Air Quality Impact Assessment for the Proposed Development of the Richards Bay Combined Cycle Power Plant (CCPP) and associated Infrastructure on a site near Richards Bay, KwaZulu-Natal Province – Scoping Report

Project done on behalf of **Savannah Environmental (Pty) Ltd**

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REPORT DETAILS

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Reviewed by	Hanlie Liebenberg-Enslin, PhD (University of Johannesburg)
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Revision Record

Revision Number	Date	Reason for Revision
Draft	May 2017	Draft for Client Review
Rev 1	August 2017	Text and map updates as per client request

ABBREVIATIONS

Airshed	Airshed Planning Professionals (Pty) Ltd
AQMP	Air Quality Management Plan
AQMS	Air Quality Monitoring Station
AQSR	Air Quality Sensitive Receptor
CBD	Central Business District
CCGT	Combined Cycle Gas Turbine
CCPP	Combined Cycle Power Plant
DEA	Department of Environmental Affairs
Eskom	Eskom Holdings SOC Limited
ESL	Effects Screening Level
EIA	Environmental Impact Assessment
EF	Emission Factor
EMP	Environmental Management Plan
HAP	Hazardous Air Pollutant
HMC	Heavy mineral concentrate
HRSG	Heat Recovery Steam Generator
ISO	International Organization for Standardization
LDAR	Leak Detection and Repair
LNG	Liquid Natural Gas
NAAQS	National Ambient Air Quality Standards
NEMAQA	National Environmental Management: Air Quality Act
NMES	National Minimum Emission Standards
PM	Particulate Matter
RBCAA	Richards Bay Clean Air Association
SABS	South African Bureau of Standards
SANS	South African National Standards
Savannah	Savannah Environmental (Pty) Ltd.
SAWS	South African Weather Service
TCEQ	Texas Commission on Environmental Quality
TRS	Total Reduced Sulfides
US EPA	United Stated Environmental Protection Agency
WRF	Weather Research and Forecasting mesoscale model

GLOSSARY

Air pollution[(a)]	The presence of substances in the atmosphere, particularly those that do not occur naturally
Dispersion[(a)]	The spreading of atmospheric constituents, such as air pollutants
Dust[(a)]	Solid materials suspended in the atmosphere in the form of small irregular particles, many of which are microscopic in size
Frequency of exceedance	Permissible margin of tolerance of the Limit Concentration
Instability[(a)]	A property of the steady state of a system such that certain disturbances or perturbations introduced into the steady state will increase in magnitude, the maximum perturbation amplitude always remaining larger than the initial amplitude
Limit Concentration	Maximum allowable concentration of a pollutant applicable for an applicable averaging period
Mechanical mixing[(a)]	Any mixing process that utilizes the kinetic energy of relative fluid motion
Oxides of nitrogen (NO_x)	The sum of nitrogen oxide (NO) and nitrogen dioxide (NO_2) expressed as nitrogen dioxide (NO_2)
Particulate matter (PM)	Total particulate matter, that is solid matter contained in the gas stream in the solid state as well as insoluble and soluble solid matter contained in entrained droplets in the gas stream
$PM_{2.5}$	Particulate Matter with an aerodynamic diametre of less than 2.5 µm
PM_{10}	Particulate Matter with an aerodynamic diametre of less than 10 µm
Stability[(a)]	The characteristic of a system if sufficiently small disturbances have only small effects, either decreasing in amplitude or oscillating periodically; it is asymptotically stable if the effect of small disturbances vanishes for long time periods
Standard	A combination of the Limit Concentration and the allowable frequency of exceedance

Notes:

(a) Definition from American Meteorological Society's glossary of meteorology (AMS, 2014)

SYMBOLS AND UNITS

°C	Degree Celsius
CO	Carbon monoxide
g	Gram(s)
HC	Hydrocarbons
kg	Kilograms
1 kilogram	1 000 grams
km²	Square kilometre
m	Metres
mamsl	Metres above mean sea level (also metres above sea level – masl)
m/s	Metres per second
MW	Megawatt
µg	Microgram(s)
µg/m³	Micrograms per cubic metre
µm	Micrometre
mg	Milligram(s)
mg/m³	Milligrams per cubic metre
m²	Square metre
m³	Cubic metre
mm	Millimetres
N_2O	Nitrous oxide
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
O_3	Ozone
PM	Particulate matter
$PM_{2.5}$	Inhalable particulate matter (aerodynamic diametre less than 2.5 µm)
PM_{10}	Thoracic particulate matter (aerodynamic diametre less than 10 µm)
SO_2	Sulfur dioxide (1)
SO_X	Oxides of sulfur
1 ton	1 000 000 grams
TRS	Total Reduced Sulfides
TVOCs	Total volatile organic compounds
VOCs	Volatile organic compounds

Notes:

(1) The spelling of "sulfur" has been standardised to the American spelling throughout the report. The International Union of Pure and Applied Chemistry, the international professional organisation of chemists that operates under the umbrella of UNESCO, published, in 1990, a list of standard names for all chemical elements. It was decided that element 16 should be spelled "sulfur". This compromise was to ensure that in future searchable data bases would not be complicated by spelling variants. (IUPAC. Compendium of Chemical Terminology, 2nd ed. (the "Gold Book"). Compiled by A. D. McNaught and A. Wilkinson. Blackwell Scientific Publications, Oxford (1997). XML on-line corrected version: http://goldbook.iupac.org (2006) created by M. Nic, J. Jirat, B. Kosata; updates compiled by A. Jenkins. ISBN 0-9678550-9-8.doi: 10.1351/goldbook)"

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1 INTRODUCTION

Eskom proposes to develop a 3000 MW Combined Cycle Power Plant (CCPP) near Richards Bay, Kwa-Zulu Natal. Airshed Planning Professionals (Pty) Ltd (Airshed) was appointed by Savannah Environmental (Pty) Ltd to address potential impacts on the atmospheric environment by conducting a comprehensive air quality impact assessment for the CCPP Project. During a screening phase assessment a preferred project site was selected from four alternative sites. This report covers Phase II – Scoping study.

1.1 Background

The proposed CCPP project site is located on Erf 2/11376 and Erf 4/11376 (71ha in extent), approximately 7 km south east of the Richards Bay Central Business District (CBD) (Figure 1-1). The CCPP will use either natural gas likely to be piped from Mozambique or Liquid Natural Gas (LNG) which will be shipped to Richards Bay. Diesel will be used as a back-up resource for power generation and stored on-site in approximately 4.5 million litres (4 500 m^3) storage tanks. The CCPP will include gas turbines, Heat Recovery Steam Generators (HRSGs), steam turbines, diesel storage, and office and other buildings.

1.2 Objectives

The main objectives of Phase II of the air quality specialist study were to identify the potential impact of the CCPP on air quality if located on the preferred project site, as part of the Environmental Impact Assessment (EIA) process. In order to achieve these objectives the scope of the air quality specialist study for Phase II included the following tasks:

- A review of project information;
- A review of legal requirements pertaining to air quality and specifically referring to;
    - The National Environmental Management Air Quality Act (NEMAQA) Act No. 39 of 2004:
        - National Ambient Air Quality Standards (NAAQS)
        - National Minimum Emission Standards (NMES)
        - National Dust Control Regulations
    - International inhalation health criteria for non-criteria pollutants
- A desktop study of the local receiving environment including:
    - An analysis of regional climate and site specific atmospheric dispersion potential;
    - Analysis and assessment of existing (baseline) ambient air quality based on existing data collected within Richards Bay;
    - The identification of air quality sensitive receptors.
- A short report summarising the findings of a desktop study of the potential impact of the proposed facility, from an air quality perspective, at the preferred site location.

Figure 1-1: Location of the proposed Eskom CCPP project, Richards Bay

1.3 Legislative Framework

Prior to discussing the impact of the CCPP on the atmospheric environment, the regulations governing the impact of such operations should be referenced. These include:

- Listed Activities and National Minimum Emission Standards (NMES)
- Ambient air quality standards and guidelines:
  - National Ambient Air Quality Standards (NAAQS) for criteria pollutants
  - International inhalation health criteria for non-criteria pollutants
- The Air Quality Management Plan (AQMP) for Richards Bay

NMES are provided for point sources and specify the amount of the pollutant acceptable in an emission stream and are often based on proven efficiencies of air pollution control equipment.

NAAQS and inhalation health criteria are fundamental to effective air quality management, providing the link between the source of atmospheric emissions and the user of that air at the downstream receptor site. NAAQS and inhalation health criteria generally indicate safe daily exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Criteria are normally given for specific averaging or exposure periods.

The primary motivation of any AQMP is to achieve and maintain compliance with ambient air quality standards through progressive realisation of air quality improvements. AQMPs for the City of uMhlathuze Local Municipality and the uMfolozi Local Municipality are still under development (http://www.saaqis.org.za/AQPlanning01.aspx, accessed 2017/02/14), but Haripursad (2007) researched Air Quality Management in the uMhlathuze Municipality. In 2006, a review of the Spatial Development Framework for the City of uMhlathuze was conducted based on an air quality investigation.

This section summarises legislation pertaining to air quality for sources and pollutants relevant to the study.

1.3.1 *National Minimum Emission Standards*

The minister has, in accordance with the National Environmental Management Air Quality Act (NEMAQA) (Act No. 39 of 2004), published a list of activities which result in atmospheric emissions and which are believed to have significant detrimental effects on the environment and human health; and, social welfare. The Listed Activities and NMES were published on the 31st of March 2010 (Government Gazette No. 33064) and the revised NMES on 22 November 2013 (Government Gazette No. 37054). NMES applicable to the proposed CCPP include:

- **Gas Combustion Installations**– Gas combustion used primarily for steam raising or electricity generation (more than 50 mega Watt (MW) heat input per unit). NMES subcategory 1.4 are applicable (Table 1-1) during normal operating conditions using natural gas or LNG.
- **Liquid fuel Combustion Installations** – Liquid fuel combustion used primarily for steam raising or electricity is generated (more than 50 mega Watt (MW) heat input per unit). NMES for liquid fuel combustion installations (Subcategory 1.2) are applicable (Table 1-2) during start-up or emergency periods when diesel will be used instead of natural gas.
- Diesel Storage – The storage and handling of petroleum products within permanent immobile liquid tanks larger than 500 m^3 in total triggers Subcategory 2.4 (Table 1-3).
  - Subcategory 2.4 NMES distinguishes between petroleum products with various vapour pressures. The vapour pressure of diesel is notably lower than 14 kPa (Table 1-3).

Table 1-1: NMES for gas combustion installations

Subcategory 1.4: Gas Combustion Installations		
Description	Gas combustion (including gas turbines burning natural gas) used primarily for steam raising or electricity generation.	
Application	All installations with design capacity equal to or greater than 50 MW heat input per unit based on the lower calorific value of the fuel used.	
Substance or mixture of substances		**mg/Nm³ under normal conditions of 3% O_2, 273 K and 101.3 kPa**
Common Name	**Chemical Symbol**	**New plant**
Particulate matter (PM)	Not applicable	10
Sulfur dioxide	SO_2	400
Oxides of nitrogen	NO_x expressed as NO_2	50

Notes:

(a) The following special arrangement shall apply:
  i. Reference conditions for gas turbines shall be 15% O_2, 273 K and 101.3 kPa; and
  ii. Where co-feeding with waste materials with calorific value allowed in terms of the Waste Disposal Standards published in terms of the Waste Act, 2008 (Act No.59 of 2008) occurs, additional requirements under subcategory 1.6 shall apply.

Table 1-2: NMES for liquid fuel combustion installations

Subcategory 1.2: Liquid fuel combustion installations		
Description	Liquid fuel combustion installations used primarily for steam raising or electricity generation.	
Application	All installations with design capacity equal to or greater than 50 MW heat input per unit based on the lower calorific value of the fuel used.	
Substance or mixture of substances		**mg/Nm³ under normal conditions of 3% O_2, 273 K and 101.3 kPa**
Common Name	**Chemical Symbol**	**New plant**
Particulate matter (PM)	Not applicable	50
Sulfur dioxide	SO_2	500
Oxides of nitrogen	NO_x expressed as NO_2	250

Notes:

(a) The following special arrangement shall apply:
  i. Reference conditions for gas turbines shall be 15% O_2, 273 K and 101.3 kPa.
  ii. Continuous monitoring of PM, SO_2 and NOx is required, however, installations less than 100MW heat input per unit must adhere to periodic emission monitoring as stipulated in Part 2 of this notice.
  iii. Where co-feeding with waste materials with calorific value allowed in terms of the Waste Disposal Standards published in terms of the Waste Act, 2008 (Act No.59 of 2008) occurs, additional requirements under subcategory 1.6 shall apply.

Table 1-3: NMES for the storage and handling of petroleum products

(a) The following transitional arrangement shall apply for the storage and handling of raw materials, intermediate and final products with a vapour pressure greater than 14 kPa at operating temperature: – Leak detection and repair (LDAR) program approved by licensing authority to be instituted, by 01 January 2014.

(b) The following special arrangements shall apply for control of TVOCs from storage of raw materials, intermediate and final products with a vapour pressure of up to 14 kPa at operating temperature, except during loading and offloading. (Alternative control measures that can achieve the same or better results may be used) –
  i. Storage vessels for liquids shall be of the following type:

True vapour pressure of contents at storage temperature	Type of tank or vessel
Type 1: Up to 14 kPa	Fixed-roof tank vented to atmosphere, or as Type 2 and 3

True vapour pressure of contents at storage temperature	Type of tank or vessel
Type 2: Above 14 kPa up to 91 kPa with a throughput of less than 50 000 m³ per annum	Fixed-roof tank with Pressure Vacuum Vents fitted s a minimum, to prevent "breathing" losses, or as per Type 3
Type 3: Above 14 kPa up to 91 kPa with a throughput greater than 50 000 m³ per annum	a) External floating roof tank with primary and secondary rim seals for tank diameter larger than 20 m, or b) fixed roof tank with internal floating deck / roof fitted with primary seal, or c) fixed roof tank with vapour recovery system
Type 4: Above 91 kPa	Pressure vessel

ii. The roof legs, slotted pipes and/or dipping well on floating roof tanks (except for domed floating roof tanks or internal roof tanks) shall have sleeves fitted to minimise emissions.

iii. Relief valves on pressurised storage should undergo periodic checks for internal leaks. This can be carried out using portable acoustic monitors or if venting to atmosphere with an accessible open end, tested with a hydrocarbon analyser as part of an LDAR programme.

