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Project Applicant: **ANGLO AMERICAN INYOSI COAL (PTY) LTD**

Project: # Phola-Kusile Overland Coal Conveyor

Report Name: # ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Volume 4: Appendix I to P (Specialist Reports)

(of 4 volumes)

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ENVIRONMENTAL-IMPACT-ASSESSMENT-REPORT

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This report is Volume 4 of 4 and contains:

Appendix I: Air Quality Specialist Assessment

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Appendix I:
Air Quality Specialist Assessment

Structuring of the Specialist Studies in terms of GNR 543 Section 32 Requirements

Legal and Regulatory Requirement	Cross Reference to Report Section
GNR 543 Section 32	
Specialist reports and reports on specialized processes	
1. An applicant or the EAP managing an application may appoint a person to carry out a specialist study or specialized process.	Appendices to the EIA main report
2. The person referred to in sub-regulation (1) must comply with the requirements of regulation 17 [declaration of independence]	Declaration of independence signed by specialists provided at back of each specialist report
3. A specialist report or a report on a specialized process prepared in terms of these Regulations must contain-	
(a) Details of- (i) the person who prepared the report; and (ii) the expertise of that person to carry out the specialist study or specialized process;	Page 2– Report Details
(b) A declaration that the person is independent in a form as may be specified by the competent authority;	Declaration of independence signed by specialists provided at back of each specialist report; Page 2 – Report Details
(c) An indication of the scope of, and the purpose for which, the report was prepared;	Chapter 1, Section 1.1 - Terms of Reference
(d) A description of the methodology adopted in preparing the report or carrying out the specialized process;	Chapter 1, Section 1.2 - Methodological Approach
(e) A description of any assumptions made and any uncertainties or gaps in knowledge;	Chapter 1 – Section 1.3 - Assumptions and Limitations
(f) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;	Section 4.2.4 – Mitigation measures recommended Chapter 5 - Conclusions and Recommendations
(g) Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;	Provided in each specialist report, where relevant Chapter 5 - Conclusions and Recommendations
(h) A description of any consultation process that was undertaken during the course of carrying out the study;	Consultation Process discussed in EIA main report
(i) A summary and copies of any comments that were received during any consultation process; and	All issues received to date included in Section 6 of the EIA main report
(j) Any other information requested by the competent authority.	Not applicable

Project done on behalf of

Synergistics Environmental Services

AIR QUALITY SPECIALIST IMPACT ASSESSMENT FOR THE PROPOSED NEW PHOLA-KUSILE COAL CONVEYOR, NKANGALA DISTRICT MUNICIPALITY, MPUMALANGA

Report No.: APP/09/SYN-03B Rev 0.2

(SYN0403-AIR-PK-01-AIR-QUALITY-SPECIALIST-REPORT)

DATE: October 2011

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REPORT DETAILS

Reference	APP/09/SYN-03B
Status	Revision 0.2
Report Title	Air Quality Impact Assessment for the Proposed New Largo Opencast Coal Mine in the Kendal Area: Initial Conveyor Transfer from Phola to Kusile Power Station
Date Submitted	October 2011
Client	Synergistics Environmental Services SYN0403-AIR-PK-01-AIR-QUALITY-SPECIALIST-REPORT
Prepared by	Reneé von Gruenewaldt (Pr. Sci. Nat.), MSc (University of Pretoria)
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EXECUTIVE SUMMARY

Anglo Coal South Africa and Eskom have identified the need for additional coal supplies to meet planned increases in power generation capacity. The New Largo coal resource has been identified as having the potential to supply the proposed Kusile Power station. Coal processed at the Phola Coal Processing Plant has been identified as an additional resource to meet the demand for coal at the Kusile Power Station. Airshed Planning Professionals (Pty) Limited was appointed by Synergistics Environmental Services to undertake an air quality assessment for the transportation of coal via the Phola-Kusile Coal Conveyor to the Kusile Power Station.

The aim of the investigation was to quantify the possible impacts resulting from fugitive sources on the surrounding environment and human health. To achieve this, a good understanding of the local dispersion potential of the site is necessary and subsequently an understanding of existing sources of air pollution in the region and the resulting air quality.

The investigation followed the methodology required for a specialist report, comprising the baseline characterisation and the impact assessment study.

Baseline Assessment

The baseline study encompassed the analysis of meteorological data. Local meteorological data (including wind speed, wind direction and temperature) was obtained from the Kendal 2 monitoring site operated by Eskom. Other meteorological parameters required for dispersion modelling purposes (including relative humidity and rainfall) were obtained from the closest South African Weather Service Station (SAWS) of Witbank. The meteorological period used for dispersion modelling purposes included 2008-2010.

Impact Assessment Criteria

Particulate concentrations represented the main pollutant of concern given the nature of the operations. These pollutants are classified as criteria pollutants, with ambient air quality guidelines and standards having been established by various countries to regulate these ambient concentrations.

Emissions Inventory

Emissions inventories provide the source input required for the simulation of ambient air concentrations. Emission rates were quantified for each hour of the year as a result of wind erosion for proposed operating conditions. In addition, fugitive emissions from conveyor transfer areas were also quantified.

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 *limitations* of the air quality impact assessment are summarised as follows:

- The quantification of sources of emission was restricted to the proposed operations only. Although other background sources were identified, such sources were not quantified.
- Information required to calculate emissions from fugitive dust sources for the proposed operations were provided. The assumption was made that this information was accurate and correct.
- Routine emissions from the proposed operations were estimated and modelled. Atmospheric releases occurring as a result of accidents were not accounted for.
- A minimum of 1 year, and typically 3 to 5 years of meteorological data are generally recommended for use in atmospheric dispersion modelling for air quality impact assessment purposes. Three years of meteorological data were used in the atmospheric dispersion modelling.
- The impact assessment was limited to airborne particulates (including total suspended particulates (TSP) and particulate matter of less than 10 µm in diameter (PM_{10})).
- The construction and closure phases were assessed qualitatively due to the temporary nature of these operations.

Impact Prediction Study

Particulate concentrations and dust deposition rates due to the proposed activities was simulated using the US-EPA approved AERMET/AERMOD dispersion modelling suite. Ambient concentrations were simulated to ascertain highest hourly, daily and annual averaging levels occurring as a result of the proposed operation.

Conclusions

An air quality impact assessment was conducted for the proposed conveyor transfer operations from Phola to the Kusile Power Station. The main objective of this study was to determine the significance of the predicted impacts from fugitive emissions on the surrounding environment and on human health. Emission rates were quantified for the proposed activities and dispersion modelling executed.

The main findings from the baseline assessment were as follows:

- The main sources likely to contribute to cumulative PM_{10} impact are surrounding mining and agricultural activities as well as vehicle entrainment on unpaved road surfaces.

- The predominant wind direction within the New Largo region is from the west-northwest (Kendal 2). Less frequent winds are from the southern sector. During daytime there is an increase in winds from the west-northwest (Kendal 2) while at night-time the frequency of winds increase from the east-southeast. Night-time conditions also reflect a decrease in wind speeds and an increase in calm conditions.

- The nearest sensitive receptors (in terms of human settlements) to the proposed conveyor operations are the Kendal Forest Holdings, Wilge and Phola.

- Modelled ambient PM_{10} concentrations (as obtained from the NEDLAC study) were predicted to be in line with the NAAQS (applicable immediately till 31 December 2014) but exceed the daily NAAQ PM_{10} limit applicable from 1 January 2015. The

highest PM_{10} concentrations were predicted over household fuel burning areas due to low-level emissions from such areas during periods of poor atmospheric dispersion (night-time). Twenty seven exceedances of the daily PM_{10} NAAQS (applicable immediately till 31 December 2014) and ninety exceedances of the daily PM_{10} NAAQS (applicable 1 January 2015) were measured at the Kendal 2 station in 2010. However, the data availability at this monitoring station was only 72%, thus the frequencies of exceedance may be higher for this period.

- The dust fallout recorded at nine monitoring stations at Klipspruit over the period February 2002 and September 2009 were generally within the SANS Residential band (<600 mg/m²/day) and the Industrial band (between 600 mg/m²/day and 1 200 mg/m²/day) with the highest dust fallout level being measured at Windmill (3 434 mg/m²/day during May 2004).

The main findings from the impact assessment due to the conveyor transfer activities from Phola to Kusile Power Station only were as follows:

- The predicted PM_{10} impacts due to the conveyor activities only were predicted to be within the relevant ambient air quality criteria at the closest sensitive receptors.

- For cumulative impacts, the contribution of the conveyor is very small with cumulative impacts really due to the baseline conditions.

- Based on assumptions of baseline PM_{10} concentrations (provided in Section 3.5.2), the predicted PM_{10} concentrations for cumulative impacts were in non-compliance with NAAQS at the sensitive receptors of Phola and Wilge given the potential elevation background PM_{10} concentrations.

- Total daily deposition due to the proposed conveyor operations were predicted to be within the SANS residential target of 600 mg/m²/day at the closest sensitive receptors of Wilge and Phola.

Recommendations

- It is recommended that PM_{10} concentrations be monitored at the closest sensitive receptors (i.e. Wilge) prior to operation in order to verify predicted cumulative impacts and refine controls accordingly (if necessary) in order for PM_{10} concentrations to be within NAAQS. Eskom currently have an ambient monitoring station at Phola. It would thus be useful for Anglo to share this monitored ambient information with Eskom in order to understand the baseline ambient concentrations and (once operations commence) proposed operational impact than to establish a new monitoring site at this sensitive receptor.
- Due to the predicted low impacts from the conveyor belt, it is recommended that these operations be allowed to be developed.

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AIR QUALITY IMPACT ASSESSMENT FOR THE PROPOSED NEW LARGO OPENCAST COAL MINE IN THE KENDAL AREA:

Initial Conveyor Transfer from Phola to Kusile Power Station

1 INTRODUCTION

Anglo Coal South Africa and Eskom have identified the need for additional coal supplies to meet planned increases in power generation capacity. The New Largo coal resource has been identified as having the potential to supply the proposed Kusile Power station. Coal processed at the Phola Coal Processing Plant has been identified as an additional resource to meet the demand for coal at the Kusile Power Station. Airshed Planning Professionals (Pty) Limited was appointed by Synergistics Environmental Services (hereafter referred to as Synergistics) to undertake an air quality assessment for the initial operations when coal from Phola will be transported via conveyor to the Kusile Power Station, which will take place to supplement the coal supply to the Kusile Power Station until the New Largo Colliery becomes operational.

The aim of the investigation is to quantify the possible impacts resulting from the proposed activities on the surrounding environment and human health. To achieve this, a good understanding of the regional climate and local dispersion potential of the site is necessary and subsequently an understanding of existing sources of air pollution in the region and the resulting air quality.

Typical of specialist investigations conducted, the air quality investigation comprises both a baseline study and an impact assessment. The baseline study includes the review of site-specific atmospheric dispersion potentials, and existing ambient air quality in the region, in addition to the identification of potentially sensitive receptors.

Particulates represent the main pollutant of concern in the assessment of operations from the proposed operations. Particulate matter is classified as criteria pollutant, with ambient air quality guidelines and standards having been established by various countries to regulate ambient concentrations of this pollutant. Particulates in the atmosphere may contribute to visibility reduction, pose a threat to human health, or simply be a nuisance due to their soiling potential.

1.1 Terms of Reference

The proposed terms of reference for the *baseline air quality characterisation* component of the assessment are as follows:

- The site-specific atmospheric dispersion potential;
- Identification of the potential sensitive receptors within the vicinity of the proposed site;
- Preparation of hourly average meteorological data for the model input;
- Identification of existing sources of emission in the area;
- Characterisation of ambient air quality and dustfall levels in the region based on observational data recorded to date (if available); and,
- The legislative and regulatory context.

The proposed terms of reference for *assessing the air quality impacts* associated with the proposed activities:

- Compilation of an emissions inventory, comprising the identification and quantification of all potential *routine* sources of emission from the proposed activities;
- Dispersion simulations of ambient concentrations and dustfall rates from the proposed activities;
- Analysis of dispersion modelling results from the proposed operations; and,
- Evaluation of potential for human health and environmental impacts.

1.2 Methodological Approach

1.2.1 Atmospheric Dispersion Model Selection

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.

It was decided to employ the most recently US Environmental Protection Agency's (US EPA) approved regulatory model. The most widely used US EPA model has been the Industrial Source Complex Short Term model (ISCST3). This model is based on a Gaussian plume model. However this model has been replaced by the new generation AERMET/AERMOD suite of models. AERMOD is a dispersion model, which was developed under the support of the AMS/EPA Regulatory Model Improvement Committee (AERMIC), whose objective has been to include state-of the-art science in regulatory models (Hanna *et al.,* 1999). The AERMOD is a dispersion modelling system with three components, namely: AERMOD (AERMIC Dispersion Model), AERMAP (AERMOD terrain pre-processor), and AERMET (AERMOD meteorological pre-processor).

- AERMOD is an advanced new-generation model. It is designed to predict pollution concentrations from continuous point, flare, area, line, and volume sources (Trinity Consultants, 2004). AERMOD offers new and potentially improved algorithms for plume rise and buoyancy, and the computation of vertical profiles of wind, turbulence and temperature however retains the single straight line trajectory limitation of ISCST3 (Hanna *et al*, 1999).
- AERMET is a meteorological pre-processor for the AERMOD model. Input data can come from hourly cloud cover observations, surface meteorological observations and twice-a-day upper air soundings. Output includes surface meteorological observations and parameters and vertical profiles of several atmospheric parameters.
- AERMAP is a terrain pre-processor designed to simplify and standardize the input of terrain data for the AERMOD model. Input data includes receptor terrain elevation data. The terrain data may be in the form of digital terrain data. Output includes, for each receptor, location and height scale, which are elevations used for the computation of air flow around hills.

There will always be some error in any geophysical model, but it is desirable to structure the model in such a way to minimise the total error. A model represents the most likely outcome of an ensemble of experimental results. The total uncertainty can be thought of as the sum of three components: the uncertainty due to errors in the model physics; the uncertainty due

to data errors; and the uncertainty due to stochastic processes (turbulence) in the atmosphere.

The stochastic uncertainty includes all errors or uncertainties in data such as source variability, observed concentrations, and meteorological data. Even if the field instrument accuracy is excellent, there can still be large uncertainties due to unrepresentative placement of the instrument (or taking of a sample for analysis). Model evaluation studies suggest that the data input error term is often a major contributor to total uncertainty. Even in the best tracer studies, the source emissions are known only with an accuracy of ±5%, which translates directly into a minimum error of that magnitude in the model predictions. It is also well known that wind direction errors are the major cause of poor agreement, especially for relatively short-term predictions (minutes to hourly) and long downwind distances. All of the above factors contribute to the inaccuracies not even associated with the mathematical models themselves.

Similar to the ISC model, a disadvantage of the model is that spatial varying wind fields, due to topography or other factors cannot be included. Although the model has been shown to be an improvement on the ISC model, especially short-term predictions, the range of uncertainty of the model predictions is -50% to 200%. The accuracy improves with fairly strong wind speeds and during neutral atmospheric conditions.

Input data types required for the AERMOD model include: meteorological data, source data, and information on the nature of the receptor grid. Each of these data types will be described below.

1.2.2 Meteorological Data Requirements

AERMOD requires two specific input files generated by the AERMET pre-processor. AERMET is designed to be run as a three-stage processor and operates on three types of data (upper air data, on-site measurements, and the national meteorological database). Local meteorological data (including wind speed, wind direction and temperature) was obtained from the Kendal 2 monitoring site operated by Eskom. Other meteorological parameters required for dispersion modelling purposes (including relative humidity and rainfall) were obtained from the closest South African Weather Service Station (SAWS) of Witbank. The meteorological period used for dispersion modelling purposes included 2008-2010.

1.2.3 Source Data Requirements

The AERMOD model is able to model point, area, volume and line sources. The conveyor transfer points were modelled as volume sources with the windblown dust from the conveyor belt modelled as area sources.

1.2.4 Modelling Domain

The dispersion of pollutants was modelled for an area covering 19.54 km (north-south) by 14.22 km (east-west) for the New Largo site. This area was divided into a grid with a resolution of 195.4 m (north-south) by 142.2 m (east-west). AERMOD simulates ground-level concentrations for each of the receptor grid points.

1.3 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 *limitations* of the air quality impact assessment are summarised as follows:

- The quantification of sources of emission was restricted to the proposed operations only. Although other background sources were identified, such sources were not quantified.
- Information required to calculate emissions from fugitive dust sources for the proposed operations were provided. The assumption was made that this information was accurate and correct.
- Routine emissions from the proposed operations were estimated and modelled. Atmospheric releases occurring as a result of accidents were not accounted for.
- A minimum of 1 year, and typically 3 to 5 years of meteorological data are generally recommended for use in atmospheric dispersion modelling for air quality impact assessment purposes. Three years of meteorological data were used in the atmospheric dispersion modelling.

- The impact assessment was limited to airborne particulates (including total suspended particulates (TSP) and particulate matter of less than 10 µm in diameter (PM_{10})).
- The construction (i.e of offices, beneficiation plant, roads, conveyors, etc.) and closure phases were assessed qualitatively due to the temporary nature of these operations.

1.4 Outline of report

The ambient air quality evaluation criteria are described in Section 2. The baseline characterisation comprising of atmospheric dispersion potential and existing sources of air pollution are discussed in the subsequent section. The impact assessment for the proposed operations is provided in Section 4. The conclusions and recommendations are made in Section 5.

2 LEGAL REQUIREMENTS, HUMAN HEALTH CRITERIA AND EFFECTS ON ANIMALS AND VEGETATION

Prior to assessing the impacts from the proposed activities, reference needs to be made to the environmental regulations and guidelines governing the emissions and impact of such operations.

Air quality guidelines and standards 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. The ambient air quality limits are intended to indicate safe daily exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Air quality guidelines and standards are normally given for specific averaging periods. These averaging periods refer to the time-span over which the air concentration of the pollutant was monitored at a location. Generally, five averaging periods are applicable, namely an instantaneous peak, 1-hour average, 24-hour average, 1-month average, and annual average. The application of these standards varies, with some countries allowing a certain number of exceedances of each of the standards per year.

2.1 Airshed Priority Area

Highveld Airshed Priority Area Air Quality Management Plan – the Highveld Airshed was declared the second priority area by the minister at the end of 2007. This requires that an Air Quality Management Plan for the area be developed. The plan includes the establishment of an emissions reduction strategies and intervention programmes based on the findings of a baseline characterisation of the area. The implication of this is that all contributing sources in the area will be assessed to determine the emission reduction targets to be achieved over the following few years.

The conveyor belt from Phola to the Kusile Power Station falls within the footprint demarcated as the Highveld Priority Area. Emission reduction strategies will be included for the numerous coal mines in the area with specific targets associated with it.

2.2 Ambient Air Quality Criteria

The South African Bureau of Standards (SABS) was engaged to assist Department of Environmental Affairs (DEA) in the facilitation of the development of ambient air quality standards. This included the establishment of a technical committee to oversee the development of standards. Standards were determined based on international best practice for PM_{10}, sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO), lead (Pb) and benzene. The new National Ambient Air Quality Standards (NAAQS) were published in the Government Gazette (no. 32816) on 24 December 2009.

Although there are a number of ambient air pollutants in the vicinity of the proposed operations, the pollutants of concern due to the conveyor will consist of particulate matter and thus will be the focus of this section.

2.2.1 Ambient Air Quality Criteria for Suspended Particulates

The impact of particles on human health is largely depended on (i) particle characteristics, particularly particle size and chemical composition, and (ii) the duration, frequency and magnitude of exposure. The potential of particles to be inhaled and deposited in the lung is a function of the aerodynamic characteristics of particles in flow streams. The aerodynamic properties of particles are related to their size, shape and density. The deposition of particles in different regions of the respiratory system depends on their size.

The nasal openings permit very large dust particles to enter the nasal region, along with much finer airborne particulates. Larger particles are deposited in the nasal region by impaction on the hairs of the nose or at the bends of the nasal passages. Smaller particles (PM_{10}) pass through the nasal region and are deposited in the tracheobronchial and pulmonary regions. Particles are removed by impacting with the wall of the bronchi when they are unable to follow the gaseous streamline flow through subsequent bifurcations of the bronchial tree. As the airflow decreases near the terminal bronchi, the smallest particles are removed by Brownian motion, which pushes them to the alveolar membrane (CEPA/FPAC Working Group, 1998; Dockery, et al., 1994).

Guidance for particulates are given for various particle size fractions, including total suspended particulates (TSP), inhalable particulates or PM_{10} (i.e. particulates with an

aerodynamic diameter of less than 10 µm), and respirable particulates of $PM_{2.5}$ (i.e. particulates with an aerodynamic diameter of less than 2.5 µm). Although TSP is defined as all particulates with an aerodynamic diameter of less than 100 µm, and effective upper limit of 30 µm aerodynamic diameter is frequently assigned. PM_{10} and $PM_{2.5}$ are of concern due to their health impact potentials. As indicated previously, such fine particles are able to be deposited in, and damaging to, the lower airways and gas-exchanging portions of the lung.

PM_{10} limits and standards issued nationally are documented in Table 2-1.

Table 2-1: National ambient air quality standard for inhalable particulates (PM_{10})

Substance	Molecular Formula / Notation	Averaging Period	Concentration (µg/m³)	Frequency of Exceedance	Compliance Date
Particulate Matter	PM_{10}	24 hour	120	4	Immediate – 31 Dec 2014
			75	4	1 Jan 2015
		1 year	50	0	Immediate – 31 Dec 2014
			40	0	1 Jan 2015

2.2.2 Dust Deposition

No criteria for the evaluation of dust fallout levels are available for the United States Environmental Protection Agency (US-EPA), European Union (EU), World Health Organisation (WHO), or the World Bank (WB). Dust deposition may be gauged according to the criteria published by the South African Department of Environmental Affairs (DEA). In terms of these criteria dust deposition is classified as follows:

SLIGHT	-	less than 250 mg/m²/day
MODERATE	-	250 to 500 mg/m²/day
HEAVY	-	500 to 1200 mg/m²/day
VERY HEAVY	-	more than 1200 mg/m²/day

The South African Department of Minerals and Energy (DME) use the 1 200 mg/m²/day threshold level as an action level. In the event that on-site dustfall exceeds this threshold, the specific causes of high dustfall should be investigated and remedial steps taken.

A perceived weakness in the current dust-fall guidelines is that they are purely descriptive, without giving any guidance for action or remediation (SLIGHT, MEDIUM, HEAVY, and VERY HEAVY). On the basis of the cumulative South African experience of dustfall measurements, a modified set of dustfall standards is proposed, within the overall framework of the new Clean Air Legislation.

Dustfall will be evaluated against a four-band scale as presented in Table 2-2 and Table 2-3.

Table 2-2: Bands of dustfall rates proposed for adoption

BAND NUMBER	BAND DESCRIPTION LABEL	DUST-FALL RATE (D) ($mg/m^{-2}/day^{-1}$,30-day average)	COMMENT
1	RESIDENTIAL	D < 600	Permissible for residential and light commercial
2	INDUSTRIAL	600 < D < 1 200	Permissible for heavy commercial and industrial
3	ACTION	1 200 < D < 2 400	Requires investigation and remediation if two sequential months lie in this band, or more than three occur in a year.
4	ALERT	2 400 < D	Immediate action and remediation required following the first exceedance. Incident report to be submitted to relevant authority.

Table 2-3: Target, action and alert thresholds for ambient dustfall

LEVEL	DUST-FALL RATE (D) (mg m-2 day-1,30-day average)	AVERAGING PERIOD	PERMITTED FREQUENCY OF EXCEEDANCES
TARGET	300	Annual	
ACTION RESIDENTIAL	600	30 days	Three within any year, no two sequential months.
ACTION INDUSTRIAL	1 200	30 days	Three within any year, not sequential months.
ALERT THRESHOLD	2 400	30 days	None. First exceedance requires remediation and compulsory report to authorities.

A draft copy of the National Dust Regulation was published for comment on the 27 May 2011 which states that the dust fall at the boundary or beyond the boundary of the premises where it originates should not exceed:

- 600 mg/m²/day averaged over 30 days In residential and light commercial areas measured using reference method ASTM 01739; or
- 1200 mg/m²/day averaged over 30 days in areas other than residential and light commercial areas measured using reference method ASTM 01739.

2.3 Effect of Dust on Vegetation, Animals and Susceptible Human Receptors

2.3.1 Dust Effects on Vegetation

Suspended particulate matter can produce a wide variety of effects on the physiology of vegetation that in many cases depend on the chemical composition of the particle. Heavy metals and other toxic particles have been shown to cause damage and death of some species as a result of both the phytotoxicity and the abrasive action during turbulent deposition (Harmens, Mills, Hayes, Williams, & De Temmerman, 2005). Heavy loads of particle can also result in reduced light transmission to the chloroplasts and the occlusion of stomata (Harmens, Mills, Hayes, Williams, & De Temmerman, 2005; Naidoo & Chirkoot, 2004; Hirano, Kiyota, & Aiga, 1995; Ricks & Williams, 1974), decreasing the efficiency of gaseous exchange (Harmens et al, 2005; Naidoo and Chirkoot, 2004, Ernst, 1981) and

hence water loss (Harmens et al, 2005). They may also disrupt other physiological processes such as budbreak, pollination and light absorption/reflectance (Harmens et al, 2005). The chemical composition of the dust particles can also affect the plant and have indirect effects on the soil pH (Spencer, 2001).

To determine the impact of dust deposition on vegetation, two factors are of importance: (i) Does dust collect on vegetation and if it does, what are the factors influencing the rate of deposition (ii) Once the dust has deposited, what is the impact of the dust on the vegetation?

Regarding the first question, there is adequate evidence that dust does collect on all types of vegetation. Any type of vegetation causes a change in the local wind fields, with an increase in turbulence which enhances the collection efficiency. The characteristics of the vegetation influences the rate; the larger the "collecting elements" (branches and leaves), the lower the impaction efficiency per element. This would seem to indicate that, for the same volume of tree/shrub canopy, finer leaves will have a better collection efficiency. However, the roughness of the leaves themselves and particularly the presence of hairs on the leaves and stems plays a significant role, with veinous surfaces increasing deposition of 1-5 micron particles by up to seven times compared to smooth surfaces. Collection efficiency rises rapidly with particle size; for moderate wind speeds wind tunnel studies show a relationship of deposition velocity on the fourth power of particle size (Tiwary and Colls 2010). In wind tunnel studies , windbreaks or "shelter belts" of three rows of trees has shown a decrease in 35 to 56% in the downwind mass transport of inorganic particles.

On the effect of particulate matter once it is deposited on vegetation, this depends on the composition of the dust. South African ambient standards are set in terms of PM_{10} (particulate matter smaller than 10 µm aerodynamic diameter) but internationally it is recognised that there are major differences in the chemical composition of the fine PM (the fraction between 0 and 2.5 µm in aerodynamic diameter) and coarse PM (the fraction between 2.5 µm and 10 µm in aerodynamic diameter). The former is often the result of chemical reactions in the atmosphere and may have a high proportion of black carbon, sulphate and nitrate whereas the latter often consist of primary particles resulting from abrasion, crushing, soil disturbances and wind erosion (Grantz et al. 2003). Sulphate is, however, often hygroscopic and may exist in significant fractions in coarse PM. This has been shown to be the case in South Africa, where the sulphate content of PM_{10} at the Eskom measuring station at Elandsfontein has been shown to have between 15% (winter) and 49% (spring) sulphate (Alade 2009). Grantz et al (op .cit.) do however indicate that sulphate is much less phototoxic than gaseous sulphur dioxide and that "it is unusual for injurious levels of particular sulphate to be deposited upon vegetation".

Naidoo and Chirkoot conducted a study during the period October 2001 to April 2002 to investigate the effects of coal dust on Mangroves in the Richards Bay harbour. The investigation was conducted at two sites where 10 trees of the Mangrove species: *Avicennia Marina* were selected and mature, fully expose, sun leaves tagged as being covered or uncovered with coal dust. From the study it was concluded that coal dust significantly reduced photosynthesis of upper and lower leaf surfaces. The reduced photosynthetic performance was expected to reduce growth and productivity. In addition, trees in close proximity to the coal stockpiles were in poorer health than those further away. Coal dust particles, which are composed predominantly of carbon were not toxic to the leaves; neither did they occlude stomata as they were larger than fully open stomatal apertures (Naidoo and Chirkoot, 2004).

In general, according to the Canadian Environmental Protection Agency (CEPA), air pollution adversely affects plants in one of two ways. Either the quantity of output or yield is reduced or the quality of the product is lowered. The former (invisible) injury results from pollutant impacts on plant physiological or biochemical processes and can lead to significant loss of growth or yield in nutritional quality (e.g. protein content). The latter (visible) may take the form of discolouration of the leaf surface caused by internal cellular damage. Such injury can reduce the market value of agricultural crops for which visual appearance is important (e.g. lettuce and spinach). Visible injury tends to be associated with acute exposures at high pollutant concentrations whilst invisible injury is generally a consequence of chronic exposures to moderately elevated pollutant concentrations. However given the limited information available, specifically the lack of quantitative dose-effect information, it is not possible to define a Reference Level for vegetation and particulate matter (CEPA, 1998).

Exposure to a given concentration of airborne PM may therefore lead to widely differing phytotoxic responses, depending on the mix of the deposited particles. The majority of documented toxic effects indicate responses to the chemical composition of the particles. Direct effects have most often been observed around heavily industrialised point sources, but even there, effects are often associated with the chemistry of the particulate rather than with the mass of particulate.

While there is little direct evidence of what the impact of dust fall on vegetation is under a South African context, a review of European studies has shown the potential for reduced growth and photosynthetic activity in Sunflower and Cotton plants exposed to dust fall rates greater than 400 mg/m²/day (Farmer 1991).

2.3.2 Effects of Particulate Matter on Animals

As presented by the Canadian Environmental Protection Agency (CEPA, 1998) studies using experimental animals have not provided convincing evidence of particle toxicity at ambient levels. Acute exposures (4-6 hour single exposures) of laboratory animals to a variety of types of particles, almost always at concentrations well above those occurring in the environment have been shown to cause:

- decreases in ventilatory lung function;
- changes in mucociliary clearance of particles from the lower respiratory tract (front line of defence in the conducting airways);
- increased number of alveolar macrophages and polymorphonuclear leukocytes in the alveoli (primary line of defence of the alveolar region against inhaled particles);
- alterations in immunologic responses (particle composition a factor, since particles with known cytotoxic properties, such as metals, affect the immune system to a significantly greater degree);
- changes in airway defence mechanisms against microbial infections (appears to be related to particle composition and not strictly a particle effect);
- increase or decrease in the ability of macrophages to phagocytize particles (also related to particle composition);
- a range of histologic, cellular and biochemical disturbances, including the production of proinflammatory cytokines and other mediators by the lungs alveolar macrophages (may be related to particle size, with greater effects occurring with ultrafine particles);
- increased electrocardiographic abnormalities (an indication of cardiovascular disturbance); and,
- increased mortality.

Bronchial hypersensitivity to non-specific stimuli and increased morbidity and mortality from cardio-respiratory symptoms occurs most likely in animals with pre-existing cardio-respiratory diseases. Sub-chronic and chronic exposure tests involved repeated exposures for at least half the lifetime of the test species. Particle mass concentrations to which test animals were exposed were very high (> 1 mg/m^3), greatly exceeding levels reported in the ambient

environment. Exposure resulted in significant compromises in various lung functions similar to those seen in the acute studies, but including also:

- reductions in lung clearance;
- induction of histopathologic and cytologic changes (regardless of particle types, mass, concentration, duration of exposure or species examined);
- production of chronic alveolitis and fibrosis; and,
- production of lung cancer (a particle and/or chemical effect).

The epidemiological finding of an association between 24 hour ambient particle levels below 100 $\mu g/m^3$ and mortality has not been substantiated by animal studies as far as PM_{10} and $PM_{2.5}$ are concerned. With the exception of ultrafine particles (0.1µm), none of the other particle types and sizes used in animal inhalation studies cause such acute dramatic effects, including high mortality at ambient concentrations. The lowest concentration of $PM_{2.5}$ reported that caused acute death in rats with acute pulmonary inflammation or chronic bronchitis was 250 g/m^3 (3 days, 6 hr/day), using continuous exposure to concentrated ambient particles.

