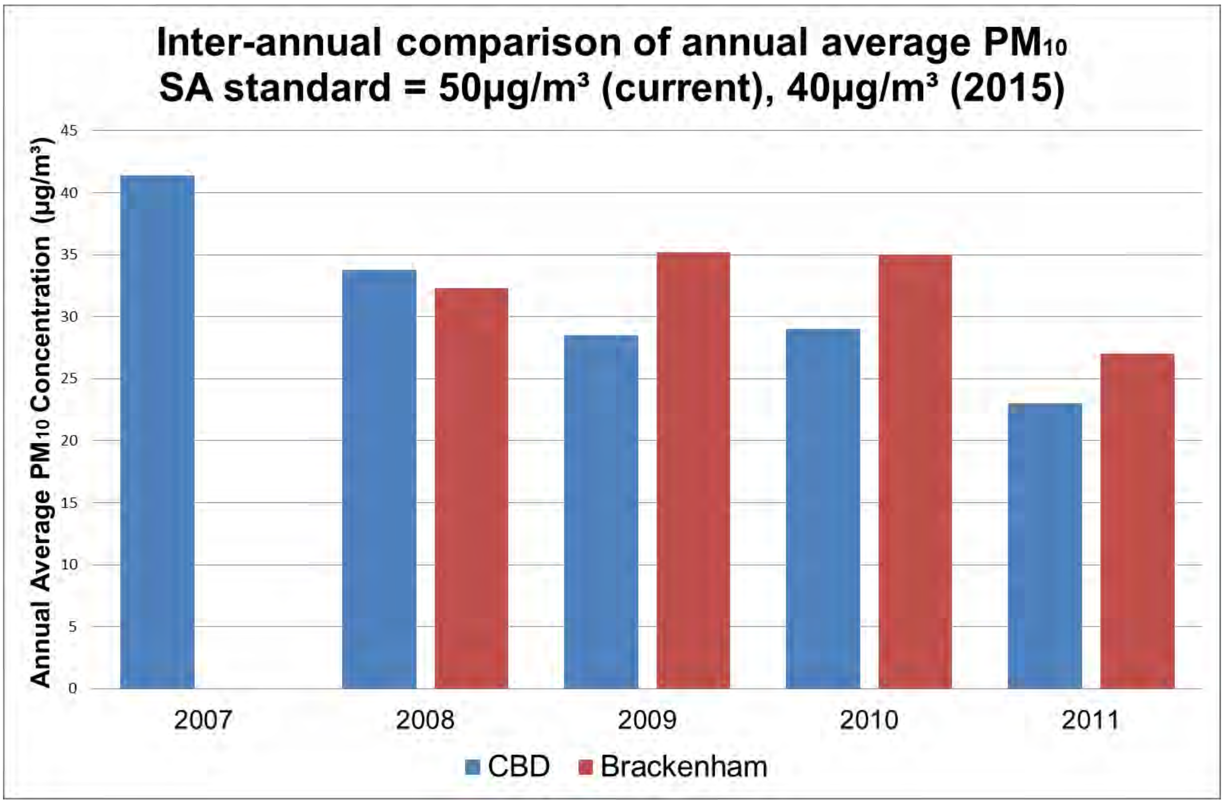

Figure 3-7: Comparison of annual average PM_{10} for the period 2007 - 2011

Annual PM_{10} concentrations measured at the CBD and Brackenham are within the current NAAQS (50 µg/m³) and only exceeded the 2015 standard at the CBD in 2007 (Table 3-7 and Figure 3-7). Data recorded at Brackenham between 2008 and 2011 were below the current (50 µg/m³) and 2015 (40 µg/m³) limit. A slight decrease in ambient PM_{10} annual concentrations is evident at both the CBD and Brackenham during 2011 as shown in Figure 3-7.

For the CBD, the current NAAQ daily limit was exceeded during 2007 with the following years slightly below the limit. When compared against the 2015 limit of 75 µg/m³, only the year 2011 was below the limit at the CBD but only the years 2009 and 2010 were in non-compliance (i.e. exceeded the limit for more than 4 days in the year). At Brackenham all the years (2008 – 2011) exceeded the 2015 NAAQ limit with only the year 2009 exceeding the current NAAQ limit. The years 2008 and 2009 resulted in non-compliance with the 2015 NAAQS. Measured PM_{10} concentrations are therefore in compliance with the current for all the years and with the 2015 NAAQSs during 2011. Maximum daily average PM_{10} concentrations and frequency of exceedances are shown in Table 3-7.

3.2.2.2 Sulphur Dioxide (SO_2)

SGS on behalf of the RBCAA operates and manages five ambient monitoring stations within the study area measuring sulphur dioxide (SO_2). The stations are Brackenham, Arboretum, the Scorpio substation (corner of John Ross Highway and Foskor/West Central Arterial), Harbour West and the Civic Centre (CBD) (see Figure 5-2). The CBD monitoring station is however no longer located at the Civic Centre. The station was relocated to the Central Sports Complex in December 2008.

The subsections that follow briefly discuss measured pollutant concentrations compared to their respective standards to indicate compliance. This information was obtained from SGS.

The SO_2 data capture was reported to be above 80% for all stations as can be seen in Table 3-8.

Table 3-8: Percentage SO_2 data capture for 2007-2011

Station name	SO_2 data capture (%)
Arboretum	92.2 (2007) 88.5 (2008) 97.9 (2009) 97.9 (2010) 99.5 (2011)
Brackenham	95.6 (2007) 94.7 (2008) 97.5 (2009) 97.8 (2010) 99.6 (2011)
CBD	94.8 (2007) 84.1 (2008) 96.7 (2009) 98.8 (2010) 98.1 (2011)
Scorpio	97.3 (2007) 95.9 (2008) 98.9 (2009) 97.3 (2010) 99.7 (2011)
Harbour West	98.9 (2007) 98.0 (2008) 99.8 (2009) 98.8 (2010) 99.7 (2011)

Table 3-9 lists the latest SO_2 averages along with those of 2003 to 2011 for comparison (see also Figure 3-8). An increase in SO_2 concentrations was measured at all monitoring sites from the period 2003 to 2005. The measured SO_2 concentrations decreased from 2005 to 2009, but have shown an increase from 2009 to 2011 at some stations.

The highest annual average SO_2 concentration (2005) was measured at the John Ross/Foskor intersection, which is located closest to major industry (Foskor, Hillside Aluminium and Bayside Aluminium). In 2011 the highest annual average SO_2 concentration was measured at the Harbour West and Scorpio stations, 42% of the NAAQS.

Table 3-9: Comparison of SO_2 annual averages (ppb) (SGS)

Station name	2003	2004	2005	2006	2007	2008	2009	2010	2011
Arboretum	3.6	4.6	6.1	4.1	2.6	2.0	2.4	2.6	3
Brackenham	3.1	4.0	5.4	3.6	1.8	1.4	1.0	1.4	3
CBD	5.3	6.8	7.0	6.2	5.0	4.6	4.1	4.4	4
Scorpio	6.9	10.6	11.9	9.1	8.0	5.7	5.9	7.2	8
Harbour West	-	-	-	8.0	7.8	3.9	8.2	8.6	8

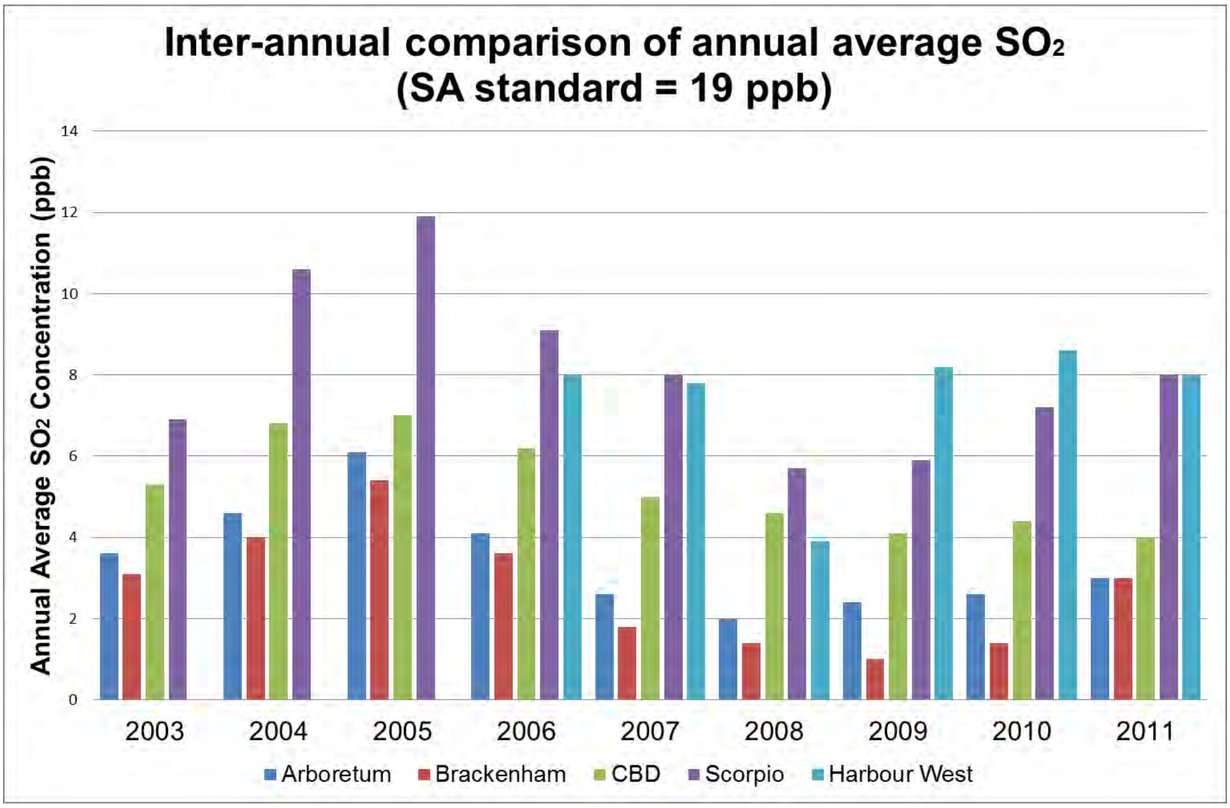

Figure 3-8: Comparison of annual average SO_2 for the period 2003 - 2010

The maximum daily and hourly average SO_2 concentrations measured from 2007 to 2011 are shown in Table 3-10. No daily exceedances were reported for the year 2011, and six hourly exceedances were reported for 2011 at the Scorpio station.

Table 3-10: Highest SO_2 concentrations (ppb) measured at each station for 2007 to 2011 and percentage of NAAQS

Station name	Daily average (48 ppb)		Hourly average (134 ppb)	
	Max SO_2 conc	% NAAQ limit	Max SO_2 conc	% NAAQ limit
Arboretum	14.7 (2007)	31	73.6 (2007)	55
	14.5 (2008)	30	60.0 (2008)	45
	19.0 (2009)	40	60.7 (2009)	45
	19.0 (2010)	39	82.0 (2010)	61
	14 (2011)	30	95 (2011)	71
Brackenham	15.4 (2007)	32	54.0 (2007)	40
	10.0 (2008)	21	133.1 (2008)	99
	12.8 (2009)	27	56.9 (2009)	42
	10 (2010)	21	41 (2010)	30
	13 (2011)	26	61 (2011)	46
CBD	37.9 (2007)	79	115.9 (2007)	87
	29.3 (2008)	61	91.8 (2008)	69
	20.2 (2009)	42	64.1 (2009)	48
	33.7 (2010)	70	72 (2010)	54
	27 (2011)	56	61 (2011)	46
Scorpio	49.8 (2007)	**> 100**	205.1 (2007)	**> 100**
	61.5 (2008)	**> 100**	133.8 (2008)	99.9
	33.1 (2009)	69	133.1 (2009)	99
	52 (2010)	**> 100**	125 (2010)	93
	45 (2011)	93	151 (2011)	**> 100**
Harbour West	53.0 (2007)	**> 100**	244.0 (2007)	**> 100**
	25.4 (2008)	53	84.9 (2008)	99
	133.8 (2009)	**> 100**	1547.4 (2009)	**> 100**
	50 (2010)	**> 100**	150 (2010)	**> 100**
	40 (2011)	**83**	134 (2011)	100

3.2.2.3 Total Reduced Sulphurs

SGS on behalf of the RBCAA operates and manages an ambient TRS monitoring station at the CBD. From 2006 to 2008 TRS was measured at the Civic Centre, the station was relocated to the Central Sports Complex in December 2008. In 2011 the measured TRS 10-minute average concentration exceeded the H_2S odour threshold 409 times. The measured annual average TRS concentration was 1.1 ppb (1.52 µg/m³) while the measured highest daily concentration was 15.9 ppb (22.1 µg/m³). Annual average TRS concentrations for the period 2006 to 2011 are provided in Table 3-11.

Table 3-11:Inter – annual comnparison of measured TRS concentrations at the CBD station.