(c) The following special arrangements shall apply for control of TVOCs from storage, loading and unloading of raw materials, intermediate and final products with a vapour pressure of more than 14 kPa at operating temperatures, except during loading and unloading. Alternative control measures that can achieve the same or better results may be used:

i. All installations with a throughput of 5 000 m³ per annum of products with a vapour pressure greater than 14 kPa, must be fitted with vapour recover / destruction units. Emission limits are set out in the table below –

Description	Vapour Recovery Units	
Application	All loading/ offloading facilities with a throughput greater than 50 000 m³	
Substance or mixture of substances		**mg/Nm³ under normal conditions of 273 K and 101.3 kPa**
Common Name	**Chemical Symbol**	**New plant**
Total volatile organic compounds (VOCs) from vapour recovery/destruction units (non-thermal treatment)	Not applicable	150
VOCs from vapour recovery/destruction units (thermal treatment)	Not applicable	40 000

1.3.2 *Ambient Air Quality Guidelines and Standards*

1.3.2.1 NAAQS for Criteria Pollutants

Criteria pollutants are considered those pollutants most commonly found in the atmosphere, that have proven detrimental health effects when inhaled and are regulated by ambient air quality criteria.

The South African Bureau of Standards (SABS) was engaged to assist the DEA in the facilitation of the development of ambient air quality standards. Standards were determined based on international best practice for particulate matter with an aerodynamic diameter of less than 10 µm (PM_{10}), particulate matter with an aerodynamic diameter of less than 2.5 µm ($PM_{2.5}$), dustfall, SO_2, NO_2, ozone (O_3), carbon monoxide (CO), lead (Pb) and benzene (C_6H_6)[1]. The final revised NAAQS for CO, C_6H_6, NO_2, O_3, Pb, PM_{10} and SO_2, were published in the Government Gazette (no. 263) on the 24th of December 2009. Standards for $PM_{2.5}$ and dustfall were subsequently published in June 2012 (Government Gazette No. 486) and

[1] *SANS 69 - South African National Standard* - Framework for setting & implementing national ambient air quality standards and *SANS 1929 - South African National Standard* - Ambient Air Quality - Limits for common pollutants.

November 2013 (Government Gazette No. 827) respectively. NAAQS for atmospheric pollutants associated with the project, that is CO, NO_2, PM_{10}, $PM_{2.5}$ and SO_2, are listed in Table 1-4.

Table 1-4: NAAQS for criteria pollutants considered in the study

Pollutant	Averaging Period	Limit Value (µg/m³)	Limit Value (ppb)	Frequency of Exceedance	Compliance Date
CO	1 hour	30 000	26 000	88	Immediate
	8 hour(b)	10 000	8 700	11	Immediate
NO_2	1 hour	200	106	88	Immediate
	1 year	40	21	-	Immediate
PM_{10}	24 hour	75(b)	-	4	Effective since 1 Jan 2015
	1 year	40(b)	-	-	Effective since 1 Jan 2015
$PM_{2.5}$	24 hour	40(b)	-	4	1 Jan 2016 – 31 Dec 2029
	24 hour	25	-	4	1 Jan 2030
	1 year	20(b)	-	-	1 Jan 2016 – 31 Dec 2029
	1 year	15	-	-	1 Jan 2030
SO_2	10 minutes	500	191	526	Immediate
	1 hour	350	134	88	Immediate
	24 hour	125	48	4	Immediate
	1 year	50	19	-	Immediate

Notes:

(a) Calculated on 1 hourly averages.
(b) Used in the screening of impacts.

1.3.2.2 *Inhalation Health Criteria for Non-criteria Pollutants*

Some VOCs are emitted from turbine units and diesel storage tanks. Ambient VOC concentrations are not currently regulated in South Africa. In the assessment of ambient VOC concentrations, however Effect Screening Levels (ESLs) published by the Texas Commission of Environmental Quality (TCEQ) are referenced. Short-term (1-hour) and long term (annual average) ESLs for diesel fumes are 1 000 µg/m^3 and 100 µg/m^3 respectively (TCEQ, 2013).

1.4 Study Approach and Methodology

The site selection and ranking following the following approach:

1.4.1 *Project and Information Review*

A review of the Project from an air quality perspective in order to identify sources of emission and associated pollutants of concern was conducted. In the review the following documents were referenced:

- Project information supplied by Savannah Environmental and Eskom;
- Emission factor documentation published by the United States Environmental Protection Agency (US EPA) for:
    - Stationary gas turbines (US EPA, 2000); and
    - Liquid storage tanks (US EPA, 2006);

- Air Quality Management in uMhlathuze Local Municipality using air dispersion modelling (Haripursad, 2007).
- Review of the Spatial Development Framework for the City of uMhlathuze Local Municipality based on an air quality investigation (Liebenberg-Enslin, H, & Petzer, 2006), which includes sources within the uMfolozi Local Municipality close to the boundary with the City of uMhalthuze.

1.4.2 *A Study of the Affected Atmospheric Environment*

The atmospheric environment was studied by taking into account:

- the local atmospheric dispersion potential;
- the position of air quality sensitive receptors (AQSRs) in relation to the project; and
- reported ambient air quality in the study area.

An understanding of the atmospheric dispersion potential of the area is essential to an air quality impact assessment. Physical environmental parameters that influence the dispersion of pollutants in the atmosphere include terrain, land cover and meteorology.

The Richards Bay Clean Air Association (RBCAA) operates 12 ambient monitoring stations, measuring both ambient pollutants (sulfur dioxide (SO_2), total reduced sulfides (TRS) and fine particulate (PM_{10})) and meteorological parameters. Recent (2013 to 2016) data sets from the RBCAA stations were provided for use in the study.

Potential AQSRs, residential areas, schools and hospitals or clinics, were identified from recent maps of the area using Google Earth™ aerial imagery, as well as previous studies conducted in the area (Haripursad, 2007) (Liebenberg-Enslin, H, & Petzer, 2006).

1.4.3 *Report*

The main deliverable of the air quality specialist study is a scoping level report including a scoping level impact rating.

1.4.4 *Terms of Reference for EIA Phase – Air Quality Impact Assessment*

The Terms of Reference, as a list of tasks, for the Air Quality Study portion of the EIA phase of the project will include:

- The compilation of a baseline emissions inventory for existing facilities within Richards Bay based on a recent RBCAA inventory;
- The establishment of an emissions inventory by referring to NMES and emission factors for combustion processes, fuel storage and fugitive dust (construction);
- Atmospheric dispersion simulations for the baseline, incremental, and cumulative scenarios using the CALPUFF atmospheric dispersion model;
- A human health risk and nuisance impact screening assessment based on dispersion simulation results;
- A comprehensive air quality impact assessment report in the format prescribed by the Department of Environmental Affairs (DEA) in support of the Atmospheric Emission License (AEL) application.
- Impact Significance rating according to the method provided by Savannah Environmental (Pty) Ltd.

1.5 Limitations

The following important limitations apply to the study and should be noted:

- The ambient air quality data set provided was for the period 1 June 2013 to 30 June 2016. The calculation of annual average concentrations and the frequency of exceedance of hourly or daily limit concentrations do not reflect the full calendar years for 2013 and 2016.
  - If available the data set will be expanded to include the remainder of these two years.
- Although other sources of pollution, especially the industrial sources, have been identified the emissions from these sources have not been quantified.
  - Emission rates for the industrial sources will be requested from the RBCAA during the EIA phase of assessment and will be used to in the atmospheric dispersion modelling to assess cumulative impact.

2 PROJECT DESCRIPTION FROM AN AIR QUALITY PERSPECTIVE

2.1 Sources of Emission and Likely Pollutants

2.1.1 *Proposed CCPP*

The CCPP involves the installation and operation of Gas Turbine units, heat recovery steam generators (HRSGs) and Steam Turbines for a total generating capacity of 3 000 MW. The following description of the operations has been taken from the Clarification Meeting presentation (25 August 2016).

- The **Gas Turbine** uses fuel (diesel or natural gas) to generate electricity – compressed air is mixed with combustion fuel to produce very high temperature combustion gases. The hot combustion gases pass through the gas turbine blades, making them spin. The fast-spinning turbine drives a generator that converts a portion of the spinning energy into electricity. Each gas turbine would likely have a bypass stack of approximately 40 to 60 metres high.
- The **Heat Recovery Steam Generator** (HRSG) captures the gas turbine exhaust heat to produce high temperature and high pressure dry steam, which is then supplied to a steam turbine. The combustion gases will be discharged into the atmosphere via the exhaust stack of approximately 40 to 60 metres high.
- The **Steam turbine** uses the dry steam to drive its turbine to generate additional electrical power.

The condenser converts exhaust steam from the steam turbine back into water through a cooling process.

A gas pipeline will supply natural gas from the gas supply take-off point at the harbour to the power station. Diesel, to be used as back-up fuel, will be off-loaded by truck and stored in on-site and storage tanks which will hold a capacity for 8 hours operation. The size of the tanks is anticipated to be between 4 000 and 4 500 m^3.

Construction phase emissions will be generated by bulk earthworks, concrete works, welding etc. Pollutants will include fugitive PM and those emitted by construction vehicles in the form of PM and gases such as NO_x, SO_2 and VOCs.

Primary pollutants from gas turbine engines are NO_x, CO and to a lesser extent VOCs. PM is also a primary pollutant for gas turbines using liquid fuels – in this case back-up diesel. NO_x formation is strongly dependent on the high temperatures developed in the combustor. CO, VOC, hazardous air pollutants (HAP), and PM are primarily the result of incomplete combustion. Trace to low quantities of HAP and SO_2 are emitted from gas turbines. Ash and metallic additives in the fuel may also contribute to PM in the exhaust. Oxides of sulfur (SO_X) will only appear in a significant quantity if heavy oils are fired in the turbine. SO_2 emissions are directly related to the sulfur content of the fuel (US EPA, 2000). In addition to the above, VOC emissions will also be released from diesel storage tanks vents as well as the off-loading and handling of diesel fuel.

2.2 Identified Air Quality Aspects

Identified air quality aspects associated with the proposed CCPP is listed in Table 2-1.

Table 2-1: Identified air quality aspects

Aspect or Project Phase	Expected Atmospheric Sources of Emissions and Associated Pollutants						
	Source	CO	NO_x	PM(a)	SO_2	VOC	
The construction phase of the CCPP	Fugitive dust from civil and building work such as excavations, piling, foundations and buildings	n/a	n/a	✓	n/a	n/a	The nature of emissions from construction activities is highly variable in terms of temporal and spatial distribution and is also transient. Detail regarding the extent of construction activities and equipment movements was also not available for inclusion in the study. Fugitive dust emissions are however mostly generated by land-clearing and bulk earthworks which will not applicable to the proposed brownfields construction site.
	Exhaust gasses from diesel mobile construction equipment and trucks delivering materials.	✓	✓	✓	✓	✓	
The normal operation phase of the CCPP	Exhaust gasses from the proposed turbine units	✓	✓	✓(c)	✓	✓	The project is designed to operate on either natural gas or Diesel. Diesel fuel will be used as back-up. Emissions from the combustion of natural gas are notably lower than from the combustion of diesel. The focus of the assessment is on the operation of the proposed turbine units and fuel storage since it triggers Subcategory 1.2, 1.4 and 2.4 NMES.
	Diesel storage (~4 000 – 4 500 m^3 storage capacity)	✓	✓	✓	✓	✓	
CCPP upset conditions that may result in atmospheric impacts	Unstable combustion conditions within turbine units	✓	✓	✓(c)	✓	✓	Incomplete diesel combustion and unstable combustion temperatures may result in higher than normal PM, CO, NO_x and VOC emissions. SO_2 emissions should not be affected.
	Diesel fuel spillages	n/a	n/a	n/a	n/a	✓	Additional VOC emissions as a result of the volatilisation of spilled diesel may occur. The vapour pressure of diesel is however very low which limits the potential for fugitive VOC emissions.
Regular Shutdowns	Fuel delivery trucks' exhaust gasses	neg.	neg.	neg.	neg.	neg.	During shutdowns there will not be any emissions from the OCGT units. Emissions as result of the delivery and storage of diesel fuel will remain similar to the normal operational conditions.
	Diesel storage	n/a	n/a	n/a	n/a	✓	
Decommissioning phase of the Project	Fugitive dust from civil work such as rehabilitation and demolition.	n/a	n/a	✓	n/a	n/a	The nature of emissions from decommissioning activities is highly variable in terms of temporal and spatial distribution and is also transient. Detail regarding the extent of decommissioning activities and equipment movements was also not available for inclusion in the study. Fugitive dust emissions are however mostly generated by demolition and rehabilitation activities.
	Exhaust gasses from diesel mobile equipment and trucks removing materials.	✓	✓	✓	✓	✓	

Notes:

(a) PM includes PM_{10} and $PM_{2.5}$

(b) n/a – not applicable

(c) neg. negligible for Natural gas and LNG

3 DESCRIPTION OF THE RECEIVING ENVIRONMENT

3.1 Site Description

The City of uMhlathuze Local Municipality falls within the King Cetshwayo District Municipality (previously known as the uThungulu District Municipality), and includes the towns of Richards Bay and Empangeni and its surrounding rural and tribal areas. The topography of the 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 3-13 shows the location of all the main industries in the region. The proposed location of the CCPP is adjacent (south-west) to the Mondi Richards Bay facility.

The proposed project site is located approximately 7 km south east of the Richards Bay Central Business District (CBD) (Figure 1-1), and is located adjacent to the Mondi Richards Bay facility. The nearest large residential areas to the project site are Bhiliya (6.5 km south); Empangeni (6.6 km west); Richards Bay CBD (6.9 km east); Wild-en-Weide (7.8 km); Arboretum (8.4 km east); Felixton (9.8 km south-west); and Nseleni A (10.5 km north). There are some individual homesteads within 5 km of the proposed location. There are several schools, hospitals and clinics located within 5 km of the proposed location (Figure 3-1). Industrial areas (Mpangene, Kuleka, ZSM Industrial, Alton, and the Richards Bay Harbour) are located within 5 km of the proposed project.