Most of the literature regarding air quality impacts on cattle, refers to the impacts from feedlots on the surrounding environment, hence where the feedlot is seen as the source of pollution. This mainly pertains to odours and dust generation. The US.EPA has recently started to focus on the control of air pollution from feed yards and dairies, primarily regulating coarse particulate matter (http://www.vetcite.org/publish/items/000944/index.html). The National Cattle Beef Association in the USA in response has disputed this decision based on the lack of evidence on health impacts associated with coarse dust (TSP) concentrations (http://hill.beef.org/newview.asp?DocumantID=16319).

A study was conducted by the State University of IOWA on the effects of air contaminants and emissions on animal health in swine facilities. Air pollutants included gases, particulates, bioaerosols, and toxic microbial by-products. The main findings were that ammonia is associated with lowered average number of pigs weaned, arthritis, porcine stress syndrome, muscle lesions, abscesses, and liver ascarid scars. Particulates are associated with the reduction in growth and turbine pathology, and bioaerosols could lower feed efficiency, decrease growth, and increase morbidity and mortality. The study concurred the lack of information on the health effects and productivity problems of air contaminants on cattle and other livestock. Ammonia and hydrogen sulphide are regarded the two most important inorganic gases affecting the respiratory system of cattle raised in confinement facilities, affecting the mucociliary transport and alveolar macrophage functions. With regard

to particulates, it was found that it is the fine inhalable fraction is mainly deriving from dried faecal dust (Holland et al., 2002). Another study conducted by DSM Nutritional Products North America indicated that calves exposed to a dust-stress environment continued to have lower serum vitamin E concentrations (http://www.dsm.com/en_US/html/dnpus/an_texas_study.htm).

Inhalation of confinement house dust and gases produces a complex set of respiratory responses. An individual's response depends on characteristics of the inhaled components (such as composition, particle size and antigenicity) and of the individual's susceptibility, which is tempered by extant respiratory conditions (http://www.cdc.gov/nasd/docs). Most of the studies concurred that the main implication of dusty environments are causing animal stress which is detrimental to their health. However, no threshold levels exist to indicate at what levels these are having a negative effect. In this light it was decided to use the same screening criteria applied to human health, i.e. the South African Standards and SANS limit values.

2.3.3 Effect of Particulate Matter on Susceptible Human Receptors

The World Health Organization states that the evidence on airborne particulates and public health is consistent in showing adverse health effects at exposures experienced by urban populations throughout the world. The range of effects is broad, affecting the respiratory and cardiovascular systems and extending to children and adults and to a number of large, susceptible groups within a general population. The epidemiological evidence shows adverse effects of particles after both short-term and long-term exposures. However, current scientific evidence indicates that guidelines cannot be proposed that will lead to complete protection against adverse health effects as thresholds have not been identified.

The Agency for Toxic Substances and Disease Registry (ATSDR, 2007) state that particulate matter causes a wide variety of health and environmental impacts. Many scientific studies have linked breathing particulate matter to a series of significant health problems, including:

- aggravated asthma
- increases in respiratory symptoms like coughing and difficult or painful breathing
- chronic bronchitis
- decreased lung function
- premature death

PM_{10} is the standard measure of particulate air pollution used worldwide and studies suggest that asthma symptoms can be worsened by increases in the levels of PM_{10}, which is a complex mixture of particle types. PM_{10} has many components and there is no general agreement regarding which component(s) could exacerbate asthma. However, pro-inflammatory effects of transition metals, hydrocarbons, ultrafine particles (due to combustion processes) and endotoxin- all present to varying degrees in PM_{10} - could be important.

Exposure to motor traffic emissions can have a significant effect on respiratory function in children and adults. Studies show that children living near heavily travelled roadways have significantly higher rates of wheezing and diagnosed asthma. Epidemiologic studies suggest that diesel exhaust may be particularly aggravating to children.

A summary of adverse health effects from particulate matter exposure and susceptible populations is given in Table 2-4.

Table 2-4: Summary of adverse health effects from particulate matter exposure and susceptible populations

Health Effects	Susceptible Groups	Notes
Acute (short-term) exposure		
Mortality	Elderly, infants, persons with chronic cardiopulmonary disease, influenza or asthma	How much lie shortening is involved and how much is due to short-term mortality displacement is uncertain.
Hospitalisation / other health care visits	Elderly, infants, persons with chronic cardiopulmonary disease, pneumonia, influenza or asthma	Reflects substantive health impacts in terms of illness, discomfort, treatment costs, work or school time lost, etc.
Increased respiratory symptoms	Most consistently observed in people with asthma, and children	Mostly transient with minimal overall health consequences, although for a few there may be short-term absence from work or school due to illness.
Decreased lung function	Observed in both children and adults	For most, effects seem to be small and transient. For a few, lung function losses may be clinically relevant.
Chronic (long-term) exposure		
Increased mortality rates, reduced survival times, chronic cardiopulmonary disease, reduced lung function, lung	Observed in broad-based cohorts or samples of adults and children (including infants). All chronically exposed are	Long-term repeated exposure appears to increase the risk of cardiopulmonary disease and mortality. May result in lower

Health Effects	Susceptible Groups	Notes
cancer	potentially affected.	lung function. Average loss of life expectancy is highly polluted cities may be as much as a few years.

Source: Adopted from Pope (2000) and Pope et al (2002)

3 BASELINE CHARACTERISATION

3.1 Site Description

Coal from Phola will be transported via conveyor to the Kusile Power Station to supplement the coal supply. The proposed operations are located in the Mpumalanga Province (Figure 3-1). The current land uses in the region include coal mining, farming, power generation facilities and small residential communities. Major towns in the region include Witbank (~30km east-northeast) with smaller residential areas including Wilge, Phola, Kendal Forest Holdings, and Ogies east and south of the mining area. The general topography is characterised by gently rolling terrain with no steep inclines.

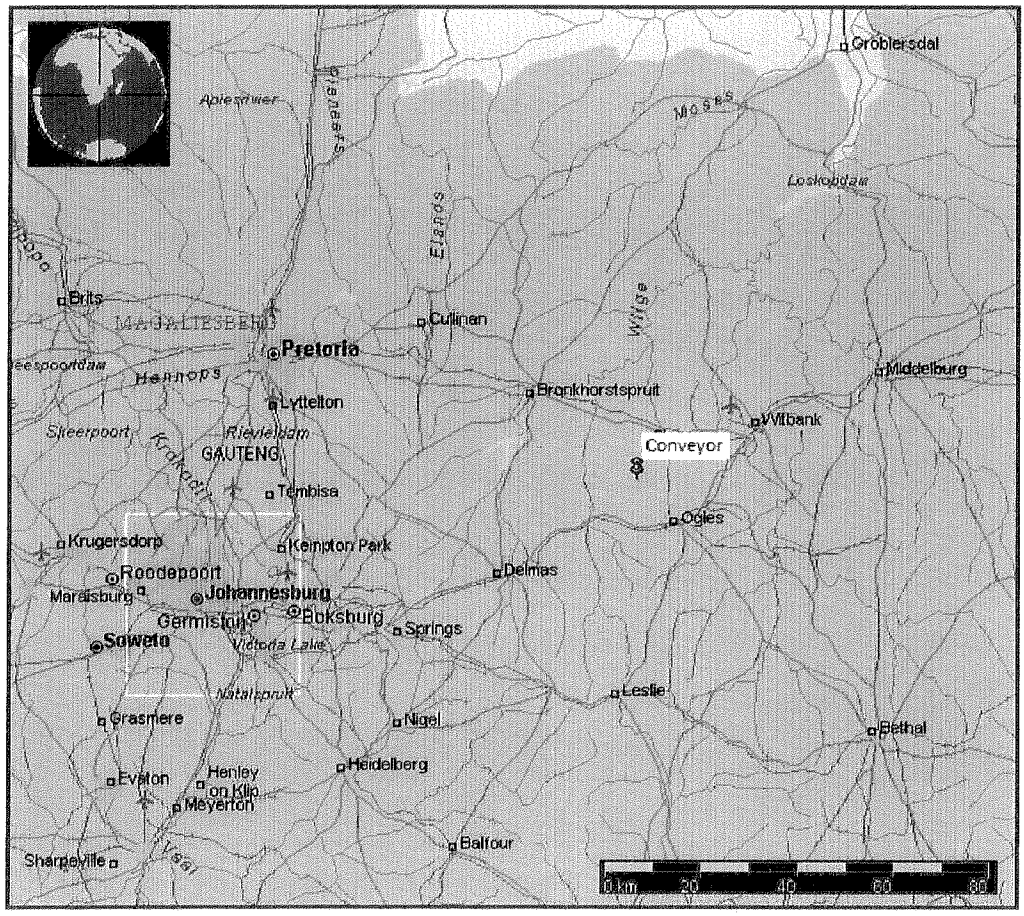

Figure 3-1: Location of the Proposed Conveyor

3.2 Sensitive Receptors

The closest residential developments to the proposed conveyor are Wilge, Kendal Forest Holdings, Phola and Ogies. Other residential areas in the region (i.e. in excess of 20km away) of the site are Botleng and Delmas to the west-southwest, Clewer, Vosman, KwaGuqa, Hlalanikahle to the east-northeast and Bronkhorstspruit to the northwest (Figure 3-2).

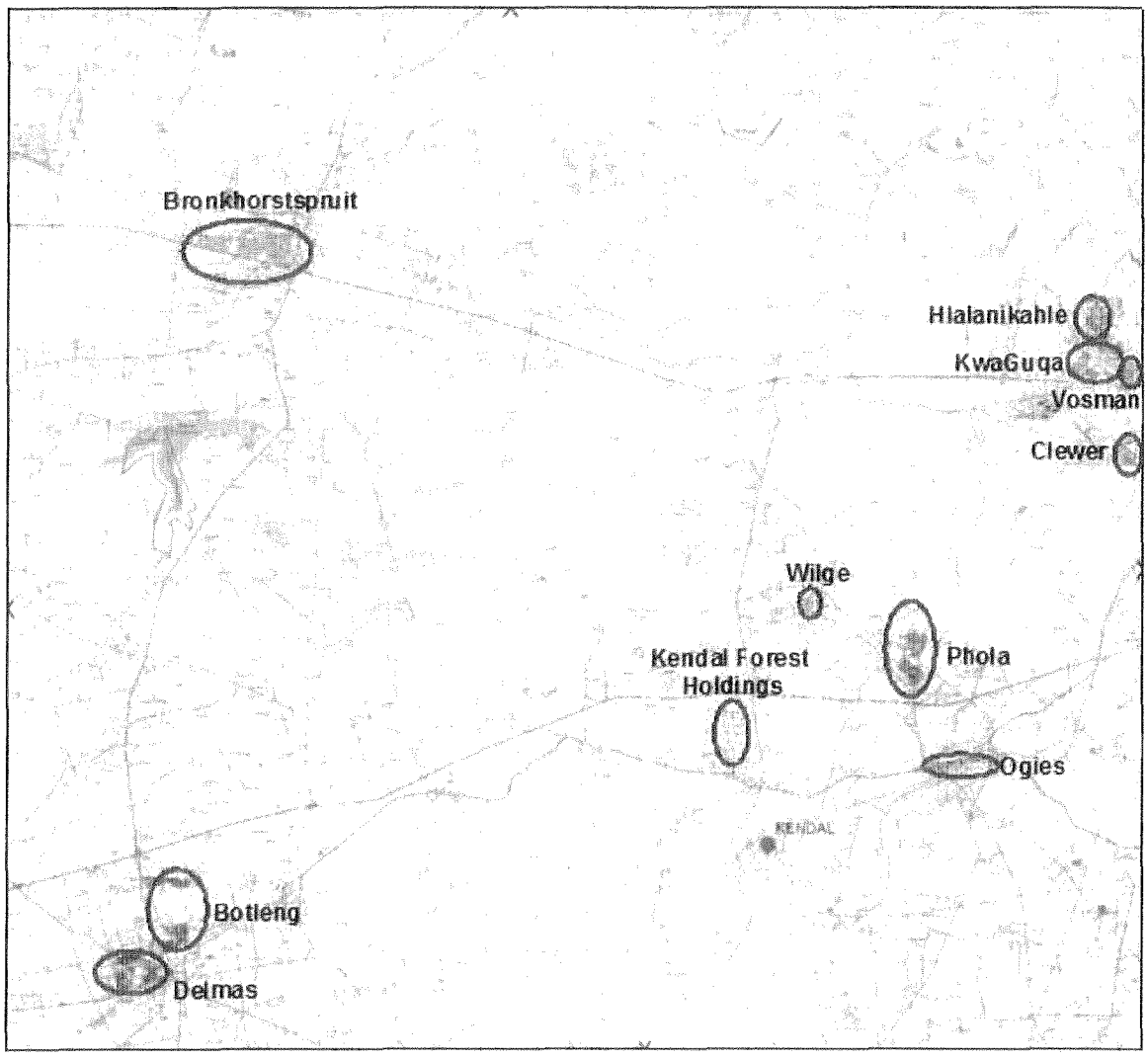

Figure 3-2: Location of the sensitive receptors to the proposed conveyor

3.3 Atmospheric Dispersion Potential

Meteorological mechanisms govern 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. 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 the wind speed, in combination with the surface roughness. The wind direction, and the variability in wind direction, determines the general path pollutants will follow, and the extent of crosswind spreading. 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.

Spatial variations, and diurnal and seasonal changes, in the wind field and stability regime are functions of atmospheric processes operating at various temporal and spatial scales (Goldreich and Tyson, 1988). Atmospheric processes at macro- and meso-scales need therefore be taken into account in order to accurately parameterise the atmospheric dispersion potential of a particular area. A qualitative description of the synoptic systems determining the macro-ventilation potential of the region may be provided based on the review of pertinent literature. Meso-scale systems may be investigated through the analysis of meteorological data observed for the region.

3.3.1 Synoptic-Scale Circulations and Regional Atmospheric Dispersion Potential

Situated in the subtropical high-pressure belt, southern Africa is influenced by several high-pressure cells, in addition to various circulation systems prevailing in the adjacent tropical and temperate latitudes. The mean circulation of the atmosphere over the subcontinent is anticyclonic throughout the year (except near the surface) due to the dominance of three high pressure cells, viz. the South Atlantic High Pressure (HP), the South Indian HP off the east coast, and the continental HP over the interior.

Seasonal variations in the positioning and intensity of the HP cells determine the extent to which the circumpolar westerlies impact on the atmosphere over the region. In winter, the

high-pressure belt intensifies and moves northward and the upper level circumpolar westerlies are able to impact significantly on the region. The winter weather of the region is, therefore, largely dominated by perturbations in the westerly circulation. Such perturbations take the form of a succession of cyclones or ridging anticyclones moving eastwards around the South African coast or across the country. During summer months, the anticyclonic belt weakens and shifts southwards and the influence of the circumpolar westerlies diminishes. A weak heat low characterises the near surface summer circulation over the interior, replacing the strongly anticyclonic wintertime circulation (Preston-Whyte and Tyson, 1988; Weather Bureau, 1986).

The general circulation of the atmosphere over southern Africa as a whole is anticyclonic throughout the year above the 700 hPa level (i.e. altitude of ~3 000m). Anticyclones are associated with convergence in the upper levels of the troposphere, strong subsidence throughout the troposphere, and divergence in the near-surface wind field. Subsidence inversions, fine conditions and little to no rainfall occur as a result of such airflow. The climatology of the highveld region has been studied extensively in the past, where the frequency of anticyclonic conditions reaches a maximum in winter. The dominant effect of the winter subsidence is that, averaged over the year, the mean vertical motion is downward. The clear, dry air and light winds, often associated with anticyclonic circulation are ideal for surface radiation inversions of temperature, responsible for limited dispersion of especially low level pollution emissions (e.g. domestic coal fires). Surface inversions increase in frequency during night-time and vary in depth between ~300 m to more than 500 m. The mean inversion strength during the winter is about 5°C – 6°C, whereas, in summer the strength is less than 2°C.

Circumpolar westerly waves are characterised by concomitant surface convergence and upper-level divergence that produce sustained uplift, cloud and the potential for precipitation. Cold fronts, which are associated with westerly waves, occur predominantly during winter when the amplitude of such disturbances is greatest. The passage of a cold front is characterised by distinctive cloud bands and pronounced variations in wind direction, wind speed, temperature, humidity, and surface pressure. Airflow ahead of a front passing over has a distinct north-northeasterly component and stable and generally cloud-free conditions prevail as a result of subsidence and low-level divergence. Following the passage of the cold front the north-easterly wind is replaced by winds with a distinct southerly component. The low-level convergence in the south-westerly airflow to the rear of the front produces favourable conditions for convection. Temperature decreases immediately after the passage of the front, with minimum temperatures being experienced on the first morning after the cloud associated with the front clears. Strong radiation cooling due to the absence of cloud cover, and the advection of cold southerly air combining to produce the lowest temperatures

The tropical easterlies, and the occurrence of easterly waves and lows affect most of southern Africa throughout the year, but occur almost exclusively during summer months. The easterly waves and lows are largely responsible for the summer rainfall pattern and the northeasterly wind component that occurs over the region (Weather Bureau, 1986; Preston-Whyte and Tyson, 1988).

In contrast to anticyclonic circulation, convective activity associated with westerly and easterly wave disturbances hinders the persistence of inversions. Cyclonic disturbances, which are associated with strong winds and upward vertical air motion, destroy, weaken, or increase the altitude of elevated inversions. Easterly and westerly wave disturbances therefore facilitate the dispersion and dilution of accumulated atmospheric pollution.

3.3.2 Meso-scale ventilation and site-specific dispersion potential

3.3.2.1 Local wind field

Period and seasonal wind roses for Kendal 2 monitoring station for the period January 2005 to April 2011 are presented in Figure 3-2 and Figure 3-3 respectively.

The predominant wind direction at Kendal 2 for the period January 2005 to April 2011 is from the west-northwest (~16% frequency of occurrence). Calm periods and low wind speeds are more prevalent during the night-time, as is to be expected. The gentle slope of the terrain may account for the increased frequency of occurrence of west-northwesterly winds during the day-time and increased east-southeasterly winds during the night-time. Differential heating and cooling of the air along a slope typically results in down-slope (katabatic) flow at night, with low-level up-slope (anabatic) airflow occurring during the day.

During winter months (July to August), the enhanced influence of westerly wave disturbances is evident in the increased frequency of southwesterly winds at Kendal 2 (Figure 3-4). An increase in the frequency of easterly and east-southeasterly winds during summer months (December to February) reflects the influence of easterly wave systems. Autumn months are associated with a greater frequency of calm wind conditions, with the smallest number of calms occurring during spring months.

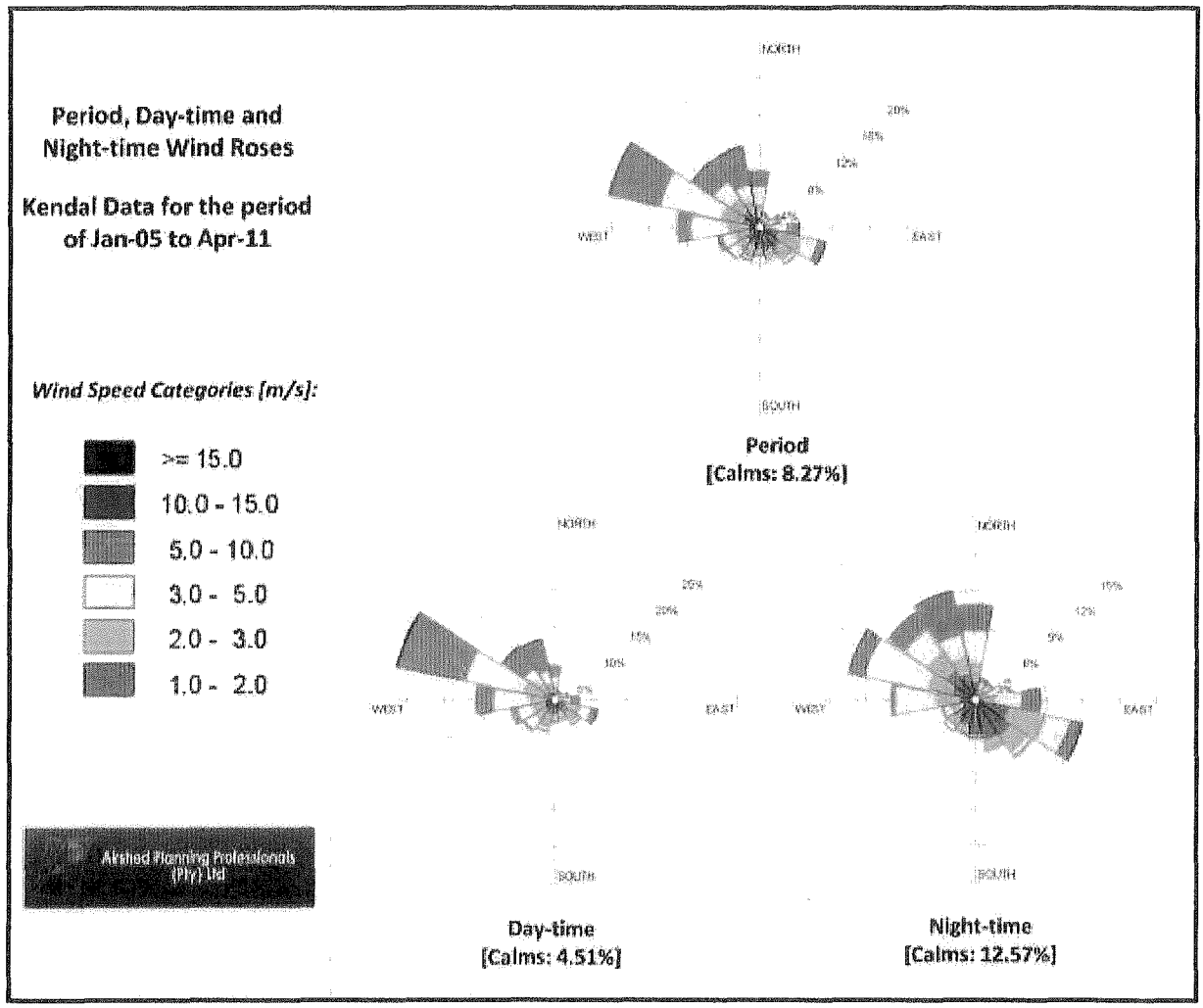

Figure 3-3: Period, day- and night-time wind roses for the Kendal 2 monitoring station (January 2005 to April 2011)

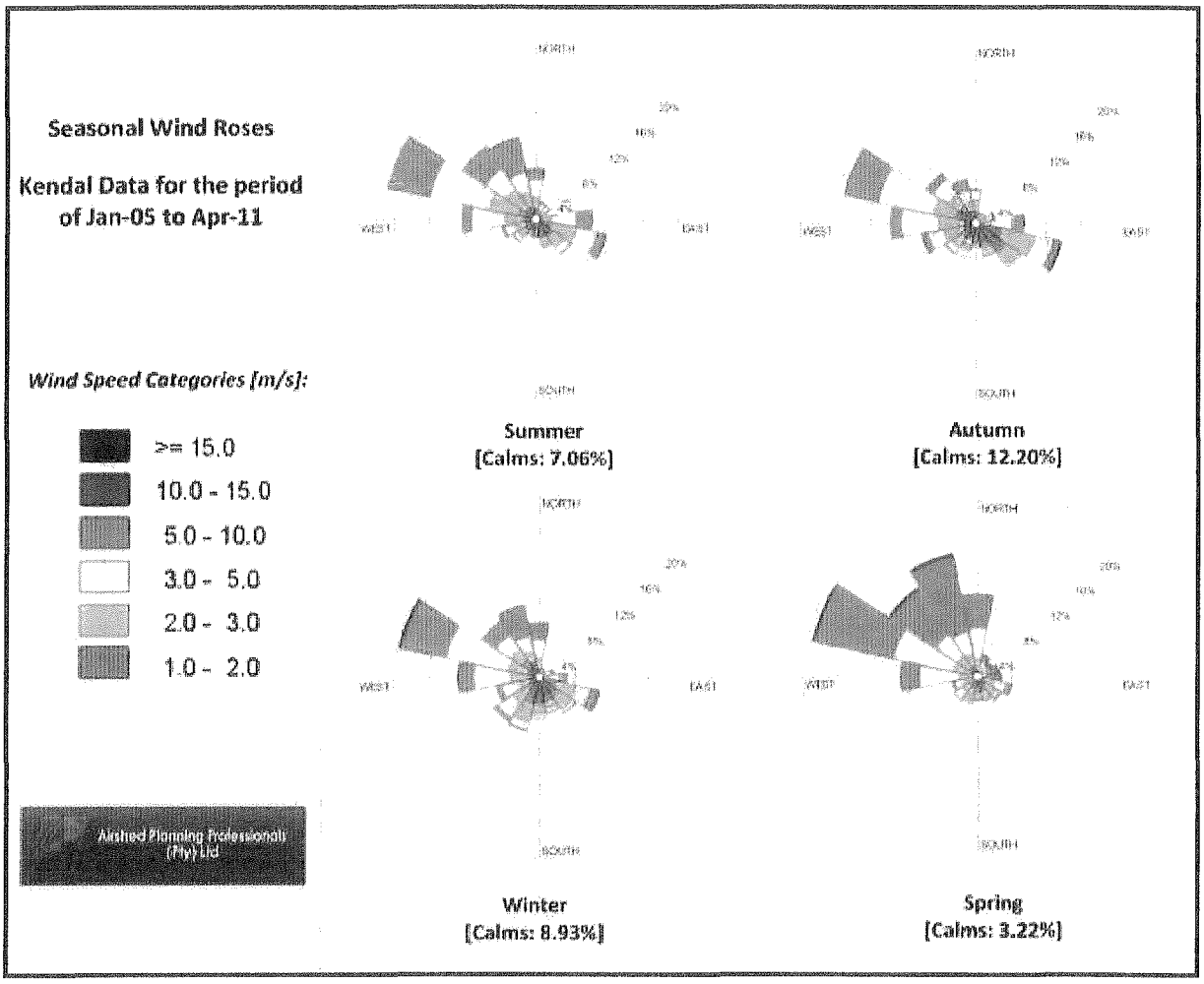

Figure 3-4: Seasonal wind roses for the Kendal 2 monitoring station (January 2005 to April 2011)

3.3.2.2 Ambient 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. Minimum, mean and maximum temperatures for Kendal 2 for the period January 2005 – April 2011 are illustrated in Figure 3-5.

Annual average maximum, minimum and mean temperatures for Kendal 2 are given as 27°C, 10°C and 16°C, respectively, based on the January 2005 to April 2011 record. Average daily maximum temperatures range from 31°C in December to 20°C in June, with daily minima ranging from 15°C in January to 3°C in July.

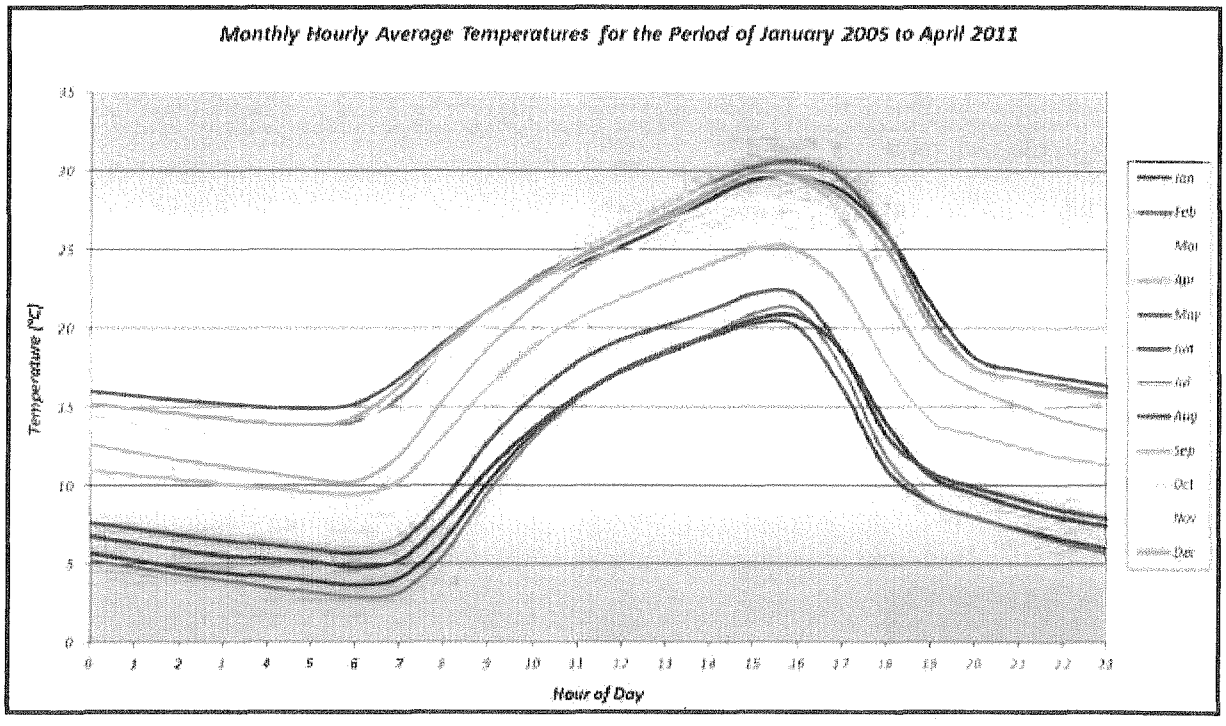

Figure 3-5: Diurnal temperature profile at Kendal 2 monitoring station for the period January 2005 to April 2011

3.3.2.3 Precipitation

Precipitation is important to air pollution studies since it represents an effective removal mechanism for atmospheric pollutants and inhibits dust generation potentials. Long-term monthly average rainfall figures for various stations within the Witbank region are given in Table 3-1. Long-term average total annual rainfall is in the range of 730 mm to 750 mm. Rain falls mainly in summer from October to April, with the peak being in January for the region.

Table 3-1: Long-term monthly rainfall figures (mm) for various stations within the Witbank region

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Middelburg (1904 – 1950)	132	103	88	42	19	7	9	8	22	63	124	118	735
Bethal (1904 – 1984)	134	94	78	46	19	7	8	10	25	78	128	120	747

3.3.2.4 Atmospheric Stability and Mixing Depth

The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. This layer is directly affected by the earth's surface, either through the retardation of flow due to the frictional drag of the earth's surface, or as result of the heat and moisture exchanges that take place at the surface. 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 (Figure 3-6).

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 to 6 hours after sunrise. This situation is more pronounced during the winter months due to strong night-time inversions and 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.

For elevated releases, the highest ground level concentrations would occur during unstable, daytime conditions. The wind speed resulting in the highest ground level concentration depends on the plume buoyancy. If the plume is considerably buoyant (high exit gas velocity and temperature) together with a low wind, the plume will reach the ground relatively far downwind. With stronger wind speeds, on the other hand, the plume may reach the ground closer, but due to increased ventilation, it would be more diluted. A wind speed between

these extremes would therefore be responsible for the highest ground level concentrations. In contrast, the highest concentrations for ground level, or near-ground level releases would occur during weak wind speeds and stable (night-time) atmospheric conditions.