Year	Annual Average TRS Concentration ppb (µg/m³)
2006	4.6 ppb (6.39 µg/m³)
2007	3 ppb (4.17 µg/m³)
2008	3 ppb (4.17 µg/m³)
2009	1.1 ppb (1.53 µg/m³)
2010	1.2 ppb (1.67 µg/m³)
2011	1.1 ppb (1.53 µg/m³)

3.3 Baseline Modelling

Dispersion models compute ambient concentrations as a function of source configurations, emission strengths and meteorological characteristics, thus providing a useful tool to ascertain the spatial and temporal patterns in the ground level concentrations arising from the emissions of various sources. Increasing reliance has been placed on concentration estimates from models as the primary basis for environmental and health impact assessments, risk assessments and emission control requirements. It is therefore important to carefully select a dispersion model for the purpose.

3.3.1 The HAWK Dispersion Model

The Hawk model is currently utilised by the RBCAA for all dispersion simulations within the greater Richards bay area. This model was also used in the Air Quality Study as part of the Spatial Development Framework (SDF) for the City of uMhlathuze in 2006. The Hawk model was also selected to be used for the current assessment at the Mondi Richards Bay Mill.

The HAWK Real-Time Dispersion Modelling System is an integration of a suite of mathematical models each chosen for its accuracy and practicality to simulate various source configurations, atmospheric structure, buoyant plume rise or cold ('heavy') gas behaviour and the subsequent dispersion and removal processes. The system was initially developed in 1983, and has undergone numerous improvements since then. Application of the model includes both routine emissions and accidental releases.

The wind field model is based on an objective analysis procedure developed by Goodin, McRae and Seinfeld (1980). The principal equation to be solved in this approach is the continuity equation or mass conservation equation. The first step in the solution is to compute any drainage flows and thermodynamic blocking effects of terrain using the empirical procedures suggested by Allwine and Whiteman (1985). Observed (or user defined) wind vectors from each weather station are used to "seed" the initial wind field guess. An iteratively procedure is then employed to solve the continuity equation.

Owing to their wide use, relative simplicity and reasonable accuracy, the Gaussian Puff model has been adopted to simulate neutrally or positively buoyant plumes. In this approach, the plume is represented by the super-positioning of serially released clouds, or puffs. The distribution within each cloud or puff is assumed to be Gaussian, or Normal. The initial phases of negatively buoyant or heavier-than-air releases are simulated with the numerical procedure first introduced by Eidsvick (1980). The set of partial differential equations include horizontal spreading due to gravity, the entrainment of air (initial and vertical) and cloud thermodynamics. A Gaussian Puff is eventually 'fitted' to this model once the cold or heavy cloud has diluted adequately to be represented by a neutral plume.

Input data types required for the Hawk model include: source data, meteorological data, and information on the nature of the receptor grid.

3.3.1.1 Source Data Requirements

The HAWK model is able to model various source types point (stack/chimney/vent), area, line, volume and fire sources. All industrial sources are modelled as point sources.

All sources require emission rates, coordinates, height above sea level and release height of emissions. In addition, point source parameters include stack height, stack diameter, exit temperature and volumetric flow rate. The current emission source information is discussed in the next section.

3.3.1.2 Meteorological Requirements

Meteorological parameters that were included in the Hawk model consisted of pressure, wind speed, wind direction, temperature, precipitation, solar radiation, and humidity. Meteorological data for the period 2011 was used for the dispersion simulations using the HAWK model. SGS provided the data on behalf of the RBCAA.

3.3.1.3 Receptor Grid

A grid of 39 km east-west, and 30 km north-south was used to include industries within the uMhlathuze and Mbonambi municipalities, with 2 043 receptor points over the modelled area.

3.3.2 Model Comparison with Observations

Using the current RBCAA emissions inventory for SO_2 (since it is considered to be the most comprehensive database), a comparison of measured and predicted SO_2 concentrations (SGS, 2012) are presented in Table 3-12

Table 3-12: Comparison of predicted concentrations at the SO_2 monitoring locations due to baseline RBCAA sources.

Monitoring Station	Measured Annual Average Concentration (ppb)	Predicted Annual Average Concentration (ppb) due to RBCAA sources
Arboretum	2.9	5.7
Brackenham	2.6	3.1
CBD	4.1	7.1
Harbour West	8.1	9.9
Scorpio	7.5	10.7

There were no measured or predicted exceedances of the SA annual SO_2 NAAQS (19 ppb) at any of the monitoring stations during 2011. Predicted values were higher than measured values at all stations.

Table 3-13 shows the comparison of predicted PM_{10} concentrations to the measured PM_{10} concentrations. Predicted concentrations are much lower than what was measured during 2011. Due to the partial completeness of the particulate emissions inventory for the study area, it is expected that the observations would be higher than the predicted concentrations.

Table 3-13: Comparison of predicted concentrations at the PM_{10} monitoring locations due to baseline RBCAA sources.

Monitoring Station	Measured Annual Average Concentration (µg/m³)	Predicted Annual Average Concentration (µg/m³) due to RBCAA sources
CBD	23	5.7
Brackenham	27	5.8

The NOx predictions were not compared to the observations since the emissions inventory is not complete.

Table 3-14 shows the comparison of predicted TRS concentrations with the measured TRS concentrations. The predicted highest concentration for the Upper Current Emission scenario is slightly lower than what was measured during 2011. The predicted highest TRS concentration for the Lower Current Emission scenario is significantly lower than the measured TRS concentrations. This is potentially an indication of an observation made during an intermittently higher TRS emission rate.

Table 3-14: Comparison of predicted TRS concentrations at the CBS monitoring station

Measured highest hourly TRS concentration (µg/m³)	Lower Current Emission Scenario		Upper Current Emission Scenario	
	Predicted highest hourly TRS concentration due to Mondi sources ONLY	Mondi contribution to TRS concentration	Predicted highest hourly TRS concentration due to Mondi sources ONLY	Mondi contribution to TRS concentration
15.9 ppb	1.6 ppb	10%	12.2 ppb	77%

4 Impact Assessment

4.1 Emissions Inventory

The establishment of an emissions inventory comprises the identification of sources of emission, and the quantification of each source's contribution to ambient air pollution concentrations. With the focus of this study on Mondi, only the pollutants associated with these processes are included in this assessment. These include particulates (PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2) and oxides of nitrogen (NO_x).

In the quantification of the industrial sources use was made of the RBCAA database for 2011 as provided by SGS whereas the Spatial Development Framework (SDF) project was based on the 2004 RBCAA emissions inventory. The database primarily covers SO_2 and particulate emissions. Mondi provided updated source and emission data that were included in the database as part of this assessment.

In the quantification of emissions from Mondi, use was made of stack monitoring data and design estimates provided by Mondi personnel. Since the particulates reflected in the database are predominantly from point source releases, and most of the industries indicated that they have dust control equipment in place, it was assumed that all particulates are PM_{10} and similarly $PM_{2.5}$ since no fraction is available.

Table 4-1 and Table 4-2 provide the source parameters as applied in the dispersion modelling of the current and future operations at Mondi. The emissions from the stacks were provided by Mondi personnel. Parameters and emission rates that will change due to the proposed upgrade are indicated in bold in Table 4-2.

Table 4-1: Stack parameters and emission rates for current sources at the Mondi Richards Bay Mill

	Lime Kiln	Power Boilers	Recovery Boilers	Gas Turbine
Stack Height (m)	65	75	100	45
Diameter (m)	2.2	3	3.6	2.8
Velocity (m/s)	10.4	15.1	36.3	10.5
Temperature (K)	202.2	190.2	145.2	125.2
Emissions Rate (g/s)				
SO_2	0.064	65.7	37.26	0.139
NO_x	16.034	42	99.5	0.86
PM	0.693	6.95	26.83	0.15

Table 4-2: Stack parameters and emission rates for future sources at the Mondi Richards Bay Mill.

	Lime Kiln	Power Boilers	Recovery Boilers	Gas Turbine
Stack Height (m)	65	75	100	45
Diameter (m)	2.2	3	3.6	2.8
Velocity (m/s)	**16.3**	15.1	**40.2**	10.5
Temperature (K)	202.2	190.2	149.2	125.2
Emissions Rate (g/s)				
SO_2	**0.1**	65.7	**40.872**	0.139
NO_x	**25.077**	42	**109.145**	0.86
PM	**1.084**	6.95	**29.431**	0.15

Table 4-3 and 4-4 indicate the contribution from Mondi to the RBCAA sources, currently and due to the proposed upgrade respectively.

Table 4-3: Total emission rates for all current sources within Richards Bay.

Source Description	Emission Rate (tpa)		
	SO_2	PM	NO_x
Mondi Richards Bay Mill (current sources)	4609	1547	7076
All RBCAA sources (excluding Mondi)	39055	5938	715
TOTAL	**43664**	**7485**	**7791**
Mondi percentage of Total	10.6%	20.7%	90.8%

The RBCAA does not keep a complete emissions inventory for NO_x. Impacts from NO_x emissions from the Mondi Richards Bay Mill will therefore only be assessed incrementally.

Table 4-4: Total emission rates for all future sources within Richards Bay.

Source Description	Emission Rate (tpa)		
	SO_2	PM	NO_x
Mondi Richards Bay Mill (current sources)	4772	1680	7911
All RBCAA sources (excluding Mondi)	39055	5938	715
TOTAL	**43827**	**7619**	**8626**
Mondi percentage of Total	10.9%	22.1%	91.7%

The increase in emission rate, both cumulatively and incrementally, due to the proposed upgrade at the Mondi Richards Bay Mill are shown in Table 4-5:

Table 4-5: Increase in emission rates due to proposed Mondi Richards Bay Mill upgrade

	Pollutant		
	SO_2	PM	NO_x
Increase in emissions rate due to proposed Mondi Richards Bay Mill upgrade	163 t/a	134 t/a	835 t/a
Percentage increase relative to current Mondi sources	3.5%	8.6%	11.8%
Percentage increase relative to all RBCAA sources	0.4%	1.8%	10.7%

4.1.1 TRS emissions

TRS impacts were evaluated for a lower and upper emission rate scenario. This was done in order to simulate routine and upset/intermittent emissions. Actual TRS emissions will likely fall somewhere between these two estimates.

TRS emissions from the Mondi Richards Bay mill are estimated to increase by approximately ~1 ton/annum due to the proposed upgrade. The TRS emissions, using the Upper Estimate scenario, are therefore estimated to increase by ~0.6% while using the Lower Estimate scenario, are estimated to increase by 3.5%. The estimated TRS emission rates are presented in Figure 4-6.

Table 4-6: Estimated current and future TRS emission rates

Source Description	Lower Current Emission Scenario	Upper Current Emission Scenario
All **current** Mondi Richards Bay mill sources	0.90 g/s (28.38 t/a)	5.03 g/s (158.63 t/a)
All **future** Mondi Richards Bay mill sources	0.93 g/s (29.32 t/a)	5.07 g/s (159.89 t/a)

4.2 Dispersion Model Results

Dispersion simulations were conducted for current conditions due to all RBCAA sources and due to current Mondi emissions only. Incremental impacts due to all sources associated with the proposed Mondi Richards Bay Mill upgrade are also presented.

4.2.1 PM_{10} Concentrations

Predicted highest daily ground level concentrations (GLCs) for PM_{10} are provided in isopleth plots (Figures 4-1 to 4-3) for all RBCAA sources, current Mondi sources and future Mondi sources. Annual average PM_{10} concentrations are depicted in Figures 4-4 to 4-6 for the same three scenarios as for highest daily concentrations.

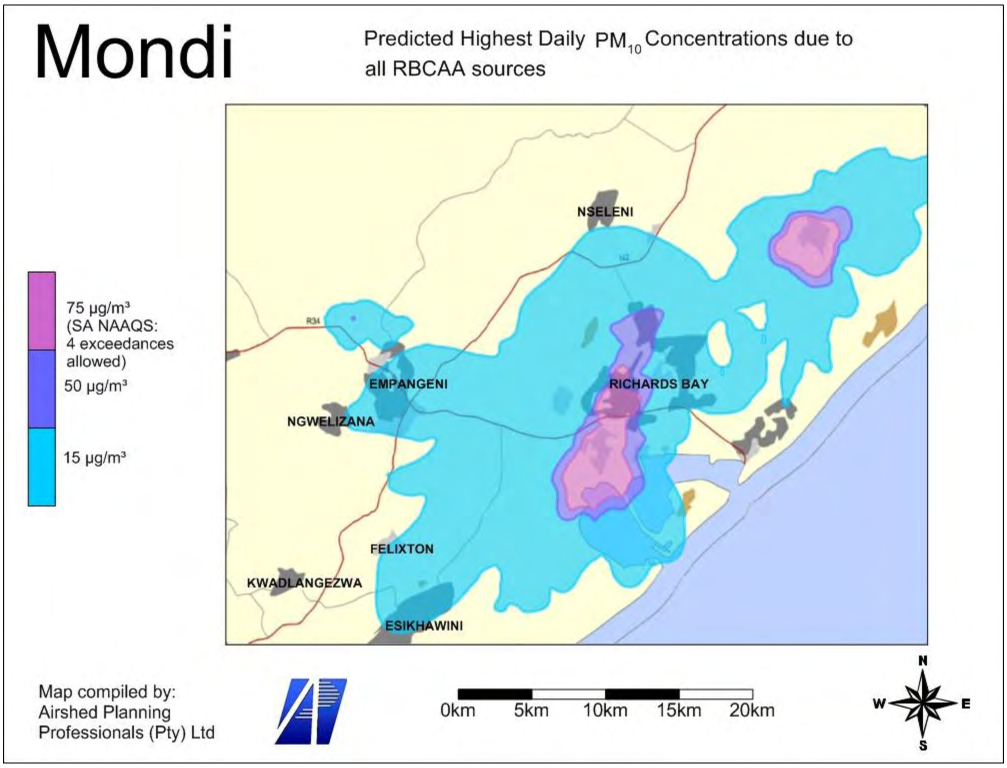

Figure 4-1: Predicted highest daily PM_{10} concentrations (µg/m³) due to all current RBCAA sources.