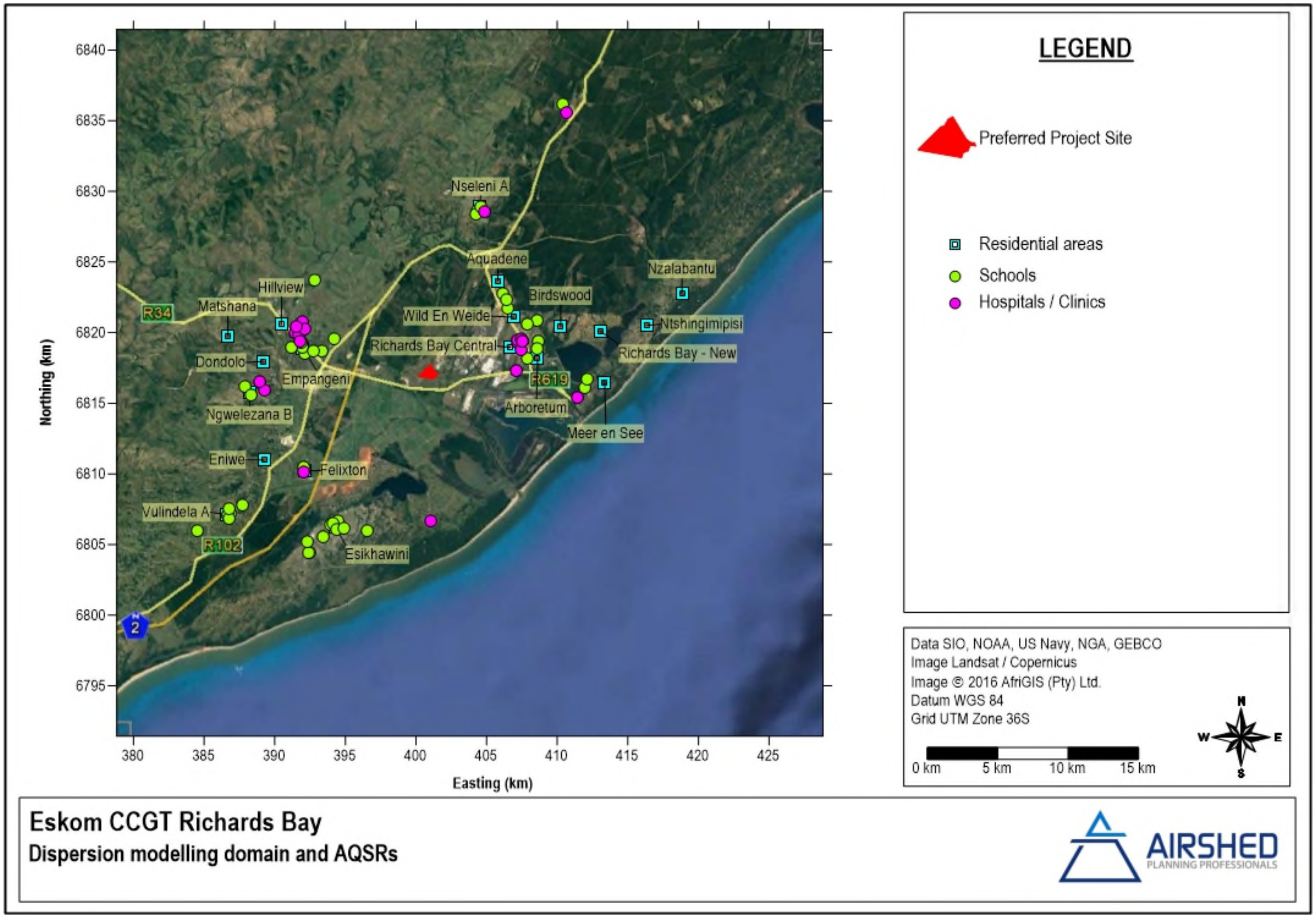


Figure 3-1: Location of the Proposed Project in relation to the AQSRs

3.2 Climate and atmospheric dispersion potential

Meteorological mechanisms direct the dispersion, transformation and eventual removal of pollutants from the atmosphere. The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the earth's boundary layer. This dispersion comprises vertical and horizontal components of motion. The stability of the atmosphere and the depth of the surface-mixing layer define the vertical component. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. 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 wind speed, in combination with surface roughness. The wind direction, and variability in wind direction, determines the general path pollutants will follow, and the extent of crosswind spreading. The pollution concentration levels therefore fluctuate in response to changes in atmospheric stability, to concurrent variations in the mixing depth, and to shifts in the wind field (Tiwary & Colls, 2010).

The CALPUFF model has been selected for use in the impact assessment phase of the proposed project to simulate maximum short-term (1 and 24-hour) and annual average ground-level concentrations at various receptor locations within the computational domain. CALPUFF is a multi-layer, multi-species non-steady-state puff dispersion model that can simulate the effects of time- and space-varying meteorological conditions on pollutant transport, transformation, and removal (Scire *et al*., 2000). It can accommodate arbitrarily varying point source, area source, volume source, and line source emissions. The CALPUFF code includes algorithms for near-source effects such as building downwash, transitional plume rise, partial plume penetration, sub grid scale terrain interactions as well as longer range effects such as pollutant removal due to wet scavenging and dry deposition, chemical transformation, vertical wind shear, overwater transport and coastal interaction effects. The model is intended for use on scales from tens of metres to hundreds of kilometres from a source (US EPA 1998). The meteorological data requirements for the CALPUFF model suite required the need for simulated data and the Weather Research and Forecasting mesoscale model (known as WRF) was used.

The WRF Model is a next-generation meso-scale numerical weather prediction system designed for both atmospheric research and operational forecasting needs. It features two dynamic cores, a data assimilation system, and a software architecture facilitating parallel computation and system extensibility. The model serves a wide range of meteorological applications across scales from tens of metres to thousands of kilometres. WRF can generate atmospheric simulations using real data (observations, analyses) or idealized conditions. WRF offers operational forecasting, a flexible and computationally-efficient platform, while providing recent advances in physics, numeric, and data assimilation contributed by developers across the very broad research community.

WRF data for the period 2013 to 2015 on a 4 km horizontal resolution for a 50 km by 50 km was used. Since no weather measurements are available from the proposed project site, simulated WRF meteorological data for the proposed location for the 1 January 2013 to 31 December 2015 period was used to generate the following summaries. Examples of the CALMET layer 1 (up to 20 m above surface) wind vector plots from the CALMET data for 1 February 2013 at 05:00 (Figure 3-2) and 15:00 (Figure 3-3) and the 1 July 2013 at 05:00 (Figure 3-4) and 15:00 (Figure 3-5) are included for comparison of the diurnal variation in wind flow. The spatial and diurnal variations in the wind field over the domain are due to terrain and coastal effects.

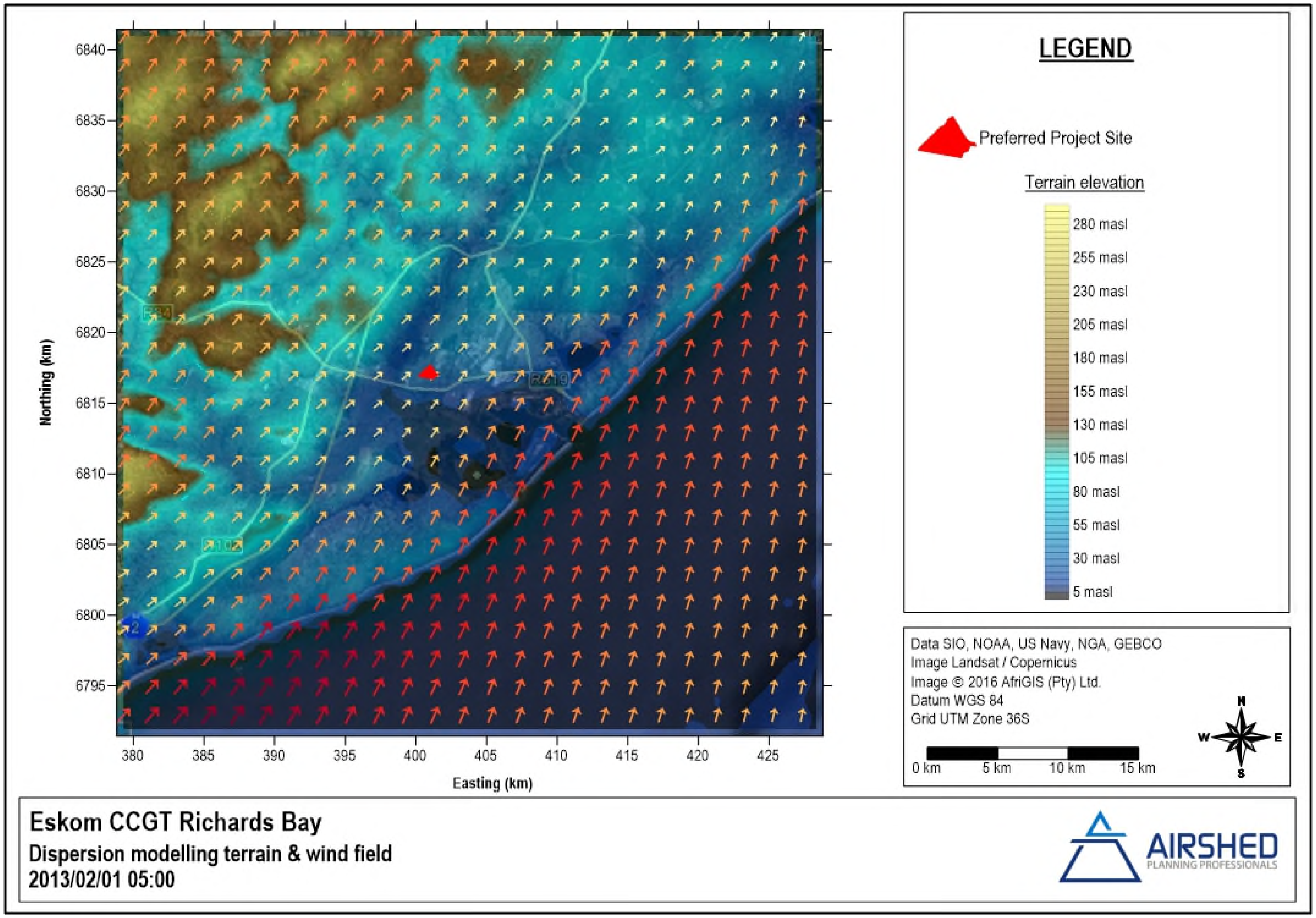

6840
6835
6830
6825
6820
6815
6810
6805
6800
6795
Northing (km)
380
385
390
395
400
405
410
415
420
425
Easting (km)
LEGEND
Preferred Project Site
Terrain elevation
280 masl
255 masl
230 masl
205 masl
180 masl
155 masl
130 masl
105 masl
80 masl
55 masl
30 masl
5 masl
Data SIO, NOAA, US Navy, NGA, GEBCO
Image Landsat / Copernicus
Image © 2016 AfriGIS (Pty) Ltd.
Datum WGS 84
Grid UTM Zone 36S
0 km
5 km
10 km
15 km
N
E
S
W
Eskom CCGT Richards Bay
Dispersion modelling terrain & wind field
2013/02/01 05:00
AIRSHED
PLANNING PROFESSIONALS