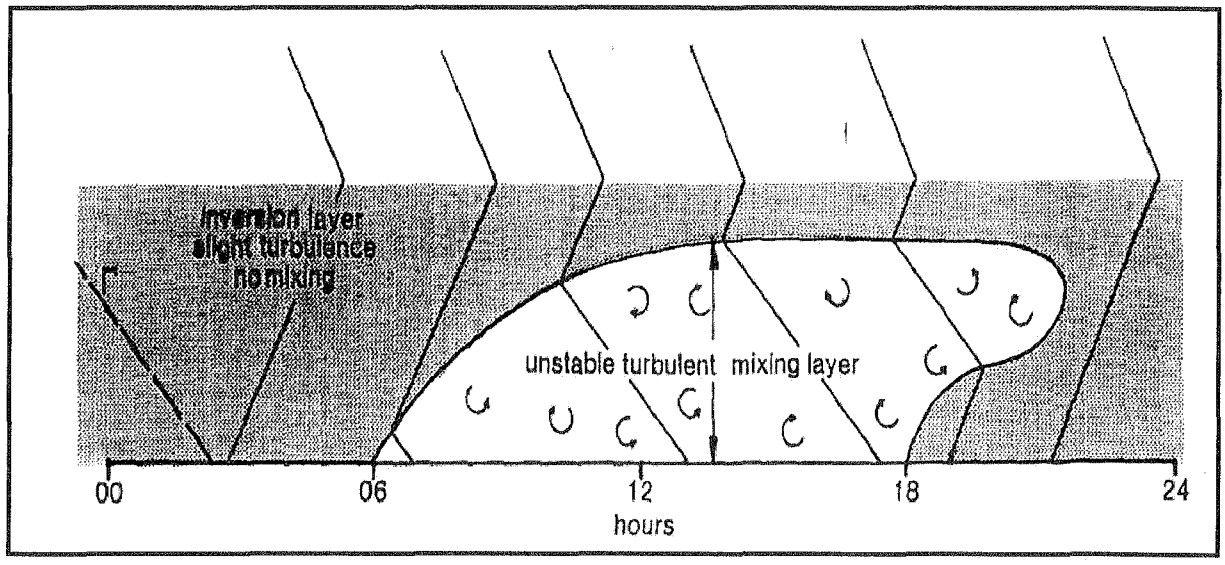

Figure 3-6: Daytime development of a turbulent mixing layer (Preston-Whyte & Tyson, 1988)

The new generation air dispersion models differ from the models traditionally used in a number of aspects, the most important of which are the description of atmospheric stability as a continuum rather than discrete classes. The atmospheric boundary layer properties are therefore described by two parameters; the boundary layer depth and the Monin-Obukhov length, rather than in terms of the single parameter Pasquill Class. The Monin-Obukhov length (LMo) provides a measure of the importance of buoyancy generated by the heating of the ground and mechanical mixing generated by the frictional effect of the earth's surface. Physically, it can be thought of as representing the depth of the boundary layer within which mechanical mixing is the dominant form of turbulence generation (CERC, 2004). The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. During the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface. Night times are characterised by weak vertical mixing and the predominance of a stable layer. These conditions are normally associated with low wind speeds and less dilution potential.

Diurnal variation in atmospheric stability, as calculated from the Kendal 2 monitored data, and described by LMo, is provided in Figure 3-7.

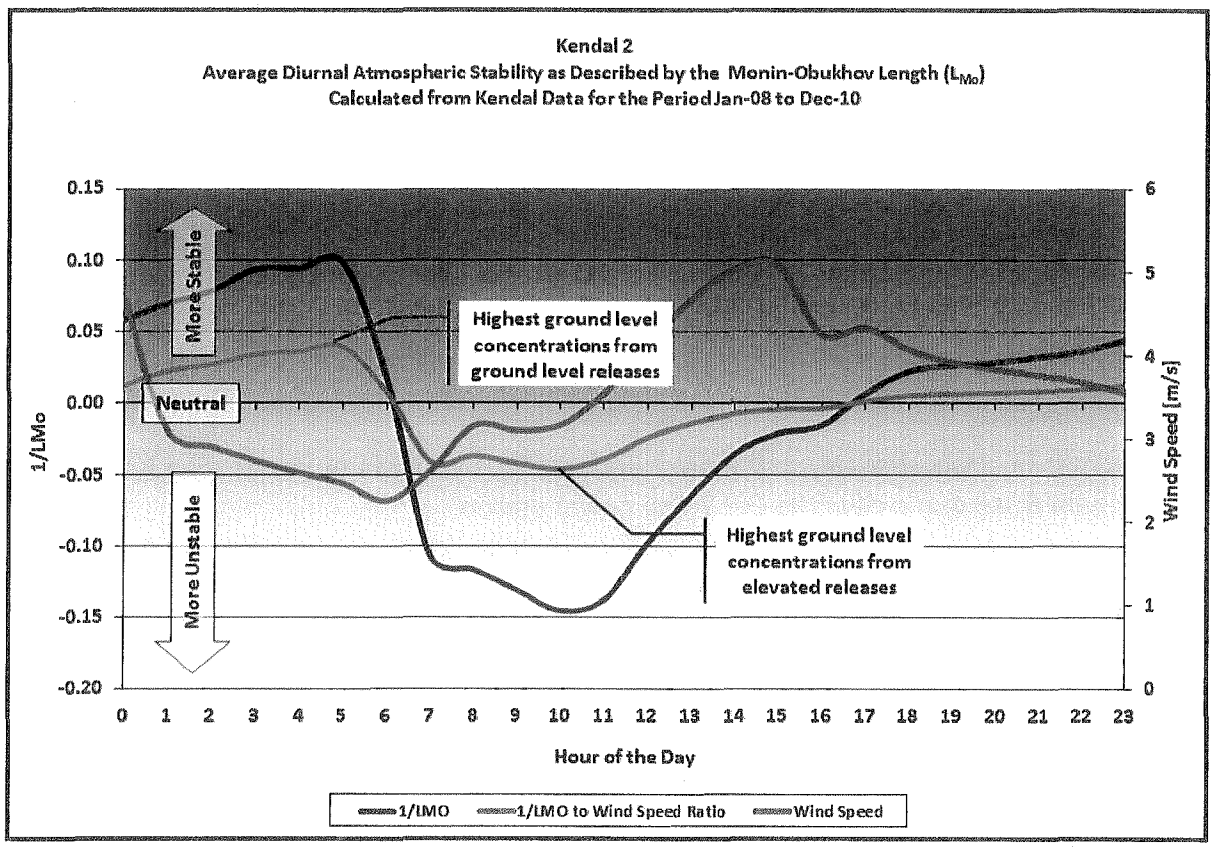

Figure 3-7: Average diurnal atmospheric stability as obtained from the Kendal 2 monitored data for the period 2008 - 2010

3.4 Existing Sources of Emissions near the Conveyor

Sources of SO_2 and NO_x that occur in the region include Eskom power stations, industrial emissions, blasting operations at mines and spontaneous combustion of discard at coal mines, veld burning, vehicle exhaust emissions and household fuel burning.

Various local and far-a-field sources are expected to contribute to the suspended fine particulate concentrations in the region. Local sources include wind erosion from exposed areas, fugitive dust from agricultural and mining operations, particulate releases from industrial operations, vehicle entrainment from roadways and veld burning. Household fuel burning also constitutes a significant local source of low-level emissions. Long-range transport of particulates, emitted from remote tall stacks and from large-scale biomass

burning in countries to the north of South Africa, has been found to contribute significantly to background fine particulate concentrations over the interior (Andrea et al., 1996; Garstang et al., 1996; Piketh et al, 1996).

3.4.1 Wind-blow Dust from Eskom's Ash Dams and Dumps

Parameters which have the potential to impact on the rate of emission from ash dam/dump facilities include the extent of surface compaction, moisture content, ground cover, the shape of the dam, particle size distribution, wind speed and precipitation.

Ash dumps in close proximity to the proposed activities consists of the existing Kendal dump and rehabilitated dump near the Old Wilge power station.

3.4.2 Materials handling

Materials handling operations associated with mining and power station activities in the area include the transfer of coal by means of tipping, loading and off-loading of trucks. The quantity of dust that will be generated from such loading and off-loading operations will depend on various climatic parameters, such as wind speed and precipitation, in addition to non-climatic parameters such as the nature (i.e. moisture content) and volume of the material handled.

3.4.3 Industrial Emissions

Industrial sources within the Mpumalanga region include the following:

- Emissions from coal combustion by power generation, metallurgical and petrochemical industries represents the greatest contribution to total emissions from the industrial / institutional / commercial fuel use sector within the Mpumalanga region.

- The metallurgical group is estimated to be responsible for at least ~50% of the particulate emissions from this sector. This group includes iron and steel, ferro-chrome, ferro-alloy and stainless steel manufacturers (includes Evraz Highveld Steel

& Vanadium (~20km from the proposed New Largo Mine), Ferrometals, Columbus Stainless, Transalloys, Middelburg Ferrochrome).

- Petrochemical and chemical industries are primarily situated in Secunda (viz. Sasol Chemical Industries). The use of coal for power generation and the coal gasification process represent significant sources of sulphur dioxide emissions. (Particulate emissions are controlled through the implementation of stack gas cleaning equipment.)

- Other industrial sources include: brick manufacturers which use coal (e.g. Witbank Brickworks, Quality Bricks, Corobrik, Hoeveld Stene, Middelwit Stene) and woodburning and wood drying by various sawmills (Bruply, Busby, M&N Sawmills) and other heavy industries (use coal and to a lesser extent HFO for steam generation). The contribution of fuel combustion (primarily coal) by institutions such as schools and hospitals to total emissions is relatively due to the extent of emissions from other groups.

In the immediate vicinity of the proposed New Largo mine, the industrial activities consist of the TOR Brickworks and the Kendal Power Station.

3.4.4 Household Fuel Burning

Despite the intensive national electrification programme a large number of households continue to burn fuel to meet all or a portion of their energy requirements. The main fuels with air pollution potentials used by households within the study region are coal, wood and paraffin.

Coal burning emits a large amount of gaseous and particulate pollutants including sulphur dioxide, heavy metals, total and respirable particulates including heavy metals and inorganic ash, carbon monoxide, polycyclic aromatic hydrocarbons, and benzo(a)pyrene. Polyaromatic hydrocarbons are recognised as carcinogens. Pollutants arising due to the combustion of wood include respirable particulates, nitrogen dioxide, carbon monoxide, polycyclic aromatic hydrocarbons, particulate benzo(a)pyrene and formaldehyde. The main pollutants emitted from the combustion of paraffin are NO_2, particulates carbon monoxide and polycyclic aromatic hydrocarbons.

An area of notable domestic fuel burning in close proximity to New Largo is Phola. The largest part of Phola falls within the 100 – 1000 households/km² burning coal and 30 – 100 households/km² burning wood with between 100 – 500 households/km² burning paraffin.

3.4.5 Vehicle Exhaust Emissions

Air pollution from vehicle emissions may be grouped into primary and secondary pollutants. Primary pollutants are those emitted directly into the atmosphere, and secondary, those pollutants formed in the atmosphere as a result of chemical reactions, such as hydrolysis, oxidation, or photochemical reactions. The significant primary pollutants emitted by motor vehicles include carbon dioxide (CO_2), carbon monoxide (CO), hydrocarbon compounds (HC), sulphur dioxide (SO_2), nitrogen oxides (NO_x) and particulate matter (PM). Secondary pollutants include nitrogen dioxide (NO_2), photochemical oxidants (e.g. ozone), hydrocarbon compounds (HC), sulphur acid, sulphates, nitric acid and nitrate aerosols. The main roads in the study area are the N4 to the north of the New Largo coal reserve and the N12 to the south with the R545 transecting through the center (north to south) of the New Largo coal reserve.

3.4.6 Fugitive Dust Emissions from Open Cast Mining

Open cast mines are associated with significant dust emissions, sources of which include land clearing, blasting and drilling operations, materials handling, vehicle entrainment, crushing, screening (etc.). Surface mines in the immediate vicinity of New Largo consist of the Winnakrans Sand Mine, Klipspruit Mine, Beesting Mine, Zondagsfontein Mine and the proposed Vlakfontein Mine.

3.4.7 Other Fugitive Dust Sources

Fugitive dust emissions may occur as a result of vehicle entrained dust from local paved and unpaved roads, wind erosion from open areas and dust generated by agricultural activities (e.g. tilling) and mining. The extent of particulate emissions from the main roads will depend on the number of vehicles using the roads and on the silt loading on the roadways.

3.5 Measured Baseline Ambient Air Quality

Particulates represent the main pollutant of concern in the assessment of the proposed operations. Particulate matter is classified as a criteria pollutant, with ambient air quality guidelines and standards having been established by various countries to regulate ambient concentrations of this pollutant. The particulates in the atmosphere may contribute to visibility reduction, pose a threat to human health, or simply be a nuisance due to their soiling potential.

3.5.1 Dust Fallout Network at Klipspruit

Klipspruit Colliery, located southwest of Phola has an ambient dust fallout network in place since January 2002. The dust fallout network comprises of single dust buckets at eight sites around the mining boundary and one site within the mining property. The locations of the dust fallout buckets are indicated in Figure 3-8.

Particulates represent the main pollutant of concern in the assessment of opencast mining operations and this monitoring network was established to define the dust problem due to the operations at Klipspruit Colliery. Particulate matter is classified as criteria pollutant, with ambient air quality guidelines and standards having been established by various countries to regulate ambient concentrations of this pollutant. Particulates in the atmosphere may contribute to visibility reduction, pose a threat to human health, or simply be a nuisance due to their soiling potential.

In assessing monitored data, ambient concentrations are typically screened against guidelines and standards, which are provided for specific averaging periods to determine compliance. However, air quality monitoring is conducted to meet various objectives as listed below:

- Compliance monitoring
- Validate dispersion model results;
- Use as input for health risk assessment;
- Assist in source apportionment;
- Temporal trend analysis;
- Spatial trend analysis;
- Source quantification; and,

- Tracking progress made by control measures.

Figure 3-8: Location of the Klipspruit dustfall sampling sites

Provided the monitoring periods which are on average over a 30 day period for dust fallout levels, the objectives of the monitoring network are primarily to assess temporal and spatial trends, and to track progress made by control measures.

Single bucket fallout monitors are deployed following the American Society for Testing and Materials standard test method for collection and analysis of dustfall (ASTM D1739-98). This method employs a single bucket device consisting of a cylinder not less than 150 mm in

diameter with height not less than twice its diameter and exposed for one calendar month (30 ±2 days). The buckets also include a wind shield as better precision is obtained when a simple aerodynamic shield is provided.

The dust fallout results have been evaluated against the SANS dust fall rate bands (see Table 2-2). The exposure period for the buckets is typically for 30 days (±2 days). Where buckets were exposed for more than 32 days or less than 28 days, the data has been flagged. The results have been provided using the following colour scheme to indicate the bands of the SANS dust fall rate:

Residential (D < 600)	Industrial (600 < D < 1200)	Action (1200 < D < 2400)	Alert (2400 < D)

The dust fallout data recorded over the period 2002 - 2009 are depicted in Table 3-2.

Table 3-2: Dust fallout recorded near Klipspruit Colliery for the period 2002-2009

Monitored Period	Monitored Dust Fallout (mg/m²/day)								
	Windmill	Enslin	Nursery	Ogies Mill	Phola	SEF Dam	Stoltz	Frigate Mining	Ogies School
	Site A	Site B	Site C	Site D	Site E	Site F	Site G	Site H	Site I
Feb 2002	40	15	135	37	36	-	-	-	-
Mar 2002	13	11	38	92	27	-	-	-	-
Apr 2002	30	56	67	23	53	-	-	-	-
May 2002	176	277	403	293	145	-	-	-	-
Jun 2002	45	46	321	132	136	-	-	-	-
Jul 2002	242	217	477	264	178	-	-	-	-
Aug 2002	239	263	773	116	582	-	-	-	-
Sep 2002	69	67	385	135	511	-	-	-	-
Oct 2002	140	72	491	276	733	-	-	-	-
Nov 2002	199	199	484	91	263	-	-	-	-
Dec 2002	752	55	565	14	248	-	-	-	-
Jan 2003	26	21	41	28	124	-	-	-	-
Feb 2003	221	457	253	235	134	-	-	-	-

Monitored Period	Monitored Dust Fallout (mg/m²/day)								
	Windmill	Enslin	Nursery	Ogies Mill	Phola	SEF Dam	Stoltz	Frigate Mining	Ogies School
	Site A	Site B	Site C	Site D	Site E	Site F	Site G	Site H	Site I
Mar 2003	356	105	238	450	149	-	-	-	-
Apr 2003	135	80	208	395	222	-	-	-	-
May 2003	379	212	273	277	297	-	-	-	-
Jun 2003	181	297	795	217	976	-	-	-	-
Jul 2003	150	65	567	102	39	-	-	-	-
Aug 2003	326	328	728	371	276	-	-	-	-
Sep 2003	331	213	390	116	1,506	-	-	-	-
Oct 2003	383	254	403	244	613	-	-	-	-
Nov 2003	237	132	90	311	938	-	-	-	-
Dec 2003	36	204	150	227	170	-	-	-	-
Jan 2004	71	143	60	105	487	-	-	-	-
Feb 2004	35.5	17.4	105.8	50.6	95.8	-	-	-	-
Mar 2004	44.0	55.0	17.0	63.0	93.0	-	-	-	-
Apr 2004	171.4	36.7	30.4	98.6	69.7	-	-	-	-
May 2004	3433.6	98.2	312.5	95.4	161.9	-	-	-	-
Jun 2004	111.6	51.1	405.3	215.7	153.9	-	-	-	-
Jul 2004	346.3	110.1	442.2	333.1	201.6	-	-	-	-
Aug 2004	184.0	94.2	457.4	285.3	288.6	-	-	-	-
Sep 2004	55.2	155.0	420.9	220.6	365.7	-	-	-	-
Oct 2004	86.0	241.3	43.3	227.6	269.3	-	-	-	-
Nov 2004	331.5	313.2	276.3	224.1	479.3	326.0	204.0	-	-
Dec 2004	394.4	231.4	337.1	732.4	131.0	153.0	184.1	-	-
Jan 2005	500.0	169.8	354.3	278.0	1108.7	189.4	261.4	-	-
Feb 2005	246.2	131.6	134.3	150.5	843.0	70.4	39.6	-	-

Monitored Period	Monitored Dust Fallout (mg/m²/day)								
	Windmill	Enslin	Nursery	Ogies Mill	Phola	SEF Dam	Stoltz	Frigate Mining	Ogies School
	Site A	Site B	Site C	Site D	Site E	Site F	Site G	Site H	Site I
Mar 2005	287.8	8.7	100.5	227.1	580.2	148.6	137.8	-	-
Apr 2005	1018.4	117.2	129.4	135.6	895.9	99.2	84.6	-	-
May 2005	64.5	5.5	168.3	117.1	81.0	9.6	4.4	-	-
Jun 2005	62.9	35.2	298.8	290.4	202.2	46.7	45.7	-	-
Jul 2005	59.7	95.9	298.1	396.2	163.4	50.7	55.6	-	-
Aug 2005	209.5	125.0	541.1	408.8	328.7	124.3	119.0	-	-
Sep 2005	105.5	94.4	471.0	446.4	1134.3	140.9	85.1	-	-
Oct 2005	101.6	89.5	318.7	335.6	158.7	79.2	84.1	-	-
Nov 2005	-	-	-	-	-	-	-	-	-
Dec 2005	-	-	-	-	-	-	-	-	-
Jan 2006	248	140	201	653	1800	186	101	496	137
Feb 2006	186	185	131	219	113	116	106	1607	121
Mar 2006	571	142	154	239	130	114	125	209	103
Apr 2006	151	36.0	76.7	176	64.2	73.8	83.1	771	56.7
May 2006	252	251	308	349	216	104	50.4	332	60.5
Jun 2006	206	93.3	587	365	111	272	68.0	673	96.7
Jul 2006	205	275	666	275	274.3	98.0	91.9	-	51.0
Aug 2006	286	1672	611	1049	416	113	108	-	107
Sep 2006	212	-	335	367	210	268	108	-	132
Oct 2006	490	-	225	639	162	101	61.9	-	108
Nov 2006	-	206	186	364	198	76.1	107	-	137

Monitored Period	Monitored Dust Fallout (mg/m²/day)								
	Windmill	Enslin	Nursery	Ogies Mill	Phola	SEF Dam	Stoltz	Frigate Mining	Ogies School
	Site A	Site B	Site C	Site D	Site E	Site F	Site G	Site H	Site I
Dec 2006	646	-	1813	551	529	391	218	-	372
Jan 2007	812	-	264	271	178	226	172	-	103
Feb 2007	1101	-	108.6	436	193.5	46.7	74.2	-	93.7
Mar 2007	507	66	123	354	132	63	65	419	52
Apr 2007	507	66	123	354	132	63	65	419	52
May 2007	161	90	434	256	344	76	123	-	95
Jun 2007	1168	1025	1564	636	262	1164	1190	-	433
Jul 2007	136	45	731	360	355	52	35	-	65
Aug 2007	570	192	606	822	778	254	186	-	209
Sep 2007	550	51	281	382	341	84	125	-	117
Oct 2007	209	114	135	419	176	69	98	-	103
Nov 2007	207	49	135	375	148	94	118	-	72
Dec 2007	7	117	97	79	108	149	55	-	14
Jan 2008	183	36	77	62	35	48	26	-	31
Feb 2008	92.1	123	72.1	43.7	104	6.13	2.04	-	125
Mar 2008	119	105	66	75	61	108	71	-	129
Apr 2008	12	14	196	167	66	48	3	-	9
May 2008	155	82	331	325	169	142	102	-	123
Jun 2008	194	51.6	387	338	157	72.2	57.1	-	-
Jul 2008	658	126	638	660	394	138	100	-	161

Monitored Period	Monitored Dust Fallout (mg/m²/day)								
	Windmill	Enslin	Nursery	Ogies Mill	Phola	SEF Dam	Stoltz	Frigate Mining	Ogies School
	Site A	Site B	Site C	Site D	Site E	Site F	Site G	Site H	Site I
Aug 2008	626	552	1157	961	604	357	338	-	-
Sep 2008	229	162	614	646	376	974	184	-	-
Oct 2008	243	39	264	684	479	158	155	-	459
Nov 2008	172	289	141	998	268	318	310	-	102
Dec 2008	406	551	389	359	592	779	403	-	345
Jan 2009	466	128	251	307	181	83	77	-	16
Feb 2009	-	485	136	177	28	47	47	-	45
Mar 2009	230	2479	254	267	326	222	219	-	161
Apr 2009	613	413	245	-	511	346	334	-	388
May 2009	211	278	251	-	261	255	142	-	341
Jun 2009		241	700	-	386	186	177	-	219
Jul 2009	579	707	1186	-	946	618	531	-	513
Aug 2009	-	-	-	-	-	-	-	-	-
Sep 2009	-	335	447	-	742	300	280	-	276

Dustfall levels recorded at the nine sites over the period February 2002 to September 2009 were mainly within the SANS Residential Band (< 600 mg/m²/day). The maximum dust fallout levels were recorded at Site A (Windmill) during May 2004, at a level of 3434 mg/m^2/day, within the SANS Alert dust fallout band.

Time plots provided for the various dust fallout sites are presented in Figures 3-9 to 3-17. The SANS limits indicates dust fallout levels of between 600 mg/m^2/day and 1,200 mg/m^2/day to be permissible for heavy commercial and industrial areas and <600 mg/m^2/day required for residential areas.

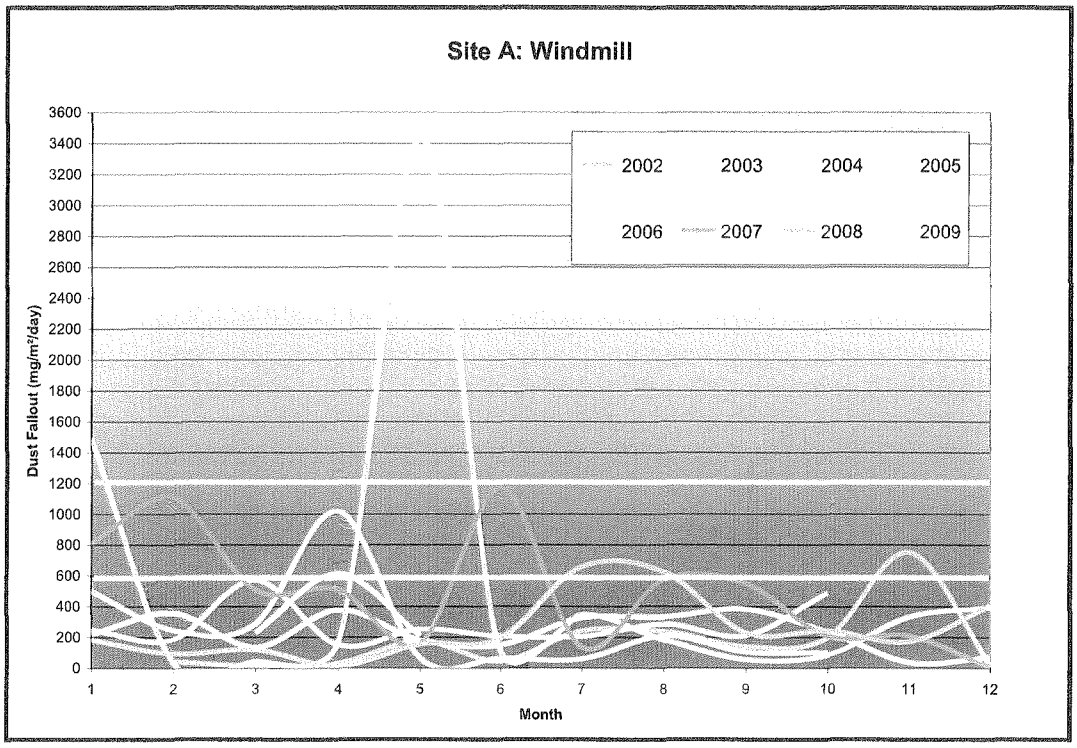

Figure 3-9: Highest daily dust fallout levels recorded at Windmill (Site A) during February 2002 to September 2009

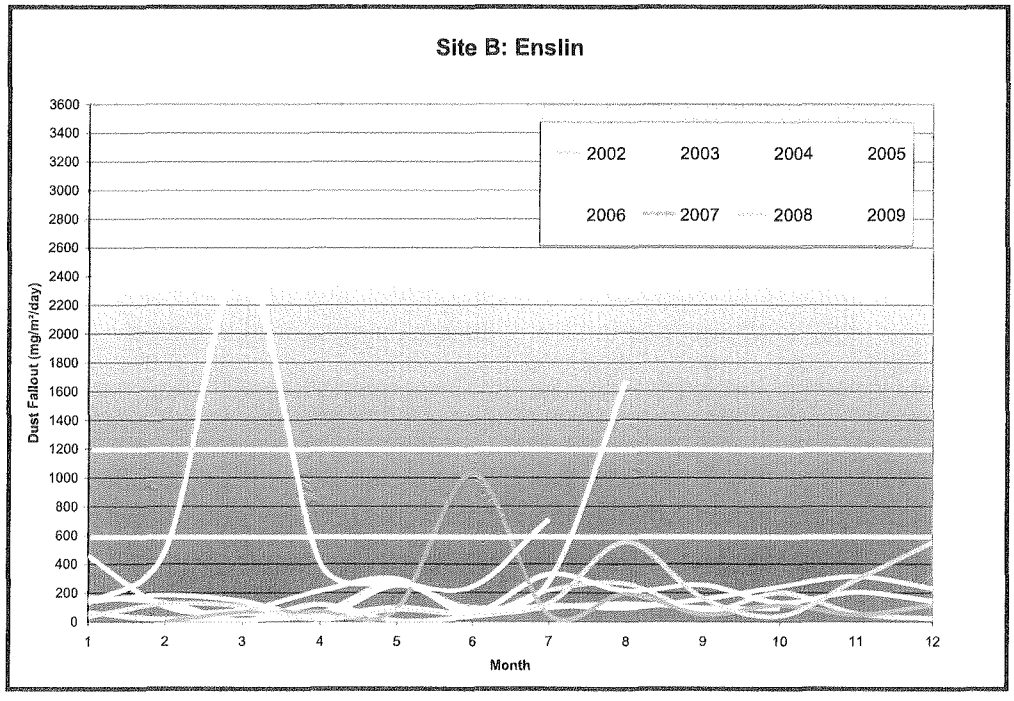

Figure 3-10: Highest daily dust fallout levels recorded at Enslin (Site B) during February 2002 to September 2009

the dedet

Department:
Economic Development, Environment and Tourism
MPUMALANGA PROVINCIAL GOVERNMENT

Details of specialist and declaration of interest in respect of an application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Phola - Kusile Coal Conveyor

Specialist:	Airshed Planning Professionals (Pty) Ltd		
Nature of specialist study compiled:	Air Quality Assessment		
Contact person:	Renee von Gruenewaldt		
Postal address:	PO Box 5260		
Postal code:	1685	**Cell:**	
Telephone:	011 805 1940	**Fax:**	011 805 7010
E-mail:	mail@airshed.co.za		
Qualifications & relevant experience:	Experience: 10 years Qualification: MSc (Atmospheric Sciences)		
Professional affiliation(s) (if any)	SACNASP		

The specialist appointed in terms of the Regulations

I, Renee van Gruenewaldt declare that -

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in Regulation 8;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of specialist:

Arnstad Planning Professionals (Pty) Ltd

Name of company:

23/09/2011

Date:

CJ 716e336-2

Signature of Commissioner of Oaths

2011-09-23

Date:

COMMISSIONER

Designation:

Official stamp (below)

Mudred op 2011/09/23

(HANDTEKENING) KOMMISSARIS VAN EDE
(SIGNATURE) COMMISSIONER OF OATHS

MKHUMELENI VICTOR NAMBAM

VOLLE VOORNAME EN VAN IN DRUKSKRIF
FULL FIRST NAMES AND SURNAME IN BLOCK LETTERS

CNR ONA-CLEAND SMUTS DRIVE

BESIGHEIDSADRES (STRAATADRES)
BUSINESS ADDRESS (STREET ADDRESS)

HALFWAY GARDEN

CJT

SOUTH AFRICAN POLICE SERVICE
MIDRAND
23 SEP 2011
CLIENT SERVICE CENTRE
SOUTH AFRICAN POLICE SERVICES

Appendix J:
Traffic Specialist Opinion

Structuring of the Specialist Studies in terms of GNR 543 Section 32 Requirements

Legal and Regulatory Requirement	Cross Reference to Report Section
GNR 543 Section 32	
Specialist reports and reports on specialized processes	
1. An applicant or the EAP managing an application may appoint a person to carry out a specialist study or specialized process.	Appendices to the EIA main report
2. The person referred to in sub-regulation (1) must comply with the requirements of regulation 17 [declaration of independence]	Declaration of independence signed by specialists provided at back of each specialist report
3. A specialist report or a report on a specialized process prepared in terms of these Regulations must contain-	
(a) Details of- (i) the person who prepared the report; and (ii) the expertise of that person to carry out the specialist study or specialized process;	Page 1
(b) A declaration that the person is independent in a form as may be specified by the competent authority;	Declaration of independence signed by specialists provided at back of each specialist report
(c) An indication of the scope of, and the purpose for which, the report was prepared;	Page 1
(d) A description of the methodology adopted in preparing the report or carrying out the specialized process;	Not applicable
(e) A description of any assumptions made and any uncertainties or gaps in knowledge;	Not applicable
(f) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;	Page 1
(g) Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;	Provided in each specialist report, where relevant
(h) A description of any consultation process that was undertaken during the course of carrying out the study;	Consultation Process discussed in EIA main report
(i) A summary and copies of any comments that were received during any consultation process; and	All issues received to date included in Section 6 of the EIA main report
(j) Any other information requested by the competent authority.	Not applicable

Our Reference: 336953/1
Your Reference: S0403

12 October 2011

Synergistics Environmental Services
P O Box 1822
RIVONIA
2128

ATTENTION: MS. VIVIENNE VORSTER

WSP SA Civil and Structural Engineers

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WSP SA Civil and Structural Engineers (Pty) Ltd
Registered Number: 1973/09683/07

A member of WSP Group Africa

Dear Madam,

TRAFFIC IMPACT OF THE PROPOSED PHOLA-KUSILE COAL CONVEYOR

The proposed Phola-Kusile coal conveyor will not have an impact on the existing road network other than the short-term traffic management and control issues during construction where the proposed conveyor will cross public roads. The two required road crossings necessary for all the conveyor route alternatives are indicated on the the attached Figure 1 and are discussed below.

1. Road Crossing A: N12 Highway

The proposed coal conveyor will be constructed through an existing Transnet culvert where it crosses the N12 highway at point A. The traffic on the N12 will therefore not be affected by the construction of the conveyor in the vicinity of point A.

2. Road Crossing B: D686 (Kendal to R545)

Due to the topography and technical considerations the design of the conveyor is such that it will cross over the D686 (point B) to the south of the N12 interchange. The road crossing will therefore include the construction of a bridge over the D686. This would involve the temporary closure of the D686 with appropriate deviations. Given the cross-section of the roadway, the gravel shoulders and the adjacent land use (agricultural) as shown in Photograph 1, this should be feasible without disrupting the peak traffic flows too much.

The bridge will be provided without altering the vertical alignment of the D686, but needs to be approved by the relevant roads authority.

Photograph 1: D686 to the south of the N12 interchange

We trust the attached is in order but should you have any queries please do not hesitate to contact the undersigned.