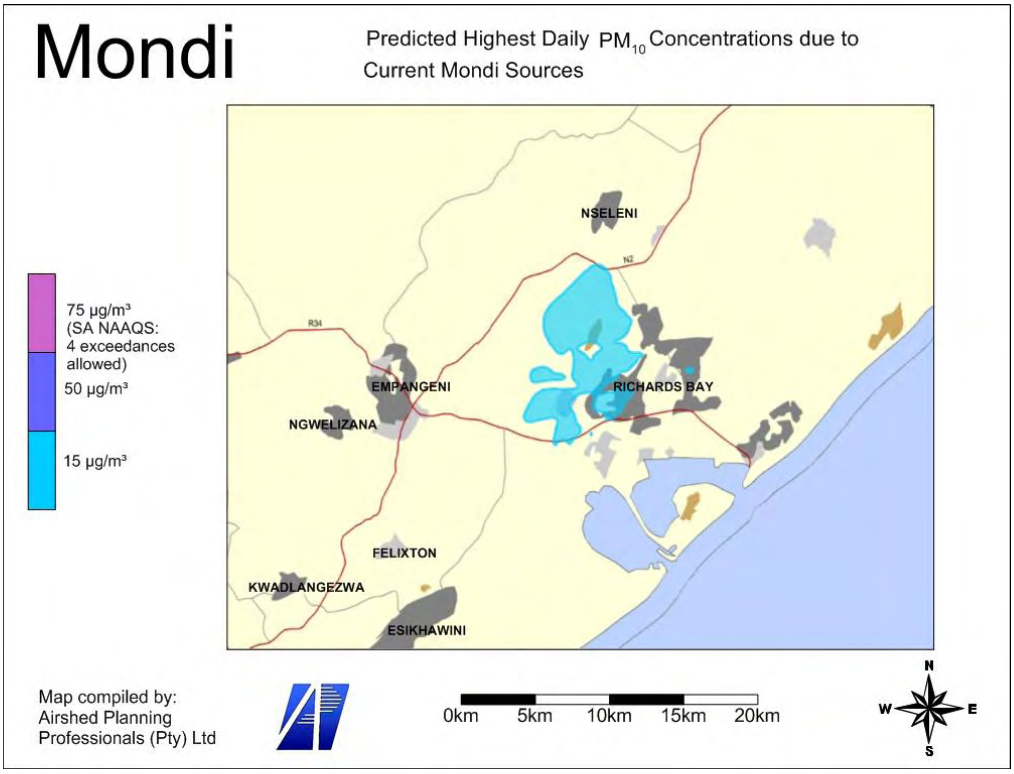

Figure 4-2: Predicted highest daily PM_{10} concentrations (µg/m³) due to current Mondi Richards Bay Mill operations.

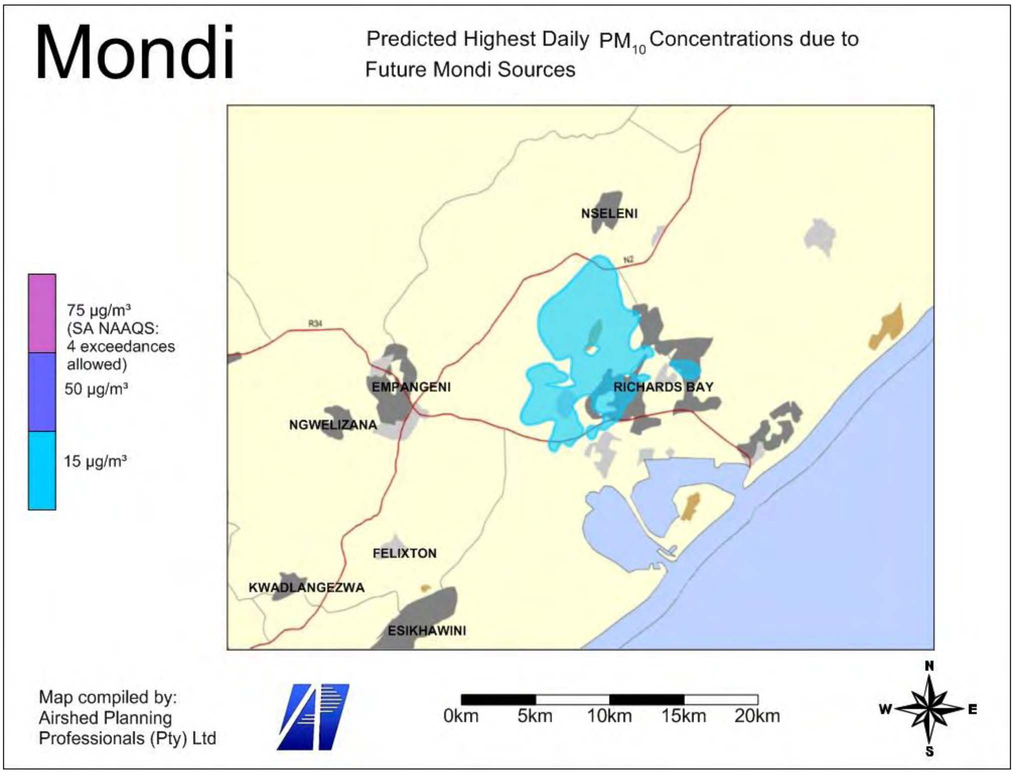

Figure 4-3: Predicted highest daily PM_{10} concentrations (µg/m³) due to future Mondi Richards Bay Mill operations.

Both highest daily and annual average ground level PM_{10} concentrations are predicted to be slightly higher in the vicinity of the Mondi Richards Bay Mill due to the Mondi upgrade. Spatially however the areas where the SA daily and annual PM_{10} NAAQS are predicted to be exceeded remain unchanged due to the upgrade at the Mondi Mill.

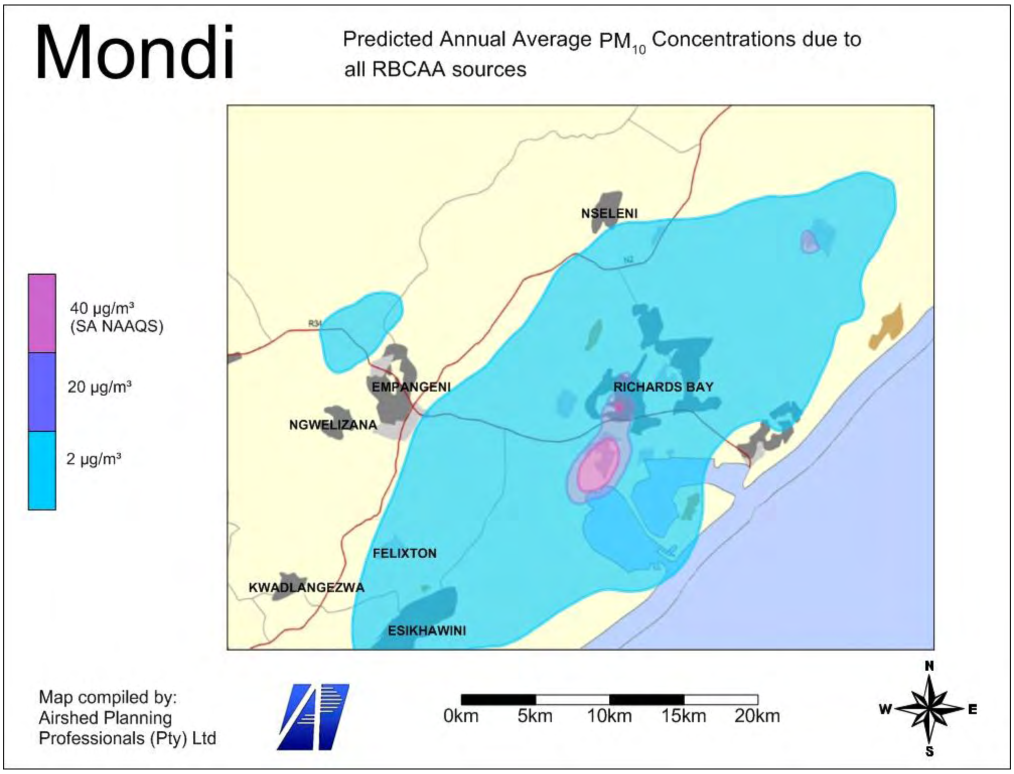

Figure 4-4: Predicted annual average PM_{10} concentrations (µg/m³) due to all current RBCAA sources.

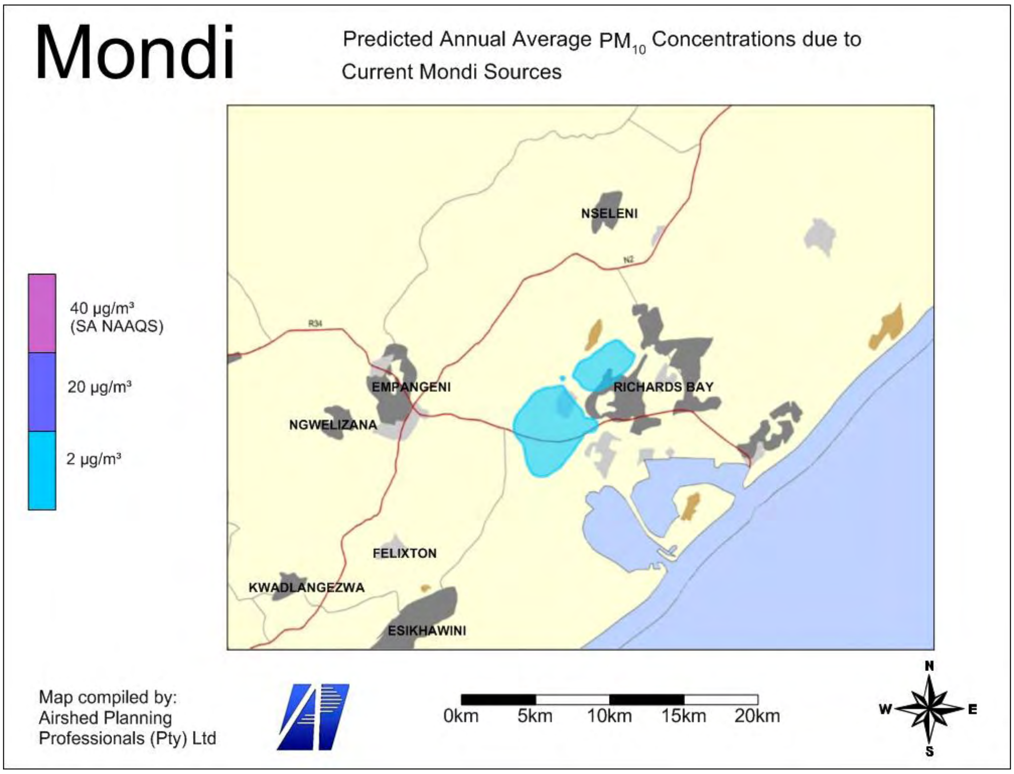

Figure 4-5: Predicted annual average PM_{10} concentrations (µg/m³) due to all current Mondi sources.

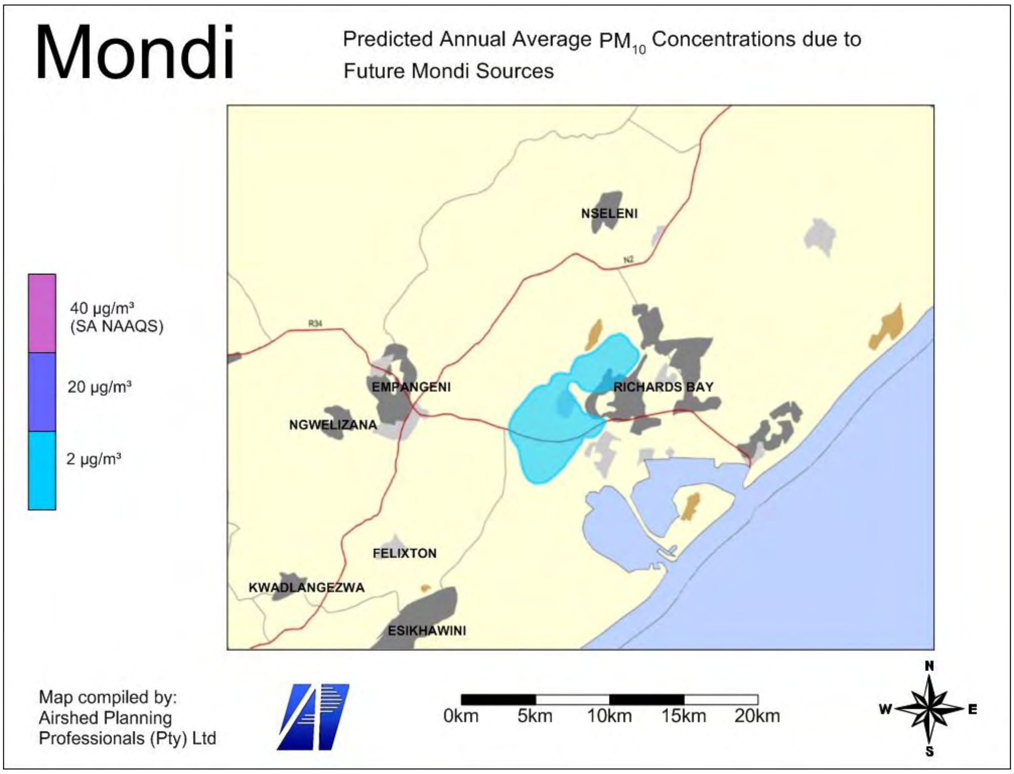

Figure 4-6: Predicted annual average PM_{10} concentrations (µg/m³) due to all current RBCAA sources.