Figure 3-2: CALMET Layer 1 wind vector plot for 1 February 2013 at 05:00

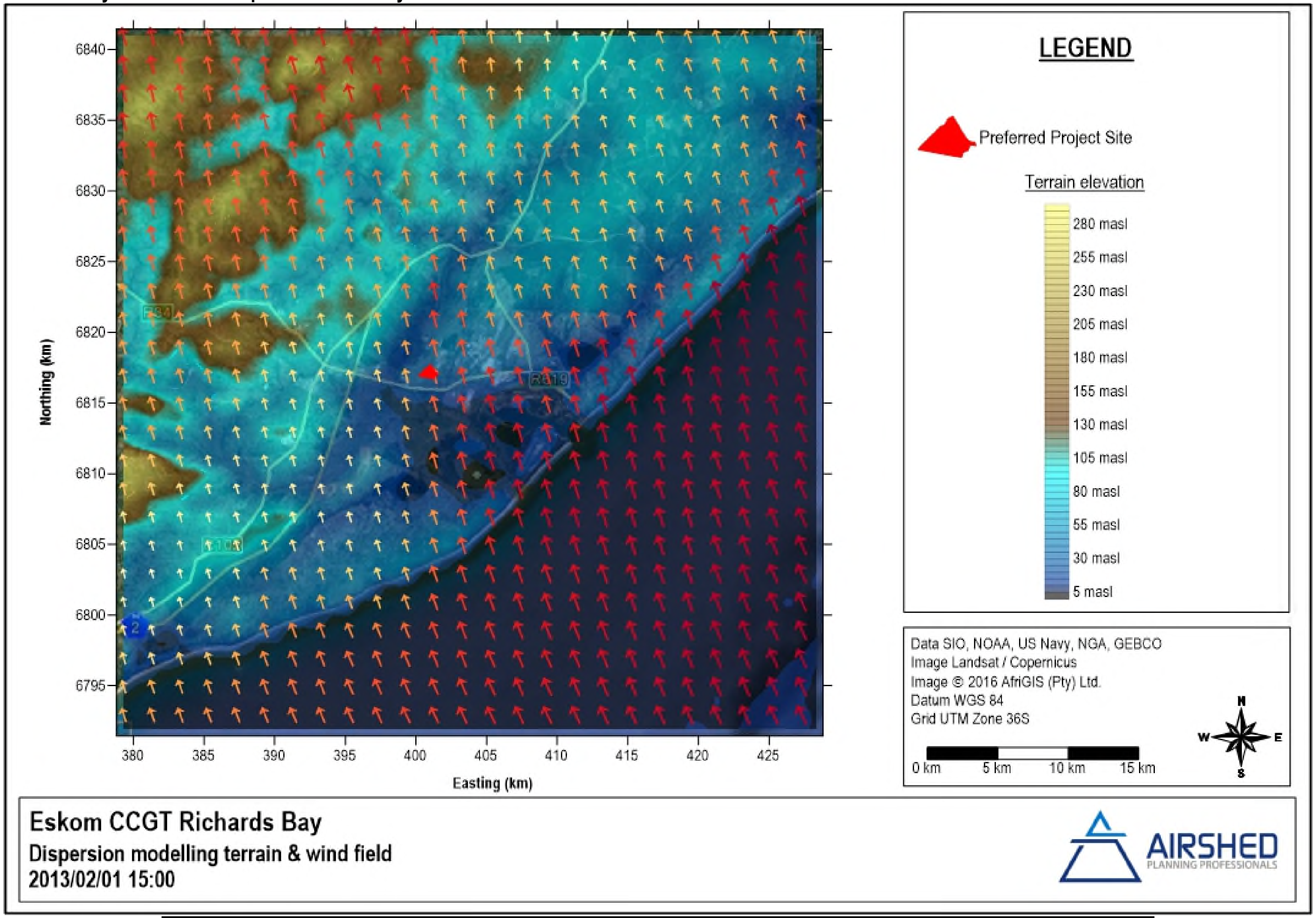


Figure 3-3: CALMET Layer 1 wind vector plot for 1 February 2013 at 15:00

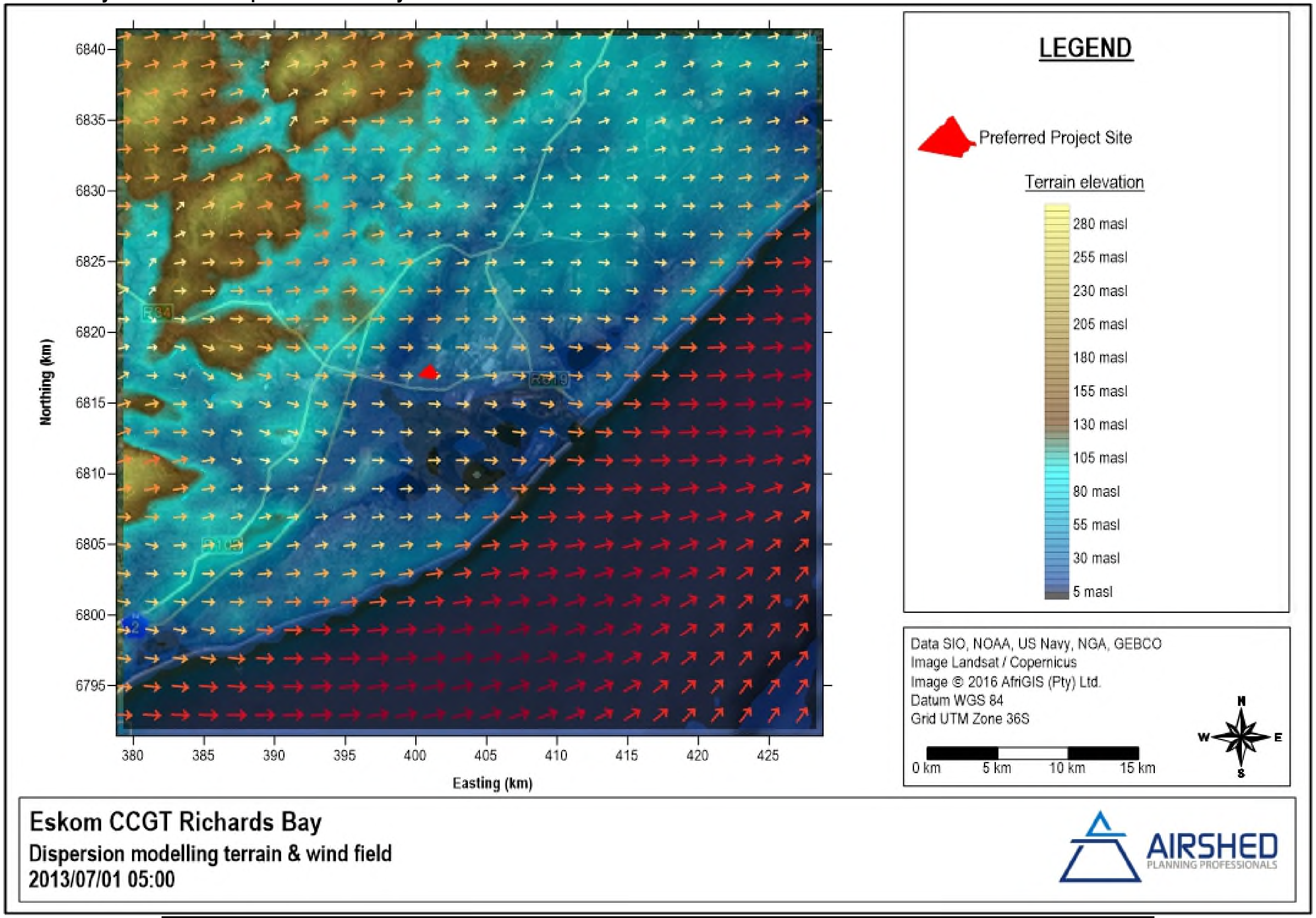


Figure 3-4: CALMET Layer 1 wind vector plot for 1 July 2013 at 05:00

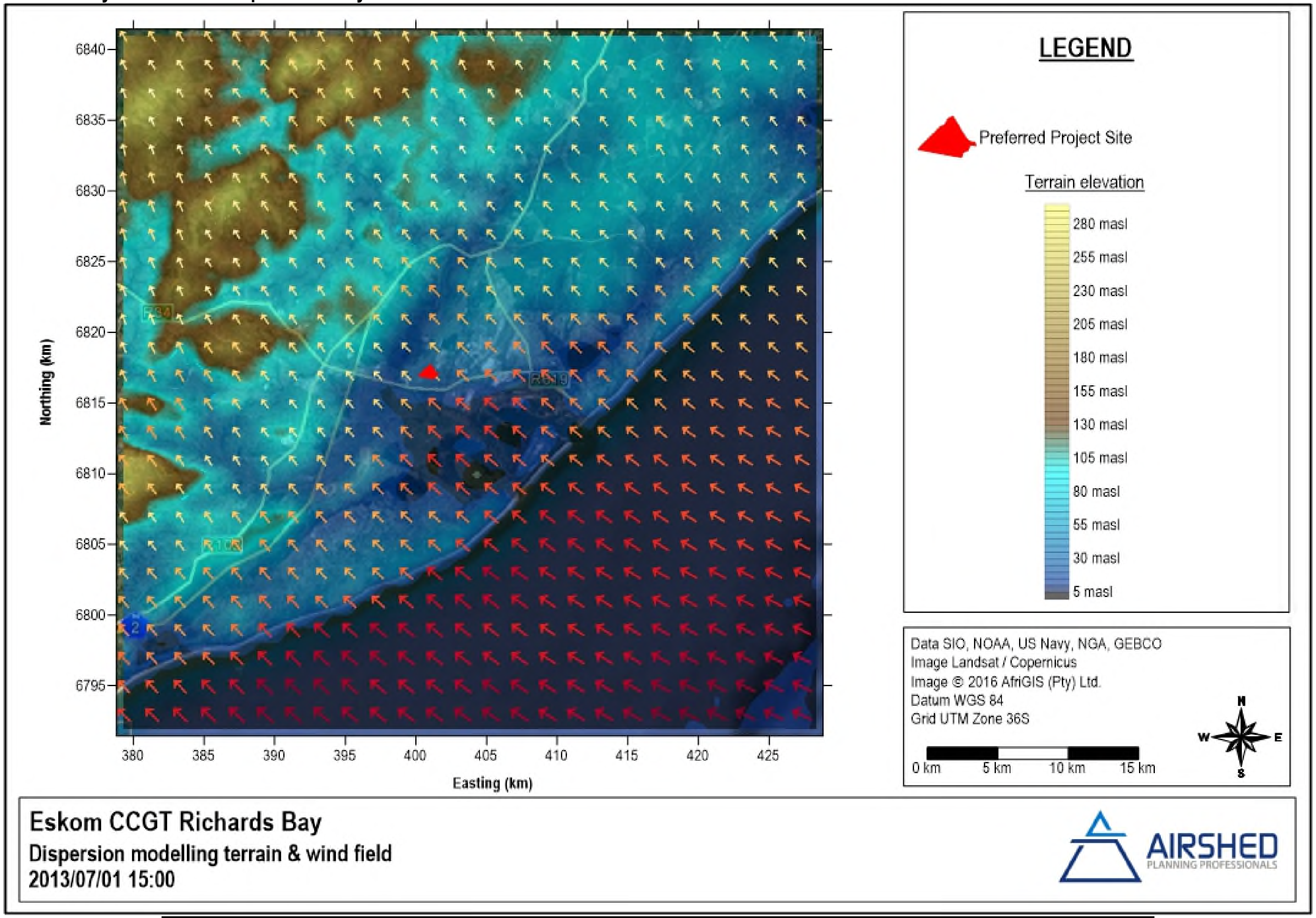


Figure 3-5: CALMET Layer 1 wind vector plot for 1 July 2013 at 15:00

3.2.1 *Local wind field*

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 dispersion potential of the site. For the purpose of describing near-site atmospheric dispersion potential, meteorological data from WRF simulated data set (extracted at the proposed project site) was used, supported by recent data from the RBCAA air quality monitoring network.

Wind roses comprise 16 spokes, which represent the directions from which winds blew during a specific period. The colours used in the wind roses below, reflect the different categories of wind speeds; the yellow area, for example, representing winds in between 5 and 7 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s, are also indicated.

The simulated WRF meteorological data for the proposed project site and two RBCAA air quality monitoring stations (AQMS) (Airport and Harbour West) were compared, in the sections below, to assess how representative the WRF data set is for the proposed project site. Harbour West was selected as it is one of the closest full (meteorology and air pollutant concentrations) AQMS stations to the proposed project site.

3.2.1.1 Simulated Wind-field for the proposed project site

The predominant wind direction at the proposed project site, from the simulated WRF meteorological data, is from the north and north-east (Figure 3-6). Southerly and south-westerly winds are also fairly common. There is a slight dominance for northerly night-time winds and north-easterlies during the day-time. High speed winds (greater than 10 m/s) are more likely to originate from the south-west during the day. Calm conditions (when wind speeds are less than 1 m/s) occur approximately on 3% of the time and wind speeds frequently exceed 5 m/s.

The seasonal variation in the wind field shows a slight northerly dominance in autumn and winter and while north-easterlies is more dominant in summer and spring (Figure 3-7). Southerly and south-westerly winds are more frequent in winter and spring. Calm conditions are more frequent in summer and least common in spring. Highest wind speeds are likely in spring.

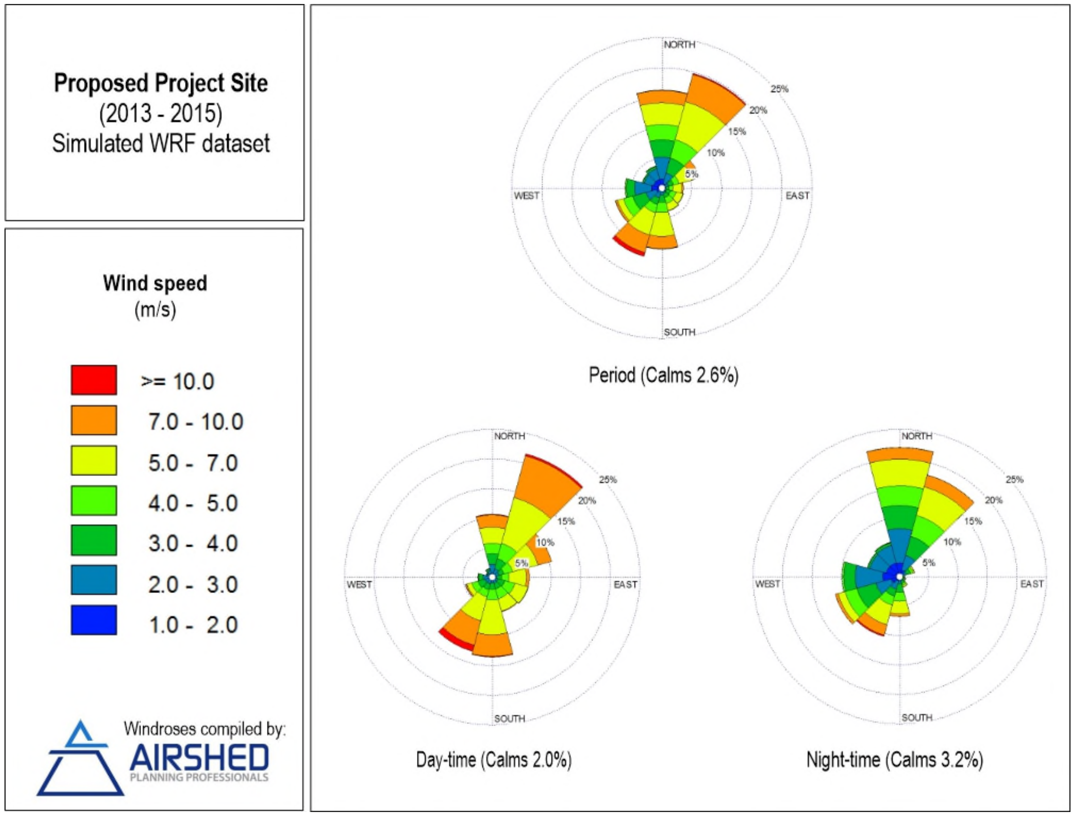


Figure 3-6: Diurnal wind-field for the proposed project site (WRF dataset 2013 - 2015)

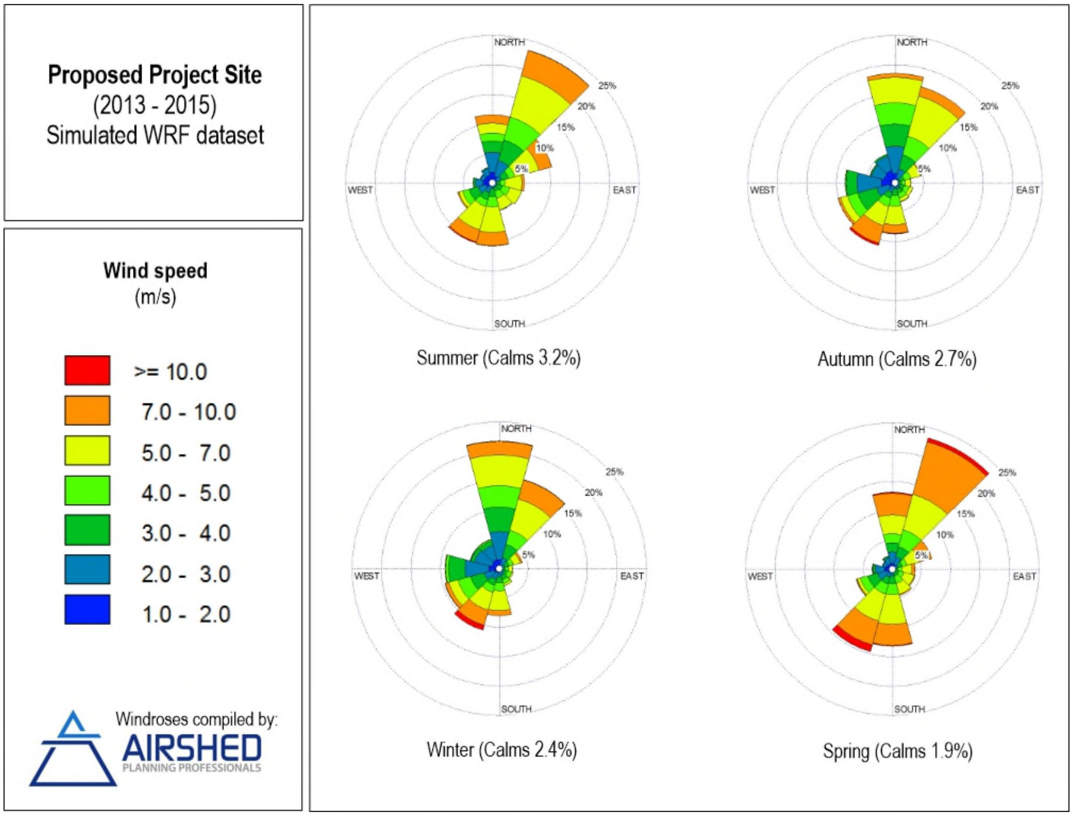


Figure 3-7: Seasonal wind-field for the proposed project site (WRF dataset 2013 - 2015)

3.2.1.2 Measured Wind-field at the Richards Bay Airport

The wind-field based on measured data at the Richards Bay Airport is similar to the simulated WRF data at the proposed project site. The predominant wind direction at the Airport is from the north (Figure 3-8). North easterly and south-westerly winds are also fairly common. There is a slight dominance for northerly night-time winds. High speed winds (greater than 10 m/s) are more likely to originate from the south and south-west during the day. Calm conditions (when wind speeds are less than 1 m/s) occur approximately on 5% of the time, more commonly at night.

The seasonal variation in the wind field shows a northerly dominance in all seasons, most frequently (more than 20% of the time) in autumn (Figure 3-9). North-easterlies are more dominant in spring. Southerly and south-westerly winds are more frequent in spring. Calm conditions are more frequent in summer and least common in spring. Highest wind speeds are likely in spring.