Yours faithfully

ROD STRONG *Pr. Eng*: SENIOR ENGINEER
WSP SA CIVIL AND STRUCTURAL ENGINEERS (PTY) LTD

the dedet

Department:
Economic Development, Environment and Tourism
MPUMALANGA PROVINCIAL GOVERNMENT

Details of specialist and declaration of interest in respect of an application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Phola - Kusile Coal Conveyor

Specialist:	Rod Strong (Pr. Eng)		
Nature of specialist study compiled:	Traffic Impact Assessment		
Contact person:	Cornelia Hutchinson		
Postal address:	PO Box 2330, Edenvale		
Postal code:	1610	**Cell:**	082 675 0299
Telephone:	011 450 2290	**Fax:**	011 450 2294
E-mail:	cornelia.hutchinson@wspgroup.co.za		
Qualifications & relevant experience:	Pr. Eng ; B. Eng ; MSC (Eng)		
Professional affiliation(s) (if any)	ECSA , CESA , SAICE		

The specialist appointed in terms of the Regulations

I, RODERICK ARTHUR GLYN STRONG, declare that -

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in Regulation 8;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of specialist:

WSP SA Civil and Structural Engineers (Pty) Ltd.
Name of company:

23 SEPTEMBER 2011
Date:

Signature of Commissioner of Oaths

DUANE FOURIE
CIB House, Riley Road Business Park
15E Riley Road, Bedfordview
Commissioner of Oaths Ex Officio
Practising Attorney, R.S.A.

Date:

Designation:

Official stamp (below)

Appendix K:
Noise Specialist Assessment

Structuring of the Specialist Studies in terms of GNR 543 Section 32 Requirements

Legal and Regulatory Requirement	Cross Reference to Report Section
GNR 543 Section 32	
Specialist reports and reports on specialized processes	
1. An applicant or the EAP managing an application may appoint a person to carry out a specialist study or specialized process.	Appendices to the EIA main report
2. The person referred to in sub-regulation (1) must comply with the requirements of regulation 17 [declaration of independence]	Declaration of independence signed by specialists provided at back of each specialist report
3. A specialist report or a report on a specialized process prepared in terms of these Regulations must contain-	
(a) Details of- (i) the person who prepared the report; and (ii) the expertise of that person to carry out the specialist study or specialized process;	Front page
(b) A declaration that the person is independent in a form as may be specified by the competent authority;	Declaration of independence signed by specialists provided at back of each specialist report
(c) An indication of the scope of, and the purpose for which, the report was prepared;	Chapter1, Section 1.2 - Terms of reference and scope of work
(d) A description of the methodology adopted in preparing the report or carrying out the specialized process;	Section 2 - Methodology
(e) A description of any assumptions made and any uncertainties or gaps in knowledge;	Chapter 3, Section 3.3.1 Worst-case assumptions Chapter 5 - Summary of noise impact implications
(f) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;	Chapter 3 - Results and findings Chapter 5 - Summary of noise impact implications
(g) Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;	Chapter 4 - Mitigation
(h) A description of any consultation process that was undertaken during the course of carrying out the study;	Consultation Process discussed in EIA main report
(i) A summary and copies of any comments that were received during any consultation process; and	All issues received to date included in Section 6 of the EIA main report
(j) Any other information requested by the competent authority.	Not applicable

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Phola-Kusile Overland Coal Conveyor Project	Report G915-R3
Environmental Impact Assessment	
Noise Study	
For: Anglo American Inyosi Coal	Revised: 07-Oct-2011

Declaration of independence

I am a single proprietor, independent acoustic consulting engineer. I have no commercial interest in Anglo American Inyosi Coal, or the above-mentioned project.

A personal curriculum vitae in support of my qualifications, expertise and experience to undertake studies of this nature, is attached in Appendix B of this report.

Executive Summary

A noise study was carried out in the area surrounding the proposed Phola-Kusile Overland Coal Conveyor Project. The study finds that the conveyor will have a significant noise impact footprint extending to a distance of approximately 1 250 m from the conveyor. This footprint can be reduced to a distance of 250 m by using low-noise rollers. Further reduction, if needed, will require the construction of a noise screen.

Ben van Zyl MSc (Eng) PhD
Acoustical Engineer

Index

1 Introduction

1.1 Location and description of the proposed development

Anglo American (AA) through its subsidiary Anglo American Inyosi Coal (AAIC) is proposing to construct an overland conveyor system, the Phola-Kusile Overland Coal Conveyor, to transport coal from the Phola Coal Processing Plant (Phola CPP) to Eskom's Kusile Power Station in the Mpumalanga Province.

The Kusile Power Station is a coal-fired power station currently under construction just south of the N4 highway between Bronkhorstspruit and Witbank (Emalahleni). It will consist of six units of 800 MW capacity each and a total capacity of 4800 MW. The proposed Phola-Kusile Overland Coal Conveyor will fall within the Nkangala District Municipality, and the Victor Khanye (Delmas) and eMalahleni (Witbank) Local Municipalities. Towns in close proximity to the proposed conveyor are Wilge (~4 km east), Phola (~3 km southeast), Ogies (~5 km south-southeast) and eMalahleni (~25 km east).

The Phola Coal Processing Plant is an existing operation located approximately 20 kilometres south-east of Kusile, between the Kendal Power Station, Ogies and Phola. Eskom has identified the middlings coal from the Phola Coal Processing Plant as an important future source of coal for the Kusile Power Station. The purpose of the proposed overland conveyor is to ensure supply of coal to Kusile as required for the generation of electricity to the national grid. To prepare Kusile Power Station for commercial operations, delivery of the first coal via the Phola-Kusile Coal Conveyor is planned for October 2013. Route alignments considered along the proposed corridor (identified in the scoping report) are indicated on Figure 1.1.

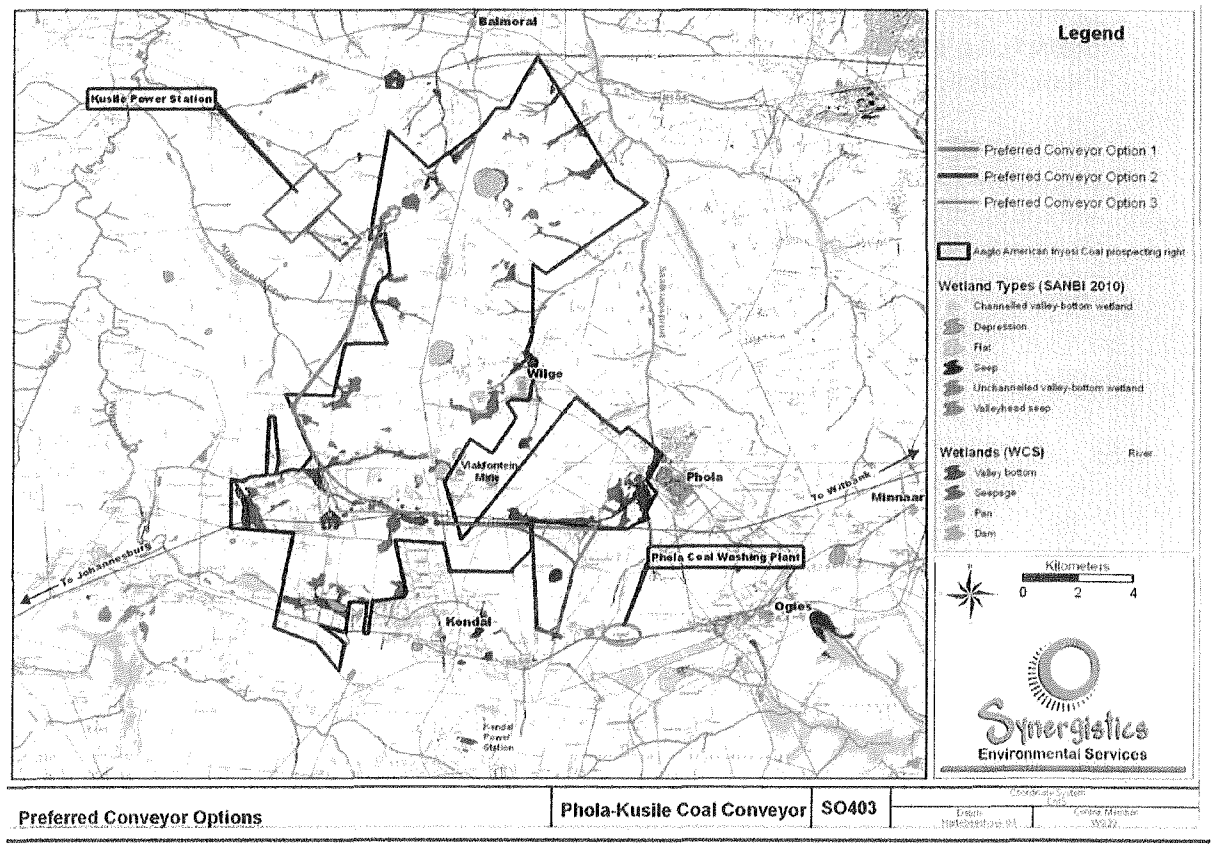

Figure 1.1

Locality of the proposed Phola-Kusile Overland Coal Conveyor Route Corridor with alternative route alignments

1.2 Terms of reference and scope of work

The acoustic specialist's brief was to investigate the noise impact of the proposed overland conveyor development on the surrounding area and, where applicable, to consider the requirements and options for mitigation.

The study area can be roughly defined as the area of land between the Phola Coal Processing Plant and the Kusile Power Station (the area over which a route for the conveyor has to be found), incorporating the proposed corridor as illustrated in Figure 1.1. The environmental impact assessment investigated a one kilometre wide strip of land within which the final alignment of conveyor will be determined. The scope of work required in support of an EIA, involves the following two main tasks:

Scoping and baseline study

Carry out a physical scoping and a measurement survey to assess the nature of the existing noise environment and to determine typical existing, i.e. predevelopment outdoor ambient sound levels in the area. The results of such a survey conducted in a baseline noise study in by Acusolv in June 2011 were published in Report G915-R1 [1]. Since it forms an integral part of the methodology and noise assessment, content of the baseline study is included in this noise study report.

Predictive noise impact study

Carry out a study in which the expected impact of the development is quantified and assessed by means of computer modeling of the emission and atmospheric propagation of noise expected to be generated by the main components of the project, i.e. open-cast operations at the colliery, the processing plant, the conveyor between Phola and Kusile Power Station and road traffic on the R545 national road to be relocated.

This report (G915-R3) presents the results of a noise impact study conducted for the proposed the Phola-Kusile Overland Coal Conveyor project. Since it forms an integral part of the methodology and noise assessment, content of the baseline study is included in the noise study report.

2 Methodology

2.1 General

The Phola-Kusile Overland Coal Conveyor Project noise study was carried out in accordance with SANS 10328 [2], a South African Standard presenting guidelines on procedures to conduct noise assessments.

2.2 Baseline Study

2.2.1 Baseline field survey

Selection of noise monitoring locations

Criteria applied and practical considerations taken into account in the selection of suitable locations for noise monitoring, include the following:

- **Community concerns:** In selecting locations for noise monitoring, concerns raised by interested and affected parties should be taken into account.
- **Worst-case impact:** Focus on areas where maximum noise impact is expected.
- **Suitability for future surveys:** As far possible, select locations likely to be accessible in future surveys.
- **Avoid interference:** As far as practically possible, stay clear of and avoid interference by localised noise sources which may distort the data. Examples are power distribution boxes, barking dogs, speech interference by curious visitors and insects.
- **Equipment safety:** Measurement procedure, integration periods and sample size depend on the availability of facilities for safeguarding equipment. Long duration samples are only possible at locations where facilities are available to lock away recording equipment connected via a cable to a microphone positioned outdoors at a point clear of vertical reflecting surfaces and protected from the elements.

Meteorological considerations

Outdoor noise measurement is not permitted under certain weather conditions. Rain, drizzle or fog affects the conductivity of measurement microphones, resulting in faulty readings. It may also damage the microphone and measuring equipment. Secondly, although measurement often has to be performed in the presence of wind, care should be taken to verify that wind turbulence noise on the microphone capsule is negligible compared to the sound level being measured. There is no fixed upper limit for permissible wind speed, it all depends on the level being measured. Another weather phenomenon which may cause interference and spoil measurement data, is thunder and lightning.

Meteorological conditions also affect the acoustic environment and the actual sound levels without causing interference or measurement error. Normal fluctuations in atmospheric conditions may cause large variations in noise level which cannot and should not be avoided in the planning and execution of noise monitoring surveys. These variations constitute the natural variance in both background and intrusive noise levels. Noise levels at a distance from large sources are highly dependent on meteorological conditions. In fact, the difference in

characteristic day and night meteorological patterns is one reason why 24-hour mining or industrial operations always have a much greater noise impacts at night[1].

It should be noted that, for the reasons explained above, the monitoring of meteorological conditions, such as temperature, wind and humidity on the ground can at best only serve to avoid errors and distortion of measurement data. Knowledge of cloud cover, temperature, humidity and wind which prevailed during the course of a noise survey has little if any value in the post-processing and interpretation of data.

Sampling considerations

To be of any use as an environmental management tool, noise monitoring has to produce accurate and relevant data. As a minimum requirement measurements should be performed using equipment with the necessary precision and accuracy as laid down in SANS 10103 [3]. Just as important, no matter how accurate the measurements, the data is only as good as the sample. What complicates noise sampling is that ambient noise is all but constant. As a rule, it is the net result of contributions from various constant, cyclic and randomly fluctuating sources.

To account for the intrinsic 24-hour cyclic variation, measurements should be taken within the relevant period of interest, e.g. daytime, night-time or a 24-hour cycle. Noise regulations require that the noise investigated must be measured (averaged) over a period of at least 10 minutes; i.e. 10 minutes or longer. Occasionally, in the investigation of noise complaints, a 10 minute sample may be sufficient to obtain the data needed to make a finding. For purposes of predictive noise studies and monitoring surveys, however, longer averaging periods are required to determine baseline or operational noise levels. Noise levels have to be averaged over intervals long enough to ensure that the sample is representative of conditions which prevailed during the period of investigation.

Where this is possible, in addition to measuring the average over the day or night-time period of interest, equipment may be programmed to simultaneously determine averages in a contiguous series of short sub-intervals of say 10-minute, 30-minute, or 1 hour duration, covering the main survey period. In this way, a picture can be obtained of the noise pattern over that period. For practical reasons, it is often not possible to attend measurements for the full duration of such long recordings.

Noise survey conducted in this study

Field surveys

It was an explicit requirement for specialists involved in the project to arrange permission access to property through Anglo American Inyosi Coal. In the case of the noise study, based on a map study and on visual and aural scoping surveys of the project area, the specialist identified and informed AAIC about areas where ambient noise samples had to be taken. AAIC (Mr. Kitching) then informed property owners of the need to conduct a baseline study in terms of an EIA, arranged permission of access and introduced them to the specialist. Following this procedure, the specialist engaged directly with the owners to arrange specific times for visits to setup equipment for noise monitoring and for collection of equipment at the end of each survey.

The number of properties where AAIC could arrange for such access was limited, though sufficient to obtain representative samples of large areas within which the characteristic noise

1 *The other main reason is the increased community sensitivity at night due to a natural decline in road traffic and human activity noise.*

climates are intrinsically homogeneous. The specialist conducted surveys at all six locations where access could be arrange by AAIC.

Scoping and measurement surveys were carried out during the period 13 to 24-Jun-2011. Locations where ambient noise was monitored for a period of approximately 24 hours (see Figure 2.1) are as follows:

M1 Premises Rockblend

M2 Residence Mac Donald

M3 Residence Engelbrecht

M4 Residence Cloete

M5 Residence Truter

M6 Residence Van den Heever

Noise recording equipment was programmed to measure averages in sequences of 10-minute intervals for a total duration of 24 hours or longer. In all recordings, A-weighted, equivalent continuous sound pressure levels L_{Aeq} (dBA) were measured, using an integrating sound analyser. For purposes of identifying sources of noise, third-octave spectra were examined during attended sessions, as well as in post-processing of data. At the same time, for purposes of identifying sources of noise, audio recordings synchronised with the data recordings were made at each monitoring point.

In the area south of the N12 highway where AAIC could not arrange access for setting up equipment in a protected location for long duration monitoring, short duration sampling and probing of noise levels were used to obtain estimates of typical daytime and night-time ambient noise levels in that area. This is indicated as M7 in Figure 2.1. For reasons explained in Section 3.1.2, the result of a longer duration sample is highly unlikely to change the findings of the noise impact assessment in respect of this area.

M7 Area south of the N12 highway

Assessment

Although measurements covered daytime periods as well, when considering noise impact, it is for all practical purposes only the night-time results that matter. Night-time, when people are normally sleeping, is when the environment is by far the most sensitive to intrusive noise and when maximum impact is experienced. Hence, in the assessment of noise, the focus is on night-time conditions.

Measurement data was processed to obtain a time history of ambient noise levels. Using the audio recordings, it was possible to listen to the actual noises which occurred at any time, to identify sources of noise and to correlate audible noise events with data.

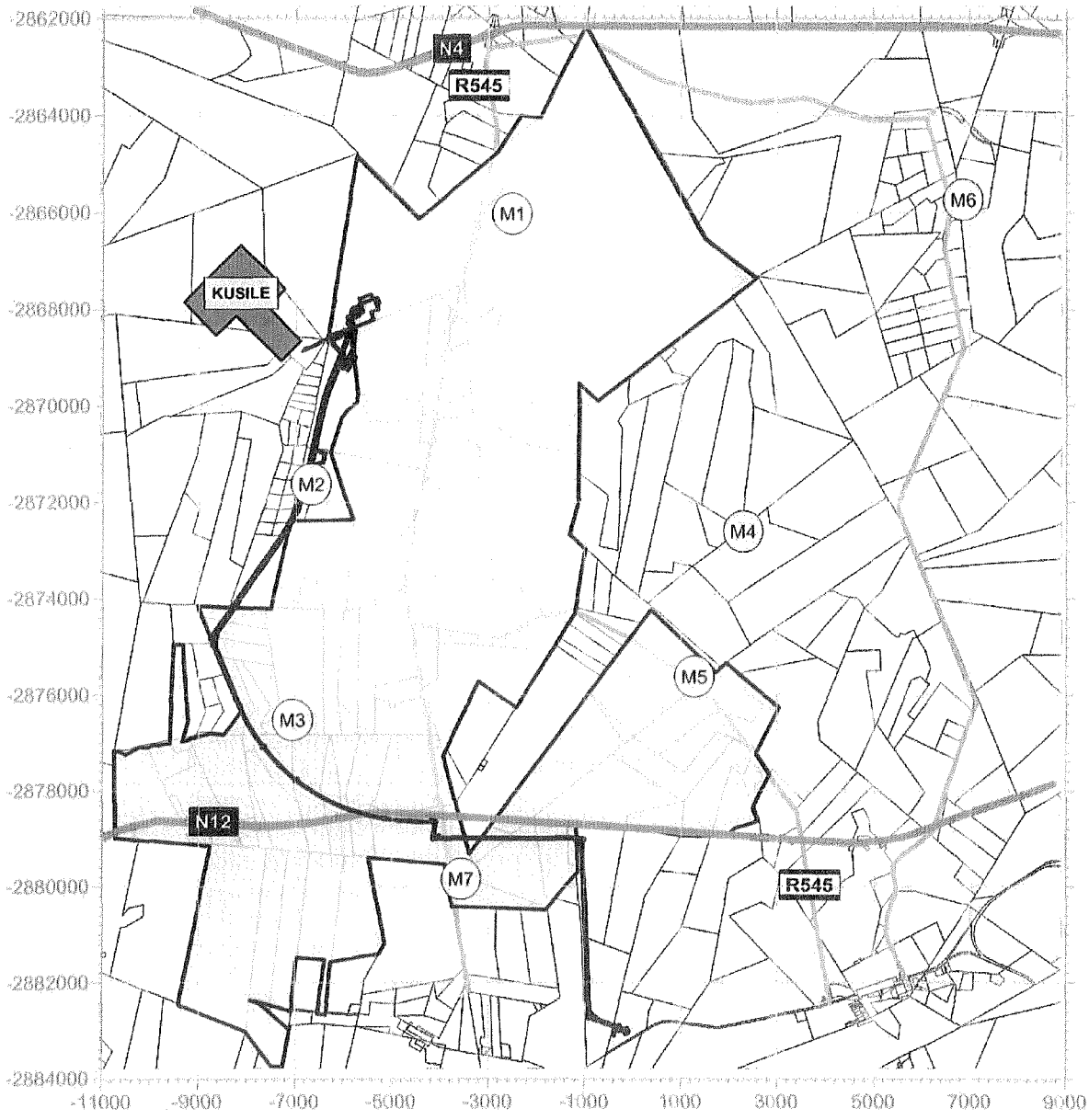

Figure 2.1

Noise monitoring locations

Monitoring location		Coordinate	Monitoring location		Coordinate
M1	Premises Rockblend	S25 54 18.4 E28 58 27.2	M4	Residence Cloete	S25 57 44.3 E29 01 24.7
M2	Residence Mac Donald	S25 57 09.9 E28 55 57.0	M5	Residence Truter	S25 59 23.7 E29 00 43.6
M3	Residence Engelbrecht	S25 59 51.0 E28 55 47.9	M6	Residence V d Heever	S25 54 00.0 E29 04 04.8
M7	Area south of the N12				

2.2.2 Test equipment

Noise level measurements

Field measurements were carried out using the following equipment:

(a) Brüel & Kjaer Type 2260 Modular Precision Sound Analyser (Ser no. 1875497)

(b) Brüel & Kjaer Type 2260 Modular Precision Sound Analyser (Ser no. 1823652)

(c) Brüel & Kjaer Type 4231 Sound Calibrator (Ser no. 2606011)

Equipment conformed to IEC 61672-1 Electro-Acoustics – Sound Level Meters – Part 1: Specifications.

Calibration:

- M& N Calibration Services Certificates No's 2010-1164 & 2010-1165
- National Metrology Institute of SA Certificate No AV/AS-4016-R
- National Metrology Institute of SA Certificate No AV/AS-4021-R

Audio recording equipment

(a) Olympus LS11 PCM Digital Recorder (Ser no. 200109647)

(b) Olympus LS11 PCM Digital Recorder (Ser no. 200114547)

2.3 Predictive noise impact study

2.3.1 Noise modelling

Estimates of future noise levels to be generated by the proposed development in the study area were derived with the aid of a model simulating noise emission from all major noise-generating components. To this end, it was required to quantify the acoustic emission (sound power) levels, as well as the frequency and directional characteristics of individual or groups of sources. This data was available from measurement data obtained in several previous conveyor noise studies and from in-house noise data archives. Calculation of geometric dispersion and atmospheric propagation of noise is based on the principles of the Concawe method SANS 10357:2000 [4], extended to deal with more complex source configurations, as well as to simulate the effect of wind.

2.3.2 Project description

The Phola-Kusile Overland Coal Conveyor will be designed to transport approximately 10.4 million tonnes of coal per year, over the life of the Kusile Power Station. It will start at the Phola Coal Processing Plant and end at coal stockyards in the vicinity of the Kusile Power Station. From the coal stockyard, there will be feed conveyors into the Kusile Power Station. The conveyor system will be approximately 21 km in length, depending on the final route selection. There will be up to five conveyor flights and a total of six transfer stations. Lighting will be provided at the transfer points. The route stops on Anglo American property bordering Kusile Power Station. Frome there, another short conveyor belt will be built to transport the coal into the power station.

Transfer stations and stream crossings will be provided with impervious concrete floors designed to contain spillages and will be linked to local pollution control systems. The conveyor will be approximately 1.35 meters wide and will run at an average speed of approximately 4.2 metres per second. It will be provided with a sheeted metal cover, open on one side. The conveyor belt will be equipped with on-line quality and mass monitoring equipment. The fenced conveyor servitude will be approximately 25 metres wide.

Three alternative corridor routes for the conveyor were initially identified. Two corridors were discarded, mainly on environmental grounds and one corridor was identified as the preferred corridor. The preferred corridor takes the Phola-Kusile Coal Conveyor across the southern section of the AAIC New Largo prospecting right area along the N12 highway – thus along an area where coal resources are already sterilised by other east-west running linear infrastructure. Route alignments considered along the preferred corridor (The Blue Route) are indicated on Figure 1.1. The route alignment will be optimised to minimise environmental impacts.

The route starts at the Phola Coal Processing Plant in the south, running in a northerly direction towards the N12, where-after it will turn west to run parallel to the N12. The initial alignment was to the north of the N12 but due to the implications of the conveyor route crossing and thus sterilising the mineral resource area of AEMFC, an alternative alignment along the south of the N12 was identified.

After the route crosses the N12, it will turn northwest until it reaches the western perimeter of the AAIC prospecting area. From here it will run in a north-easterly direction until it reaches the stockyard near the Kusile Power Station. This route crosses land owned by Anglo Operations Limited, Ingwe Surface Holdings, Truter Boerdery, Bronlaw Properties, South African National Roads Agency Limited (SANRAL), Waterfontein Boerdery, Frazer Alexander Coal, Eskom Holdings Ltd and privately owned farms. From south to north it runs across the farms Smaldeel IS, Bankfontein 216 IR, Vlakfontein 569 and Klipfontein 568 JR.

The centreline coordinate points for the Blue Corridor Route are provided in Table 2.1.

Table 2.1

Phola-Kusile Coal Conveyor
GPS Coordinates for preferred route corridor illustrated in Figure 1.1

Corner / Bend Point	Southern Coordinate	Eastern Coordinate
Phola-Kusile Coal Conveyor Preferred Route Corridor (Blue Route)		
1	25° 55.617' S	28° 56.982' E
2	25° 57.906' S	28° 54.510' E
3	26° 0.633' S	28° 53.106' E
4	26° 1.606' S	28° 53.059' E
5	26° 2.342' S	28° 53.903' E
6	26° 2.957' S	28° 55.279' E
7	26° 3.059' S	28° 56.574' E
8	26° 3.442' S	28° 57.928' E
9	26° 3.542' S	28° 59.212' E
10	26° 3.400' S	28° 59.956' E

The centreline coordinates of the proposed route option, which was identified during the evaluation of various route options, are presented below

Corner / Bend Point	Southern Coordinate	Eastern Coordinate
Phola-Kusile Coal Conveyor Proposed Route Option (Option 1)		
Corner / Bend Point	**EAST**	**SOUTH**
1	28° 55.731' E	25° 55.758' S
2	28° 56.475' E	25° 55.445' S
3	28° 56.303' E	25° 55.844' S
4	28° 55.715' E	25° 57.623' S
5	28° 54.754' E	25° 58.902' S
6	28° 55.474' E	26° 0.208' S
7	28° 57.528' E	26° 0.987' S
8	28° 57.506' E	26° 1.175' S
9	28° 58.798' E	26° 1.207' S
10	29° 0.203' E	26° 1.925' S
11	28° 59.838' E	26° 3.246' S
12	28° 59.672' E	26° 3.194' S
13	28° 59.949' E	26° 3.338' S

Service and maintenance roads will be provided in the servitude to provide access for maintenance and emergency purposes as well as to act as a fire break.

2.3.3 Project overview - programme and phasing

Table 2.2 gives a simplified summary of the programme implementation schedule.

Table 2.2

Phola-Kusile Coal Conveyor
Simplified Project Implementation Programme

Project Phase	Schedule
Planning Phase	2010
	2011
Construction Phase	2012
First coal delivered to Kusile	2013
Operation of Phola-Kusile conveyor	
	Beyond 2070

2.3.4 Potential sources of noise

A Construction phase – Potential sources of noise

Construction activities will take place along the coal conveyor corridor and are scheduled to commence in 2012 and to be completed in the first half of 2013. In terms of noise generation, construction will involve low intensity, short-term activities and singular vehicle movements with little or no consequence.

B Operational phase – Potential sources of noise

A conveyor constitutes a line noise source characterised by medium to low-frequency audible content with a relatively wide physical footprint. The main components contributing the overall conveyor noise are the conveyor itself, coal transfer stations and start-up alarms. Although transfer stations appear to be noisier when judged from a short distance (a few meters from the source), by far the greatest contribution to the noise heard at distances more than 200 m away comes from the conveyor. The reason for this is twofold:

- Firstly, the distance laws applicable to the two sources are completely different: transfer station noise falls at a relatively fast rate of 6 dB per doubling of distance (point source), while conveyor noise falls at a much slower rate of 3 dB per doubling of distance (line source). Consequently, the distance from source (the width) of the noise footprint is much greater for the conveyor than for a transfer station.

- Secondly, unlike transfer stations that are only located at a few singular points, the conveyor covers the entire route, resulting in a much longer noise footprint (greater length).

The primary noise generator in a conveyor is the idler (roller) and the idler-belt combination which generate noise as a result of idler rotation, as well as continuous belt and idler excitation by impulsive belt-idler impact.

C Decommissioning and Closure

Decommissioning and closure is assumed to involve removal of surface infrastructure and rehabilitation of disturbed areas.

2.4 Noise regulations and assessment criteria

2.4.1 South African noise regulations

In 1994, with the devolution of regulatory power from governmental to provincial level, the authority to promulgate noise regulations was ceded to provinces. Each province could henceforth decide whether to develop their own regulations, or to adopt and adapt existing regulations. As yet, however, only three provinces (Gauteng, Free State and Western Cape) have promulgated such regulations. Elsewhere, including Mpumalanga Province, no provincial noise regulations have been put in place.

Consequently, in noise studies undertaken in provinces lacking official noise regulations, specialists usually consider the old national noise regulations [5] to apply by default. For further guidance, it is noted that noise criteria in all previous national and current provincial regulations, as well as current metropolitan noise policies, are all derived from SANS 10103 [3]. SANS 10103 defines the relevant acoustic parameters that should be measured, gives guidelines with respect to acceptable levels and assessment criteria and specifies test methods and equipment requirements.

In this noise monitoring survey, the provisions of the old national noise regulations are taken into account, but noise assessment is based by and large on the principles, guidelines and criteria of SANS 10103.

Prohibitions

Prohibition of disturbing noise

In accordance with international and South African standard practice, noise impact assessments are made with respect to outdoor noise levels. Noise regulations prohibit any changes to existing facilities, or uses of land, or buildings or the erection of new buildings, if it will house activities that will cause a disturbing noise, unless precautionary measures to prevent disturbing noises have been taken to the satisfaction of the local authority. Noise is deemed to be disturbing, if it exceeds certain limits. Depending on what data is available, SANS 10103 allows for different formulations of the excess.

- **If the actual residual ambient level is known:** The excess is taken to be the difference between the noise under investigation and the residual noise measured in the absence of the specific noise under investigation. This definition, based on the *noise emergence criterion,* finds application in both predictive and noise monitoring assessments, if baseline noise data is available.

- **If the actual residual ambient level is unknown:** Alternatively, the excess may also be defined as the difference between the ambient noise under investigation and the acceptable ambient rating for the type of district under consideration in accordance with SANS 10103. This definition, based on the *acceptable level criterion,* is employed in predictive noise studies and in noise monitoring assessments, if there is no baseline data available or if an existing source of intrusive noise cannot be switched off for purposes of measuring the residual background level.

In terms of the old national noise regulations, a disturbing noise means a noise that causes the ambient sound level to increase by 7 dB or more above the designated zone level, or if no zone level has been designated, the ambient sound level measured at the same point. Noise regulations also require that the measurement and assessment of ambient noise comply with the guidelines of SANS 10103.

It should be cautioned, however, that the legal limit of 7 dB should not be construed as the upper limit of acceptability. SANS 10103 (See Table 2.4 in this report) warns that an increase of 5 dB is already significant and that an increase of 7 dB can be expected to evoke widespread complaints from the community. Hence, although the applicant would be within legal limits if the noise impact is prevented from exceeding 7 dB, that would not prevent a community from being disturbed and to complain about the noise. In the EIA phase, i.e. in the design and planning stage of a new development, it is advised the target be set much lower at 3 dB. The 4 dB margin is required as a matter of good planning and to maintain good relations with neighbors. It also brings the assessment in line with World Bank guidelines. Once in operation, an appropriate limit in EMP noise monitoring of the actual levels would be an excess of 5 dB, which is still 2 dB below the legal limit.