4.2.2 $PM_{2.5}$ Concentrations

Predicted highest daily ground level concentrations (GLCs) for $PM_{2.5}$ are provided in isopleth plots (Figures 4-7 to 4-9) for all RBCAA sources, current Mondi sources and future Mondi sources. Annual average $PM_{2.5}$ concentrations are depicted in Figures 4-10 to 4-12 for the same three scenarios as for highest daily concentrations.

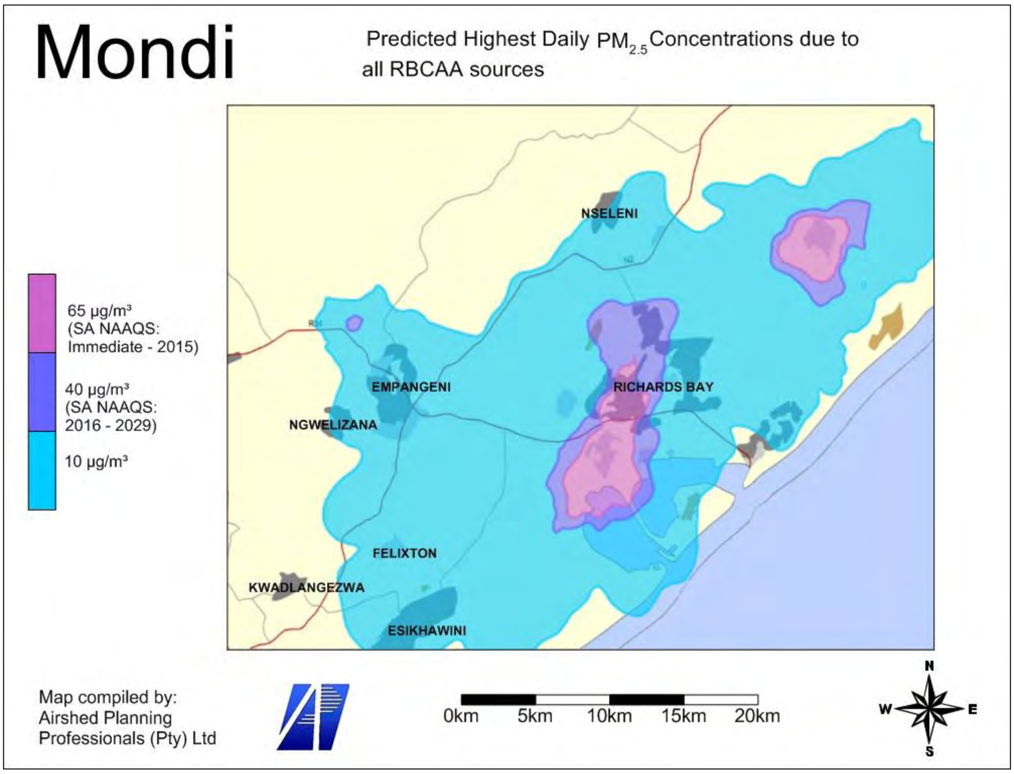

Figure 4-7: Predicted highest daily $PM_{2.5}$ concentrations (µg/m³) due to all current RBCAA sources.

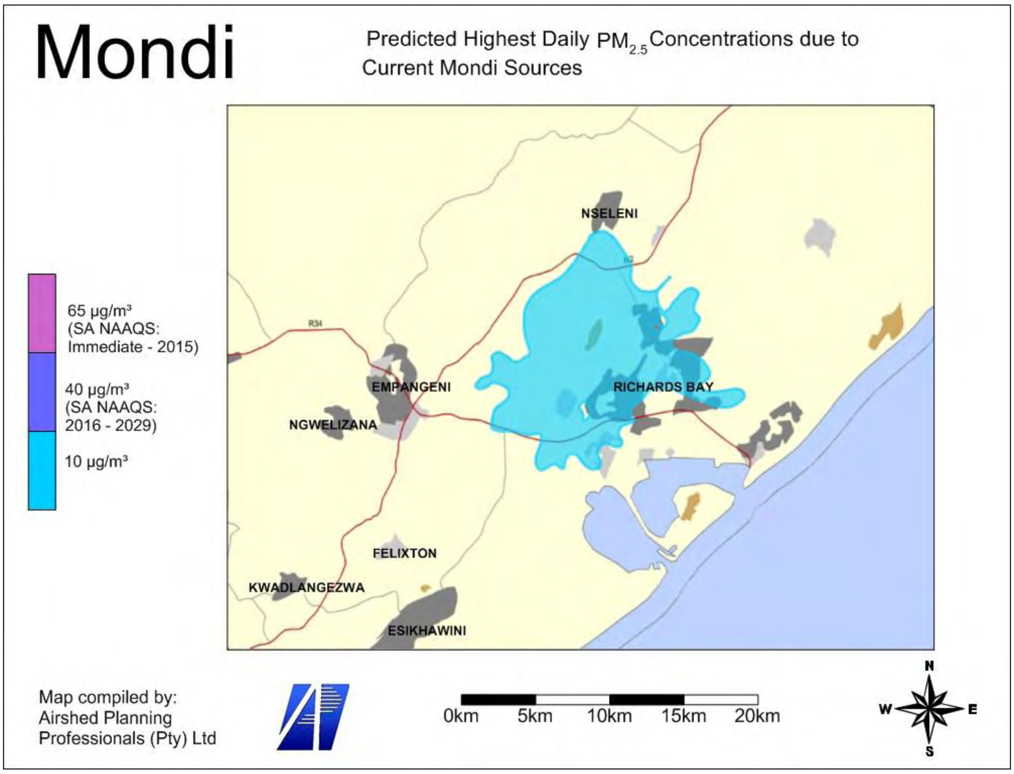

Figure 4-8: Predicted highest daily $PM_{2.5}$ concentrations (µg/m³) due to current Mondi Richards Bay Mill operations.

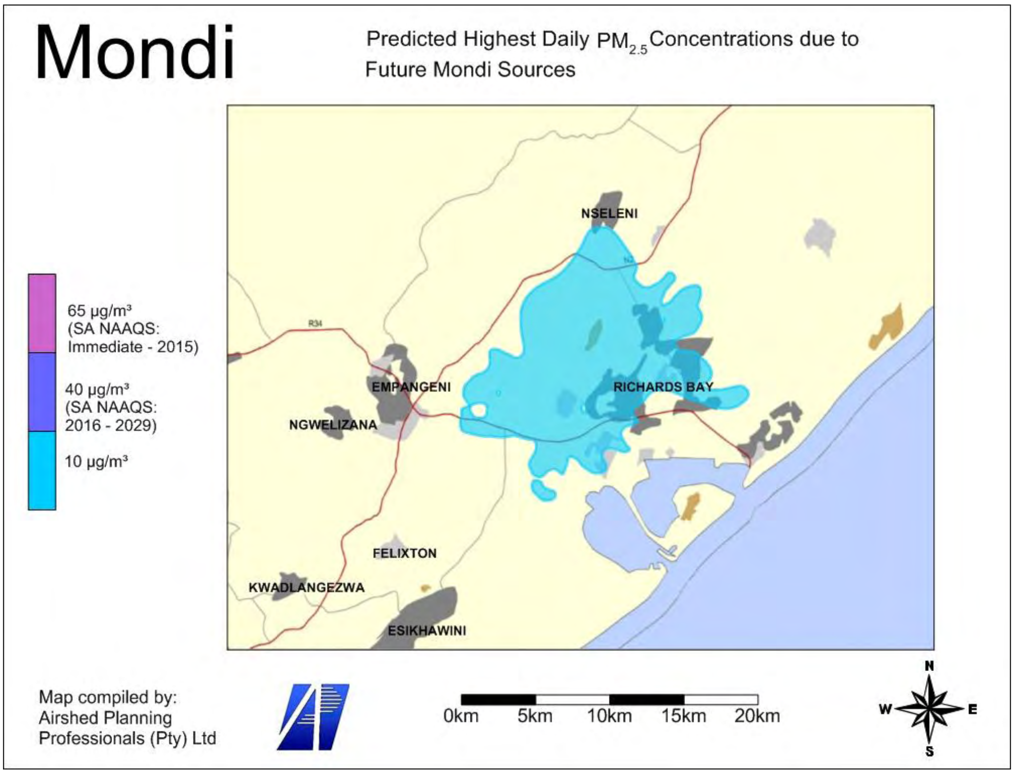

Figure 4-9: Predicted highest daily $PM_{2.5}$ concentrations (µg/m³) due to future Mondi Richards Bay Mill operations.

Both highest daily and annual average ground level $PM_{2.5}$ concentrations are predicted to be slightly higher in the vicinity of the Mondi Richards Bay Mill due to the Mondi upgrade. Spatially however the areas where the new SA daily and annual $PM_{2.5}$ NAAQS are predicted to be exceeded remain unchanged due to the upgrade at the Mondi Richards Bay Mill.

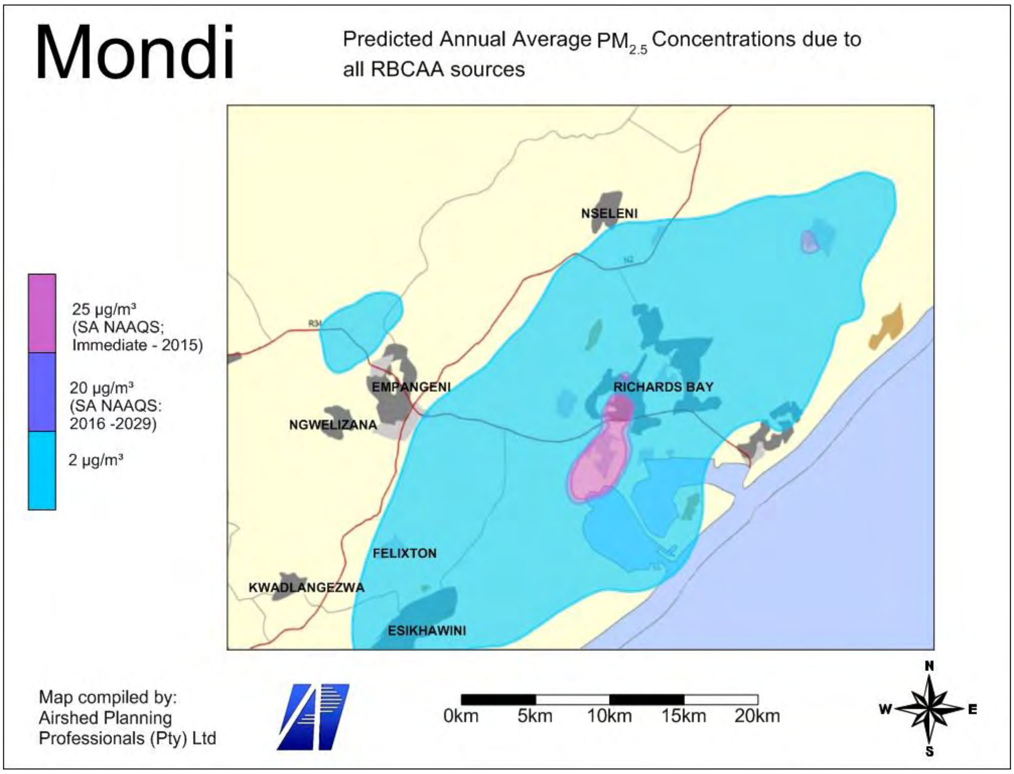

Figure 4-10: Predicted annual average $PM_{2.5}$ concentrations (µg/m³) due to all current RBCAA sources.