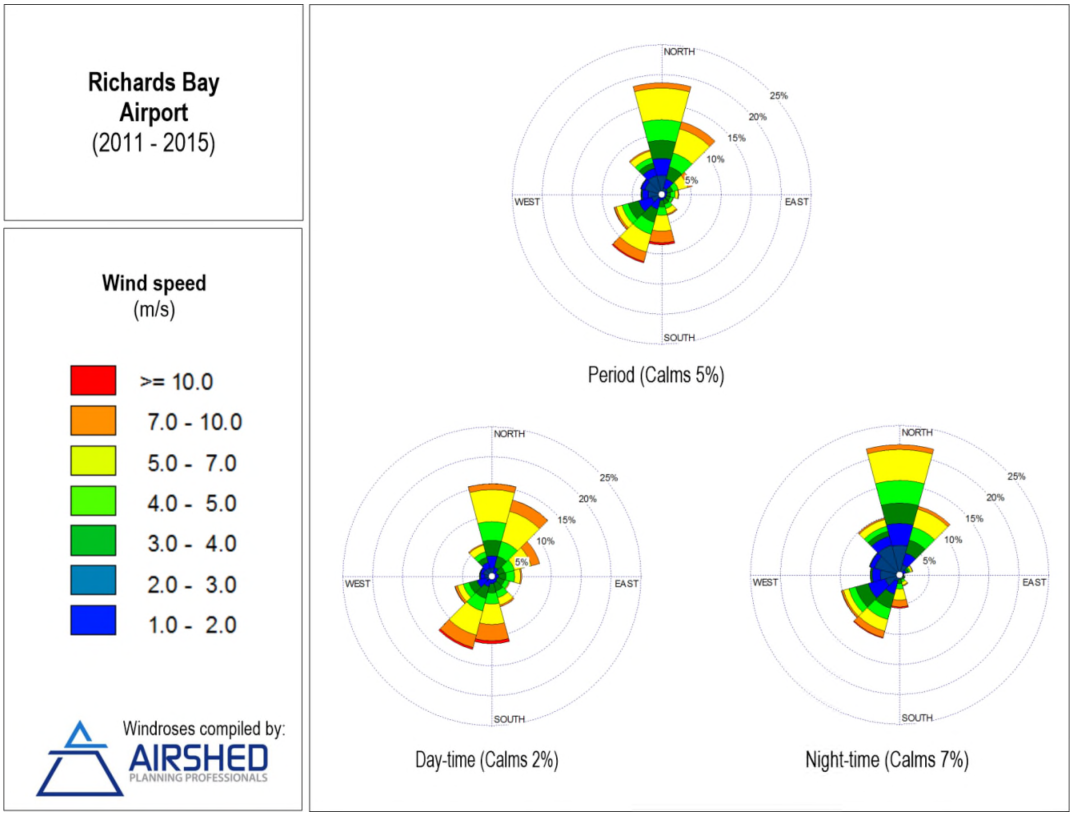


Figure 3-8: Diurnal wind-field for the Richards Bay Airport (measured data 2013 - 2015)

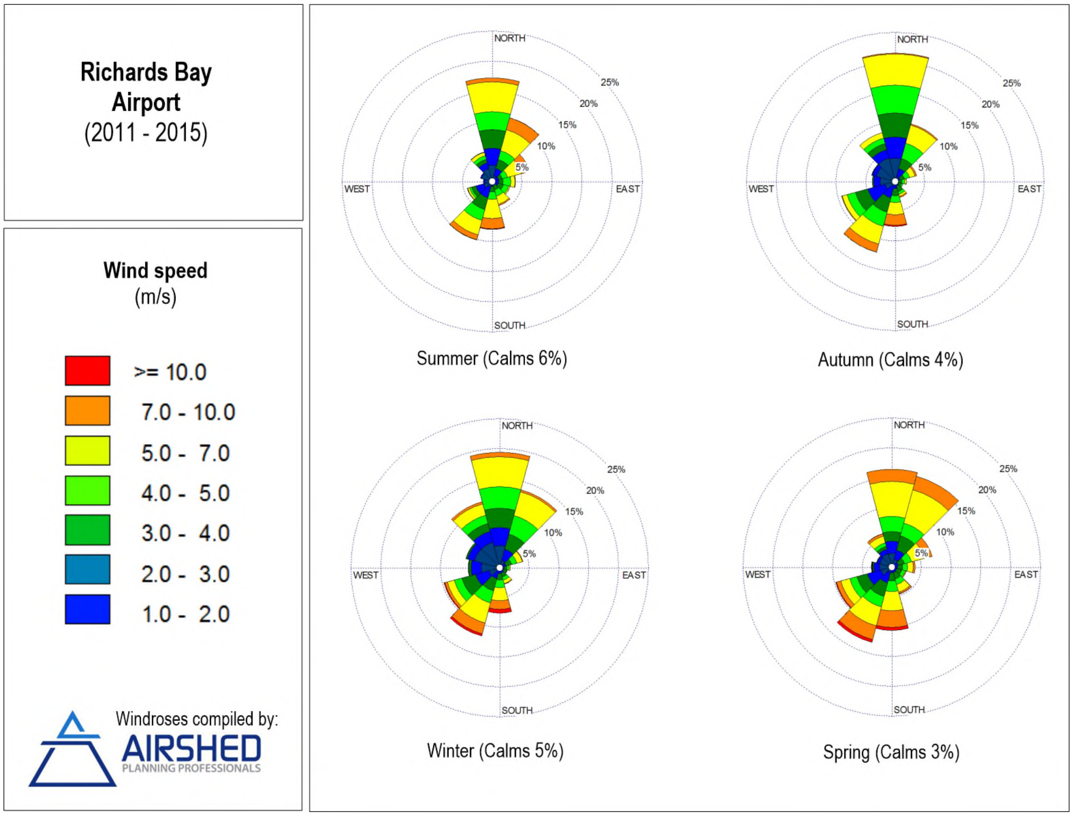


Figure 3-9: Seasonal wind-field for the Richards Bay Airport (measured data 2013 - 2015)

3.2.1.3 Measured Wind-field at the Harbour West Air Quality Monitoring Station

The wind-field based on measured data at the Harbour West AQMS is more similar to the simulated WRF data at the proposed project site. The predominant wind direction at the Airport is from the north and north-east (Figure 3-10). Southerly and south-westerly winds are also fairly common. North-easterly winds dominate the Harbour West wind-field at night. High speed winds (greater than 10 m/s) are more likely to originate from the south and south-west during the day. Calm conditions (when wind speeds are less than 1 m/s) occur approximately on 5% of the time, more commonly during the day. The increased frequency of day-time calm conditions in dissimilar to both the simulated data for the proposed project site and for the Airport, however; night-time wind speeds at the Harbour West AQMS are lower than day-time average wind speeds.

The seasonal variation in the wind field shows a north-easterly dominance in all seasons however the frequency of north-easterly and south-westerly winds is largest in spring (Figure 3-11). The frequency of calm conditions is lowest in summer and highest in winter. Highest wind speeds are likely in spring.

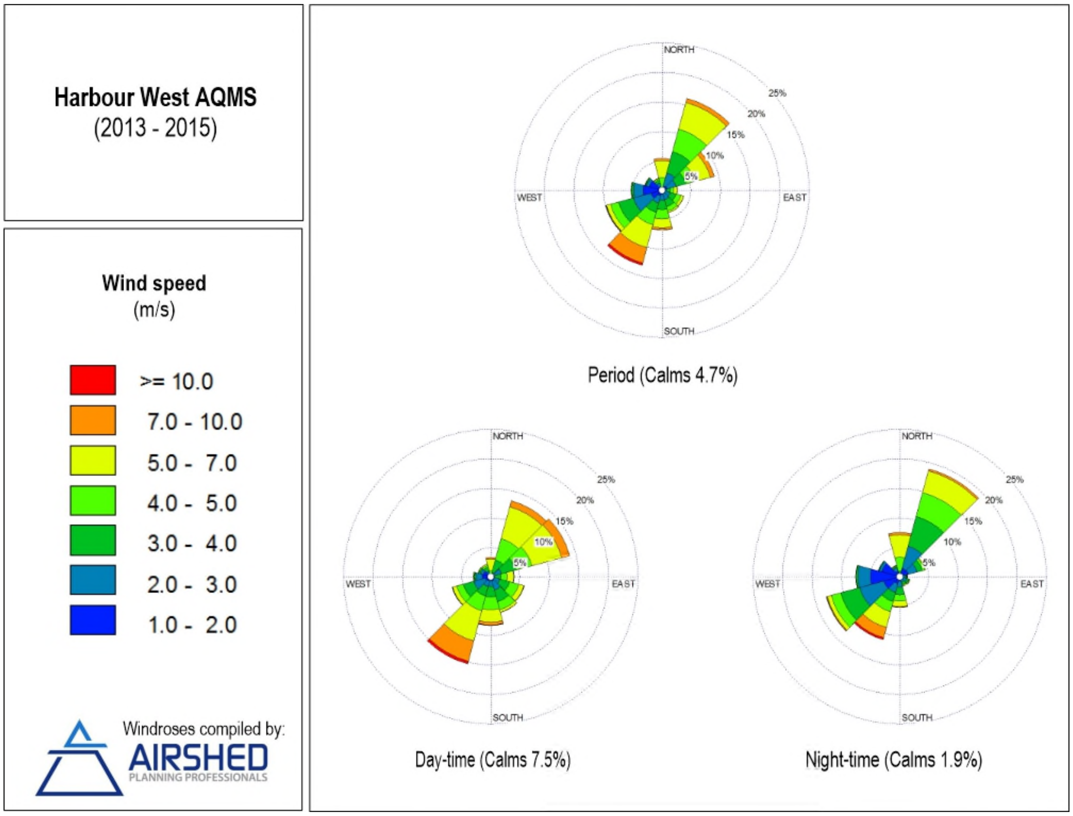


Figure 3-10: Diurnal wind-field for the Harbour West AQMS (measured data 2013 - 2015)

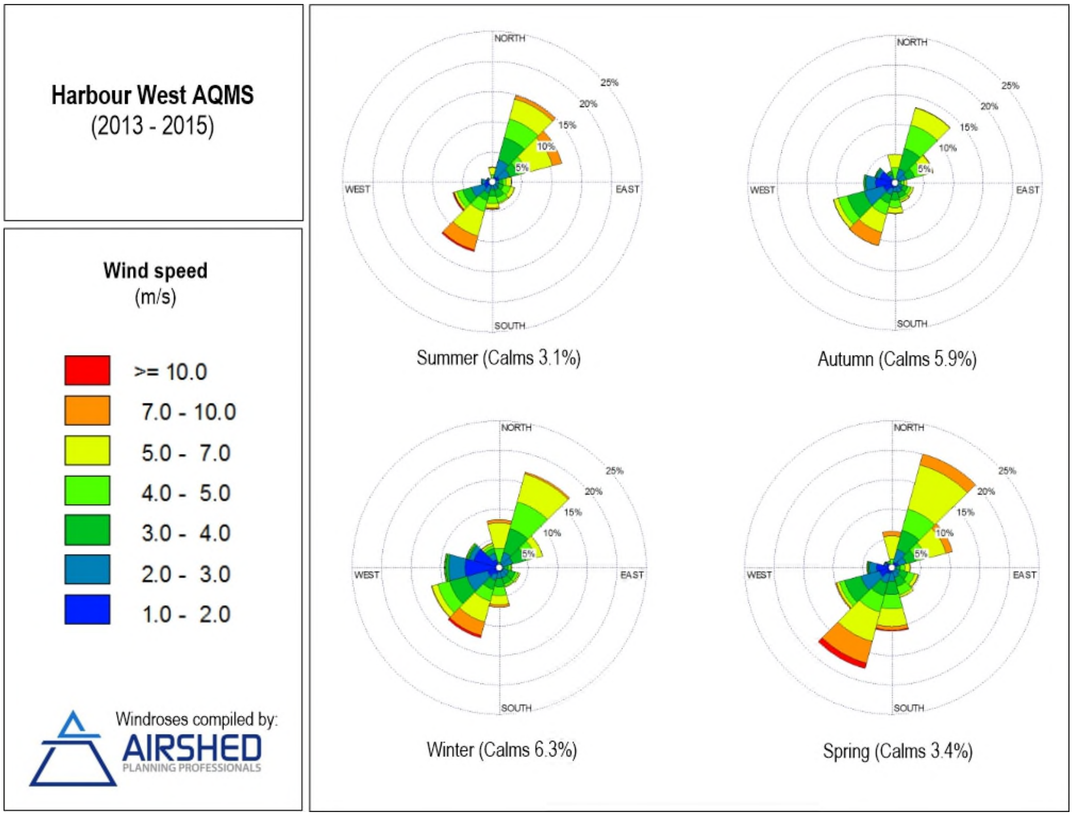


Figure 3-11: Seasonal wind-field for the Harbour West AQMS (measured data 2013 - 2015)

3.2.2 *Ambient Temperature (Simulated WRF Temperatures at the proposed project site)*

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the emission plume and the ambient air, the higher the plume is able to rise), and determining the development of the mixing and inversion layers.

Monthly mean, maximum and minimum temperatures from the simulated WRF meteorology for the proposed project site are given in Table 3-1. Diurnal temperature variability is presented in Figure 3-12. Temperatures ranged between 7.3°C and 44.7°C. During the day, temperatures increase to reach maximum near 14:00 in the afternoon; however, elevated temperatures can persist between 10:00 and 19:00 in the evening. Ambient air temperature decreases to reach a minimum at between 01:00 and 07:30 in the morning, seldom dropping below 10°C.