Prohibition of a noise nuisance

Noise regulations also prohibit the creation of a noise nuisance, defined as any sound which disturbs, or impairs the convenience or piece of any person. The intent of this clause is to make provision for the control of types of noise not satisfactorily covered by measurement and assessment criteria applicable to disturbing noises. These are noises which are either difficult to capture[2], or noises for which the readings registered on sound level meters do not correlate satisfactorily with the annoyance it causes, when assessed against standard criteria. Noise regulations list specific activities which are prohibited if exercised in a manner to cause a noise nuisance, such as[3]:

- The playing of musical instruments and amplified music;
- Allowing an animal to cause a noise nuisance.
- Discharging fireworks;
- Discharge of explosive devices, firearms or similar devices which emit impulsive sound, except with the prior consent in writing of the local authority concerned and subject to conditions as the local authority may deem necessary;
- Load, unload, open, shut or in any other way handle a crate, box, container, building material, rubbish container or any other article, or allow it to be loaded, unloaded, opened, shut or handled, (if this may cause a noise nuisance).
- Drive a vehicle on a public road in such a manner that it may cause a noise nuisance.
- Use any power tool or power equipment used for construction work, drilling or demolition work in or near a residential area, (if this may cause a noise nuisance).

And:

- Except in an emergency, emit a sound, or allow a sound to be emitted, by means of a bell, carillon, siren, hooter, static alarm, whistle, loudspeaker or similar device (if it may cause a noise nuisance).

One or more of these activities may occur on industrial sites and in project activities. Common causes of noise nuisance are reverse hooters, the last item listed above.

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2 *For example, barking dogs. Not only is the occurrence of the noise unpredictable and erratic, but the presence of a person investigating the problem with a noise meter is likely to attract attention and trigger incessant barking.*

3 *See Noise Regulations [5] for the full list of prohibited activities.*

The essential difference between a disturbing noise and a noise nuisance is as follows:

Noise disturbance – Is quantifiable and its assessment is based on estimated or measured sound levels, expressed in decibel (dBA). Investigation and assessment of existing noise disturbance problems involve the measurement of ambient levels in the presence of a specific source under investigation and comparison of this level with either the level measured in the absence of the source, or a table value deemed to be an acceptable level for the type of district under consideration.

Noise nuisance – Is difficult to quantify and is not confirmed or assessed by measurement. Judging whether a noise qualifies as a nuisance is based purely on its character and audibility, in conjunction with subjective considerations such as the perceived intent of the noise maker and connotations attributable to the source of noise. Where measurement is possible, measured data may serve as supplementary information.

SANS 10103

As mentioned before, noise regulations require that the measurement and assessment of noise comply with the guidelines of in SANS 10103. The concept of noise nuisance, however, only features in the regulations. SANS 10103 only deals with quantifiable noise (noise disturbance), without any guidelines for, or reference to noise nuisance whatsoever.

It is normally expected of an EIA noise study to make findings based on noise modelling and quantitative assessment of predicted noise levels, i.e. based on noise disturbance considerations. The same applies to noise monitoring conducted in terms of an EMP, where the report is expected to make findings based on measured data, assessed in terms of noise disturbance criteria as well. But once an industrial site or mine starts operating, predictable as well as unexpected sources of noise nuisance may emerge. If present, they often constitute a major cause of complaints. It is therefore imperative that, in addition to quantitative predictions and measurements, noise studies as well as monitoring surveys also identify potential and actual sources of noise nuisance.

2.4.2 SANS 10103 - Acceptable ambient levels

Noise regulations require that the rating level of the ambient noise be compared with the rating level of the residual noise (where this can be measured), or alternatively (where the noise source cannot be switched off or interrupted), with the appropriate rating level given in Table 2 of SANS 10103. Neither the noise regulations, nor SANS 10103 defines or refers to the term noise impact. It is however generally understood and defined for purposes of this study, as the amount in dB by which the total noise level exceeds the nominal or the measured ambient level rating, whichever is applicable, for the area under consideration.

Table 2.3 in this report summarises SANS 10103 criteria for acceptable ambient levels in various districts. Note that ratings increase in steps of 5 dB from one to the next higher category and that, in general, regardless of the type of district, ambient noise levels tend to decline by typically 10 dB from daytime to night-time. It follows that, for the same level of intrusive noise, the noise impact would typically increase by 10 dB from daytime to night-time.

Table 2.3

Typical outdoor ambient noise levels in various districts (SANS 10103)

Type of district	Noise level Equivalent continuous level L_{Aeq} (dBA)		
	Day-Night L_{dn}	**Day-time** L_d	**Night-time** L_n
(a) Rural	45	45	35
(b) Suburban – With little road traffic	50	50	40
(c) Urban	55	55	45
(d) Urban - With some workshops, business premises & main roads	60	60	50
(e) Central business districts	65	65	55
(f) Industrial districts	70	70	60

The periods in Table 2.3 into which a 24 hour cycle is divided, are defined as follows:

Day-time (06:00 – 22:00)
Night-time (22:00 – 06:00)
Day-Night (24-hour day-night period)

The day-night level L_{dn} represents a 24-hour average of the ambient noise level, with a weighting of +10 dB applied to night-time levels, yielding numerically equal values for daytime and day-night levels.

SANS 10103 also gives guidelines in relation to expected community response to different levels of noise impact (increase in noise level), as summarized in Table 2.4.

Table 2.4

Expected community response to an increase in ambient noise level (SANS 10103)

Increase in ambient level [dB]	Expected community reaction
0 – 10	Sporadic complaints
5 – 15	Widespread complaints
10 – 20	Threats of community action
More than 15	Vigorous community action

2.4.3 Practical considerations

By defining the actual predevelopment ambient sound level as the reference, noise regulations applicable in Mpumalanga effectively apply what is known as *noise emergence criteria*. An alternative approach (as employed in the Gauteng Noise Regulations), is to use nominal table values recommended in SANS 10103. This is known as *acceptable level criteria.* Both methods have advantages and disadvantages.

Caution should be exercised in applying noise criteria, bearing in mind that no single principle or criterion will perfectly fit and be adequate or fair in all applications. The sensibility and fairness of any given criterion depend on the nature and origin of the existing ambient noise. In situations where existing ambient levels are on the high side, it is of crucial importance in the assessment of noise impact of a new development, to establish whether the existing ambient sound is primarily a result of interior or domestic activity (self-noise), or whether it is primarily caused by external sources of noise (intrusive noise).

Where the predevelopment ambient sound is dominated by noise emanating from external sources, such as industrial plants, mining activity and road traffic on external main roads, special precaution needs to be exercised not to aggravate conditions. If the existing ambient level is already higher than what is regarded as typical or recommended, specific noise from a proposed new development should not be allowed to exceed the nominal value regarded as acceptable for the type of district under consideration. It would be more fitting in such instances, to apply acceptable level criteria; e.g. setting the daytime limit for specific noise from the development at the lower nominal limit.

Noise criteria should never be applied without due consideration of the practical consequences. Finally, whatever guidelines are followed, it should always be investigated if there is a specific period (daytime or night-time) during a 24-hour cycle during which the noise impact will be at its worst. For constant 24-hour operations, this would normally occur at night-time.

3 Results and findings

3.1 Baseline study

3.1.1 Current state of the environment - Background ambient noise levels

General

The proposed Phola-Kusile Overland Coal Conveyor project will be located in a district where the character of ambient noise is to some extent determined by industrialisation and economic activity which over time has resulted in an increase in road traffic noise and noise generated by mining and agricultural activities. Road traffic noise emanates from the N4 and N12 highways, the R545 provincial road, as well as from other secondary roads.

In terms of SANS 10103 guidelines (See Table 2.3) the area falls in the category between Rural and Urban, described as "Suburban – With little road traffic". As such, one would expect typical ambient levels in the area to be in the order of 50 dBA (daytime) and 40 dBA (night-time), respectively. The results of the baseline survey should serve to verify the current status and to establish the extent to which ambient levels are currently affected by abovementioned activities.

Ambient levels at M1 (Premises at Rockblend – Nelson family)

Average daytime and night-time ambient levels recorded at this location during the course of this investigation, were 55 dBA (daytime) and 37 dBA (night-time), respectively. The daytime ambient level was determined by:

- Noise from the R545 main road;
- Noise from work activities on this property;
- Trucks and other vehicles arriving at and leaving from the premises.

Audible sources of noise at night were road traffic from local roads, as well as insect and bird calls.

Ambient levels at M2 (Residence Mac Donald)

Average daytime and night-time ambient levels recorded at this location were 52 dBA (daytime) and 40 dBA (night-time), which include noise from Malachite Mine. The primary source of noise during day and night-time, however, was not mining noise as such, but the noise of heavy mining vehicle traffic on the local unpaved road approximately 500 m from the residence. Other audible sources of noise during daytime were found to be farming activities, livestock noise and distant traffic noise on the R545 main road. At night, in addition to aforementioned truck noise, it was mainly road traffic in the distance, livestock noise, as well as insect and bird calls which contributed to audible noise.

Ambient levels at M3 (Residence Engelbrecht)

Average daytime and night-time ambient levels recorded at this location were 50 dBA (daytime) and 37 dBA (night-time). Audible sources of noise during daytime were found to be farming activity, livestock and barely audible levels of road traffic noise in the distance. At night it was mainly livestock, bird and insect calls, and at a much lower level, noise from traffic on distant roads.

Ambient levels at M4 (Residence Cloete)

Average daytime and night-time ambient levels recorded at this location were 52 dBA (daytime) and 43 dBA (night-time). The level of activity and the ambient levels are higher but the types of noise sources contributing to audible ambient noise were found to be the same as those recorded at M3.

Ambient levels at M5 (Residence Truter)

Average daytime and night-time ambient levels recorded at this location were 54 dBA (daytime) and 48 dBA (night-time). Daytime levels were determined by traffic on the R545 passing at a distance of approximately 250 m and by work activities and vehicle movement on the premises. Night-time levels are determined predominantly by traffic on the R545.

Ambient levels at M6 (Residence Van den Heever)

Average daytime and night-time ambient levels recorded at this location were 49 dBA (daytime) and 45 dBA (night-time). The types of noise sources contributing to audible ambient noise are similar to those recorded at M3. Night-time levels were elevated by dogs barking. In the absence of barking, the level dropped to 41 dBA.

Ambient levels at M7 (Area south of N12 highway)

Based on probing and short duration averaging, typical daytime and night-time ambient levels in this area are 54 dBA (daytime) and 46 dBA (night-time), respectively. Levels are elevated by traffic noise on the N12.

Summary

The results of the survey are summarised on the map in Figure 3.1. Daytime and night-time periods are as defined in SANS 10103 (See Section 2.4.2). Detailed results of the recordings made in 10-minute intervals at all monitoring locations are presented in Appendix A.

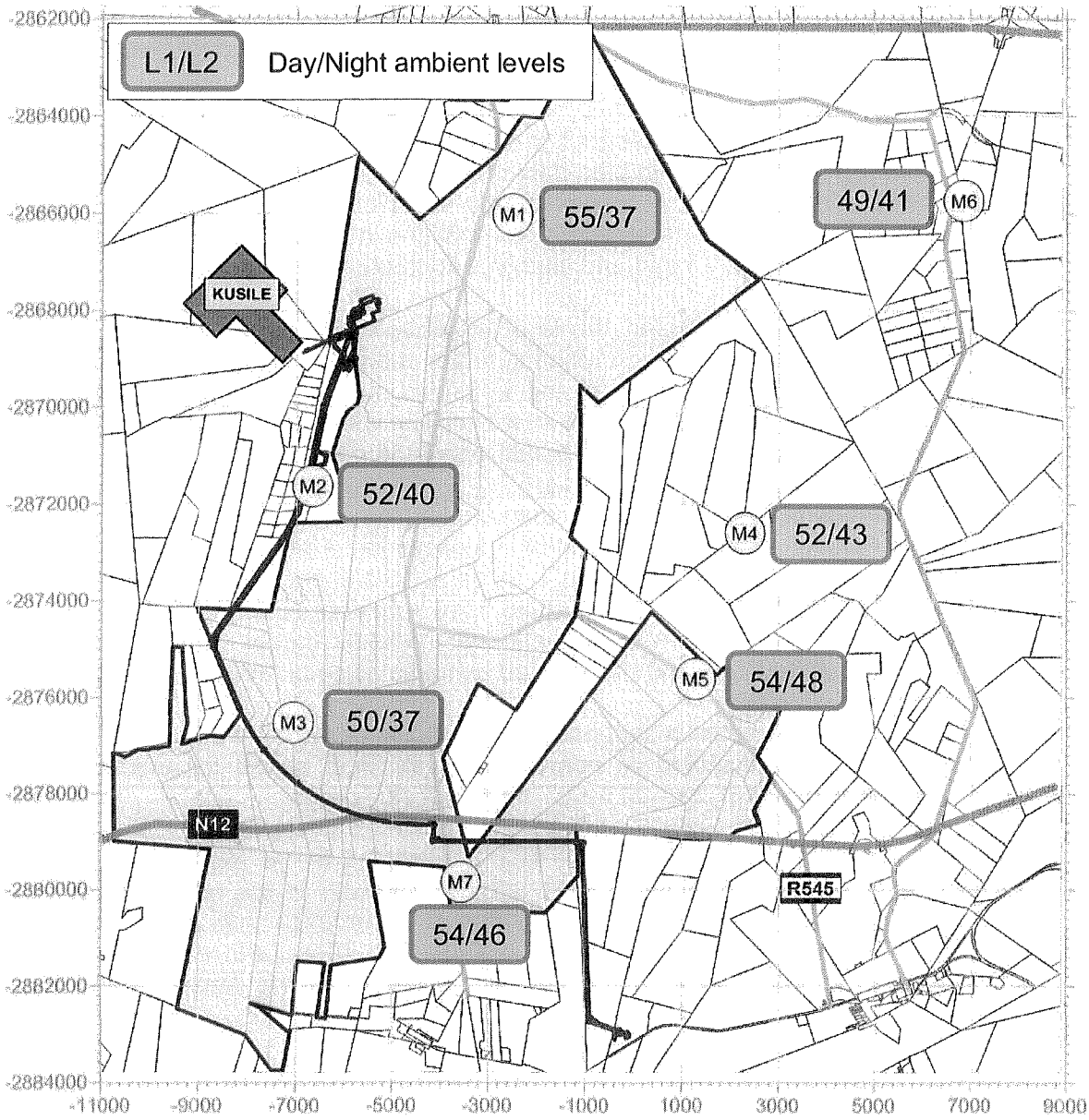


Figure 3.1

Results of baseline survey

Average daytime (06:00 to 22:00) and night-time (22:00 to 06:00) ambient levels

Monitoring location		Coordinate	Monitoring location		Coordinate
M1	Premises Rockblend	S25 54 18.4 E28 58 27.2	M4	Residence Cloete	S25 57 44.3 E29 01 24.7
M2	Residence Mac Donald	S25 57 09.9 E28 55 57.0	M5	Residence Truter	S25 59 23.7 E29 00 43.6
M3	Residence Engelbrecht	S25 59 51.0 E28 55 47.9	M6	Residence V d Heever	S25 54 00.0 E29 04 04.8
M7	Area south of the N12				

3.1.2 Baseline ratings

In assigning baseline ambient noise ratings for the project area, the following should be borne in mind:

(a) Ambient noise levels measured in any particular survey do not represent definitive (absolute) values, but samples only of what in practice is a variable parameter. Even relatively long-duration averages of day and night ambient levels at any location will vary over time. This is in response to variances in noise source emission levels, as well as unpredictable day, night and seasonal fluctuations in atmospheric conditions.

In rural areas in particular, the level measured at any location also depends on the proximity of the recording microphone to the nearest singing birds or insects, something that cannot be controlled at all and which is bound to change from one survey to the next. Experience shows that with insects calling within 10 m distance of the microphone, night-time levels may easily rise to well above 55 dBA.

(b) The results of the survey show that ambient noise climate is homogeneous over the largest part of the project area. With the exception of M5 and M7, night-time levels vary between 37 and 43 dBA, which is in good agreement with the typical level (40 dBA) expected in accordance with SANS 10103 guidelines for this type of district. Two locations where the ambient levels are markedly higher, are M5 situated in close proximity of the R545 and M7 affected by traffic noise on the N12.

(c) For purposes of noise impact assessment, noise contours in noise impact assessments for EIA's are calculated at nominal intervals best suited for evaluation of specific locations of concern, as well as for the global study area.

With these considerations in mind, the ratings assigned to the New Largo project area are determined by rounding the levels obtained in the survey to the nearest 5 dB day or night interval of typical levels for district categories in accordance with SANS 10103 guidelines (See Table 2.3). The result is presented in Table 3.1. These are realistic best estimates of baseline ambient noise ratings for the area used to define limits in the noise impact assessment.

Table 3.1

Phola-Kusile Overland Coal Conveyor Project
Baseline outdoor ambient noise levels derived from field surveys
Rounded to the nearest nominal rating in 5 dB steps in accordance with SANS 10103 system

Area	Baseline ambient noise level L_{Aeq} (dBA)	
	Day-time L_d	Night-time L_n
All areas excluding M5 and M7 (see Figure 3.1)	50	40
Locations within 500 m from the N12	55	45
Locations within 100 m from R545 main road	55	45

3.1.3 Recommended limits

24-hour operation noise - Maximum impact occurs at night

Daytime intrusive noise levels created by distant industrial noise sources such as the proposed Phola-Kusile Overland Coal Conveyor, are as a general rule substantially lower than the levels created by the same sources at night. The reason is that typical daytime meteorological conditions result in skyward refraction of sound propagation, in contrast with downward diffraction caused by typical night-time temperature profiles (vertical gradients). During the day, most of the noise emitted by a large source does not reach the ground, while at night, both direct sound and a portion of the energy radiated skywards are focussed back to earth. This contrast between day and night levels is further accentuated by a considerable drop at night in the residual ambient level due to a decline in road traffic and human activity noise. As a consequence, not only are the levels of intrusive noise from distance sources much higher at night, but the sensitivity of the environment increases sharply, as well.

It follows that for continuous noise from a 24-hour operation, such as opencast mining, conveyors, processing plant operation and truck movements, maximum impact will occur at night and that for all practical purposes, provided the night-time impact is contained to acceptable levels, the daytime impact would not be of any consequence or concern at all.

Significant impact criterion

With reference to the principles explained in Section 2.4, a significant impact on properties bordering the Phola-Kusile Overland Coal Conveyor Project area is deemed to occur if the specific level of an intrusive noise exceeds the existing ambient rating in Table 3.1 (deemed to be the acceptable level) by 5 dB or more. For the main study area this implies that up to 40 dBA is still considered an acceptable level for specific noise generated by the Project, while 45 dBA is deemed to be a disturbing noise resulting in a significant impact. For zones within 100 m from the R545 main road and within 500 m from the N12 highway, the corresponding night-time limits are 45 dBA (acceptable) and 50 dBA (significant impact), respectively.

3.2 Noise impact – Construction phase

Construction along the coal conveyor corridor even if it takes place during night-time, will involve relatively low intensity activities and singular vehicle movements with negligible or no noise consequences.

3.3 Noise impact – Operational phase

3.3.1 Worst-case assumptions

Depending on the time of day or night and on meteorological conditions in particular, noise levels produced by industrial sources over long distances vary by a considerable margin. Noise contours were derived from calculations intended to investigate probable worst-case conditions (Night-time levels and Concawe model Meteorological Category 6). On average, typical levels are expected to be lower. "Probable worst-case" in the context of this study refers to levels that are higher than typical levels. Although less probable than typical levels, they are expected to occur from time to time during the course of the year, sometimes possibly for several days on end. Occurrence of worst-case conditions is not simplistically related to weather conditions and not limited to any particular season of the year.

Confidence in the predictions is high. Conveyor modeling and noise calculations are based on appropriately scaled data obtained in numerous conveyor studies and measurements conducted by the author to investigate the dependence of conveyor noise on design features such as conveyor type, speed, canopy design, structural stiffness and roller type. It should nevertheless be cautioned that predicted noise levels and contours are not to be taken as absolute. Noise maps must be interpreted with caution. Although the confidence level in the acoustic model is high, predicted levels are valid for the assumptions made in respect of meteorological and other conditions. Since meteorological conditions in particular are highly variable, levels produced at a distance by a source at a constant acoustic output will vary considerably, even during the course of a single day-time or night-time period. Variance in noise level due to changes in atmospheric conditions increases with distance from the source. It should also be borne in mind that noise propagation is not only affected by distance and wind, but by temperature gradients in the atmosphere as well. The contours represent best estimates of continuous project activity noise levels averaged over a relatively long duration, in this case the nominal night-time period of 8 hours.

The noise impact at any location depends on wind direction. Annual average and day/night-time wind roses (Kendal 2 weather station) in Figure 3.2 show that the most prevalent night-time wind direction in the Phola-Kusile Overland Coal Conveyor study area is blowing from the east. Less frequently, it also blows from directions falling within the east-north-west sector.

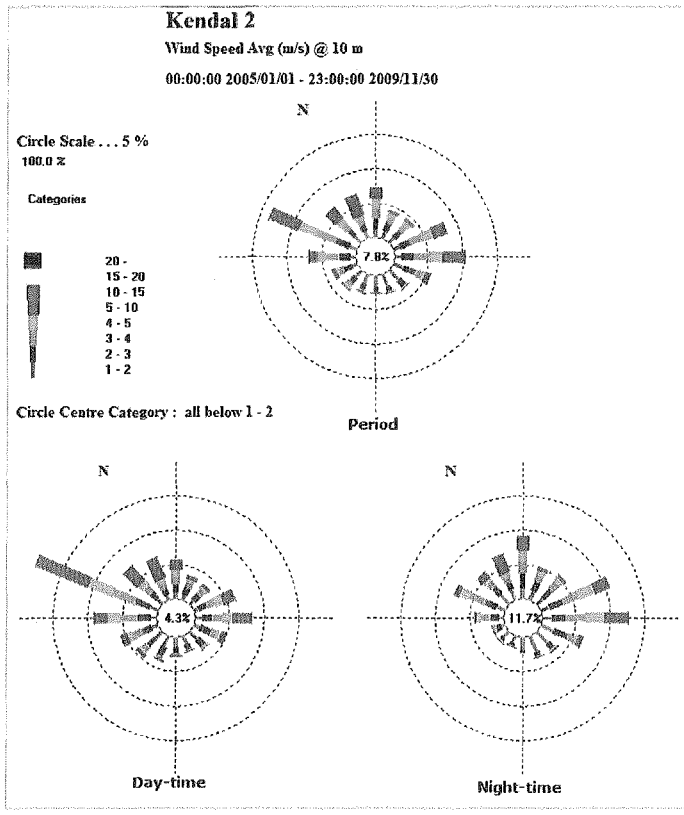


Figure 3.2

Annual average and day/night time wind roses (Kendal 2 weather station)

Rather than taking only the prevailing wind direction into account, it is assumed in the calculation of noise contours presenting the findings of this noise study, that Meteorological Category 6 atmospheric propagation conditions prevail at night. Although this worst-case condition may occur when the recipient is situated down-wind relative to the source of noise, it

is not uniquely related to wind direction, or to one specific state of weather conditions. It also transpires in the absence of wind, when (typically at night) a positive temperature gradient develops in the lower atmosphere. This is a common occurrence on cloudless nights following sunny days, when strong radiation and cooling of the earth results in an increase in temperature with height.

Although both down-wind and a positive temperature profile will result in an increase in noise levels, the effects of the two phenomena differ in one important respect: Downwind conditions causes the noise level to increase in one direction only, while the effect of temperature gradient is omni-directional, i.e. the noise level is increased in all directions.

3.3.2 Presentation of results

The operational noise footprint of the Phola-Kusile Overland Coal Conveyor system is presented with the aid of noise contour maps. In an area where the background ambient noise level is more or less homogeneous, the effect of a new development can be effectively demonstrated with a noise map showing a contour of the total noise calculated at a level corresponding to a significant impact. This only works when the background ambient level can be assumed to be relatively homogeneous, so that a significant impact occurs at the same level. In the Phola-Kusile Conveyor system study area this is not the case. Although the ambient level is more or less the same over the largest part of the study area, there is a marked increase in the proximity of the N12 highway. This complicates the reading of a noise map showing a contour of the total level, because the level of significant impact rises steadily towards the highway.

For this reason, instead of the total level, noise maps in this report show the increase in the (dBA) level of ambient noise as a result of additional noise expected to be generated by the proposed conveyor. These noise contours represent the actual impact (increase in ambient level) and were calculated taking into account the rise in background ambient level in a zone parallel with the N12 highway, the degree depending on the distance from the highway. This greatly simplifies reading of the maps.

The 5 dB contour shown on the noise maps defines the significant noise impact footprint of the conveyor, including the transfer stations. Outside the zone demarcated by the 5 dB contour, the noise impact is deemed insignificant and the noise level gradually declines with distance and converges to the background ambient level.

To elucidate the significance of the 5 dB contour, it is noted first of all that if the specific level of conveyor noise at an observation point rises to the point where it equals the background level, the ambient level will rise by 3 dB above its initial level. This represents a noise impact of 3 dB, which is still acceptable in terms of noise regulations and SANS 10103 criteria. A significant impact is deemed to occur (See SANS 10103 criteria in Table 2.4) if the ambient level is exceeded by 5 dB or more.

3.3.3 Findings - Unmitigated operational noise

Conveyor noise footprints calculated for various conveyor routes are shown on Noise Maps 3.1 to 3.3. Please bear in mind that the assessment focuses on typical worst-case night-time conditions. In all cases, noise was calculated for a conveyor equipped with standard steel rollers and with conventional dog-house canopy. Because of the length and shape of the conveyor routes, the noise footprint is very long and rather convoluted. The impact on any specific property or recipient of interest, as well as the relative merits of the various routes must be assessed by inspection of the noise maps.

What the maps do show is the following:

- Over most of the study area (more than 500 m away from and outside the noise influence sphere of the N12 highway), the conveyor is expected to have a significant noise impact footprint (5 dB increase in the ambient level) extending to a distance of approximately 1 250 m from the conveyor. Inside the 5 dB zone, conveyor noise will be clearly audible at night and disturbing.

- In the vicinity of the N12, higher background ambient levels resulting from traffic noise on the highway will serve to effectively mask conveyor noise, resulting in a reduced elevation in conveyor noise impact. The closer the conveyor to the highway, the less audible its noise will become and the smaller the impact.

- Transfer station noise, although loud at source, is not showing in the overall result (please refer to Section 2.3.5 B for an explanation). Mitigation, where required, should in the first place focus on the conveyor as the primary source of noise.

It should be borne in mind that the noise levels and the impacts calculated for noise from continuous operations such as the conveyor under consideration are long-duration (e.g. 8-hour night-time) averages. Although it may cause a noise disturbance, transient noises of brief duration will not necessarily affect the long-term calculated or measured average level. One such a source of noise is the start-up alarm on conveyors which produce a high level pure-tone noise. The actual level at a distance is lower than that of a conveyor running at full speed, but can be particularly audible and annoying because it starts at a time when the conveyor is standing still and continuous to operate for a period while the conveyor starts up and picks up speed. Although the distance at which it causes a disturbance is less than the noise footprint of a conveyor with standard steel rollers running at full speed, it does become a problem when conveyor noise is mitigated by installation of low-noise rollers. For possible solutions to mitigate this problem, please refer to Section 4.2.

3.4 Noise impact – Decommissioning phase

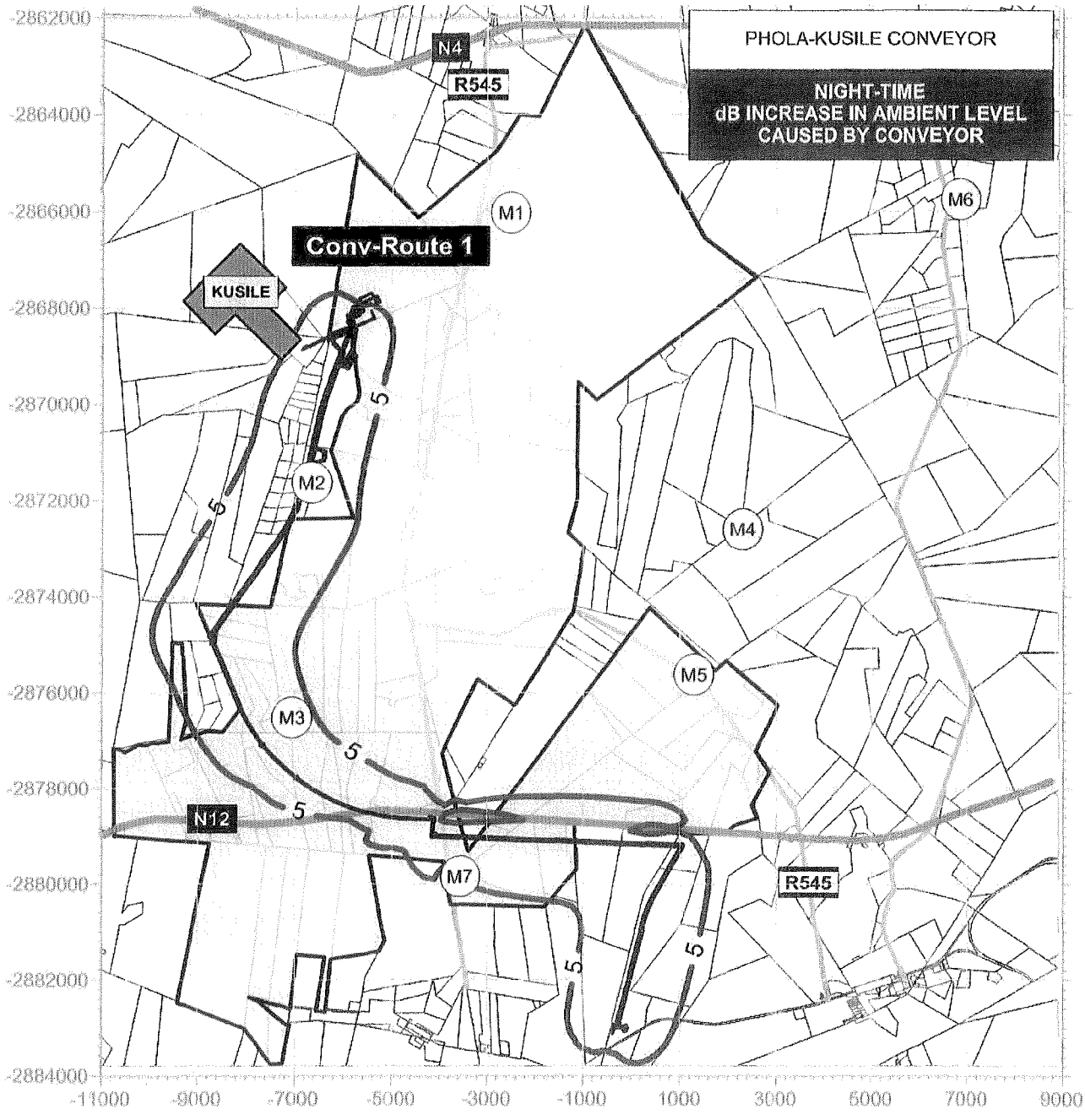
Noise in the decommissioning phase will be of a similar nature, but at a lower intensity and of shorter duration compared to noise in the construction phase. Decommissioning noise will be inaudible in noise-sensitive areas and the noise impact will be negligible.

3.5 Noise impact – Closure phase

No residual noise impacts will remain after decommissioning of the conveyor.