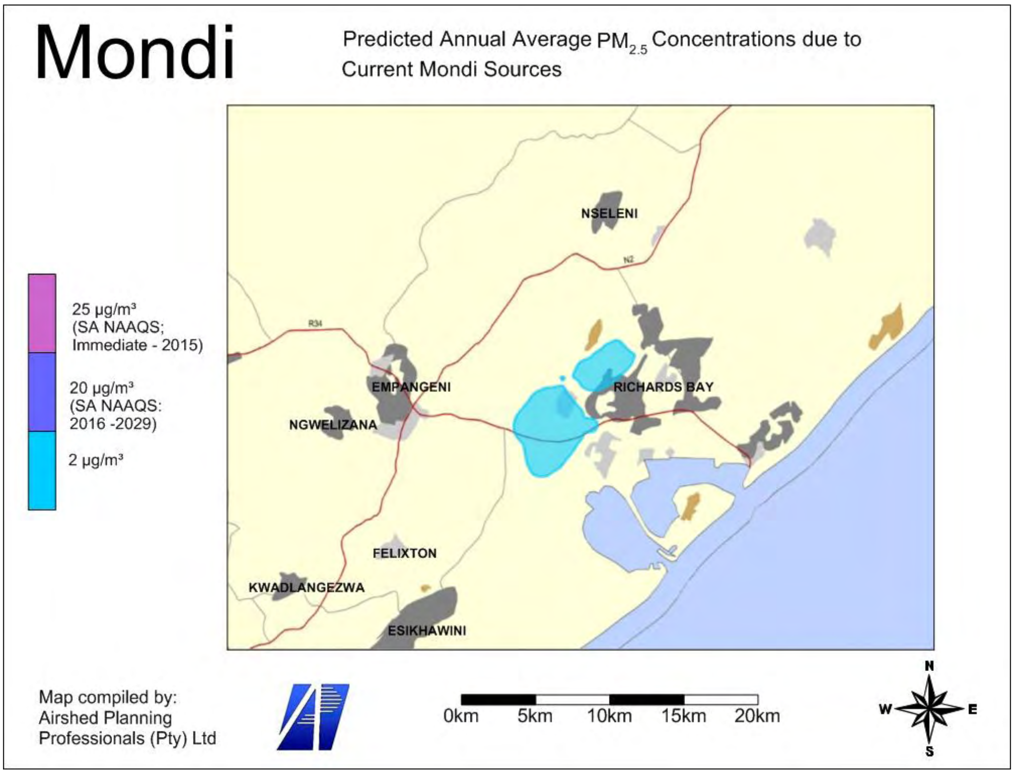

Figure 4-11: Predicted annual average $PM_{2.5}$ concentrations (µg/m³) due to all current Mondi sources.

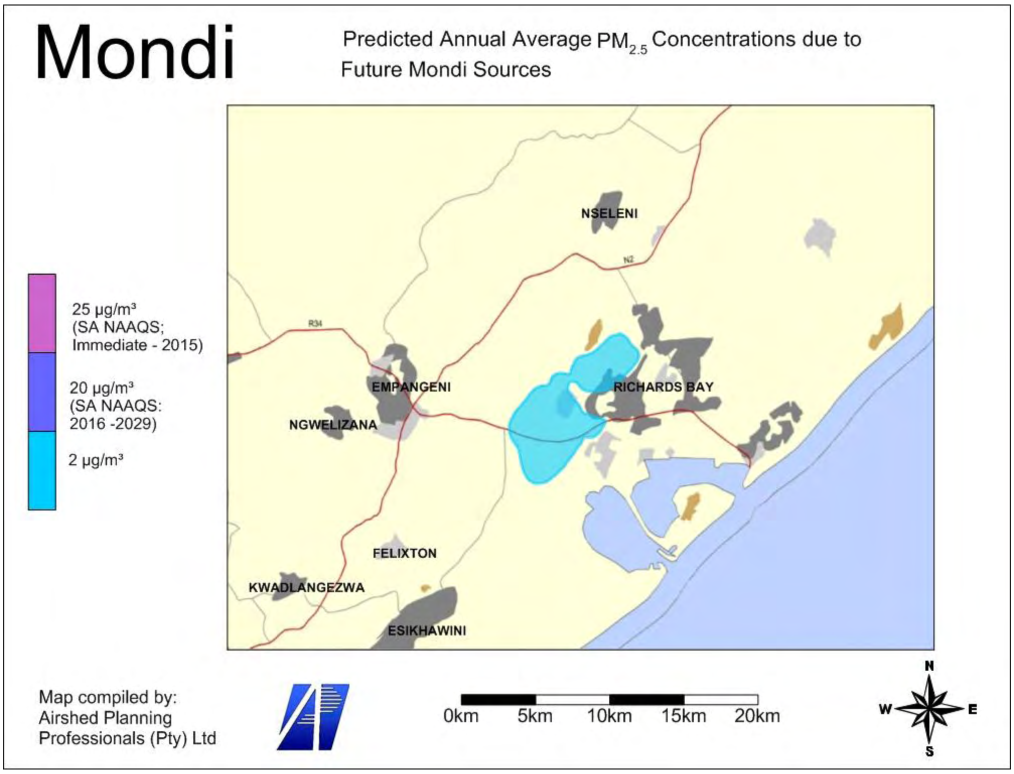

Figure 4-12: Predicted annual average $PM_{2.5}$ concentrations (µg/m³) due to all future Mondi sources.

4.2.3 SO_2 Concentrations

Predicted highest hourly ground level concentrations (GLCs) for SO_2 are provided in isopleth plots (Figures 4-13 to 4-15) for all RBCAA sources, current Mondi sources and future Mondi sources. Highest daily SO_2 concentrations are depicted in Figures 4-16, 4-18 and 4,19. Annual average concentrations are shown in Figures 4-17, 4-20 and 4-21.

Highest hourly, highest daily and annual average ground level SO_2 concentrations are predicted to remain almost unchanged after the Mondi Richards Bay mill upgrade.

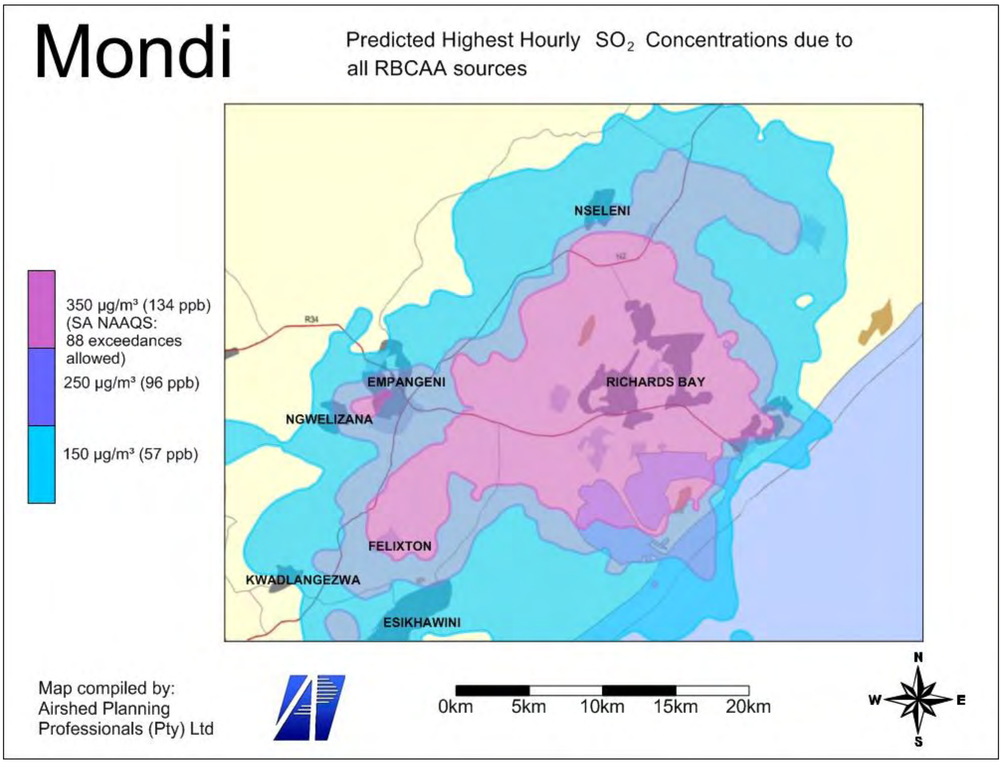

Figure 4-13: Predicted highest hourly SO_2 concentrations (µg/m³) due to all current RBCAA sources.

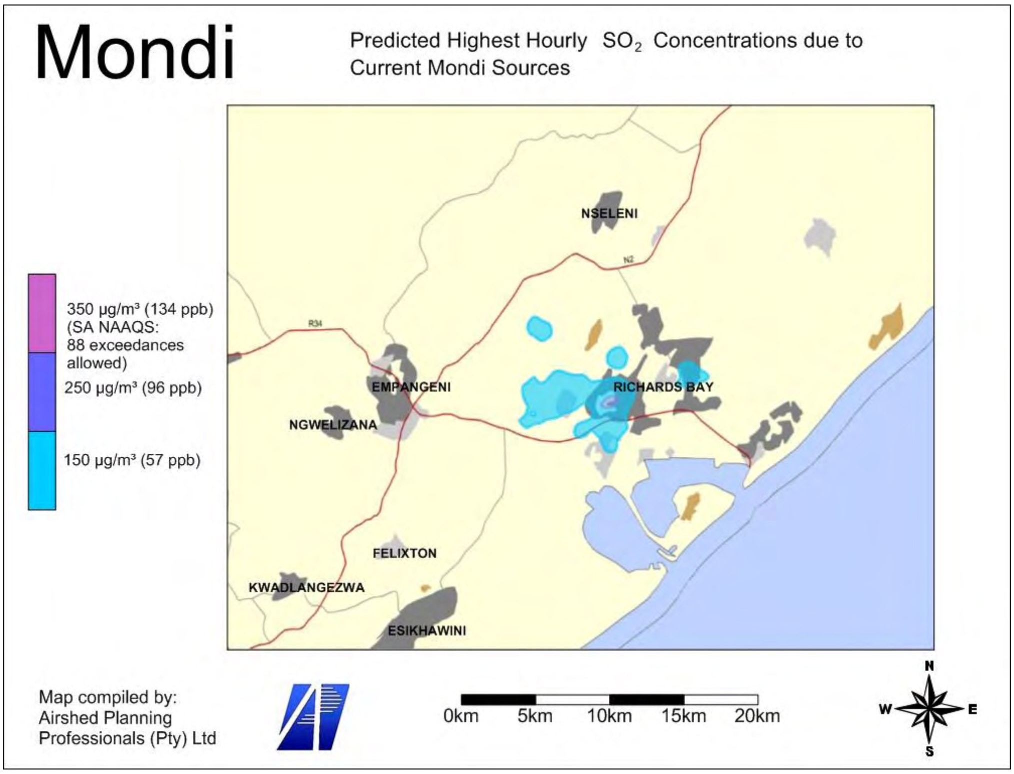

Figure 4-14: Predicted highest daily SO_2 concentrations (µg/m³) due to current Mondi Richards Bay Mill operations.

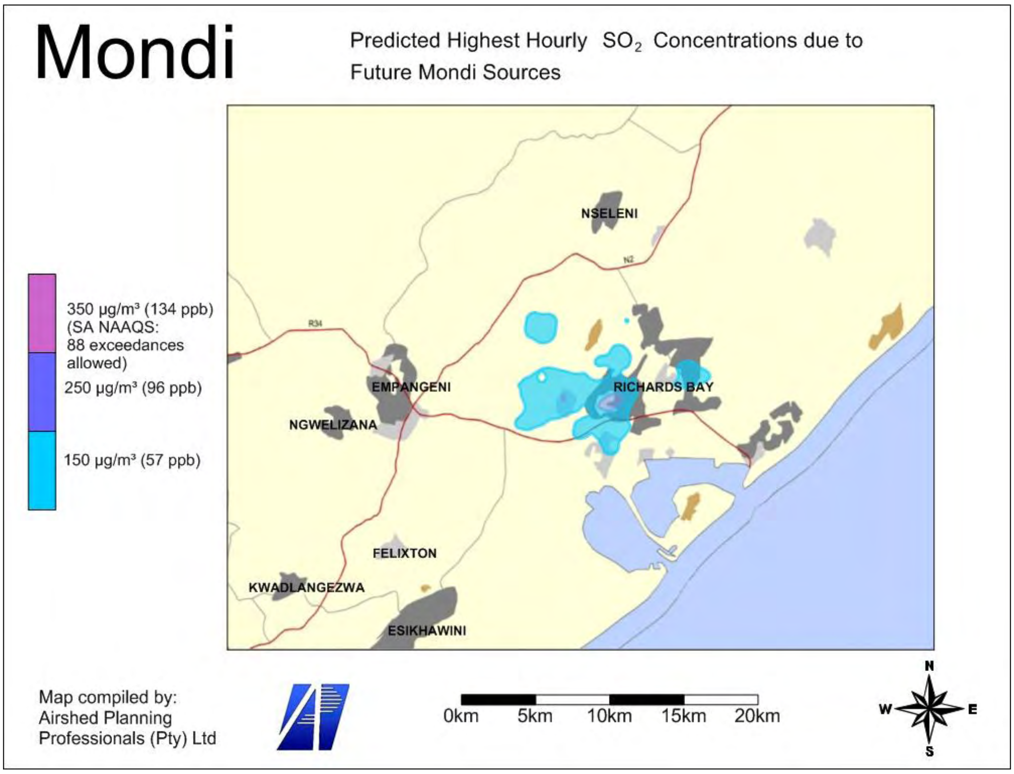

Figure 4-15: Predicted highest daily SO_2 concentrations (µg/m³) due to future Mondi Richards Bay Mill operations.