Table 3-1: Monthly temperature summary (WRF data, proposed project site January 2013 to December 2015)

Monthly Minimum, Maximum and Average Temperatures (°C)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Minimum	16.2	14.6	14.9	10.7	10.6	7.3	7.9	8.5	9.7	12.4	12.7	13.1
Average	24.5	24.3	23.8	21.3	20.3	18.3	18.0	19.6	21.0	21.2	22.3	23.5
Maximum	37.3	37.0	37.4	34.5	33.0	34.6	33.1	35.0	40.6	44.7	36.9	40.8

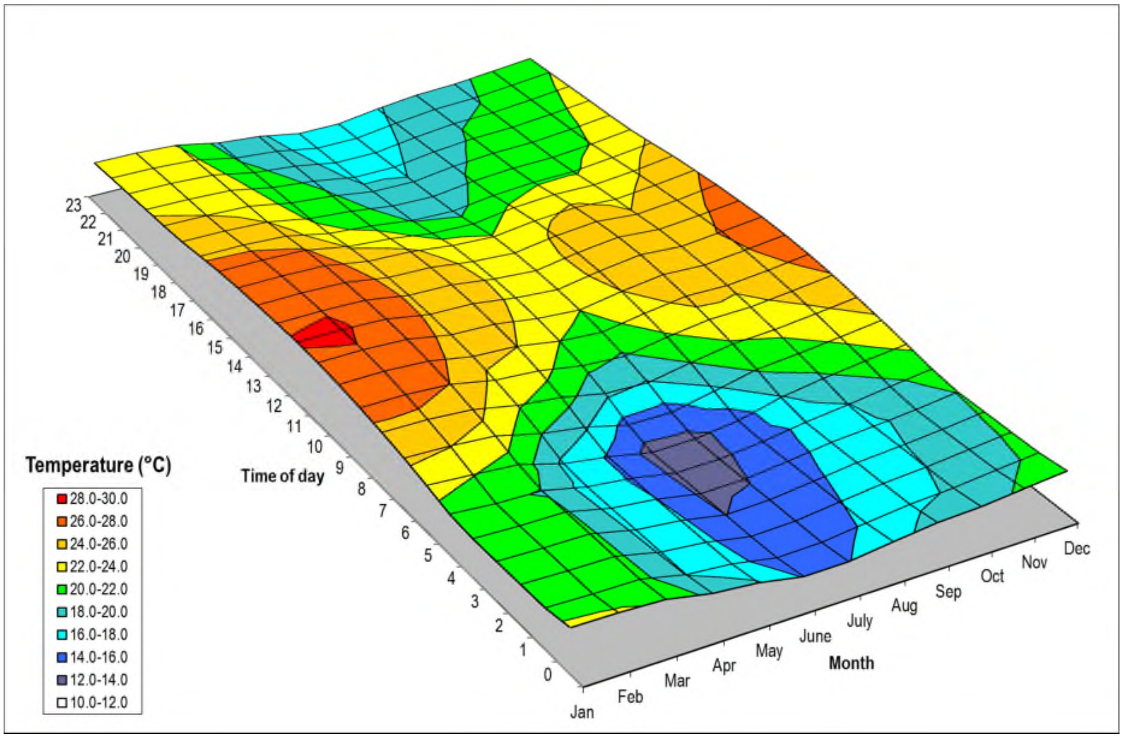


Figure 3-12: Diurnal temperature profile (WRF data, January 2013 to December 2015)

3.3 Sources of Air Pollution in the Region

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. 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;
- 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).

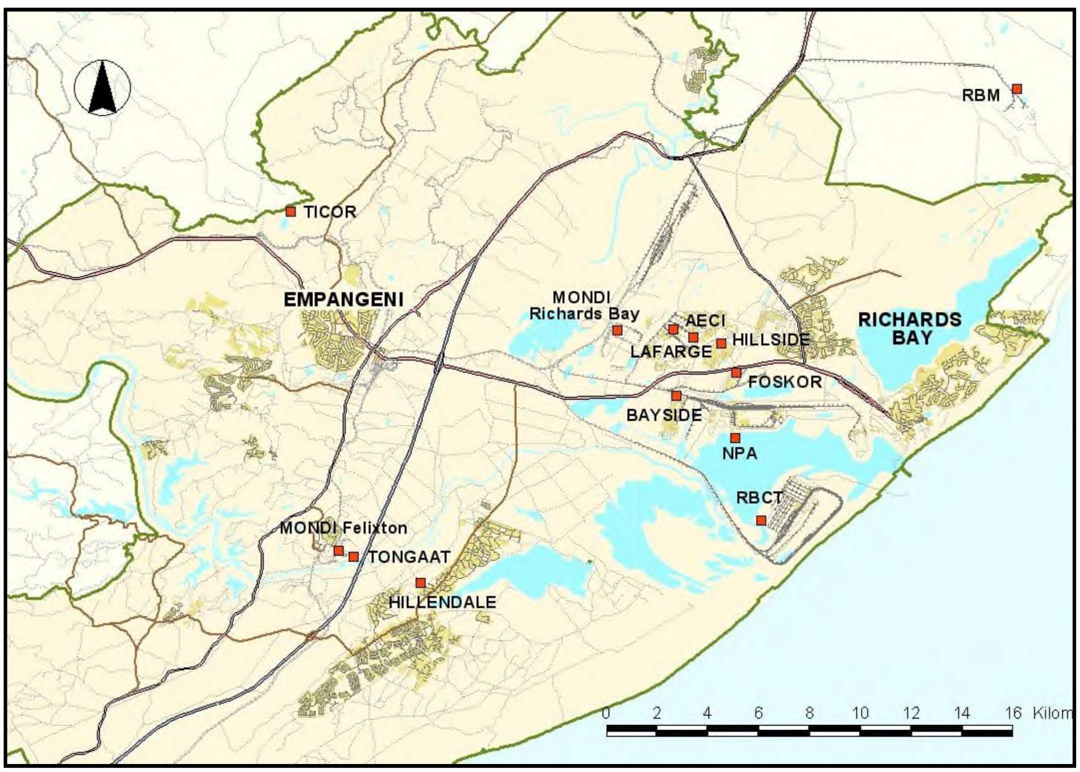


Figure 3-13: Location of all the main industries and mines within the uMhlathuze Local Municipality (Liebenberg-Enslin, H, & Petzer, 2006).

<u>Industrial Sources</u>

Most of industrial sources within the region are located within Richards Bay. These industrial operations have a substantial influence on ambient concentrations in Richards Bay.

Mining sources

Mining operations within the Richards Bay area almost exclusively include mineral sand mining activities. Only two mines are operational within the municipal boundaries namely Tronox Hillendale, and Hlanganani Sandwork Operations. There might be other smaller sandwork operations within the municipality. The Tronox Hillendale Mine is nearing the end of its life, and the proposed Fairbreeze Mine to the south of Hillendale, will provide the mineral concentrate for the smelter once the Hillendale operations have ceased. The Zulti South Mining Lease Area is a proposed mineral sand mine to be located northeast of Mtunzini, covering an area of 20 km in length by a maximum of 2 km in width. The operations will include opencast dry mining of dune sand and processing to produce heavy mineral concentrate (HMC) (Liebenberg-Enslin & Shackleton, 2016).

Mining operations represent potentially significant sources of fugitive dust emissions, where the particulate emissions are the main pollutant of concern. Fugitive dust sources associated with sand mining activities include materials handling activities, vehicle-entrainment by haul trucks and wind-blown dust from tailings impoundments and stockpiles.

Transport related emissions

Vehicles, railroad, shipping and the airport are included in this category. The main source of concern in the area is vehicle tailpipe emissions. The main national and provincial highways and roads include the N2 from Durban in the south to north of Empangeni. Various main and secondary roads link the rural and urban areas within the municipality (Liebenberg-Enslin & Petzer, 2006).

Biomass burning

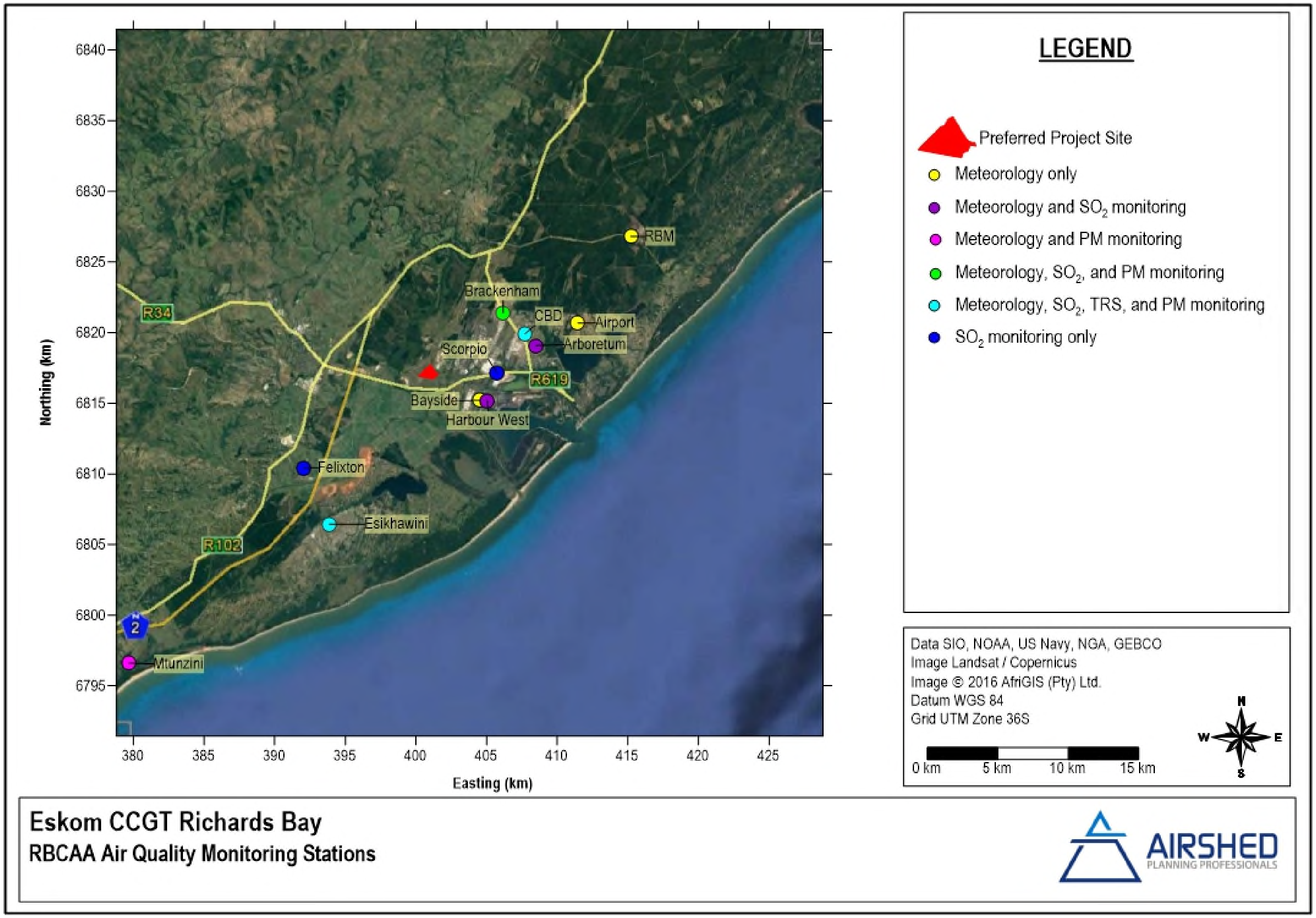
Crop-residue burning and general wild fires (veld fires) represent significant sources of combustion-related emissions associated with agricultural areas and forestry. Major pollutants from veld fires are particulates, CO and VOCs. The extent of NO_X emissions depend on combustion temperatures, with minor quantities of sulfur oxides 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.

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.

3.4 Measured Baseline Ambient Air Quality

The RBCAA operates 12 ambient monitoring stations, measuring meteorological parameters and ambient SO_2, TRS and PM_{10} concentrations (Figure 3-14). Hourly data from all stations was provided by the RBCAA for the period June 2013 to June 2016 (Table 3-2). One station – St Lucia – was excluded from assessment as it is located outside of the 50 x 50 km modelling domain.



LEGEND
Preferred Project Site
Meteorology only
Meteorology and SO_2 monitoring
Meteorology and PM monitoring
Meteorology, SO_2, and PM monitoring
Meteorology, SO_2, TRS, and PM monitoring
SO_2 monitoring only
RBM
Brackenham
CBD
Airport
Arboretum
Scorpio
R619
Bayside
Harbour West
Felixton
Esikhawini
R34
R102
Mtunzini
Northing (km)
Easting (km)
Data SIO, NOAA, US Navy, NGA, GEBCO
Image Landsat / Copernicus
Image © 2016 AfriGIS (Pty) Ltd.
Datum WGS 84
Grid UTM Zone 36S
0 km
5 km
10 km
15 km
Eskom CCGT Richards Bay
RBCAA Air Quality Monitoring Stations

Figure 3-14: RBCAA ambient monitoring network

Table 3-2: RBCAA ambient monitoring network with parameters measured

RBCAA Monitoring Station	Meteorology	SO_2	TRS	PM_{10}
Airport (at Richards Bay Airport)	√			
Arboretum	√	√		
Bayside (next to Bayside Aluminium)	√			
Brackenham	√	√		√
CBD (situated in the Sports Complex)	√	√	√	√
Esikhawini	√	√	√	√
Felixton		√		
Harbour West (near the western entrance to the harbour)	√	√		
Mtunzini	√			√
RBM (situated at Richards Bay Minerals)	√			
Scorpio (intersection of John Ross Highway and West Central Arterial)		√		
St Lucia[(a)]	√			√

Notes:

(a) Excluded from results summary as the station is located outside of the modelling domain

3.4.1 *PM_{10} Ambient Concentrations*

The daily PM_{10} concentrations – for the data period provided (June 2013 to July 2016) – indicate non-compliance with the daily PM_{10} NAAQS at Brackenham and CBD stations during 2015, where daily average concentrations measured exceeded 75 µg/m³ on more than four occasions during the year (Table 3-3). The number of exceedances at Mtunzini remains the same. Annual average PM_{10} concentrations were compliant with the NAAQS at all stations and similarity between years at each station is noted (Figure 3-15). Interpretation of compliance the 2013 and 2016 data (for daily and annual averages) is cautioned as the data sets provided were incomplete and represent approximately 50% of the year or less. This will be updated during the EIA phase of assessment.