Noise Maps

Unmitigated Project Noise



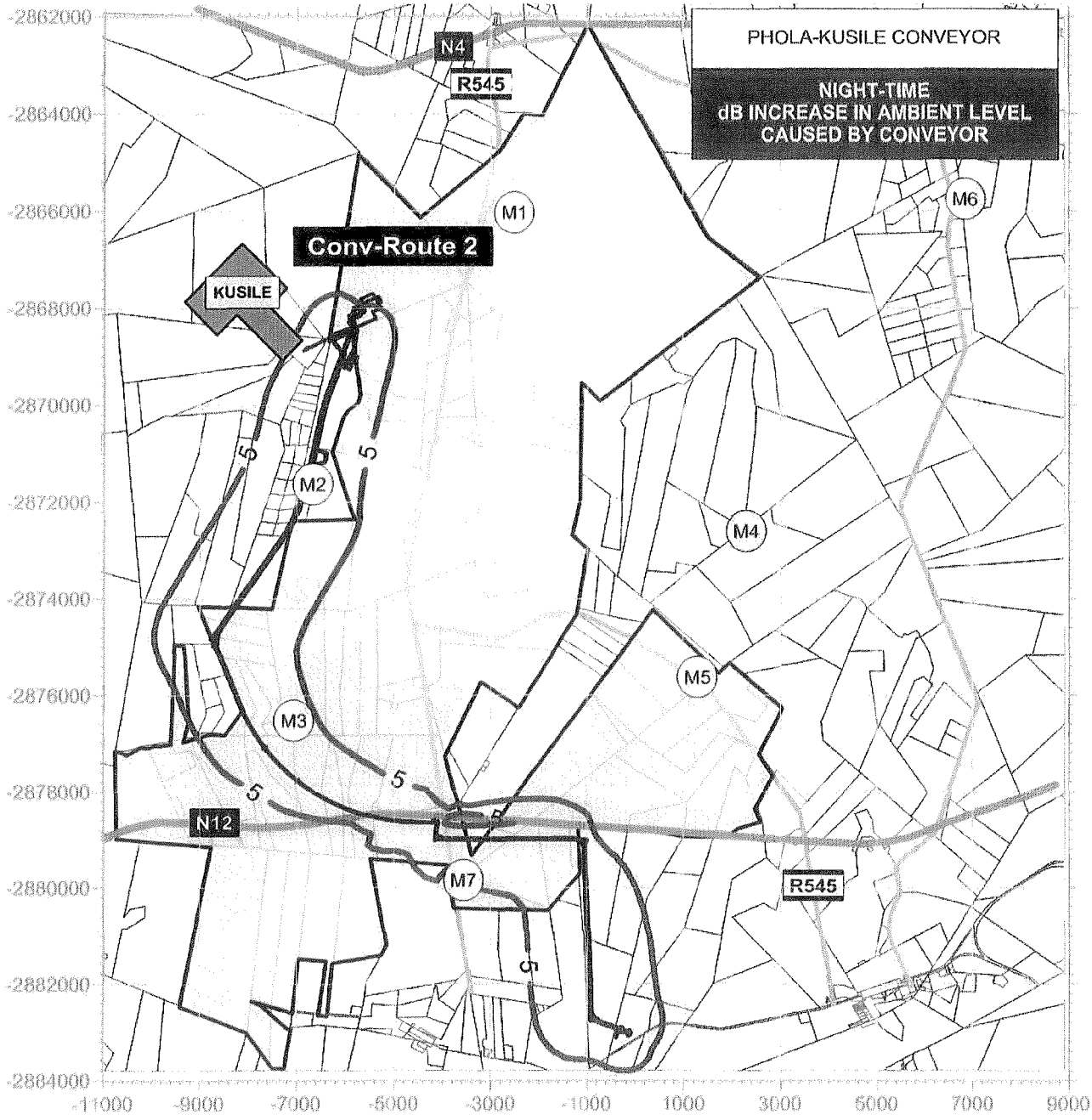
Noise Map 3.1

Unmitigated Phola-Kusile Coal Conveyor Noise
Conveyor Route 1

Unmitigated
Conveyor with standard steel rollers and bearings with conventional canopy

Night-time outdoor noise footprint
Increase in dBA ambient level as a result of conveyor system noise

Significant impact occurs inside the 5 dB elevation contour



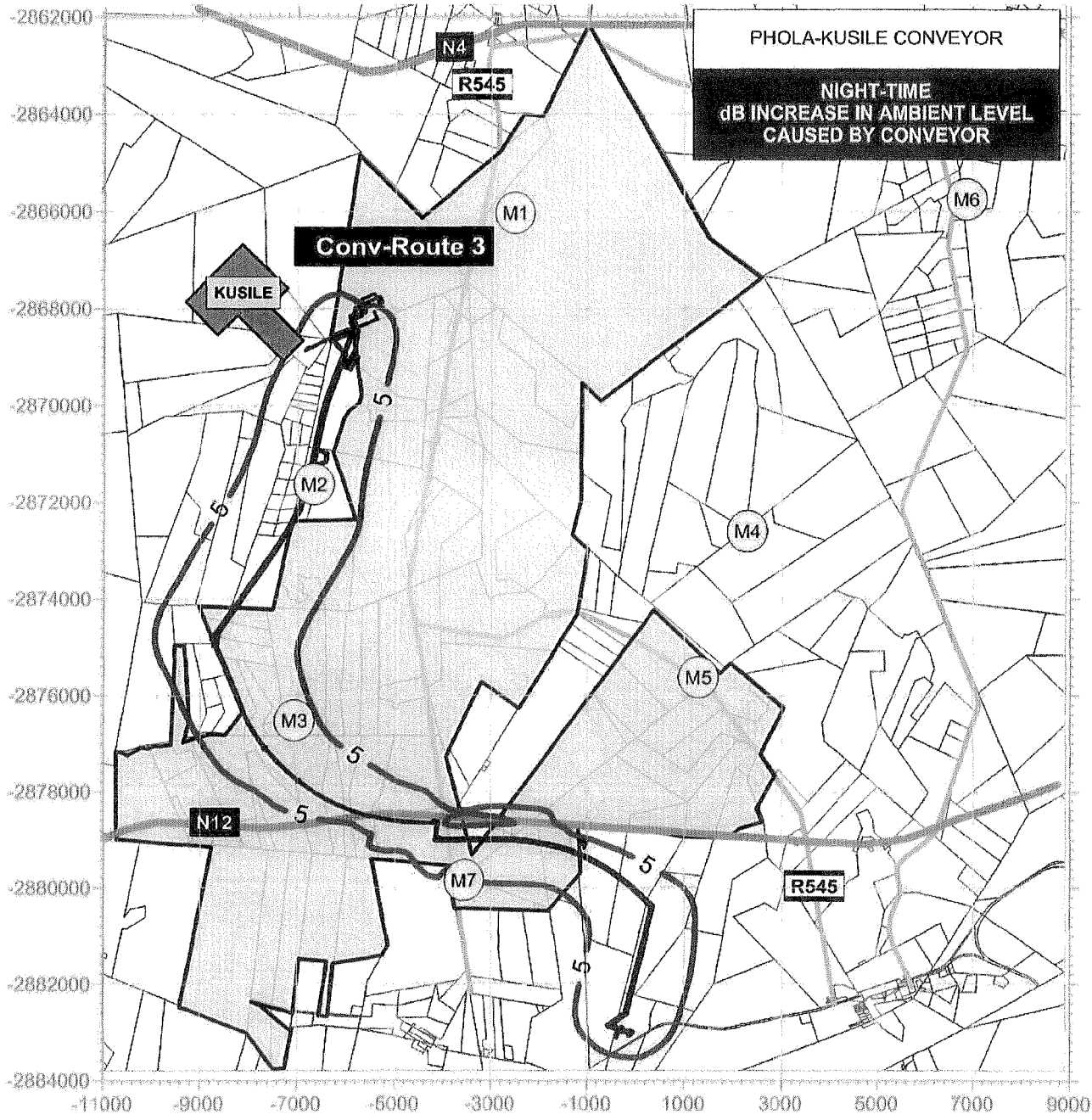
Noise Map 3.2

Unmitigated Phola-Kusile Coal Conveyor Noise
Conveyor Route 2

Unmitigated
Conveyor with standard steel rollers and bearings with conventional canopy

Night-time outdoor noise footprint
Increase in dBA ambient level as a result of conveyor system noise

Significant impact occurs inside the 5 dB elevation contour



Noise Map 3.3

Unmitigated Phola-Kusile Coal Conveyor Noise
Conveyor Route 3

Unmitigated
Conveyor with standard steel rollers and bearings with conventional canopy

Night-time outdoor noise footprint
Increase in dBA ambient level as a result of conveyor system noise

Significant impact occurs inside the 5 dB elevation contour

4 Mitigation

4.1 Mitigation - Construction noise

Construction noise will be of low intensity and will be largely restricted to daytime hours. No mitigation is required.

4.2 Mitigation - Operational noise

When considering mitigation of conveyor noise impact it must be cautioned that attempts to reduce conveyor noise by structural changes and canopy modifications are bound to fail and result in fruitless expenses. Conveyor noise is for all practical purposes generated by the rollers and by belt-roller impact. Moreover, a conventional canopy, contrary to what might be expected, provides very little screening on the "closed" side.

The significant impact footprint calculated for the Phola-Kusile conveyor in the noise maps assumes standard steel rollers and the predicted noise levels are derived from actual levels measured in numerous studies and noise problem investigations involving conveyors, as well as comparative measurements conducted on conveyors equipped with different types of rollers and canopies. If AAIC is of the opinion that the roller technology or conveyor design to be employed in the Phola-Kusile project should render lower noise levels, the specialist would be happy to perform measurements on existing AAIC conveyors of such design.

Two measures which can be employed to achieve a significant reduction in conveyor noise are the use of low-noise rollers and the erection of a noise screen. Because of the high costs involved, a noise screen would only be considered as a last resort. It should be cautioned that the design of a noise screening system for a conveyor is a specialist task. Although the canopy may form part of a noise screening system, minor modifications to the design of a conventional canopy or simply lining it acoustically will have no effect at all. Should the option of noise screening be considered as an alternative to or in conjunction with the use of low-noise rollers, an acoustical engineer should be involved in the design.

The decision whether and where along the conveyor route noise mitigation is required, will depend on agreements already made and negotiations between AAIC and property owners, considerations outside the scope of this study. Where residents will remain inside the significant impact zone (approximately 1 250 m from the conveyor in some areas) mitigation will be required. To this end, it is recommended that the following guidelines be followed:

- Use low-noise HDPE[4] instead of standard steel idlers on conveyors, which gives a substantial reduction in conveyor noise. Reductions of 15 to 20 dB have been achieved in controlled tests and on existing lines where noise problems had been experienced.

- In supplier specification, stipulate:

  "The sound pressure level measured at 3 m distance from the conveyor (running at the specified speed) with or without load shall not to exceed 69 dBA at 3 m distance from the edge of the conveyor belt."

- If mitigation is only required in respect of singular receptors, the length of line equipped with low-noise rollers must extend at least 750 – 1 250 m in each direction (depending on the distance between the conveyor and the noise-sensitive receptor), measured from the intersection of the normal projected from the receptor onto the conveyor route.

[4] *High Density Polyethylene*

Noise Maps 4.1 to 4.3 show noise contours for a conveyor equipped with low-noise rollers, with a conventional canopy. Comparing the results with those in Noise Maps 3.1 to 3.3, it is seen that the significant noise impact footprint has now been contracted from roughly 1 250 to 250 m. Where the conveyor route is located near the N12 highway, the footprint is reduced to less than 100 m, which cannot be resolved on the scale of the noise maps.

Should the reduced noise footprint still include noise-sensitive receptors, the construction of a noise screen or barrier may have to be considered. The design of such a screen is a specialised task for which the services of an acoustical engineer should be employed. As a preliminary guide, please bear in mind the following broad requirements:

- The noise screen must be loose-standing. If the canopy is to form part of the screening system, it would have to be detached from the conveyor and constructed and clad in a special way; i.e. it cannot be a conventional canopy construction.

- If a separate loose-standing screen is constructed in addition to a conventional canopy, the screen will have to be higher than the top of the canopy (height depending on topography) and must be acoustically treated on the side facing the conveyor.

- Because of its line source characteristics (slow fall-off in noise level with distance), it would be futile to screen off only a short length of conveyor line. Bear in mind that the distance to any point on the line from a distant observer does not change much with the position of that point along the line. Consequently the observer receives more or less the same level of noise per unit length from a very long length of line. As heard by a distant observer (500 – 1 000 m from the line) the exposed sections of line on either side of a short screened section would remain almost as loud as the centre section before it was screened off. The length that needs to be treated depends on the distance to the noise-sensitive receptor. For the Phola-Kusile conveyor under consideration, with a significant impact range of about 1 250 m, calculations show that the line must be screened off for a distance of up to 1 200 m in each direction from the centre point on the line as viewed from the noise-sensitive receptor to be protected.

Potential annoyance caused by start-up alarm noise in the external environment may be mitigated in two possible ways:

- A noise screening canopy or barrier, if employed for reduction of conveyor noise, would at the same time serve to reduce start-up alarm noise. In both cases, the reduction would of course only occur in the direction of propagation which is screened off.

- It should be investigated by AAIC if it is viable (taking safety requirements into account) to replace conventional pure-tone alarms with buzzer types, as is successfully implemented on earth-moving equipment to reduce the audibility of reverse alarm noise at large distances.

4.3 Mitigation – Decommissioning phase

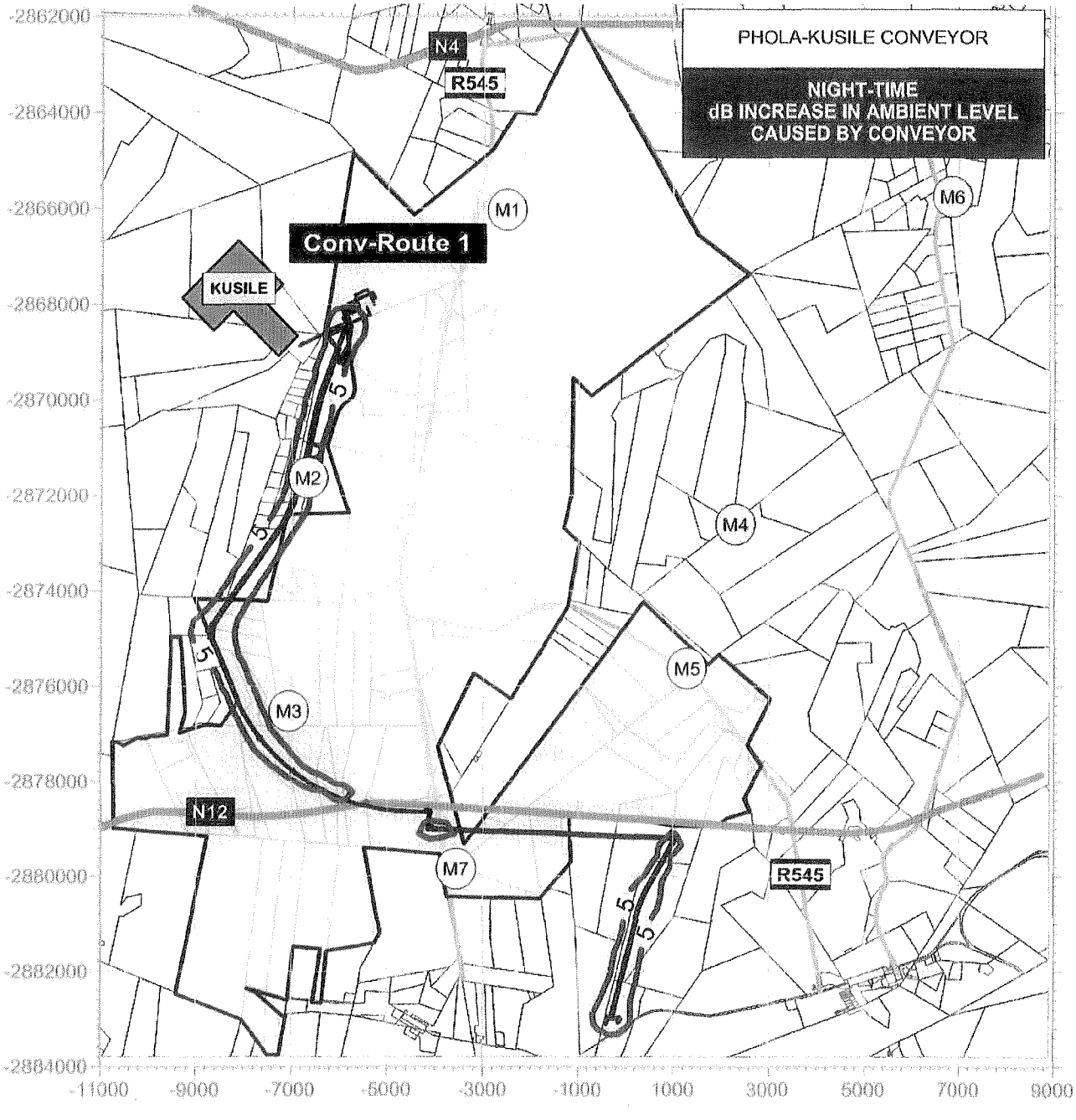
No mitigation will be required during decommissioning.

4.4 Mitigation – Closure phase

No mitigation will be required after decommissioning.

Noise Maps

Mitigated Project Noise



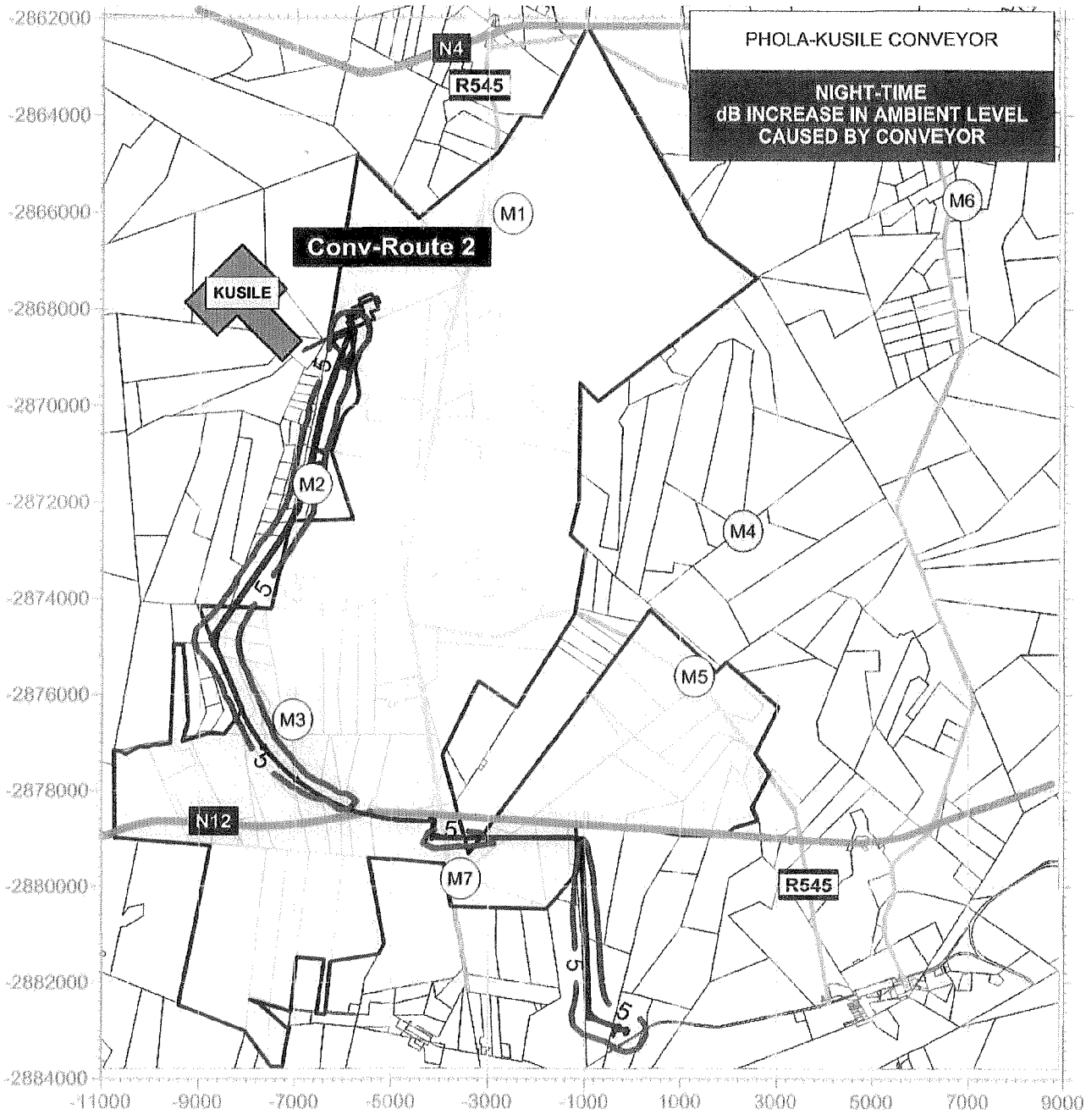
Noise Map 4.1

Mitigated Phola-Kusile Coal Conveyor Noise
Conveyor Route 1

Mitigated
Conveyor with low-noise HDPE rollers and conventional canopy

Night-time outdoor noise footprint
Increase in dBA ambient level as a result of conveyor system noise

Significant impact occurs inside the 5 dB elevation contour



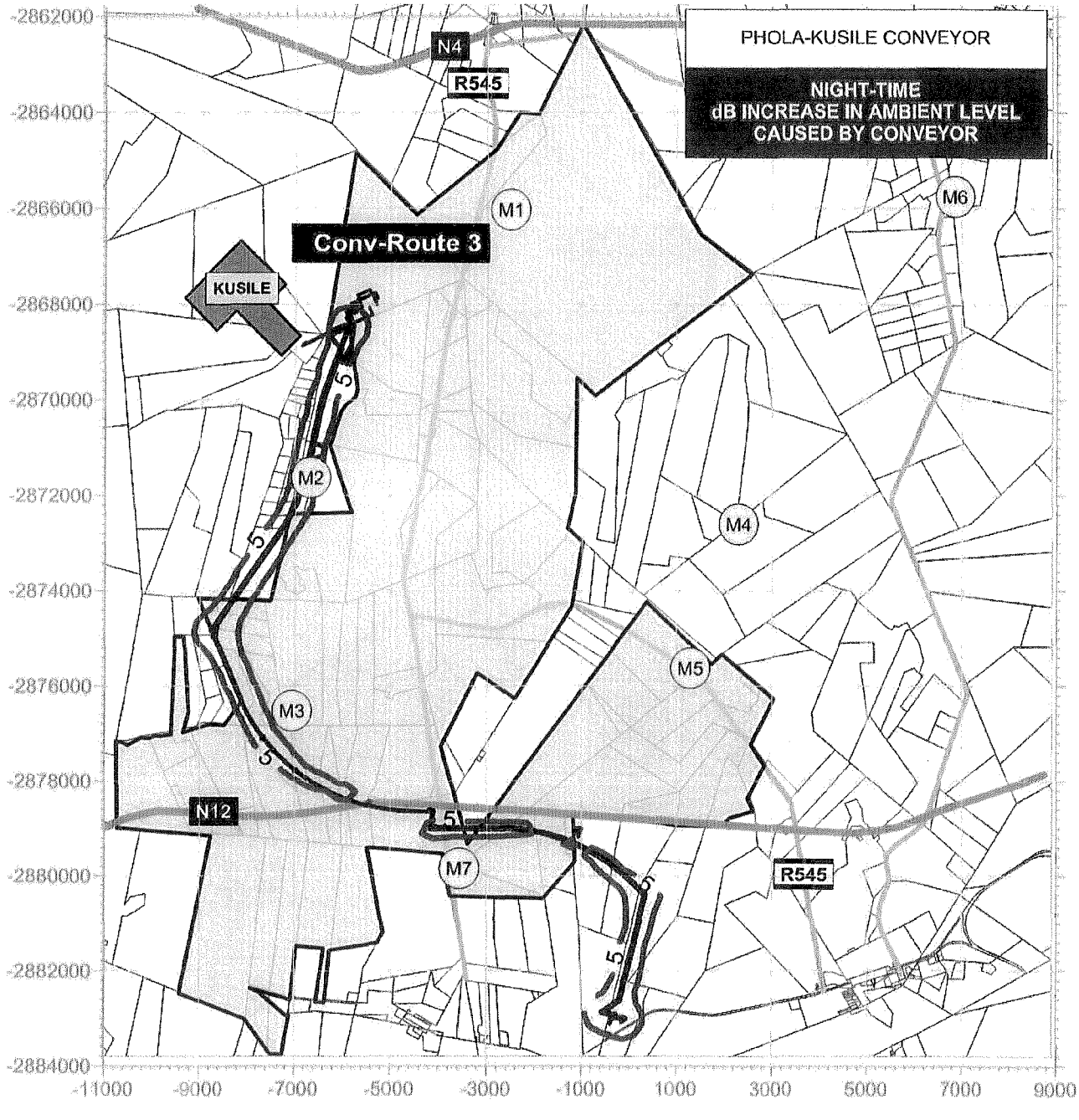
Noise Map 4.2

Mitigated Phola-Kusile Coal Conveyor Noise
Conveyor Route 2

Mitigated
Conveyor with low-noise HDPE rollers and conventional canopy

Night-time outdoor noise footprint
Increase in dBA ambient level as a result of conveyor system noise

Significant impact occurs inside the 5 dB elevation contour



Noise Map 4.3

Mitigated Phola-Kusile Coal Conveyor Noise
Conveyor Route 3

Mitigated
Conveyor with low-noise HDPE rollers and conventional canopy

Night-time outdoor noise footprint
Increase in dBA ambient level as a result of conveyor system noise

Significant impact occurs inside the 5 dB elevation contour

5 Summary of noise impact implications

To the best of the information available and the accuracy of noise prediction methods, the noise impact implications of the Phola-Kusile Conveyor Project are as summarised in Table 5.1.

Validity of impact ratings and the findings of the study may be summarised as follows:

Adequacy of predictive methods and tools used	Adequacy of underlying assumptions	Uncertainties in information provided
Noise predictions are based on internationally accepted and proven Concave method Confidence in the predictions, to the extent that the current design information is valid, is high	Sufficient information was available for acoustic modelling of conveyor noise	Information provided was sufficient to estimate with good accuracy the extent of the noise footprint. The effect of uncertainties is relatively small and does not compromise the validity of the significance ratings of impacts or the main findings of the study

Table 5.1

Noise impact implications of the Phola-Kusile Conveyor Project

Receptor	Activity	Before Mitigation						After Mitigation					
		Severity	Duration	Spatial Scale	Consequence	Probability	Significance	Severity	Duration	Spatial Scale	Consequence	Probability	Significance
		Construction phase											
Properties bordering the conveyor	Conveyor and service road construct	L	L	L	L	L	L	L	L	L	L	L	L
		Operational Phase											
Properties bordering the conveyor	Conveyor and transfer station noise	M	M	M	M	H	M	L	M	L	L	L	L
		Decommissioning Phase											
Study Area	Dismantling	L	L	L	L	L	L	L	L	L	L	L	L
		Closure Phase											
Study Area	No residual noise	L	L	L	L	L	L	L	L	L	L	L	L

6 Monitoring programme

Construction phase

Noise during the construction phase is not expected to be audible at any of the noise-sensitive locations in the study area. No noise monitoring is required.

Operational phase

(a) A noise survey should be carried out shortly before and immediately after commissioning of the conveyor commences.

(b) Measure noise levels at reference points in the area most likely to be effected, selected on the final route selected, on basis of a scoping assessment carried out prior to commencement of mining and based on the locations where noise-sensitive receptors will remain.

(c) Measure the A-weighted equivalent continuous noise level in a sequence of 10-minute intervals covering a period of preferably 24 hours, but at least the night-time period from 22:00 to 06:00.

(d) Process the data and determine the increase in ambient level caused by the conveyor.

(e) Assess the noise impact and present the findings in a report. If applicable, make recommendations for steps required to mitigate excessive noise.

(f) On account of the findings of the survey, advise on the necessity for additional commissioning surveys and the procedures to follow.

(g) Monitoring locations and procedures for annual surveys must be revised prior to each survey and taking the findings of previous surveys into account.

(h) Equipment, calibration and measurement procedures must comply with the requirements laid down in SANS 10103.

Decommissioning phase

Noise during the commissioning phase is not expected to be audible at any of the noise-sensitive locations in the study area. No noise monitoring is required.

Closure phase

Noise during the closure phase is not expected to be audible at any of the noise-sensitive locations in the study area. No noise monitoring is required.

7 References

[1] Acusolv: Report G915-R1; *New Largo Colliery Project, Environmental Impact Assessment; Baseline Noise Study,* 30-Jun-2011

[2] SANS 10328: *Methods for environmental noise impact assessments.*

[3] SANS 10103: *The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication.*

[4] SANS 10357:2000: *The calculation of sound propagation by the Concawe method.*

[5] Department of environment affairs: *Noise control regulations under the environment conservation act*, (Act No. 73 of 1989), Government Gazette No. 15423, 14 January 1994.