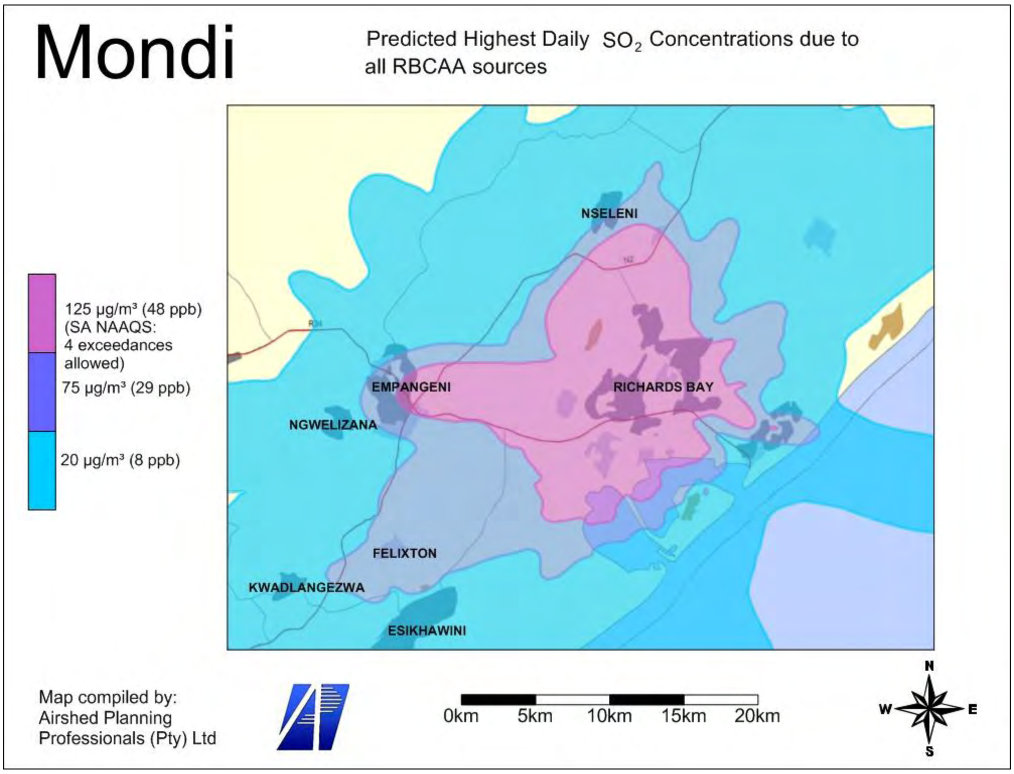

Figure 4-16: Predicted highest daily SO_2 concentrations (µg/m³) due to all current RBCAA sources.

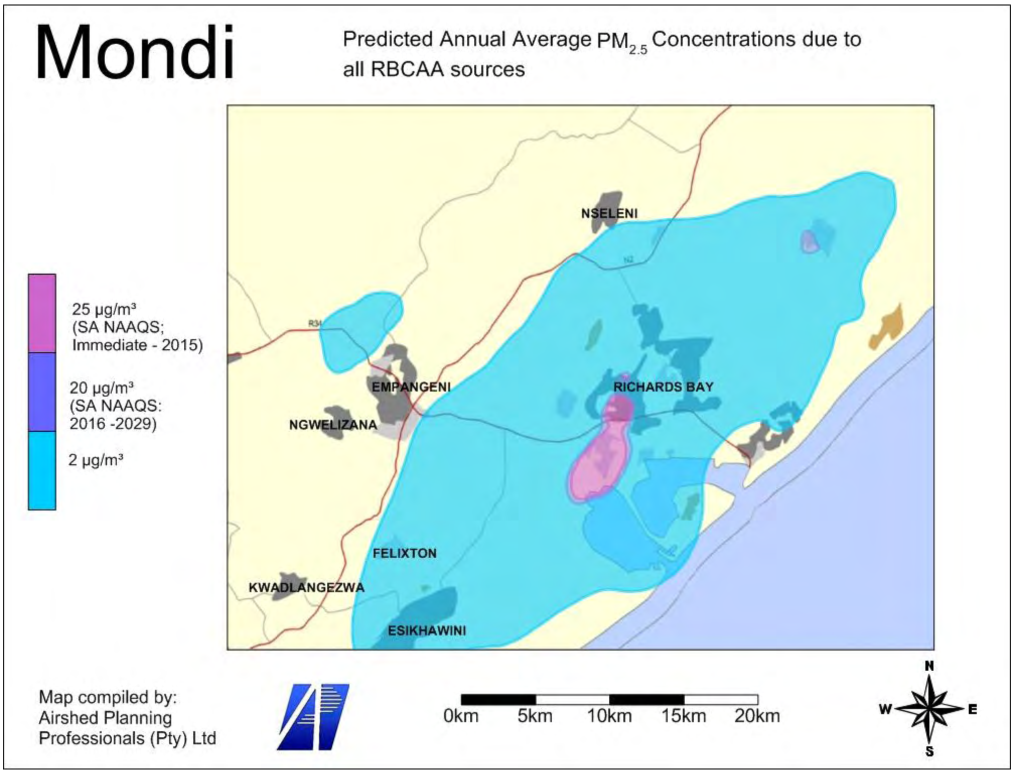

Figure 4-17: Predicted annual average SO_2 concentrations (µg/m³) due to all current RBCAA sources.

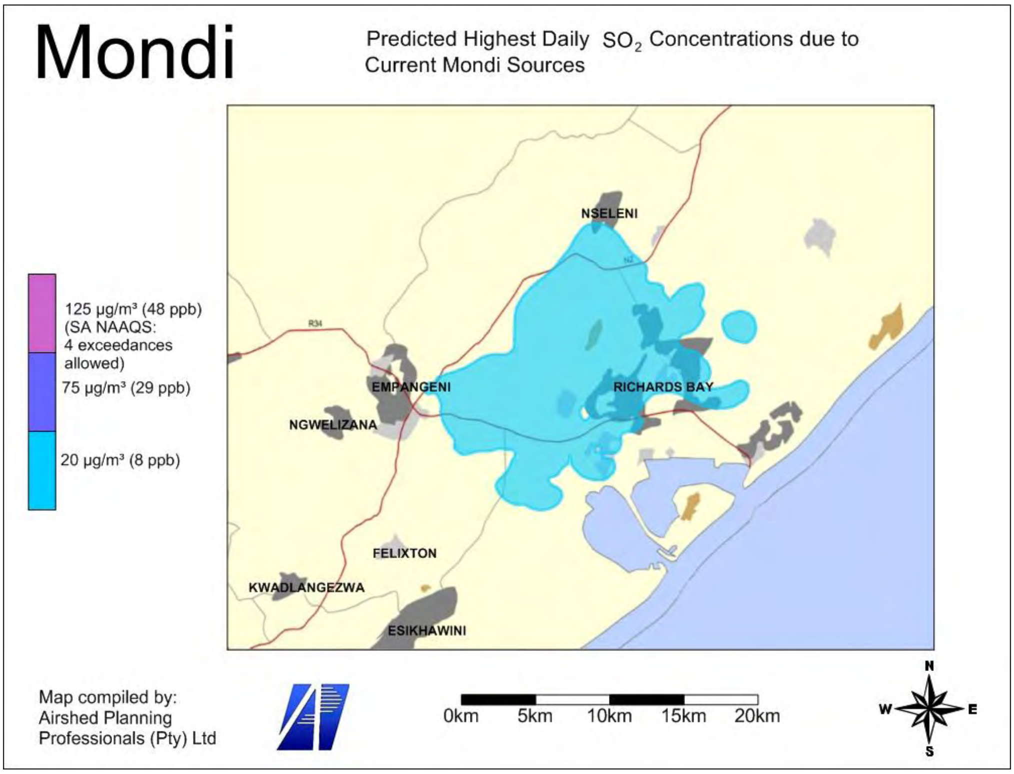

Figure 4-18: Predicted highest daily SO_2 concentrations (µg/m³) due to all current Mondi sources.

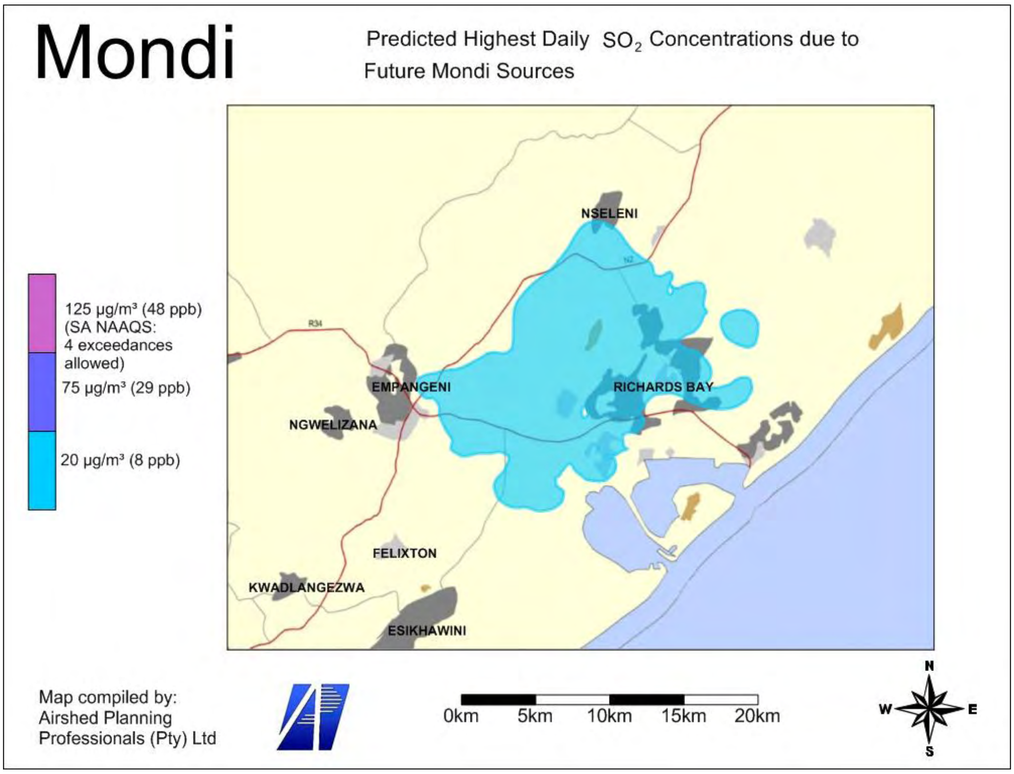

Figure 4-19: Predicted highest daily SO_2 concentrations (µg/m³) due to all future Mondi sources.

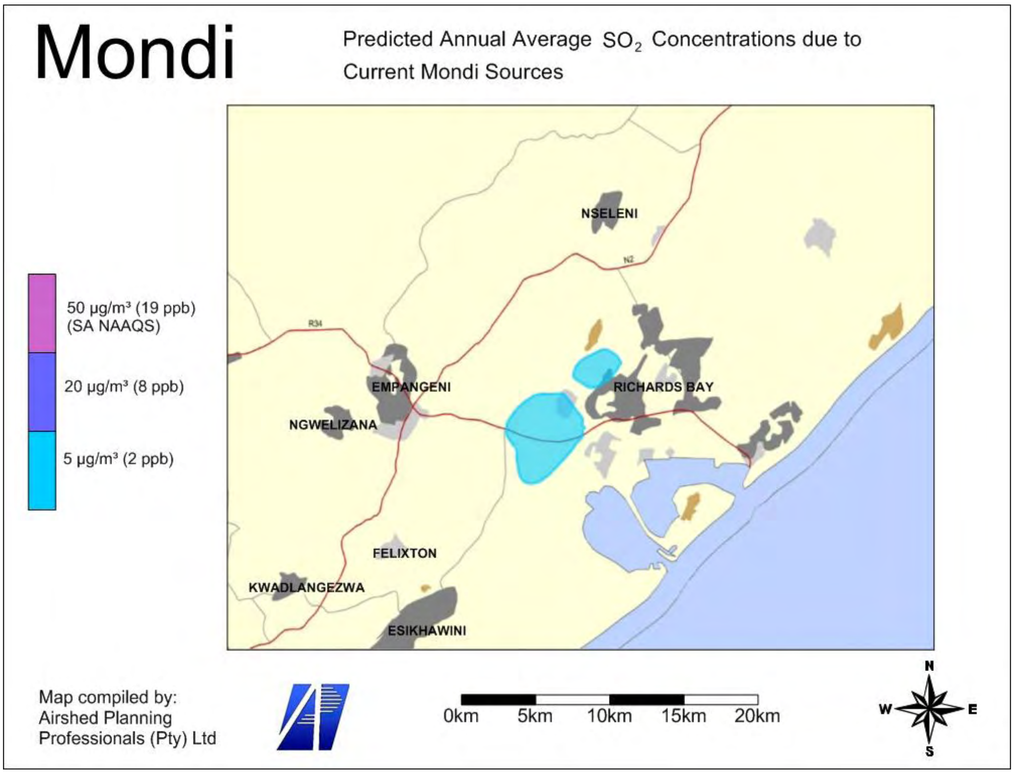

Figure 4-20: Predicted annual average SO_2 concentrations (µg/m³) due to all current Mondi sources.