Table 3-3: Frequency of exceedance of daily PM_{10} limit concentration (bold text indicates non-compliance with daily PM_{10} NAAQS)

Year	Frequency of Exceedance of daily limit concentration			
	Brackenham	CBD	Esikhawini	Mtunzini
2013[(a)(b)]	-	-	1	-
2014[(a)]	-	3	1	1
2015	**6**	**5**	1	2
2016[(b)]	-	-	-	1

Notes:

(a) Daily limit concentration 120 µg/m³ valid until 1 January 2015; thereafter daily limit concentration of 75 µg/m³ applies

(b) incomplete data set available; number of daily exceedances could be in non-compliance with the permitted frequency of exceedance (4 days per calendar year)

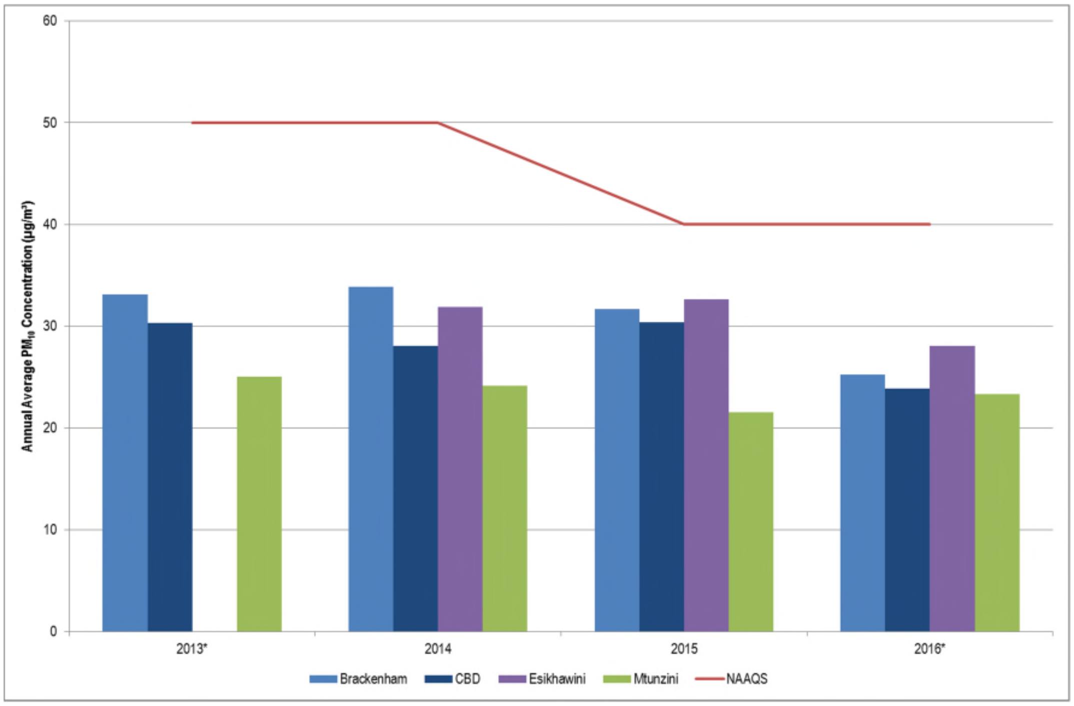


Figure 3-15: Annual average PM_{10} concentrations (June 2013 to June 2016) [*indicates incomplete dataset; calculated average may not be accurate based on 50% data availability or less]

The 'openair' statistical package (Carslaw & Ropkins, 2012; Carslaw, 2014) was used to plot the PM_{10} concentrations measured at the RBCAA stations. An analysis of the observed PM_{10} concentrations at the AQMS involved categorising the concentration values into wind speed and direction bins for different concentrations in order to generate polar plots. Polar plots can provide an indication of the directional contribution as well as the dependence of concentrations on wind speed, by providing a graphical impression of the potential sources of a pollutant at a specific location. The directional display is fairly obvious, i.e. when higher concentrations are shown to occur in a certain sector, e.g. south-west of Brackenham (Figure 3-16(a)), it is understood that most of the high concentrations occurred when winds blew from that sector. The dotted circular lines indicate the wind-speed with which the concentrations are associated. At all four stations analysed elevated PM_{10} concentrations were recorded when wind speeds exceeded 8 m/s. The directional contributions, however, varied between the stations, where the contributors at high wind speeds are located: to the south-west of Brackenham station; to the south and north-north-east of the CBD station; to the west and north-west of the Esikhawini station; and, to the east-north-east, north and, south of the Mtunzini station.

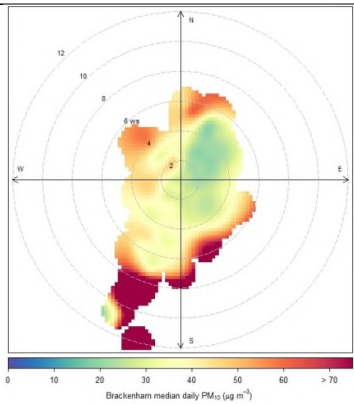
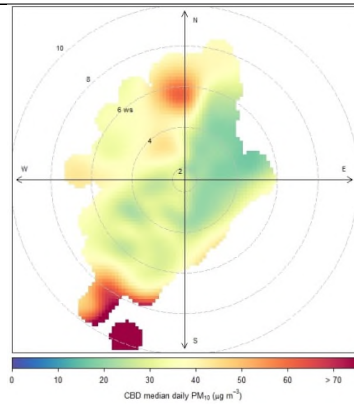
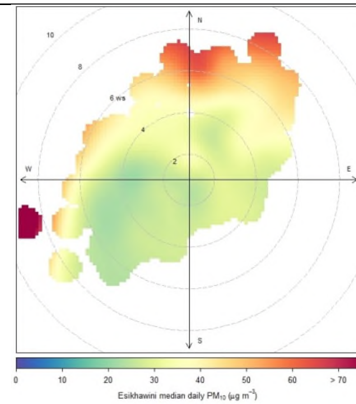
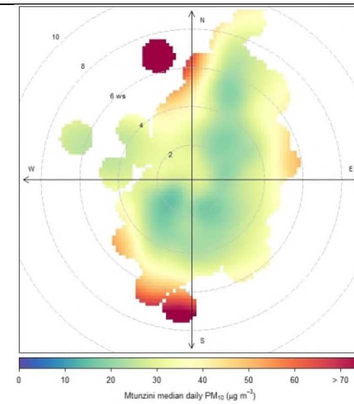
Brackenham	CBD	Esikhawini	Mtunzini
			
(a)	(b)	(c)	(d)

Figure 3-16: Polar plots of median daily PM_{10} concentrations for four RBCAA stations (2013 to 2016)

3.4.2 *SO_2 Ambient Concentrations*

Hourly SO_2 concentrations recorded at seven RBCAA stations complied with the hourly NAAQS for all years in the data set (Table 3-4). Scorpio AQMS had the largest number of hourly exceedances, 48 hours in 2013 and 5 hours in 2014. The NAAQS allows for 88 hours exceeding the limit concentration per year (350 µg/m³). The Harbour West AQMS recorded 2 hours (in 2014) and CBD 1 hour (in 2016) exceeding the hourly limit concentration. No hourly exceedances were measured at the other stations during the June 2013 to July 2016 period. The Scorpio AQMS recorded non-compliance with the daily SO_2 NAAQS (125 µg/m³) in 2013 due to 9 days recording averages in excess of the limit concentration (4 days are allowed) (Table 3-4). Although the daily average SO_2 concentrations exceeded the limit concentration at Scorpio for two days during 2014 no further daily exceedances at the Scorpio (or other AQMS) have been recorded. Annual average SO_2 at all stations was compliant with the NAAQS (Figure 3-17) with a slight trend towards improvement at all stations.

Table 3-4: Frequency of exceedance of the hourly and daily SO_2 NAAQS (bold text indicates non-compliance with applicable NAAQS)

Year	RBCAA monitoring station						
	Arboretum	**Brackenham**	**CBD**	**Esikhawini**	**Felixton**	**Harbour West**	**Scorpio**
Frequency of Exceedance of hourly limit concentration(350 µg/m³)							
2013[(a)]	-	-	-	-	-	-	48
2014	-	-	-	-	-	2	5
2015	-	-	-	-	-	-	-
2016[(a)]	-	-	1	-	-	-	-
Frequency of Exceedance of daily limit concentration (125 µg/m³)							
2013[(a)]	-	-	-	-	-	-	**9**
2014	-	-	-	-	-	-	2
2015	-	-	-	-	-	-	-
2016[(a)]	-	-	-	-	-	-	-

Notes:
(a) incomplete data set available; number of hourly and daily exceedances could be in non-compliance with the permitted frequency of exceedance (88 hours or 4 days per calendar year)

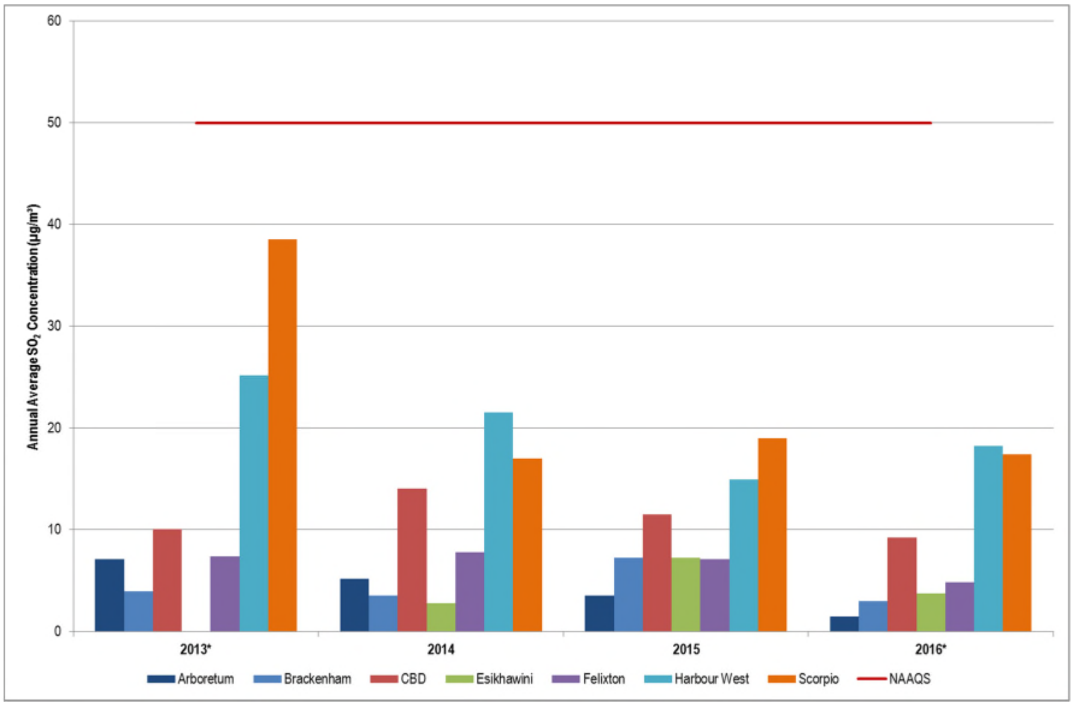


Figure 3-17: Annual average SO_2 concentrations (June 2013 to June 2016) [*indicates incomplete dataset; calculated average may not be accurate based on 50% data availability or less]

Polar plots were generated for five of the RBCAA stations where SO_2 and meteorological parameters are recorded (Figure 3-18). At the Arboretum AQMS elevated SO_2 contributions originated to the south-west of the station at wind speeds between 2 and 10 m/s. Sources of SO_2 are located to the south of the Brackenham AQMS and contributed at wind speeds between 5 and 15 m/s. The median hourly SO_2 concentrations at the Arboretum and Brackenham stations were similar, generally below 20 µg/m³. The CBD and Harbour West AQMS recorded similar median hourly SO_2 concentrations however the directional contributions differ. At the CBD station SO_2 sources were located to the south-west of the station where elevated SO_2 concentrations contributed at wind speeds between 2 and 12 m/s. The Harbour West AQMS recorded elevated SO_2 concentrations from the north-west and north-east at low wind speeds (less than 10 m/s). The Esikhawini station recorded the lowest median hourly SO_2 concentrations and the polar plot shows that elevated concentrations originate to the north-west (at wind speeds above 4 m/s) and north-east (at wind speeds above 10 m/s) of the station.

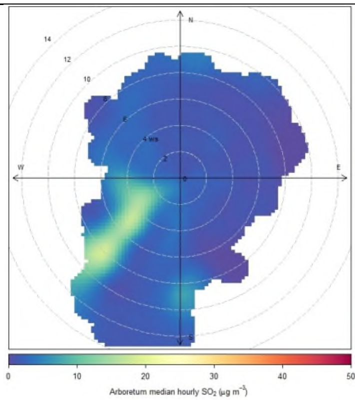
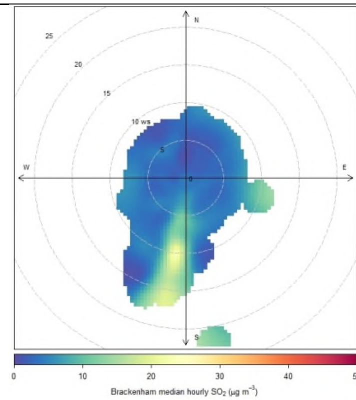
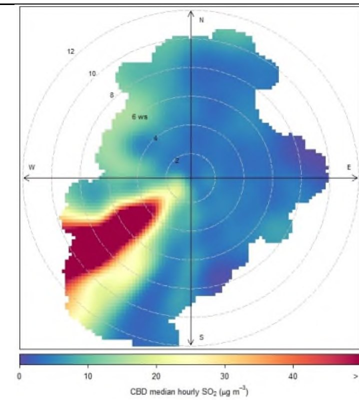
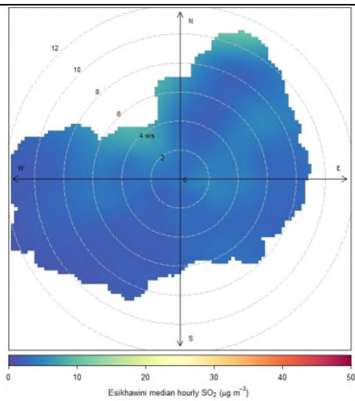
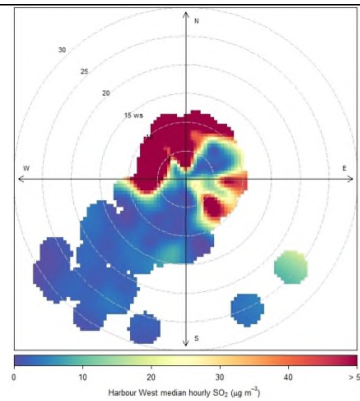
Arboretum	Brackenham	CBD
 (a)	 (b)	 (c)
Esikhawini	**Harbour West**	
 (d)	 (e)	

Figure 3-18: Polar plots of median hourly SO_2 concentrations for five RBCAA stations (2013 to 2016)