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Acoustical Engineer

Appendix A

Noise survey complete data sets

Figure A.1	Monitoring Point M1	Premises Rockblend (Nelson)	14 to 15 Jun-2011

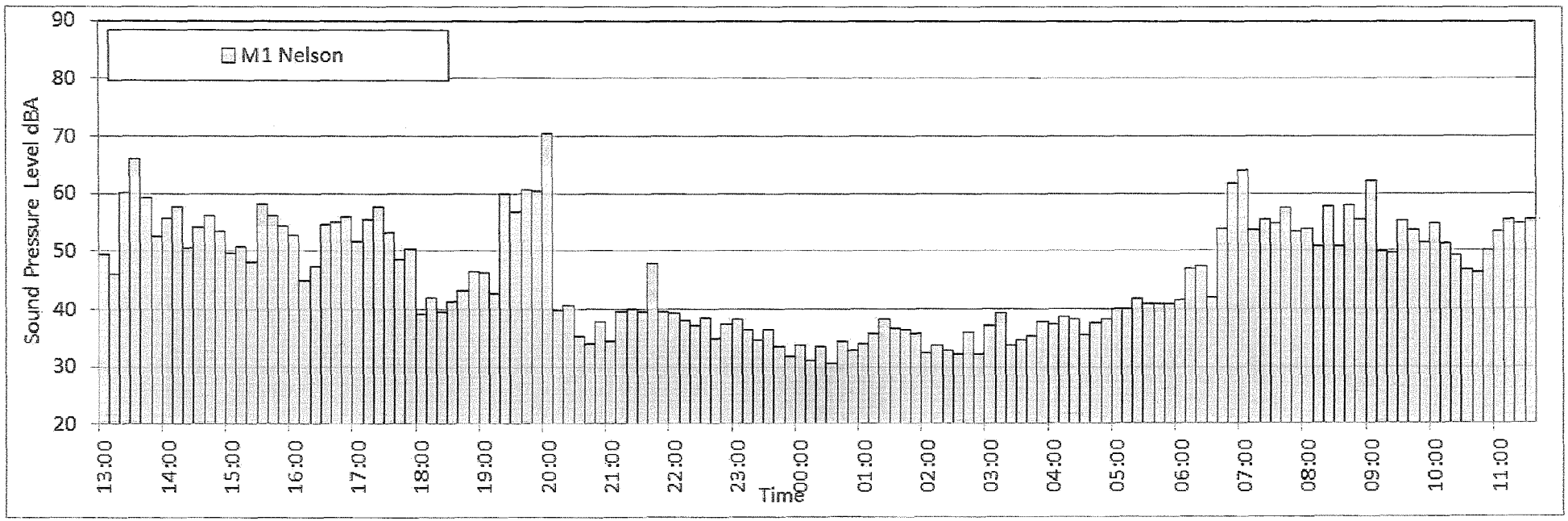


Figure A.2	Monitoring Point M2	Residence Mac Donald	14 to 15 Jun-2011

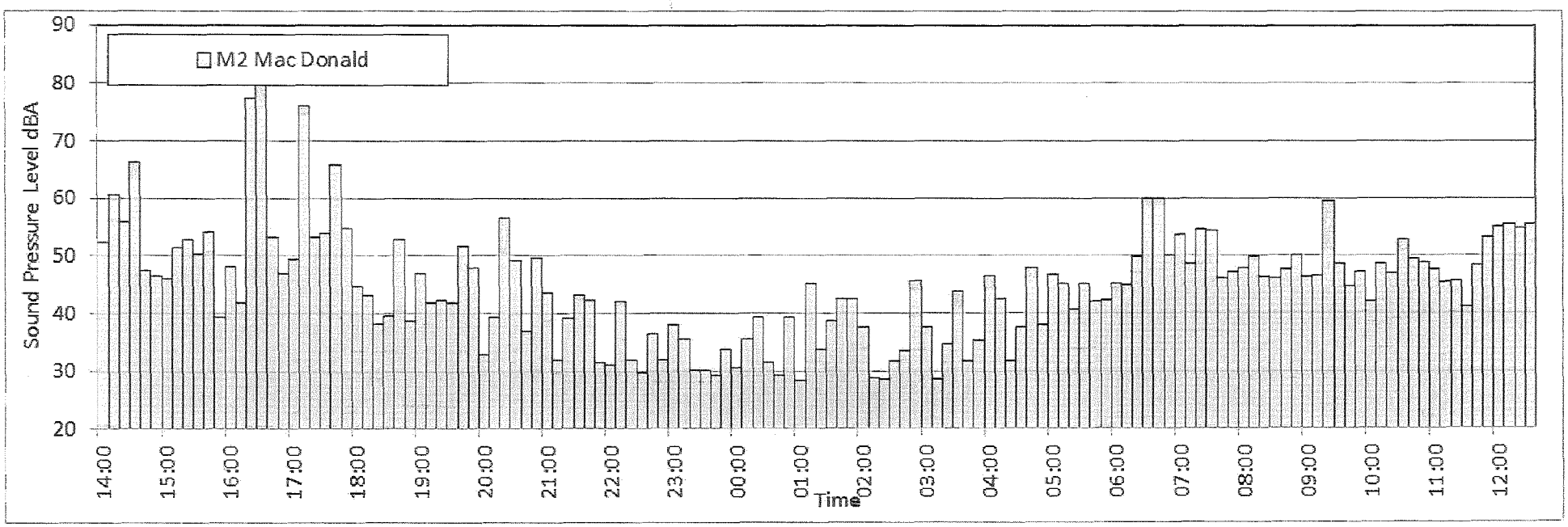


Figure A.3	Monitoring Point M3	Residence Engelbrecht	20 to 21 Jun-2011

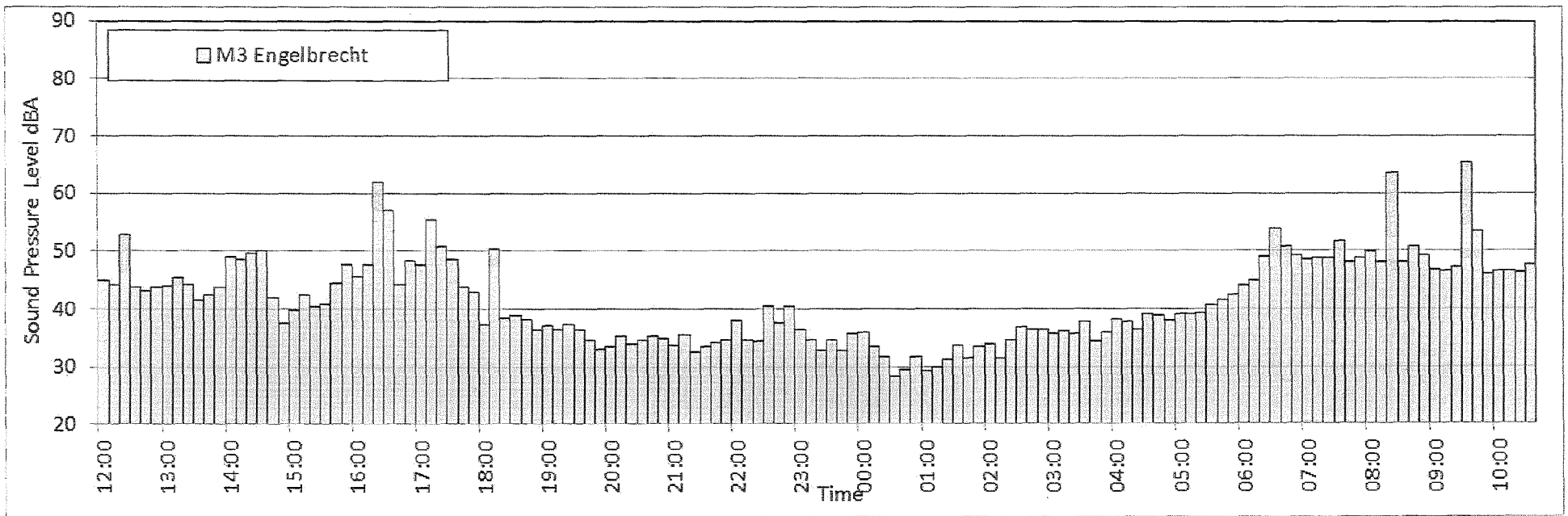


Figure A.4 Monitoring Point M4 Residence Cloete 20 to 21 Jun-2011

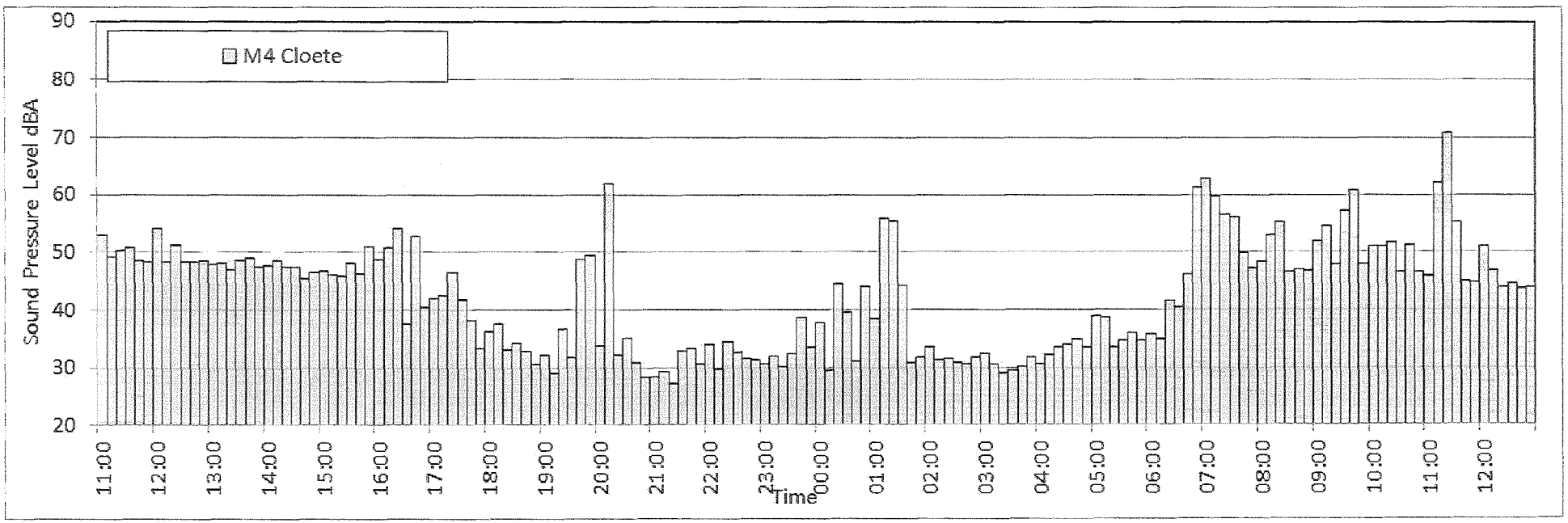


Figure A.5 Monitoring Point M5 Residence Truter 21 to 22 Jun-2011

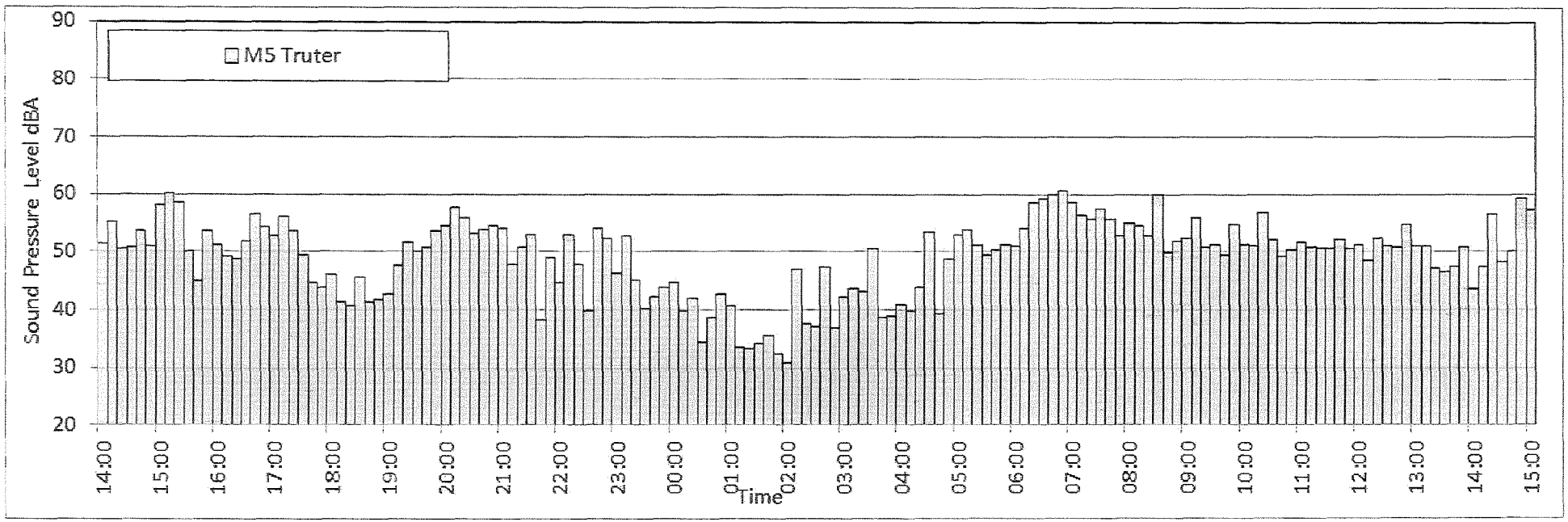
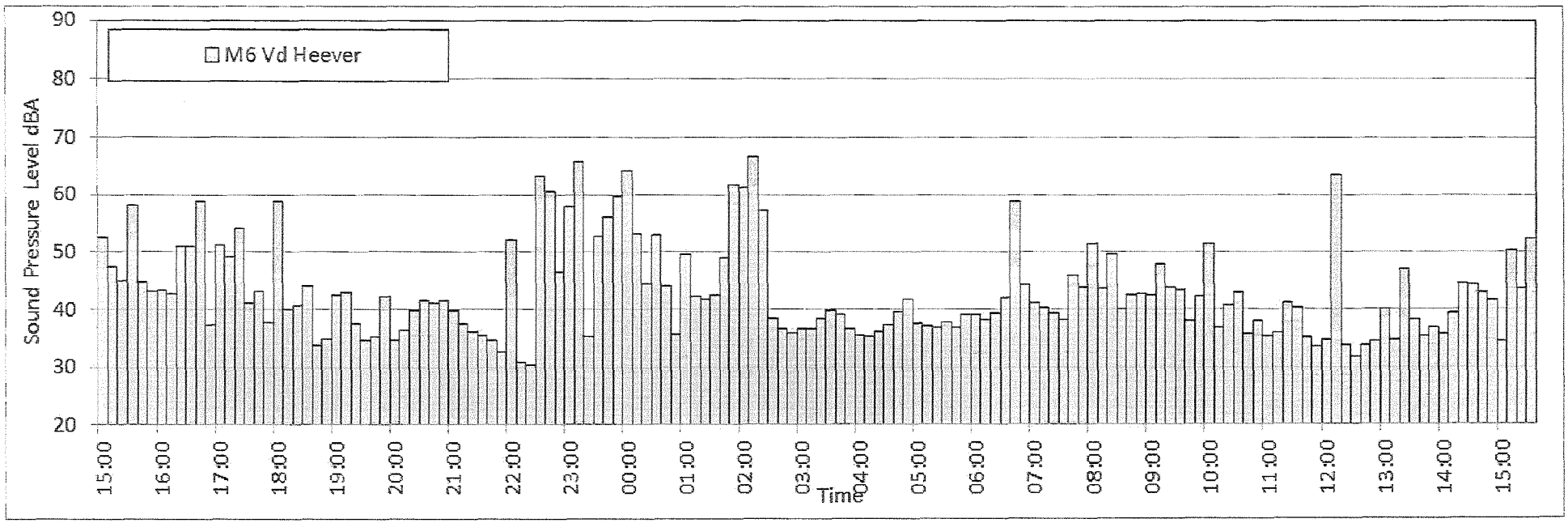


Figure A.6 Monitoring Point M6 Van den Heever 21 to 22 Jun-2011



Appendix B

Curriculum Vitae

Barend Gideon van Zyl - ID No 4605105089082
P O Box 70 596, Die Wilgers, 0041; 542 Verkenner Ave, Die Wilgers, Pretoria

Qualifications		Institution	Year Completed
(1)	BSc (Eng) Elec	University of Pretoria	1970
(2)	BSc (Eng) Hon Elec	University of Pretoria	1972
(3)	MSc (Eng) (Cum Laude)	University of Pretoria	1974
(4)	PhD	University of Natal	1986

MSc thesis: Sound intensity vector measurement
PhD thesis: Sound transmission analysis by measurement of sound intensity vector

Professional registration and membership

- Southern African Acoustics Institute Fellow (President 1994) Member since 1974

Career

CSIR 1971 – 1989: Join the Acoustics Division of the Council for Scientific and Industrial Research (CSIR) in 1971; Chief Specialist Research Engineer 1981 - 1989.

- Undertake basic and applied acoustic research & development projects;
- Pioneer technique and instrumentation for measurement of sound intensity vector, leading to sponsored research & consulting work in the Netherlands (TNO 1978) and Denmark (Brüel & Kjaer 1981).
- Acoustic consulting engineering services rendered in the fields of building acoustics, industrial noise control, acoustic materials development & environmental acoustics.

Advena 1989 – 1990

- SA Space Programme: Manager Systems Integration & Environmental Test Laboratories;
- Design and commissioning of ultra-high noise level simulation facilities for endurance testing of rocket launch vehicles, spacecraft, satellites, instrumentation and payload.

SABS 1991 – 1994

- Acoustic consulting engineering services rendered to industry
- Building acoustics, industrial noise control and environmental acoustics.

Private Practice Since 1995: Private practice - Sole proprietor - Acoustic consulting engineering

- Noise studies; Environmental noise surveys; Blast noise measurement & assessment
- Design & problem solving: Building acoustics, Industrial & machinery noise reduction, Vehicle noise reduction (road, rail & air)
- Specialised services: Theoretical analysis & design of multi-layered acoustic panels.
- SABS Laboratory & field testing: Building systems and materials, Equipment & machinery noise

---

Papers and publications

- Several papers presented at international congresses and symposia.
- Several papers published in international acoustic journals, such as

Journal of the Acoustical Society of America; Applied Acoustics; Noise Control Engineering Journal.

- Several papers published in Southern African journals.

Other

- Part-time lecturer: Architectural acoustics, Department of Architecture, University of Pretoria;
- Associate of and specialist advisor to SABS Laboratory for Sound and Vibration

Ben van Zyl MSc (Eng) PhD
ACOUSTIC CONSULTING ENGINEER T/A Acusolv
ben@acusolv.co.za
Tel: 012 807 4924 ▸ Fax: 086 508 1122
P O Box 70596 ▸ Die Wilgers ▸ 0041
542 Verkenner Ave ▸ Die Wilgers ▸ Pretoria

Practice Profile

Sole Proprietor: Dr Ben van Zyl

Practicing since 1995.

An independent sole proprietor acoustic consulting engineering practice with in-house expertise and experience in various acoustic disciplines, including building acoustics, noise impact studies, industrial noise control, test and evaluation and acoustic materials development. Based in Pretoria South Africa, specialist services have been rendered throughout the RSA, as well as in the United Kingdom, Taiwan, Pakistan, Madagascar, Mauritius and Botswana.

Equipped with state-of-the-art acoustic measuring instruments employed in noise monitoring surveys, measurement of blast noise, laboratory and field testing of systems and materials and as an aid in the investigation and solving of noise problems.

Ben van Zyl MSc (Eng) PhD
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542 Verkenner Ave ▸ Die Wilgers ▸ Pretoria

Examples of projects

Acoustic Field: Noise studies

Project	For	Aspects
Gauteng Waste Plant	S E Solutions	Impact study: New waste plant
Swartland	Centurus	Residential and commercial development - traffic
Mapoch II	Marlin Granite	Quarry Impact study: Blasting, opencast mining
Delmas Extension: mining dev	Ingwe Coal Corp	Noise study – Plant, conveyors, trains, roads
Twistdraai new access roads	Sasol Coal	Noise study – Roads, conveyors
Bosjesspruit shaft ventilation fans	Sasol Coal	Noise study; shaft & ventilation fan noise rural area
Hillendale new mining development	Iscor Heavy Minerals	Noise study – Plant, road transport
Empangeni Central Processing Plant	Iscor Heavy Minerals	Noise study – Large processing plant
Rooiwater mining development	Iscor Mining	Noise study – Plants, road & rail transport
Sigma overland conveyor	Sasol Mining	Conveyors: Analyse sources of conveyor noise
Sigma overland conveyor	Sasol Mining	Noise study – Conveyors measurement survey
Maputo steel project	Gibb Africa	Noise study peer review: trains, slurry pipe
Pump station noise	Transvaal Suiker Bpk	Noise study & Design for noise reduction
GPMC Environmental Resources Plan	GPMC	Noise policy & resources plan
Damelin College Randburg	Titan Construction	Assess impact of traffic noise on college + design
Atterbury Value Mart	Parkdev	Land use planning - City Council requirements noise
Holmes Place HAC London	V Z de Villiers	Land use planning - City Council requirements noise
Elmar College Pretoria	Iscor Pension Fund	Assess impact of traffic noise on college + design
Sanae 4 Base Antarctica	Dept Public Works	Noise impact design for control - Plant rooms
New truck fuel & service station	Bulktrans	Noise study & Design for noise control
Country Lane	Country Lane Dev	Land use planning – Road traffic noise impact
Randburg Water Front	Randburg City	Advisor & specialist court witness
Syferfontein overland conveyor	Sasol Coal	Noise impact as function of idler properties
Twistdraai East mining noise	Sasol Coal	Mitigation of noise impact on neighbouring farm
Little Loftus – The Rest Nelspruit	TAP de Beer	Sports bar - Impact study
Blast noise	Somchem	Blast noise impact assess & design noise control
Syferfontein overland conveyor	Sasol Coal	Noise impact as function of conveyor design
Leeuwpan Mine Delmas district	Iscor/Ticor	Noise study – Plant noise, loading
Fairbreeze opencast mine KwaZulu	Iscor/Ticor	Noise study – Open cast mining; plant, transport
Brandspruit mine	Sasol	Noise study - Ventilation fan noise rural area
Irene Ext 47	Irene Land Dev Corp	Noise study - Mixed development; road traffic noise
Irene Ext 55	Irene Land Dev Corp	Noise study - Residential; road traffic noise
Lynnwood filling station & car wash	Town Planning Hub	Noise study: Filling station & car wash in residential
Lyttleton 190	Ferero	Noise study: Residential next to N1 highway
Twistdraai N-East Mine shaft	Sasol Mining	Noise study; shaft & ventilation fan noise rural area

Acoustic Field: Noise studies (Continued)

Project	For	Aspects
• Wesput opencast mine	Petmin	Noise study: Blasting, excavation & transport
• Gedex opencast mine	Petmin	Noise study: Open cast excavation & transport
• Kensington college	Centurus	Noise study: Sport grounds, roads
• Spandow mine shaft	Sasol Mining	Noise study; shaft & ventilation fan noise rural area
• Twistdraai Central Mine Shaft	Sasol Mining	Noise study; shaft & ventilation fan noise rural area
• Addington Hospital	Delen Oudkerk	Equipment outdoor noise impact & mitigation
• Fourways Gardens Country Club	Fourways Gardens	Music noise impact assess & design for mitigation
• Irene Ext 29	Irene Land Dev Corp	Noise study: New township & highway noise
• Pick 'n Pay Warehouse Meadowbrook	Pick 'n Pay	Truck movement & loading: Assessment
• Irene Sports Academy	Centurus	Impact assessment: Sports grounds & road traffic
• Jameson substation transformer	EThekwini Municipal	Transformer noise: Assess & design mitigation
• Eugene Marais Hospital	Eugene Marais Hosp	Plantroom & outdoor equipment impact & mitigate
• Klipspruit mine wash plant	Billiton & DRA	Coal wash plant infra-sound: design for mitigation
• Eagle Quarry	Mapochs Action	Quarry new application: peer review
• Blast Test Facility Somchem	Denel	Blast noise impact: assess & design for mitigation
• Virgin Active Sandton Gym	Virgin Active	Aerobics, squash & equipment: assess & mitigate
• Conveyor noise study	Bateman	Overland conveyor noise: Causes & parameters
• Zuid Afrikaans Hospital	Z A Hospital	Chiller outdoor noise: design for mitigation
• K54 Road	Tshwane	Noise Study: Future road through residential
• PWV6 Road	Gautrans	Noise Study: Future highway noise contours
• Zandfontein mine shaft	Sasol Mining	Noise Study: Mine shaft & fan noise outdoor impact
• Pierre van Ryneveld Ext 24	Van Vuuren Dev	Noise study: New township & highway noise
• PFG Glass new float plant	PFG Glass	Noise study: Future plant noise in residential area
• Sterkfontein residential development	M&T	Noise study: Road noise impact mitigation
• Sasol future Irenedale mine	Sasol	Noise study: Prediction of shaft & conveyor noise
• Ammunition demolition	SA Army	Noise study: Long distance noise impact assess
• Rietvlei Ridge residential development	M&T	Noise study: Road noise impact mitigation
• Mooiplaats / Hoekplaats	Chieftain	Noise study: Road noise impact mitigation
• Sasol Syferfontein conveyor	Bateman	Noise study: Noise complaints from farmers
• Madagascar Toliara Sands	Exxaro	Noise study: Future mining, plant, transport
• Rooipoort Mine	Sasol Mining	Noise study: Mining and conveyor noise
• Vlakplaats	Quantum	Noise study: Residential development
• Polokwane 2010 Soccer stadium	Africon	Noise study: Stadium noise in residential area
• New Clydesdale colliery	Exxaro	Noise study: Open cast mining, blasting and plant
• Grootfontein ventilation shaft	Sasol Mining	Noise study: Ventilation shaft & surface fan
• Cicada Pycna mating call study	Anglo Platinum	Cicada mating call – Mining noise interference
• Weltevreden ventilation shaft	Sasol Mining	Noise study: Ventilation shaft & surface fan
• Leandra North new colliery	Ingwe	Noise study: Mining development
• PTM new platinum mine	PTM Platinum	Noise study: Mining development
• Lyttleton X191	Pro-Direct	Noise study, new residential development
• Barking noise nuisance	Vd Merwe	Barking noise measurements, specialist report

Acoustic Field: Noise studies (Continued)

Project	For	Aspects
• Vanggatfontein	Exxaro/Metago	Noise study: Open-cast mine
• Forfar clay mining extension	Forfar/Zimbiwe	Noise study: Open-cast clay mining operations
• Luhfereng Doringkop development	Bigen	Noise study: Mixed development, train noise
• K113 Road noise study	Heartland/Bokamoso	Noise study: Road, mixed development
• Eland Mine	Exstrata/Metago	Noise study: New access road for product transport
• Sheraton Hotel	Pan Pacific Property	Noise study: Hotel impact on residential area
• Sishen Infrastructure Relocation	Kumba/Synergistics	Noise study: Railway route options evaluation
• Tharisa Mine noise monitoring	Tharisa/Metago	Baseline noise monitoring surveys
• Sishen Mine baseline monitoring	Kumba/Synergistics	Baseline noise monitoring surveys
• Sishen Mine Protea discard dump	Kumba/Synergistics	Discard dump location - Noise screening assess
• Eastplats	Barplats/Metago	Noise study: New vertical shaft
• Inyanda Mine noise disturbance	Exxaro	Noise surveys: Noise complaints investigation
• Irenedale Mine commissioning	Sasol Mining	Noise Monitoring: New shaft operational phase
• Honey Ridge indoor shooting range	Insul-Coustic	Design for noise reduction
• Sishen Mine expansion project 2	Kumba/Synergistics	Noise study: New processing plant Sishen mine
• Sishen Mine noise monitoring	Kumba Iron Ore	Peer review: Baseline survey
• Sishen Mine new 10 MTon plant	Kumba/AGES	Noise study: New 10 MTon processing plant
• Khameni Kalkfontein/Tamboti Mine	Khameni/Metago	Noise study: New opencast mine and plant
• Exxaro Kalbasfontein rail load-out	Exxaro	Noise survey: Assess impact of railway loud-out
• Sishen Mine Lylyveld development	Kumba/EGES	Noise study: New opencast mine & transport
• Haasfontein new opencast mine	Exxaro/Synergistics	Noise study: New underground mine + conveyor
• Westlake mixed development	Heartland/SEF	Noise study: New urban mixed development
• Marlboro road M60	Heartland/SEF	Noise study: New road traffic noise modelling
• Driefontein Mine	Goldfields	Noise scoping assessment and recommendations
• Bokfontein Chrome Mine	Hernic/Metago	Noise study: New furnaces and beneficiation plant
• Eland opencast mine extensions	Exstrata/Metago	Noise study: Opencast mine extensions
• Tharisa Mine EMP noise monitoring	Tharisa/Metago	EMP noise monitoring survey 1
• Dragline noise reduction Kriel	Anglo Coal	Dragline noise – Design for noise reduction
• Ivory Coast noise studies	Metago	Peer review
• Eskom Grootvlei Power Station	Insul-Coustic	Design for noise reduction - internal
• Inyanda Mine	Exxaro	Design for plant noise reduction - enviromental

Details of specialist and declaration of interest in respect of an application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Phola-Kusile Coal Conveyor

Specialist:	Ben van Zyl T/A Acusolv		
Nature of specialist study compiled:	Noise Study		
Contact person:	Dr B G van Zyl		
Postal address:	P O Box 70596, Die Wilgers		
Postal code:	0041	**Cell:**	083 469 3888
Telephone:	012 807 4924	**Fax:**	086 508 1122
E-mail:	ben@acusolv.co.za		
Qualifications & relevant experience:	MSc (Eng) PhD; 40 years experience in acoustics		
Professional affiliation(s) (if any)	South African Acoustics Institute (Fellow)		

The specialist appointed in terms of the Regulations

I, Barend Gideon van Zyl declare that -

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in Regulation 8;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of specialist:

Acusolv

Name of company:

23-Sep-2011

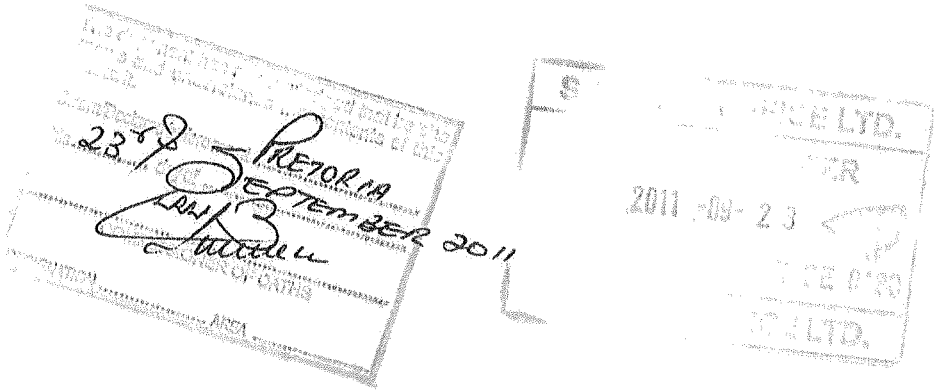
Date:

Signature of Commissioner of Oaths

Date: 23-09-2011

Designation: THE BRANCH MANAGER

Official stamp (below)



Appendix L:
Heritage Resources Specialist Assessment

HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED PHOLA-KUSILE COAL CONVEYOR, NKANGALA DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE

(EIA REFERENCE: S0403-PK-HER-01-Heritage-Impact-Assessment)

HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED PHOLA-KUSILE OVERLAND COAL CONVEYOR, NKANGALA DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE

EIA REFERENCE: S0403-PK-HER-01-Heritage-Impact-Assessment

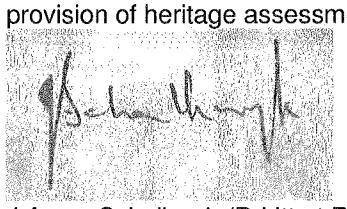
Report No: 2011/JvS/074
Status: Draft
Revision No: **0**
Date: September 2011

Prepared for: Synergistics Environmental Services
Representative: Ms M Medallie
Tel: 011 807 8225
E-mail: marline@synergistics.co.za

Prepared by: J van Schalkwyk (D Littet Phil), Heritage Consultant
ASAPA Registration No: 168
Principal Investigator: Iron Age, Colonial Period, Industrial Heritage
Postal Address: 62 Coetzer Avenue, Monument Park, 0181
Mobile: 076 790 6777
Fax: 012 347 7270
E-mail: jvschalkwyk@mweb.co.za

Declaration:

I, J.A. van Schalkwyk, declare that I do not have any financial or personal interest in the proposed development, nor its developers or any of their subsidiaries, apart from the provision of heritage assessment and management services.



J A van Schalkwyk (D Litt et Phil)
Heritage Consultant
September 2011

HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED PHOLA-KUSILE OVERLAND COAL CONVEYOR, NKANGALA DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE

EXECUTIVE SUMMARY

Anglo American (AA), through its subsidiary Anglo American Inyosi Coal (Pty) Ltd (AAIC), is proposing to construct an overland conveyor system, the Phola-Kusile Overland Coal Conveyor, to transport coal from the Phola Coal Processing Plant (Phola CPP) to Eskom's Kusile Power Station (Kusile) in the Mpumalanga Province, to meet the demand for coal at the Kusile Power Station.

The Phola-Kusile Coal Conveyor will start at the Phola Coal Processing Plant and it will end at the coal stockyard of the Kusile Power Station. Various alternatives conveyor routes were evaluated but the preferred route is approximately 23 km in length (for details please refer to the main EIA report).

An overland conveyor can put constraints on heritage resources. Therefore, in accordance with Section 38 of the NHRA, an independent heritage consultant was appointed by **Synergistics Environmental Services (Pty) Ltd** on behalf of the applicant, Anglo American Inyosi Coal (Pty) Ltd (AAIC), to conduct a Heritage Impact Assessment (HIA), as part of the Environmental Impact Assessment (EIA) for the Phola-Kusile Overland Coal Conveyor, to determine if any sites, features or objects of cultural heritage significance occur within the boundaries of the area where it is planned to develop the conveyor.

The cultural landscape qualities of the larger region essentially consist of two components. The first is a rural area in which the human occupation is made up of a pre-colonial (Stone Age and Iron Age) occupation and a much later colonial (farmer) component. The second component is an urban one consisting of a number of smaller towns, most of which developed during the last 150 years or less.

Irrespective of this low density of habitation, a variety of heritage sites dating to all periods of the past are known to exist in the larger region. The aim of this survey was therefore to locate, identify, evaluate and document any sites, objects and structures of cultural significance found within the area of the proposed development, to assess the significance thereof, and to consider alternatives and plans for the mitigation of any adverse impacts.

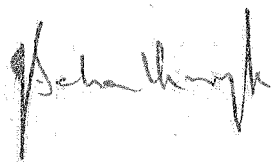
Some grave sites were identified within a 200 m area around the Phola-Kusile Coal Conveyor proposed route.

It is anticipated that the overall impact of the development will be largely indirect. Graves located outside the conveyor servitude will not be directly impacted, and impacts will therefore be visual but posing no physical threat to the graves. Since the servitude will be fenced and the graves will be located outside the fenced servitude, the will not be impacted.

Where the graves are located in the conveyor servitude, impact will be direct and it is recommended that these graves are relocated, after consultation with family and other affected parties, and the necessary permits have been obtained from the police, Department of Health as well as SAHRA.

Therefore, from a heritage point of view it is recommended that the proposed development be allowed to continue on acceptance of the recommended mitigation measures.

It is also requested that should archaeological sites or graves be exposed during construction work, it must immediately be reported to a heritage practitioner so that an investigation and evaluation of the finds can be made.



J A van Schalkwyk
Heritage Consultant
September 2011

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GLOSSARY OF TERMS AND ABBREVIATIONS

TERMS

Study area: Refers to the entire study area as indicated by the client in the accompanying Fig. 1 & 2.

Stone Age: The first and longest part of human history is the Stone Age, which began with the appearance of early humans between 3-2 million years ago. Stone Age people were hunters, gatherers and scavengers who did not live in permanently settled communities. Their stone tools preserve well and are found in most places in South Africa and elsewhere.