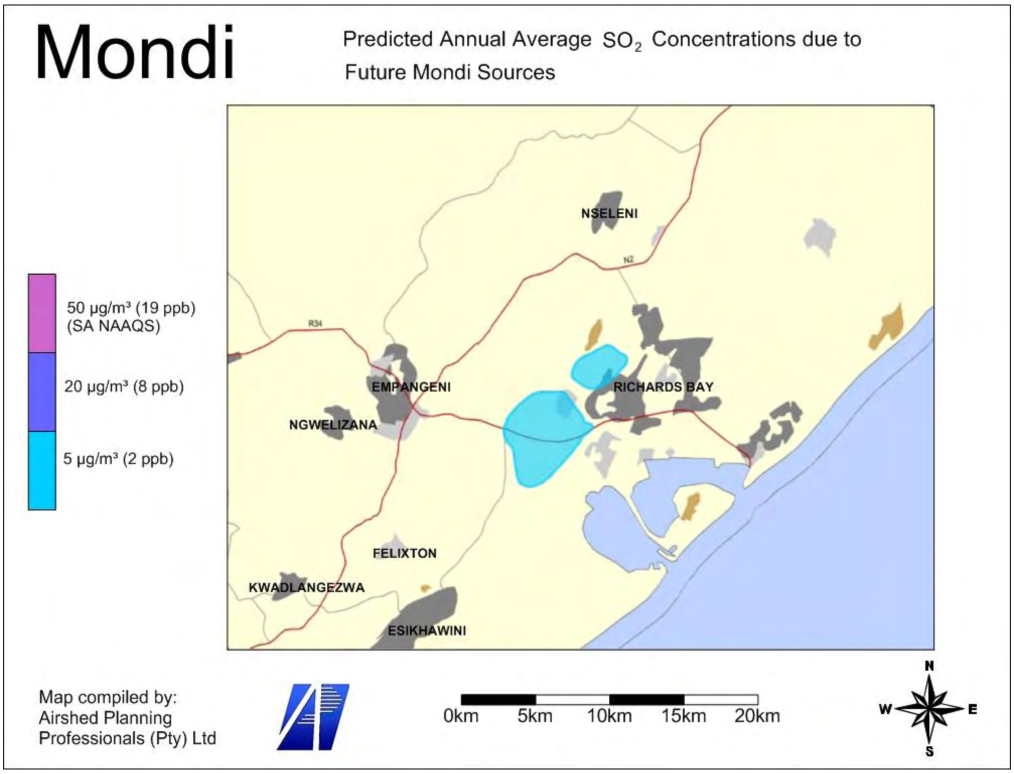

Figure 4-21: Predicted annual average SO_2 concentrations (µg/m³) due to all future Mondi sources.

4.2.4 NO_x Concentrations

Predicted highest hourly ground level concentrations (GLCs) for NO_x are provided in isopleth plots (Figures 4-22 to 4-23) for all current Mondi sources and future Mondi sources. Annual average NO_x concentrations are depicted in Figures 4-24 to 4-25 for the same scenarios.

Highest hourly NO_x concentrations are predicted to increase slightly, but the SA hourly NAAQS are not predicted to be exceeded during either the current or future scenarios. Although future annual average NO_x concentrations are slightly higher than current concentrations, ground level NO_x concentrations are predicted to be well below the SA annual NAAQS.

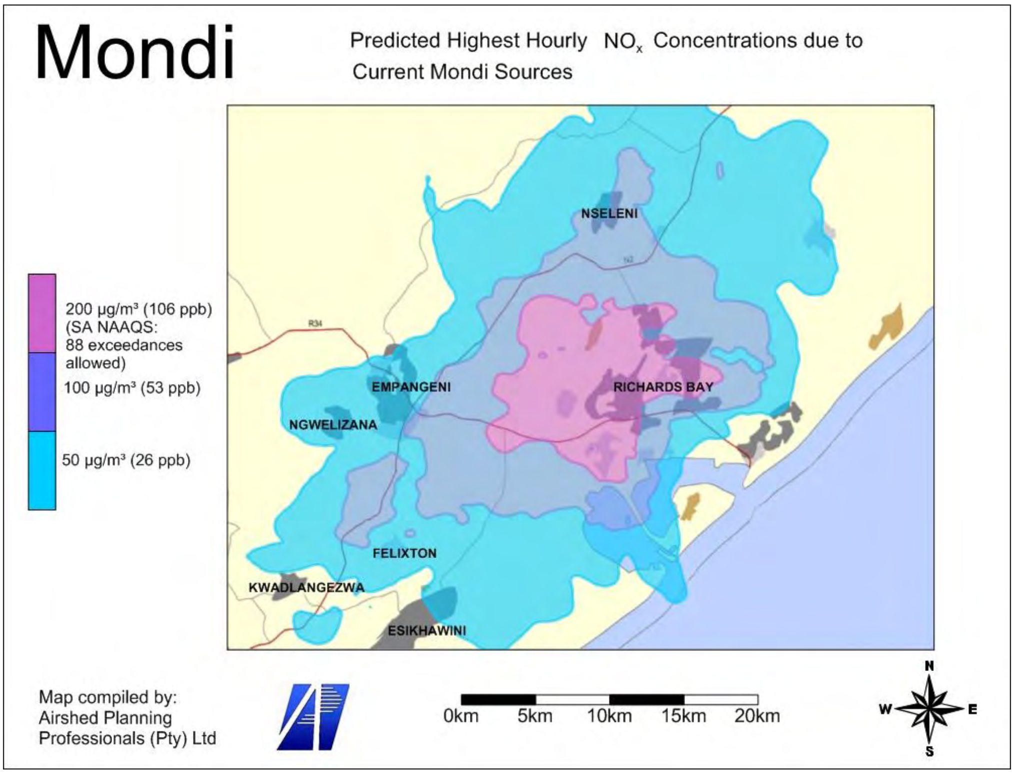

Figure 4-22: Predicted highest hourly NO_x concentrations (µg/m³) due to current Mondi Richards Bay Mill operations.

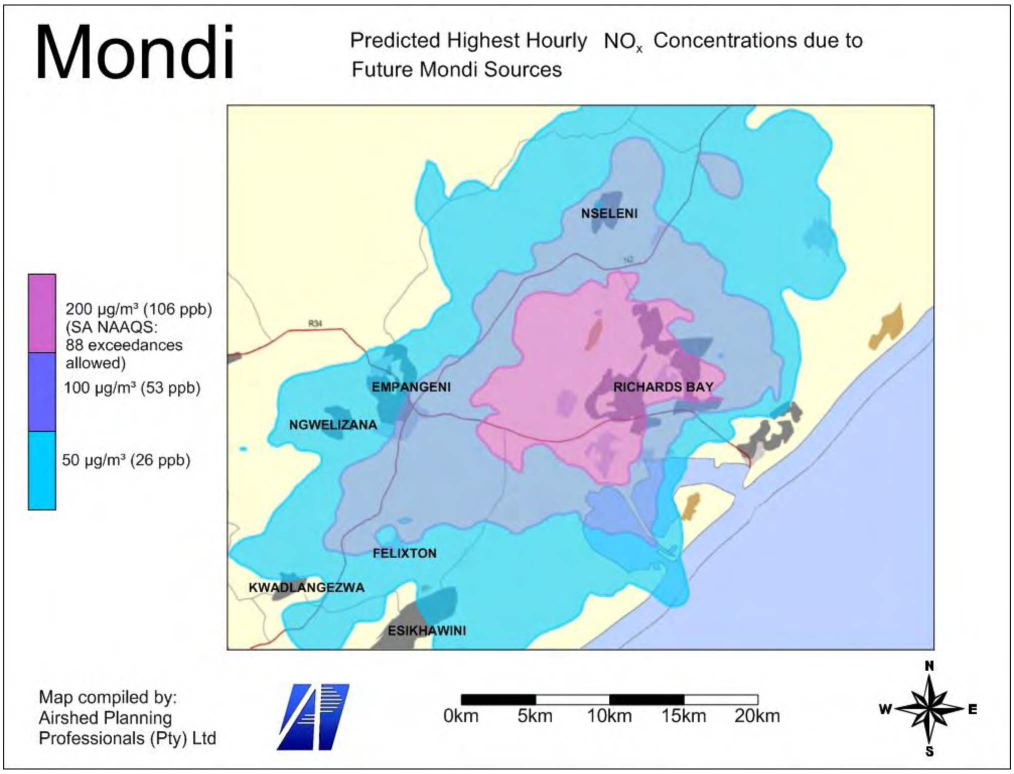

Figure 4-23: Predicted highest hourly NO_x concentrations (µg/m³) due to future Mondi Richards Bay Mill operations.

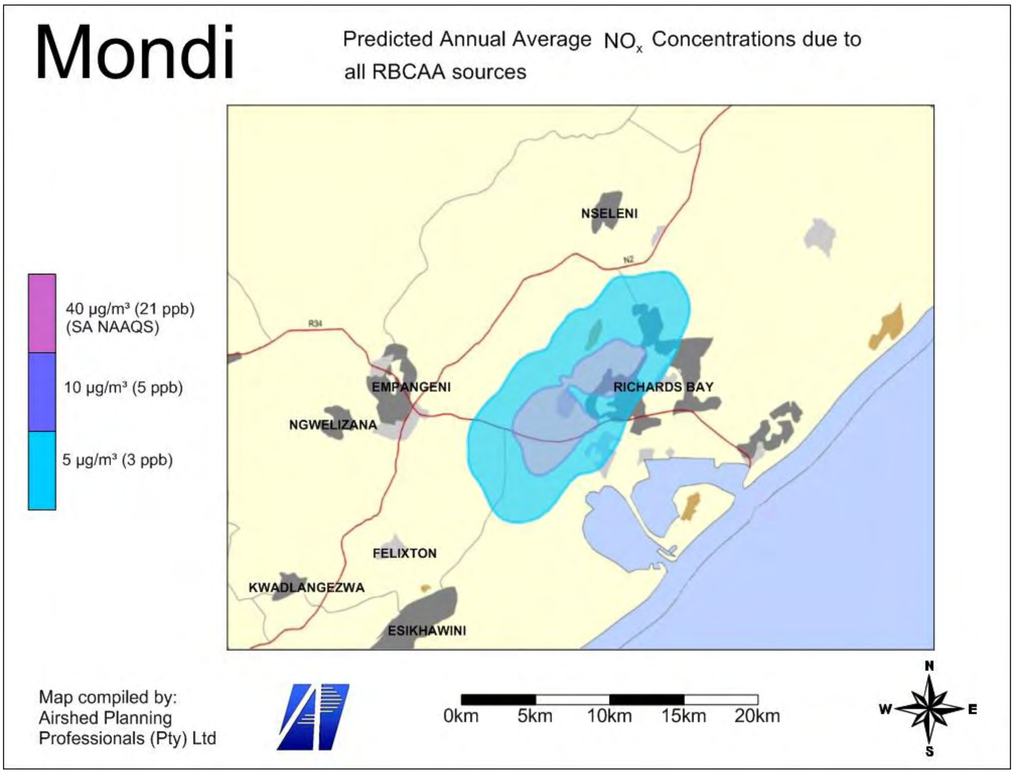

Figure 4-24: Predicted annual average NO_x concentrations (µg/m³) due to all current Mondi sources.

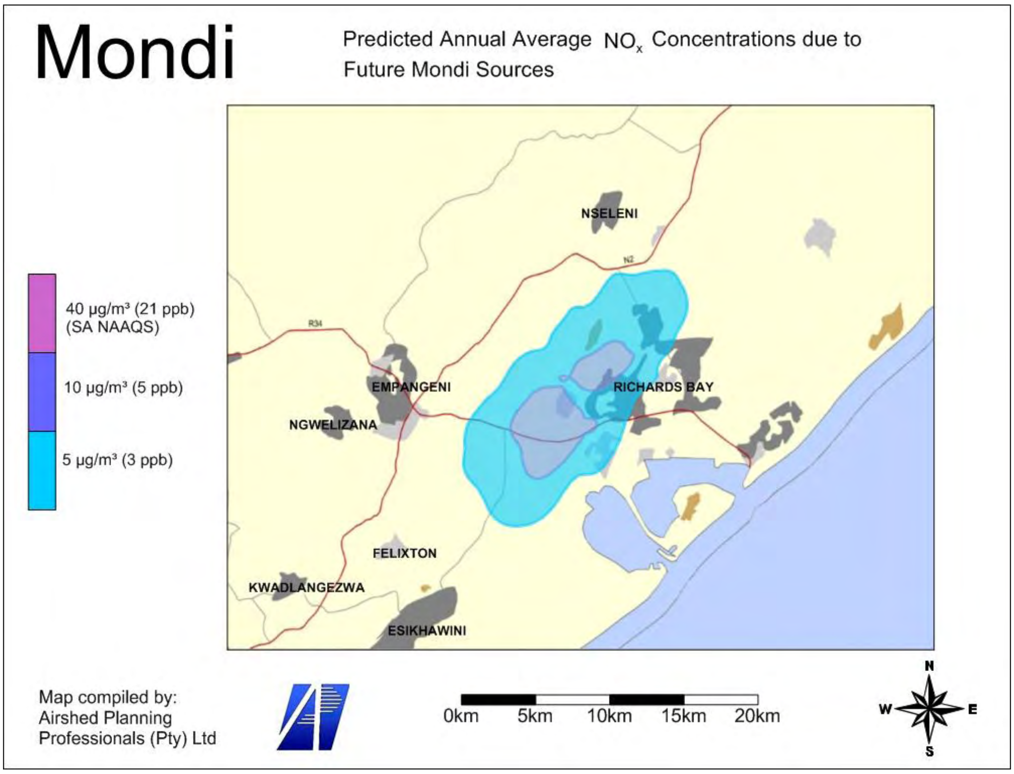

Figure 4-25: Predicted annual average NO_x concentrations (µg/m³) due to all future Mondi sources.