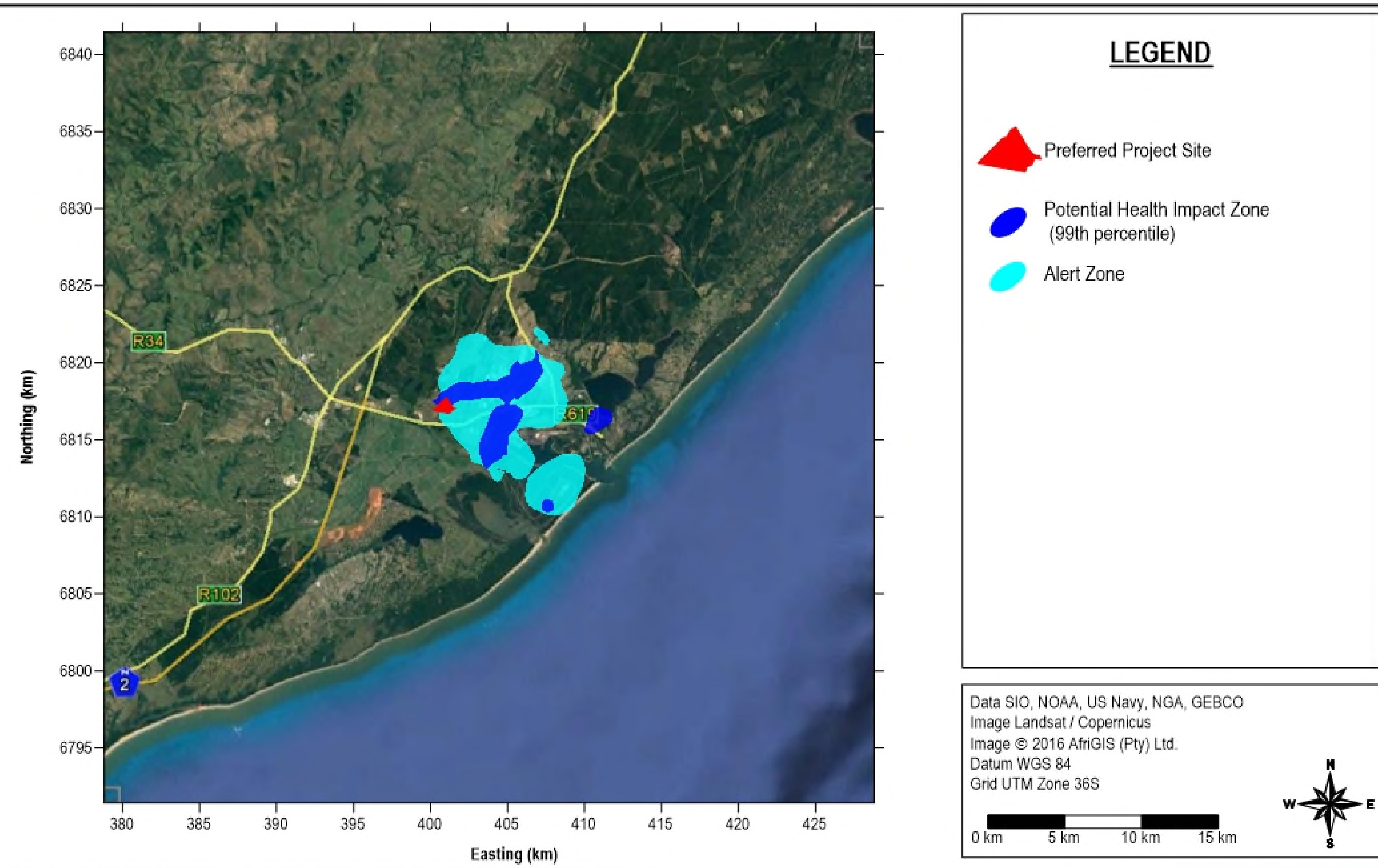
3.5 Dispersion Modelling Results for Richards Bay

Figure 3-19 shows the historical air quality management zone based on dispersion modelling results for the then "future" scenario for the City of uMhlathuze (Liebenberg-Enslin, H, & Petzer, 2006). The future scenario included TATA Steel and Pulp United. The buffer zone delineation was based on the 99th percentile as representative of the frequency of Exceedance. This was applied to SO_2 (hourly and daily) and PM_{10} (daily) and screened against the SANS limit values[2]. The Health Impact Zone and the Alert Zone were considered the main focus for decision making within the City of uMlathuze. These buffer zones showed areas where the ambient air quality was already elevated with no room for additional sources of specifically SO_2 and PM_{10} emissions.

The modelled SO_2 concentrations for 2014, as shown in Figure 3-20, reflect a similar area of non-compliance than the management zones. The highest hourly concentrations are high over the central part of Richards Bay, at Felixton and at RBM (Golder Associates (Pty) Ltd, 2015).

The 2007 air quality management study only modelled SO_2 as an indicator pollutant and had similar results as the other studies – the study found 1-hour average SO_2 concentrations in the City of uMhlathuze to be above the NAAQS limit in both the residential and industrial areas, and above the 24-hour and annual average standards in the industrial areas (Haripursad, 2007).

[2] This study was done before the NAAQS were published.



Eskom CCGT Richards Bay

Recommended Management Buffer Zones

(For the City of uMhlathuze from Liebenberg-Enslin & Petzer, 2006)

Figure 3-19: Air Quality Management Zones for the City of uMhlathuze (Liebenberg-Enslin, H, & Petzer, 2006)

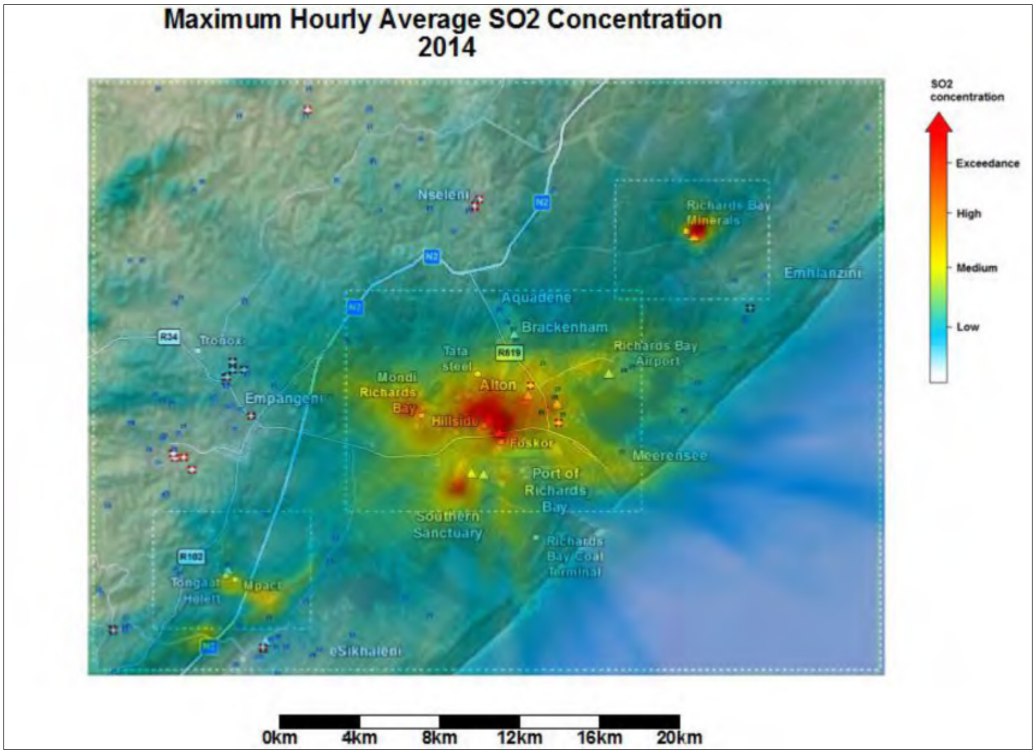


Figure 3-20: Maximum predicted hourly average SO_2 concentrations (Golder Associates (Pty) Ltd, 2015)

4 SCOPING PHASE IMPACT ASSESSMENT

The purpose of the Scoping Report is to identify the main issues and potential impacts of the proposed project based on a desktop assessment of existing information. The scoping assessment of the proposed CCPP project focussed on the preferred alternative project site, which was selected during the screening phase. The impact assessment methodology provided by Savannah Environmental (Appendix A) was used to summarise the potential impacts of the construction (Table 4-1) and operation phases (Table 4-2) of the proposed project.

Table 4-1: Potential Impact Associated with the Construction of the CCPP at the Scoping Phase

<table>
<tr><td colspan="5">Impacts
Elevated ambient concentrations of particulate and gaseous atmospheric pollutants as a result of construction activities.</td></tr>
<tr><td colspan="5">Desktop Sensitivity Analysis of the Site
Due to the prevailing wind field impacts are expected to the north-east and south-west of the proposed site. Construction activities are, by nature, intermittent and variable in duration. Impacts from these activities can, through good housekeeping practices, be limited to a local extent. Bulk earth works and vehicle activity on-site will result in cumulative local impacts, with possible non-compliance with the NAAQS, as a result of the proximity to the Mondi Richards Bay facility.</td></tr>
<tr><td>Issue</td><td colspan="2">Nature of Impact</td><td>Extent of Impact</td><td>No-Go Areas</td></tr>
<tr><td>Fugitive PM_{10} emissions</td><td colspan="2">Elevated PM_{10} concentrations as a result of bulk earthworks, concrete works, welding, and vehicle exhaust emissions.</td><td>Local</td><td>None</td></tr>
<tr><td>Gaseous pollutant emissions</td><td colspan="2">Elevated NO_X, SO_2, VOC concentrations as a result of vehicle exhaust emissions.</td><td>Local</td><td>None</td></tr>
<tr><td colspan="5">Description of <u>expected</u> significance of impact</td></tr>
<tr><td><u>Significance</u>
Low</td><td><u>Consequence</u>
Minor</td><td><u>Duration</u>
Short</td><td><u>Probability</u>
Probable</td><td><u>Degree of reversibility</u>
(cc) can be avoided, managed or mitigated</td></tr>
<tr><td colspan="5">Gaps in knowledge & recommendations for further study
The duration and scale of construction activities is unknown at this stage. Construction impacts will be assessed during the EIA phase. Relevant information required includes: expected fuel use; vehicle types, activity patterns and on-site road usage; and, full extent of bulk earthworks.</td></tr>
</table>

Table 4-2: Potential Impact Associated with the Operation phase of the CCPP at the Scoping Phase

<table>
<tr><td colspan="5">Impacts
Elevated ambient concentrations of gaseous atmospheric pollutants as a result of CCPP operational activities.</td></tr>
<tr><td colspan="5">Desktop Sensitivity Analysis of the Site
Due to the prevailing wind field impacts are expected to the north-east and south-west of the proposed site. Emission sources will be the combustion of gas in the turbine units; as well as fugitive losses of VOCs from the diesel storage tanks. Cumulative impacts are expected due to the proximity to other industrial sources in Richards Bay.</td></tr>
<tr><th>Issue</th><th colspan="2">Nature of Impact</th><th>Extent of Impact</th><th>No-Go Areas</th></tr>
<tr><td>Gaseous pollutant emissions</td><td colspan="2">Emissions as a result of gas combustion in turbine units. Pollutants of concern are: NO_X, VOCs, SO_2, and PM_{10}.</td><td>Regional</td><td>None</td></tr>
<tr><td>Fugitive emissions of VOCs</td><td colspan="2">Fugitive evaporative losses from large diesel storage tanks.</td><td>Local</td><td>None</td></tr>
<tr><td colspan="5">Description of expected significance of impact</td></tr>
<tr><td>Significance
Medium</td><td>Consequence
Moderate</td><td>Duration
Long-term</td><td>Probability
Probable</td><td>Degree of reversibility (cc) can be avoided, managed or mitigated</td></tr>
<tr><td colspan="5">Gaps in knowledge & recommendations for further study
NO_X emissions are likely to be significant from the gas (and diesel) combustion during the operation phase. Ambient NO_X and NO_2 are not currently monitored by the RBCAA. Atmospheric dispersion modelling will be used during the EIA phase to assess the extent of the impact of the proposed facility and the cumulative impact, of the pollutants of concern, including NO_X.</td></tr>
</table>

5 MAIN FINDINGS AND CONCLUSIONS

The main findings from the scoping assessment are as follows:

- The airflow in the study area and project site is dominated by winds from the north-westerly and south-easterly sectors. There is little diurnal variation with the prevailing wind field from the southwest during the night and early morning, and more frequent flow from the northeast during the afternoon and evening. The seasonal wind-field reflects the same prevailing north-westerly and south-easterly winds with stronger winds in spring and summer.
- The area is highly populated with numerous settlements along the coast, to the north of Richards Bay and south along the coast to Mtunzini. The towns in the area are Richards Bay, Empangeni, Mtunzini and Felixton.
- The main pollutants of concern in the greater Richards Bay area are mainly SO_2 and PM_{10}. Measured and modelled SO_2 concentrations indicated elevated levels over the main industrial and some residential areas of Richars Bay, at Felixton and at RBM. Measured PM_{10} concentrations also indicated elevated levels over the CBD of Richards Bay, Brackenham and some settlements. The air quality study as part of the spatial development framework indicated that ambient air quality was already elevated within Richards Bay with no room for additional sources of specifically SO_2 and PM_{10} emissions.
- Pollutants of concern from the proposed CCPP, mainly associated with gas turbines, are NO_x, CO and to a lesser extent, SO_2 and VOCs. PM is also more associated with combustion of diesel fuel to be used as back-up. VOC emissions will also be released from diesel storage tank vents as well as the off-loading and handling of diesel fuel.

The main issues and potential impacts of the proposed project based on a desktop assessment of existing information from an air quality perspective.

> The proposed CCPP at the preferred location may result in elevated (and potentially non-compliance with NAAQS) daily PM_{10} concentrations during the construction phase due to background PM_{10} and the proximity to other particulate emission sources. The impacts are likely to be local.
>
> During the operation phase, the proposed CCPP is likely to contribute NO_X, CO, and VOCs to the existing baseline concentrations. Cumulative impacts of SO_2 and PM emissions, although small, may result in cumulative impacts with possible non-compliance to already elevated baseline concentrations. The impacts are likely to be regional.
>
> Atmospheric dispersion modelling will be used to assess incremental and cumulative impacts on ambient pollutant concentrations during the EIA phase of assessment.

6 References

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7 APPENDIX A: SCOPING REPORT IMPACT ASSESSMENT METHODOLOGY

The purpose of the Scoping Report is to determine the main issues and potential impacts of the proposed project during the scoping phase at a desktop level based on existing information:

- Identify potential sensitive environments and receptors that may be impacted on by the proposed facility and the types of impacts (i.e. direct, indirect and cumulative) that are most likely to occur.
- Determine the nature and extent of potential impacts during the construction and operational phases.
- Identify 'No-Go' areas, where applicable.
- Summarise the potential impacts that will be considered further in the EIA Phase through specialist assessments.

For each phase, the scoping report must include:

- a description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed project
- a description and evaluation of environmental issues and potential impacts (including direct, indirect, cumulative impacts and residual risks) that have been identified
- Direct, indirect, cumulative impacts and residual risks of the identified issues must be evaluated within the Scoping Report in terms of the following criteria:
    - the nature, which shall include a description of what causes the effect, what will be affected and how it will be affected, for each impact anticipated;
    - the extent, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international. See Table on the next page.
- a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts
- a comparative evaluation of the identified feasible alternatives, and nomination of a preferred alternative for consideration in the EIA phase
- Identification of potentially significant impacts to be assessed within the EIA phase and details of the methodology to be adopted in assessing these impacts. This should be detailed enough to include within the Plan of Study for EIA and must include a description of the proposed method of assessing the potential environmental impacts associated with the project. This must also include any gaps in knowledge at this point of the study and further recommendations for the EIA Phase. Consideration of areas that would constitute "acceptable and defendable loss" should be included in this discussion.

Example of Impact table summarising the evaluation of Potential Impacts Associated with the Construction of the Facility at the Scoping phase

Impacts Description of the expected impacts. Areas anticipated to be affected. **Desktop Sensitivity Analysis of the Site:** Sensitivity analysis in terms of the impacts expected. Discuss areas of high concern.			
Issue	**Nature of Impact**	**Extent of Impact**	**No-Go Areas**
i.e. Disturbance to and loss of indigenous natural vegetation	Discussion of the consequences of the construction of the facility to the issue/impact considered in column 1.	i.e. Local/Regional/ National	No-Go areas would include the larger drainage lines, and Duneveld.

Gaps in knowledge & recommendations for further study