4.2.5 TRS Concentrations

Predicted highest hourly ground level concentrations (GLCs) for TRS are provided in isopleth plots (Figures 4-22 to 4-23) for current Mondi sources and future (i.e. following the proposed upgrade) Mondi sources.

Ground level TRS concentrations are predicted to be slightly higher after the upgrade, for both the Lower and Higher Emissions Estimate scenarios. The spatial extent of impacts is predicted to increase, with more of the industrial area and Acton experiencing exceedances of the H_2S 50% recognition odour threshold during the Lower Estimate scenario. The predicted incremental change with the Higher Emission Estimate scenario is less significant.

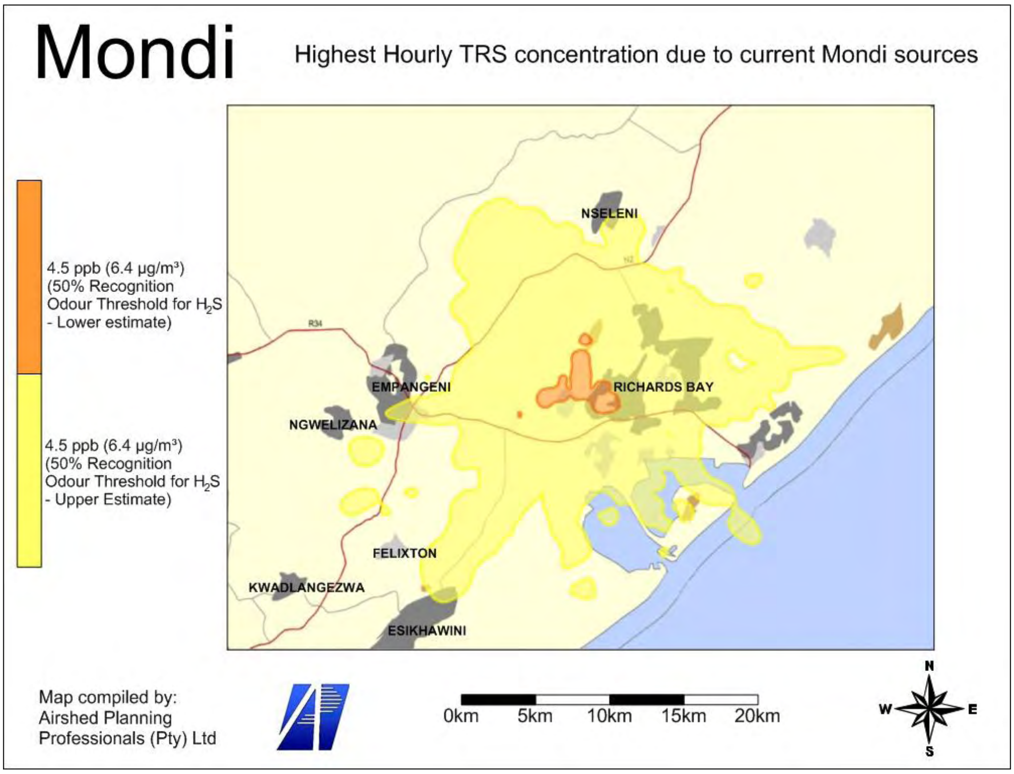

Figure 4-26: Predicted highest hourly TRS concentrations (µg/m³) due to current Mondi Richards Bay Mill operations.

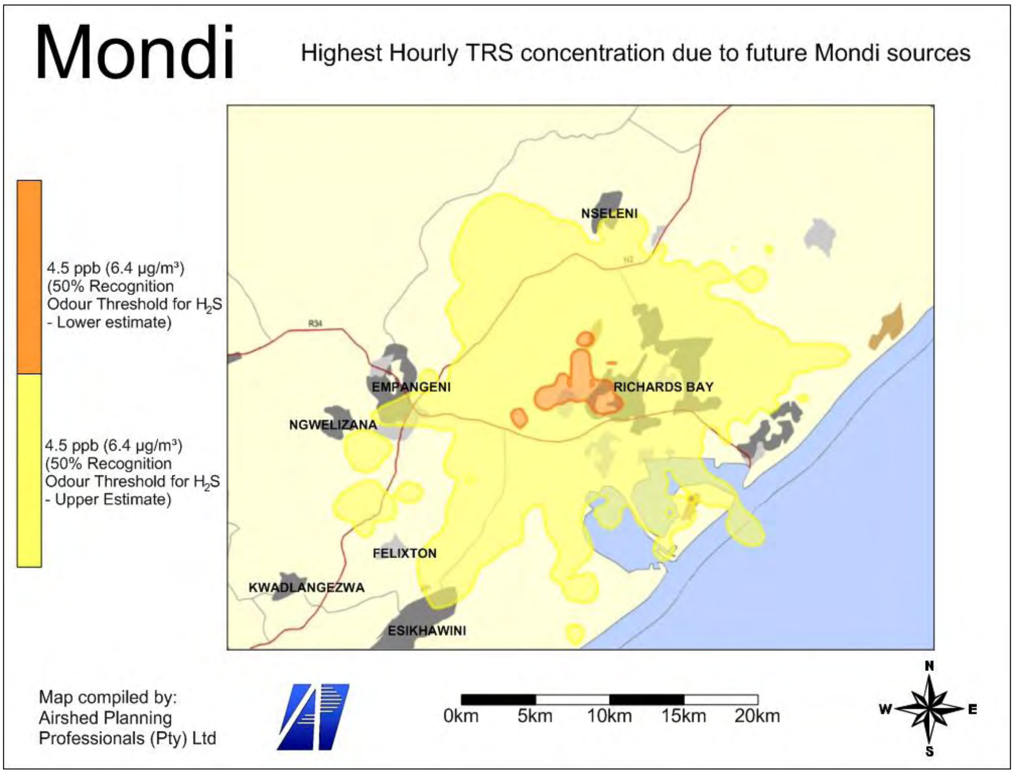

Figure 4-27: Predicted highest hourly TRS concentrations (µg/m³) due to future Mondi Richards Bay Mill operations.

5 Conclusions

The main objective for the study was to assess the significance of the contribution of the proposed Mondi Richards Bay Mill upgrade on ambient air quality.

5.1 Baseline

5.1.1 Meteorological Conditions

- The prevailing wind field at the five RBCAA sites is north-northeast to south-west with highly infrequent winds from the east and west. The SAWS Airport station shows similar prevailing winds but with more dominant northerly winds. Low intensity winds are mainly associated with winds from the northerly to south-westerly sector with strong winds occurring from the north, north-easterly and south-westerly directions.

- During daytime, winds are in general stronger and more frequent from the south-west and south-southwest. Very few calm conditions were recorded at the various stations ranging between 0% and 1% with 11% recorded at the Airport.

- Dominant south-westerly airflow remains during the night but with an increase in the north-east and north-north-easterly airflow. Wind speeds are in general lower with increasing calm conditions of up to 5% at all the RBCAA stations and 12% at the SAWS Airport station.

- The highest wind speeds recorded during 2011 were at Harbour West at 20.1 m/s.
- Ambient temperatures recorded range between 9°C and 32°C.
- Long-term average total annual monthly rainfall is in the range of 57 mm to 172 mm. The study area falls within a summer rainfall region, with ~60 % of the annual rainfall occurring during the October to February period.

5.1.2 *Existing Air Quality*

- The main industries within the area include Billiton's Bayside and Hillside Aluminium, Mondi Paper and Pulp Mills in Richards Bay and Felixton, Foskor, Tongaat Hulett, Lafarge Cement, Exxaro and Richards Bay Minerals
- Annual PM_{10} concentrations measured at the CBD and Brackenham are within the current NAAQS (50 µg/m³) and only exceeded the 2015 standard at the CBD in 2007. Data recorded at Brackenham between 2008 and 2011 were below the current (50 µg/m³) and 2015 (40 µg/m³) limit. A slight decrease in ambient PM_{10} annual concentrations is evident at both the CBD and Brackenham during 2011.
- For the CBD, the current PM_{10} NAAQS daily limit was exceeded during 2007 with the following years slightly below the limit. When compared against the 2015 limit of 75 µg/m³, only the year 2011 was below the limit at the CBD but only the years 2009 and 2010 were in non-compliance (i.e. exceeded the limit for more than 4 days in the year). At Brackenham all the years (2008 – 2011) exceeded the 2015 NAAQ limit with only the year 2009 exceeding the current NAAQ limit. The years 2008 and 2009 resulted in non-compliance with the 2015 NAAQS. Measured PM_{10} concentrations are therefore in compliance with the current for all the years and with the 2015 NAAQSs during 2011.
- An increase in SO_2 concentrations was measured at all monitoring sites from the period 2003 to 2005. The measured SO_2 concentrations decreased from 2005 to 2009, but have shown an increase from 2009 to 2011 at some stations.
- The highest annual average SO_2 concentration (2005) was measured at the John Ross/Foskor intersection, which is located closest to major industry (Foskor, Hillside Aluminium and Bayside Aluminium). In 2011 the highest annual average SO_2 concentration was measured at the Harbour West and Scorpio stations, 42% of the NAAQS. No daily exceedances were reported for the year 2011, and six hourly exceedances were reported for 2011 at the Scorpio station.

5.2 Impact Assessment

- Main sources of emissions associated with the Mondi Richards Bay Mill include stack releases from the lime kiln, power boilers, recovery boilers and gas turbines.

- The proposed upgrade will result in an increase of 3.5% SO_2, 8.6% PM and 11.8% NO_x emissions relative to current Mondi Richards Bay Mill sources.

- The proposed upgrade will result in an increase of 0.4% SO_2, 1.8% PM and 10.7% NO_x emissions relative to all current RBCAA sources.

- Due to the difficulty in estimating all TRS emissions (including stack, vent and fugitives) it is difficult to determine exactly what the increase in TRS emissions would be. With the highest estimated emissions, the TRS emissions are projected to only increase by 0.6%, whereas with the lower estimated emissions, the TRS emissions are projected to increase by 3.5 %.

- Both highest daily and annual average ground level PM_{10} and $PM_{2.5}$ concentrations are predicted to be slightly higher in the vicinity of the Mondi Richards Bay Mill due to the Mondi upgrade. Spatially however the areas where the SA daily and annual PM_{10} and $PM_{2.5}$ NAAQS are predicted to be exceeded remain unchanged due to the upgrade at the Mondi Richards Bay Mill.

- Highest hourly, highest daily and annual average ground level SO_2 concentrations are predicted to remain almost unchanged after the Mondi Richards Bay mill upgrade.

- Highest hourly NO_x concentrations are predicted to increase slightly, but the SA hourly NAAQS are not predicted to be exceeded during either the current or future scenarios. Although future annual average NO_x concentrations are slightly higher than current concentrations, ground level NO_x concentrations are predicted to be well below the SA annual NAAQS.

- Ground level TRS concentrations were predicted to be slightly higher after the upgrade using both the *Lower* and *Upper TRS Emission* scenarios. Using the Lower Emission Estimate, the spatial extent is predicted to increase, with more of the industrial area and Acton experiencing exceedances of the H_2S 50% recognition odour threshold. However, with the Upper Emission Estimate, only small changes in the impact were predicted.

5.3 Impact on the City of uMhlathuze Air Quality Buffer Zones

- The proposed Mondi Richards Bay Mill upgrade is unlikely to have a noticeable impact on the current Air Quality Buffer Zones since the predicted increases in cumulative PM, SO_2 and NO_x impacts are very low. These Buffer Zones were based on the 2004 RBCAA database, with the health screening based on a set of international criteria. These buffer zones may need to be updated based on the latest RBCAA database and incorporating the NAAQSs for South Africa.

5.4 Recommendations

TRS emissions are only available for the Mondi Richards Bay mill sources. It is recommended that emissions from all RBCAA sources be quantified in order to establish an accurate baseline of TRS concentrations.

NO_x emissions are only available for the Mondi Richards Bay Mill and a few other industries, as there is no complete NO_x emissions inventory available for Richards Bay. It is recommended that NO_x emissions from all industries in Richards Bay be quantified in order to establish accurate baseline conditions.

Due to the relatively small increase in NOx, $SO_{2,}$ TRS and particulate matter emissions due to the upgrade, and the insignificant changes to the ground level concentrations for TRS, SO_2 and particulate matter, no further mitigation measures are recommended.

6 References

Allwine K.J. and Whiteman C.D.,1985. A mesoscale air quality model for complex terrain. Volume 1 - Overview, technical description and user's guide, Pacific Northwest Laboratory, Richland, Washington, (as sited in EPA, 1995b).

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