Early Stone Age	2 000 000 - 150 000 Before Present
Middle Stone Age	150 000 - 30 000 BP
Late Stone Age	30 000 - until c. AD 200

Iron Age: Period covering the last 1800 years, when new people brought a new way of life to southern Africa. They established settled villages, cultivated domestic crops such as sorghum, millet and beans, and they herded cattle as well as sheep and goats. These people, according to archaeological evidence, spoke early variations of the Bantu Language. Because they produced their own iron tools, archaeologists call this the Iron Age.

Early Iron Age	AD 200 - AD 900
Middle Iron Age	AD 900 - AD 1300
Late Iron Age	AD 1300 - AD 1830

Historical Period: Since the arrival of the white settlers - c. AD 1800 - in this part of the country

ABBREVIATIONS

ADRC	Archaeological Data Recording Centre
ASAPA	Association of Southern African Professional Archaeologists
BP	Before Present
CS-G	Chief Surveyor-General
EIA	Early Iron Age
ESA	Early Stone Age
LIA	Late Iron Age
LSA	Later Stone Age
HIA	Heritage Impact Assessment
MSA	Middle Stone Age
NASA	National Archives of South Africa
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Agency
SAHRA	South African Heritage Resources Agency

HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED PHOLA-KUSILE OVERLAND COAL CONVEYOR, NKANGALA DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE

1. INTRODUCTION

Anglo American (AA) through its subsidiary Anglo American Inyosi Coal (Pty) Ltd (AAIC) is proposing to construct an overland conveyor system, the Phola-Kusile Overland Coal Conveyor, to transport coal from the Phola Coal Processing Plant (Phola CPP) to Eskom's Kusile Power Station (Kusile) in the Mpumalanga Province, to meet the demand for coal at the Kusile Power Station.

The proposed Phola-Kusile Overland Coal Conveyor will fall within the Nkangala District Municipality, and the Victor Khanye (Delmas) and eMalahleni (Witbank) Local Municipalities. The towns in close proximity to the proposed conveyor are Wilge (~4 km east), Phola (~3 km southeast), Ogies (~5 km south-southeast) and eMalahleni(~25 km east).

The Phola-Kusile Coal Conveyor will start at the Phola Coal Processing Plant and it will end at the coal stockyard of the Kusile Power Station. Various alternatives conveyor routes were evaluated but the preferred route is approximately 23 km in length (for details refer to the main EIA report).

An overland conveyor can put constraints on heritage resources. Therefore, in accordance with Section 38 of the NHRA, an independent heritage consultant was appointed by **Synergistics Environmental Services (Pty) Ltd** on behalf of the applicant, Anglo American Inyosi Coal (Pty) Ltd (AAIC), to conduct a Heritage Impact Assessment (HIA), as part of the Environmental Impact Assessment (EIA) for the Phola-Kusile Overland Coal Conveyor, to determine if any sites, features or objects of cultural heritage significance occur within the boundaries of the area where it is planned to develop the conveyor.

The cultural landscape qualities of the larger region essentially consist of two components. The first is a rural area in which the human occupation is made up of a pre-colonial (Stone Age and Iron Age) occupation and a much later colonial (farmer) component. The second component is an urban one consisting of a number of smaller towns, most of which developed during the last 150 years or less.

2. TERMS OF REFERENCE

2.1 Scope of work

The aim of this HIA, broadly speaking, is to determine if any sites, features or objects of cultural heritage significance occur within the boundaries of the area where it is planned to develop the Phola-Kusile Overland Coal Conveyor.

The scope of work for this study consisted of:

- Conducting a desk-top investigation of the area, in which all available literature, reports, databases and maps were studied;
- A visit to the proposed development area.

The objectives were to:

- Identify possible archaeological, grave, cultural and historic sites within the proposed development area;
- Evaluate the potential impacts of construction, operation and maintenance of the proposed Phola-Kusile Overland Coal Conveyor on archaeological, cultural and historical resources;
- Recommend mitigation measures to ameliorate any negative impacts on areas of archaeological, cultural or historical importance.

2.2 Limitations

- It must be kept in mind that by its very nature, archaeological sites occur below ground surface, making its detection is some cases, difficult.

Table 1: Applicable category of heritage impact assessment study and report

Type of study	Aim	SAHRA involved	SAHRA response
Heritage Impact Assessment	The aim of a full HIA investigation is to provide an informed heritage-related opinion about the proposed development by an appropriate heritage specialist. The objectives are to identify heritage resources (involving site inspections, existing heritage data and additional heritage specialists if necessary); assess their significances; assess alternatives in order to promote heritage conservation issues; and to assess the acceptability of the proposed development from a heritage perspective. The result of this investigation is a heritage impact assessment report indicating the presence/ absence of heritage resources and how to manage them in the context of the proposed development. Depending on SAHRA's acceptance of this report, the developer will receive permission to proceed with the proposed development, on condition of successful implementation of proposed mitigation measures.	Provincial Heritage Resources Authority	Comments on built environment and decision to approve or not
		SAHRA Archaeology, Palaeontology and Meteorites Unit	Comments and decision to approve or not

3. HERITAGE RESOURCES

3.1 The National Estate

The NHRA (No. 25 of 1999) defines the heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations that must be considered part of the national estate to include:

- places, buildings, structures and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, including-
    - ancestral graves;
    - royal graves and graves of traditional leaders;
    - graves of victims of conflict;
    - graves of individuals designated by the Minister by notice in the Gazette;

  - historical graves and cemeteries; and
  - other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);
- sites of significance relating to the history of slavery in South Africa;
- movable objects, including-
  - objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
  - objects to which oral traditions are attached or which are associated with living heritage;
  - ethnographic art and objects;
  - military objects;
  - objects of decorative or fine art;
  - objects of scientific or technological interest; and
  - books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).

3.2 Cultural significance

In the NHRA, Section 2 (vi), it is stated that "cultural significance" means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. This is determined in relation to a site or feature's uniqueness, condition of preservation and research potential.

According to Section 3(3) of the NHRA, a place or object is to be considered part of the national estate if it has cultural significance or other special value because of

- its importance in the community, or pattern of South Africa's history;
- its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
- sites of significance relating to the history of slavery in South Africa.

A matrix was developed whereby the above criteria were applied for the determination of the significance of each identified site (see Appendix 1). This allowed some form of control over the application of similar values for similar sites.

4. STUDY APPROACH AND METHODOLOGY

4.1 Extent of the Study

This survey and impact assessment covers the area as presented in Section 5 and as illustrated in Figures 1 & 2.

4.2 Methodology

4.2.1 *Preliminary investigation*

4.2.1.1 Survey of the literature

A survey of the relevant literature was conducted with the aim of reviewing the previous research done and determining the potential of the area. Some published books and papers deal with areas, events or groups of people in the larger region (e.g. Cloete 2000; De Jong 2004; Pelser et al 2006; Van Schalkwyk 2002, 2004a, 2004b, 2006).

- All of these sources contributed some information on historic events in the larger region as well as on the location of specific heritage sites and features.

4.2.1.2 Data bases

The *Heritage Atlas Database,* the *Environmental Potential Atlas*, the *Chief Surveyor General* (CS-G) and the *National Archives of South Africa* (NASA) were consulted.

- Database surveys produced information on a number of sites located in the larger region of the proposed development.
- The original Title Deeds of some of the farms were located, but produced limited information of use such as the dating of farmsteads, etc.

4.2.1.3 Other sources

Aerial photographs and topocadastral and other maps were also studied - see the list of references below.

- Information of a very general nature were obtained from these sources

4.2.2 Field survey

The area that had to be investigated was identified by **Synergistics Environmental Services (Pty) Ltd** by means of maps.

As this is a linear development the survey was done by travelling the conveyor route as far as possible.

4.2.3 Structuring of the Report in terms of GNR 543 Section 32 Requirements (EIA Regulations)

Legal and Regulatory Requirement	Cross Reference to Report Section
GNR 543 Section 32	
Specialist reports and reports on specialized processes	
1. An applicant or the EAP managing an application may appoint a person to carry out a specialist study or specialized process.	Appendices to the EIA main report
2. The person referred to in sub-regulation (1) must comply with the requirements of regulation 17 [declaration of independence]	Declaration of independence signed by specialists provided at back of each specialist report
3. A specialist report or a report on a specialized process prepared in terms of these Regulations must contain-	

Legal and Regulatory Requirement	Cross Reference to Report Section
GNR 543 Section 32	
(a) Details of- (i) the person who prepared the report; and (ii) the expertise of that person to carry out the specialist study or specialized process;	Heritage Impact Assessment Front page of report
(b) A declaration that the person is independent in a form as may be specified by the competent authority;	Declaration of independence signed by specialists provided at back of each specialist report
(c) An indication of the scope of, and the purpose for which, the report was prepared;	Heritage Impact Assessment Section 2 of report
(d) A description of the methodology adopted in preparing the report or carrying out the specialized process;	Heritage Impact Assessment Section 4 of report
(e) A description of any assumptions made and any uncertainties or gaps in knowledge;	Heritage Impact Assessment Section 3 and Section 2.2 of report
(f) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;	Heritage Impact Assessment Section 5 of report
(g) Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;	Heritage Impact Assessment Section 7 of report
(h) A description of any consultation process that was undertaken during the course of carrying out the study;	Consultation Process discussed in EIA main report
(i) A summary and copies of any comments that were received during any consultation process; and	All issues received to date included in EIA main report
(j) Any other information requested by the competent authority.	Not applicable

5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

5.1 Site location and description

The study area forms a corridor from the east of the town of Kendal, northwards, turning west at the N12 some distance, before turning north again towards the new Kusile Power Station (Fig. 1).

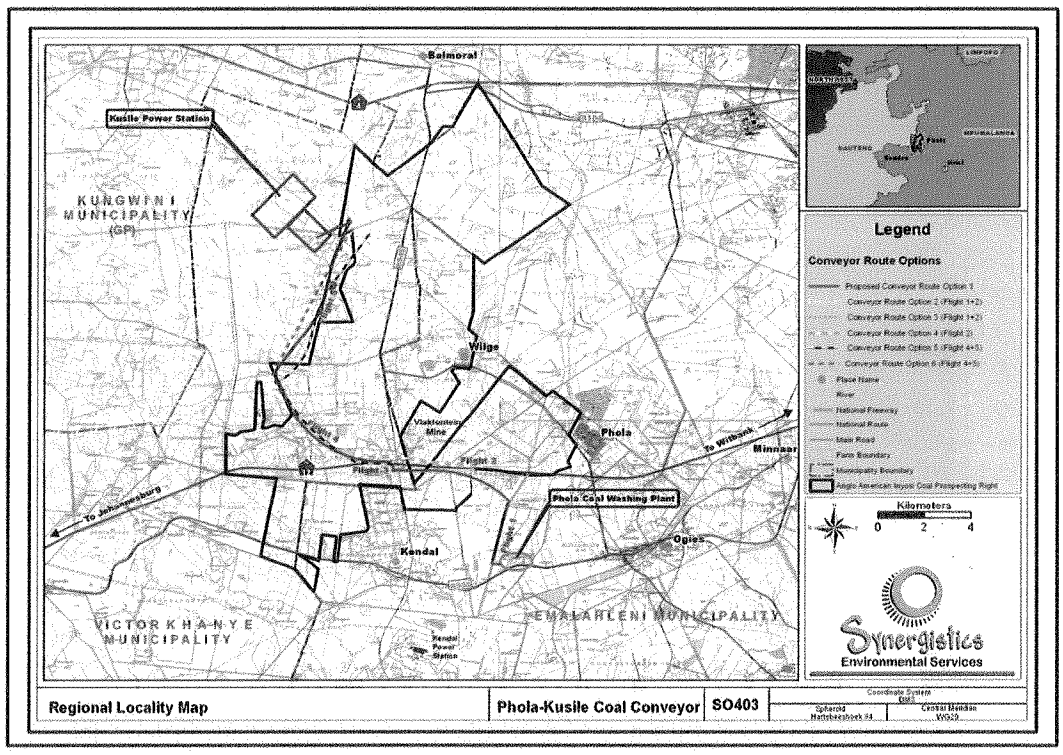


Fig. 1. Location of the study area in regional context

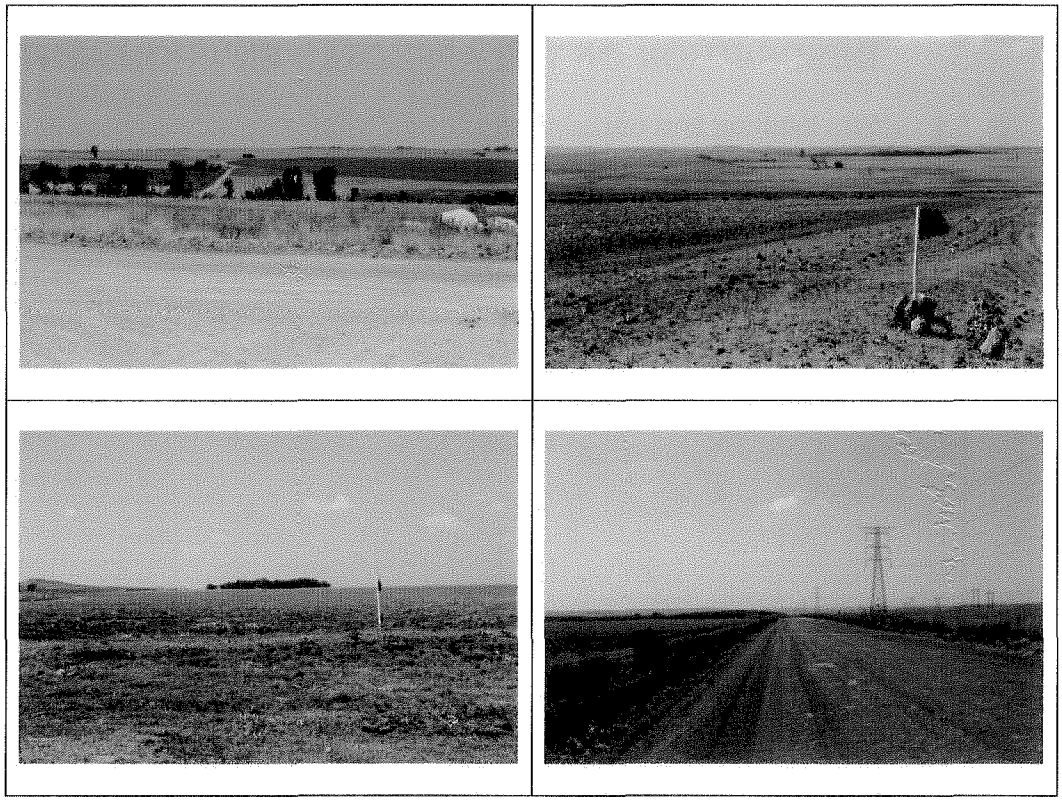


Fig. 2. Elements of the landscape through which the conveyor route will pass

(Clockwise from top left – northern end to southern end)

The geology of the area is quite complex, being made up of irregular intrusions of tillte, norite, arenite and granite, overlain in areas by shale. The original vegetation is classified as Moist Cool Highveld Grassland, but has been replaced over most of the area by agricultural fields, mining activities or wattle plantations. The topography is described as gently rolling hills. A few small rivers pass through the area, with the Wilge River as the most significant. A number of pans occur sporadically throughout the area.

As a result of the above environmental factors the following aspects can be seen to dominate in the environment:

- Plains which make up the largest section of the study area. Much of these areas are used for either agricultural fields or for grazing. Water sources and potential shelter is limited.

- A number of small rivers cross through the area, many of which are perennial. These would have offered an attractive choice for settlement as the plains were largely denuded of trees, whereas in the vicinity of water trees grew in abundance, offering not only shelter, but firewood as well as material for house construction.

5.2 Overview of the region

The cultural landscape qualities of the larger region essentially consist of two components. The first is a rural area in which the human occupation is made up of a pre-colonial (Stone Age and Iron Age) occupation and a much later colonial (farmer) component. The second component is an urban one consisting of a number of smaller towns, most of which developed during the last 150 years or less.

Figure 3 presents an overview of the location of known sites of heritage significance. Due to the scale of presentation, some sites overlap, with the result that there seems to be fewer sites than is the case. In similar vein, it might seem that sites occur in the various corridors, but are actually some distance from the exact route.

5.2.1 Pre-colonial period

Very little habitation of the highveld area took take place during Stone Age times. Tools dating to the Early Stone Age period are mostly found in the vicinity of larger watercourses, e.g. the Vaal River, or in sheltered areas such as the Magaliesberg. During Middle Stone Age (MSA) times (c. 150 000 – 30 000 BP), people became more mobile, occupying areas formerly avoided. The MSA is a technological stage characterized by flakes and flake-blades with faceted platforms, produced from prepared cores, as distinct from the core tool-based ESA technology. Open sites were still preferred near watercourses and outcrops where suitable material for the making of tools could be obtained, were exploited (Fig. 4).

Late Stone Age (LSA) people had even more advanced technology than the MSA people and therefore succeeded in occupying even more diverse habitats. Some sites are known to occur in the region. These vary from sealed (i.e. cave) sites, located to the north and south of the study area, to open sites in the Magaliesberg. Also, for the first time we get evidence of people's activities derived from material other than stone tools. Ostrich eggshell beads, ground bone arrowheads, small bored stones and wood fragments with incised markings are traditionally linked with the LSA. The LSA people have also left us with a rich legacy of rock art, which is an expression of their complex social and spiritual beliefs.

Iron Age people started to settle in southern Africa c. AD 300, with one of the oldest known sites at Broederstroom, south of Hartebeespoort Dam, dating to AD 470. Having only had cereals (sorghum, millet) that need summer rainfall, Early Iron Age (EIA) people did not move outside this rainfall zone, and neither did they occupy the central interior highveld area. Because of their specific technology and economy, Iron Age people preferred to settle on the alluvial soils near rivers for agricultural purposes, but also for firewood and water.

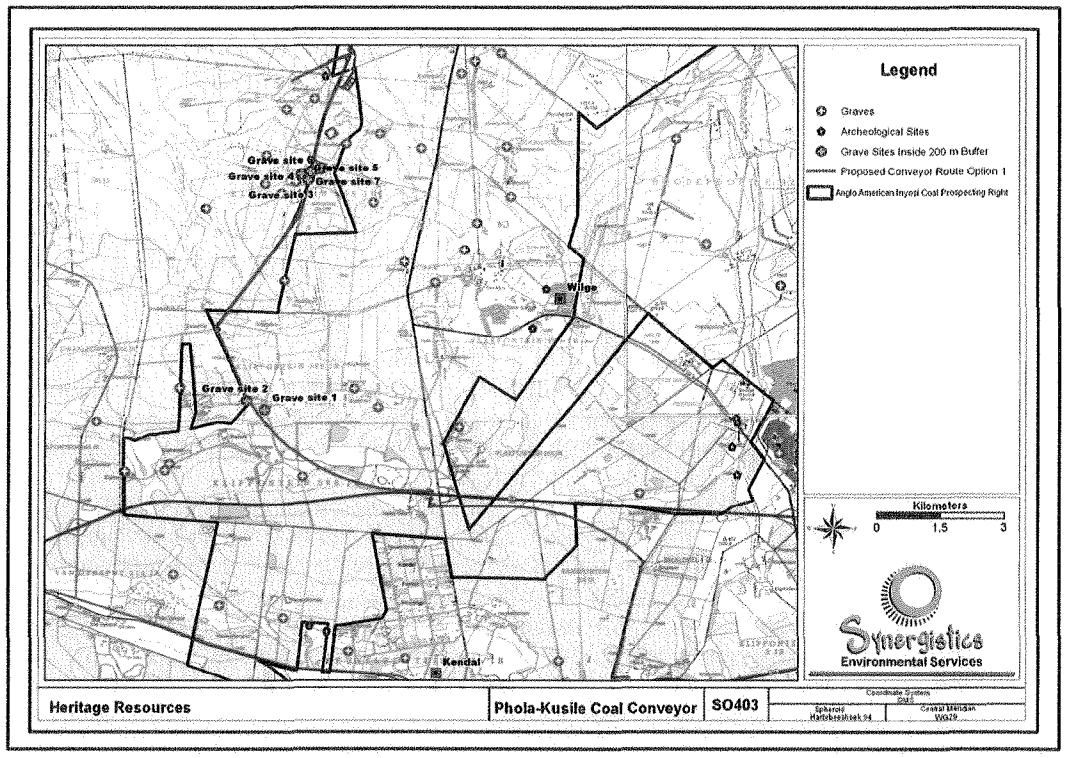


Fig. 3. Location of identified heritage sites in relation to the conveyor (pink line)

The occupation of the larger geographical area (including the study area) did not start much before the 1500s. By the 16th century things changed, with the climate becoming warmer and wetter, creating condition that allowed Late Iron Age (LIA) farmers to occupy areas previously unsuitable, for example the treeless plains of the Free State and the Mpumalanga highveld.

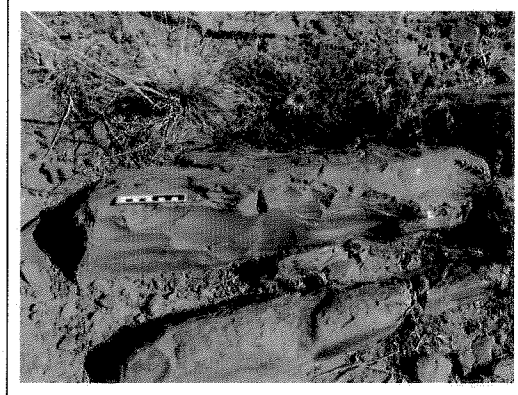
This wet period came to a sudden end sometime between 1800 and 1820 by a major drought lasting 3 to 5 years. The drought must have caused an agricultural collapse on a large, subcontinent scale.

This was also a period of great military tension. Military pressure from Zululand spilled onto the highveld by at least 1821. Various marauding groups of displaced Sotho-Tswana moved across the plateau in the 1820s. Mzilikazi raided the plateau extensively between 1825 and 1837. The Boers trekked into this area in the 1830s. And throughout this time settled communities of Tswana people also attacked each other.

As a result of this troubled period, Sotho-Tswana people concentrated into large towns for defensive purposes. Because of the lack of trees they built their settlements in stone. These stone-walled villages were almost always located near cultivatable soil and a source of water. Such sites are known to occur near Kriel (e.g. Pelser et al 2006) and in the Bronkhorstspruit area.

- Archaeological sites

NHRA Category	Archaeological and palaeontological sites
Protection status	
General Protection - Section 35: Archaeology, palaeontology and meteorites	



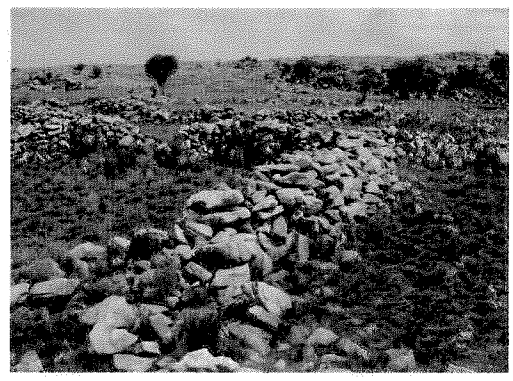


Fig. 4. Factory site dating to the Middle Stone Age and Late Iron Age stone walling

5.2.2 Historic period

White settlers moved into the area during the first half of the 19th century. They were largely self-sufficient, basing their survival on cattle/sheep farming and hunting. Few towns were established and it remained an undeveloped area until the discovery of coal and later, gold. The establishment of the NZASM railway line in the 1880s, linking Pretoria with Lourenço Marques and the world at large, brought much infra-structural and administrative development to the area. This railway line also became the scene of many battles during the Anglo-Boer War and a concentration camp was established near the Balmoral station to the northwest.

During the Anglo-Boer War, a number of skirmishes occurred in the larger region, with one of the last and biggest battles fought that being at Bakenlaagte south of the town of Kriel on 30 October 1901. In line with the 'scorched earth' policy, most farmsteads were destroyed by the British during the latter part of the hostilities.

Coal mining occurred only sporadically in the area. However, with the discovery of the Witwatersrand gold fields, the need for a source of cheap energy became important, and coal mining developed on a large scale in various regions. By 1899, at least four collieries were operating in the Middelburg-Witbank[1] district, supplying the gold mining industry.

- Farmsteads

Farmsteads are complex features in the landscape, being made up of different yet interconnected elements. Typically these consist of a main house, gardens, outbuildings, sheds and barns, with some distance from that labourer housing and various cemeteries. In addition, roads and tracks, stock pens and wind mills complete the setup. An impact on one element therefore impacts on the whole.

The architecture of these farmsteads can be described as an eclectic mix of styles modified to adapt to local circumstances. Farm buildings were generally single storied. Walls were thick and built in stone or bricks. The roof was either flat or ridged and thatched or tiled and was terminated at either end by simple linear parapet gables.

[1] Witbank was only established after 1903.

In some cases outbuildings would be in the same style as the main house, if they date to the same period. However, they tend to vary considerably in style and materials used as they were erected later as and when they were required.

NHRA Category	Buildings, structures, places and equipment of cultural significance
Protection status	
General Protection - Section 34: Structures older than 60 years	

Fig. 5. Examples of farmsteads and farming related features identified in the region

- Cemeteries

Apart from the formal cemeteries that occur in municipal areas (towns or villages), a number of these, some quite informal, i.e. without fencing, are expected to occur sporadically all over, but probably in the vicinity of the various farmsteads. Many might also have been forgotten, making it very difficult to trace the descendants in a case where the graves are to be relocated.

Most of these cemeteries, irrespective of the fact that they are for land owners or farm labourers (with a few exceptions where they were integrated), are family orientated. They therefore serve as important 'documents' linking people directly by name to the land.

NHRA Category	Graves, cemeteries and burial grounds
Protection status	
General Protection - Section 36: Graves or burial grounds	

Fig. 6. Examples of informal cemeteries identified in the region

- Infrastructure and industrial heritage

In many cases this aspect of heritage is left out of surveys, largely due to the fact that it is taken for granted. However, the land and its resources could not be accessed and exploited without the development of features such as roads, bridges, railway lines, electricity lines and telephone lines, as well as industries that exploit locally available resources.

NHRA Category	Buildings, structures, places and equipment of cultural significance
Protection status	
General Protection - Section 34: Structures older than 60 years	

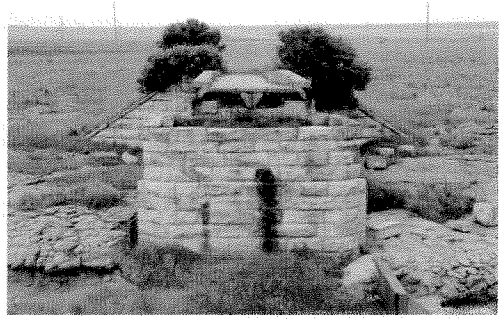


Fig. 7. Remains of an old sandstone bridge

5.3 Identified sites

The following sites that would be impacted on by the proposed development of the conveyor, line have been identified, although these must be dealt with on a case by case basis to determine the exact distance to the preferred conveyor route and to determine which measures must be put in place to deal with these sites. For more information on their approximate location and significance, please see Section 5.3.3.1.

5.3.1 Stone Age

- No sites, features or objects dating to the Stone Age were identified in the study area.

5.3 2 Iron Age

- No sites, features or objects dating to the Iron Age were identified in the study area.

5.3.3 Historic period

Some grave sites have been identified to occur within a 200 m area around the Proposed Phola-Kusile Coal Conveyor route.

5.3.3.1 Grave sites identified along the preferred Phola – Kusile Conveyor Route

The following grave sites were identified along the preferred Phola-Kusile Conveyor Route:

- A number of graves were found to be present on farm **Klipfontein 568 JR, Portion 36** (owned by AAIC). This graveyard is w~ 175 meters from the of the proposed conveyor route and will not be impacted as it is outside and some distance away from the fenced conveyor servitude.

- A number of graves were found to be present on farm **Klipfontein 568 JR, Portion 4** (owned by AAIC). This site is ~30 to 50 m from the proposed conveyor route. Depending on the final route alignment, this site is expected to fall outside the fenced conveyor servitude and impact can therefore be avoided.

- Individual graves were found to be present on farm **Klipfontein 566 JR, Portion 44** (owned by Eskom Holdings Ltd) from 8 metres to 50 metres from the conveyor route. Depending on the final route alignment, some graves is expected to fall outside the fenced conveyor servitude and impact can therefore be avoided, but graves falling within the conveyor route will require mitigation and relocation, after consultation with family and other affected parties and the necessary permits have been obtained from the police, Department of Health as well as SAHRA.

6. SITE SIGNIFICANCE AND ASSESSMENT

6.1 Heritage assessment criteria and grading

According to the NHRA, No. 25 of 1999, Section 2(vi), the *significance* of heritage sites and artefacts is determined by it aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential.

The NHRA stipulates the assessment criteria and grading of archaeological sites. The following categories are distinguished in Section 7 of the Act:

- **Grade I**: Heritage resources with qualities so exceptional that they are of special national significance;
- **Grade II**: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
- **Grade III**: Other heritage resources worthy of conservation, on a local authority level.

The occurrence of sites with a Grade I significance will demand that the development activities be drastically altered in order to retain these sites in their original state. For Grade II and Grade III sites, the application of mitigation measures would allow the development activities to continue.

A matrix was developed whereby the above criteria, as set out in Sections 3(3) and 7 of the NHRA, No. 25 of 1999, were applied for each identified site (see Appendix 1). This allowed some form of control over the application of similar values for similar sites.

6.2 Impact assessment

Impact analysis of cultural heritage resources under threat of the proposed development, are based on the present understanding of the proposed development.

- Some grave sites have been identified to occur within a 200 m area around the preferred Phola-Kusile Coal Conveyor route (see Section 5.3.3.1).
- Depending on the final route alignment, some graves is expected to fall outside the fenced conveyor servitude and impact can therefore be avoided.
- Graves falling within the conveyor route will require mitigation and relocation, after consultation with family and other affected parties and the necessary permits have been obtained from the police, Department of Health as well as SAHRA.

7. RECOMMENDED MANAGEMENT MEASURES

Heritage sites are fixed features in the environment, occurring within specific spatial confines. Any impact upon them is permanent and non-reversible. Those resources that cannot be avoided and that are directly impacted on by the proposed development can be excavated/recorded and a management plan can be developed for future action. Those sites that are not impacted on can be written into the management plan, whence they can be avoided or cared for in the future.

7.1 Objectives

- Protection of archaeological, historical and any other site or land considered being of cultural value within the project boundary against vandalism, destruction and theft.
- The preservation and appropriate management of new discoveries in accordance with the NHRA, should these be discovered during mining activities.

It is recommended that once the final route has been determined, the route be walked again to determine the exact impacts on the graves and mitigation required on a case by case basis.

The following shall apply:

- Known sites should be clearly marked in order that they can be avoided during construction activities.
- The contractors and workers should be notified that archaeological sites might be exposed during the construction activities.
- Should any heritage artefacts be exposed during excavation, work on the area where the artefacts were discovered, shall cease immediately and the Environmental Control Officer shall be notified as soon as possible;
- All discoveries shall be reported immediately to a heritage practitioner so that an investigation and evaluation of the finds can be made. Acting upon advice from these specialists, the Environmental Control Officer will advise the necessary actions to be taken;
- Under no circumstances shall any artefacts be removed, destroyed or interfered with by anyone on the site; and
- Contractors and workers shall be advised of the penalties associated with the unlawful removal of cultural, historical, archaeological or palaeontological artefacts, as set out in the National Heritage Resources Act (Act No. 25 of 1999), Section 51. (1).

7.2 Control

In order to achieve this, the following should be in place:

- A person or entity, e.g. the Environmental Control Officer, should be tasked to take responsibility for the heritage sites and should be held accountable for any damage.
- Known sites should be located and isolated, e.g. by fencing them off. All construction workers should be informed that these are no-go areas, unless accompanied by the individual or persons representing the Environmental Control Officer as identified above.
- In areas where the vegetation is threatening the heritage sites, e.g. growing trees pushing walls over, it should be removed, but only after permission for the methods proposed has been granted by SAHRA. A heritage official should be part of the team executing these measures.

8. CONCLUSIONS

The cultural landscape qualities of the larger region essentially consist of a two components. The first is a rural area in which the human occupation is made up of a pre-colonial (Stone Age and Iron Age) occupation and a much later colonial (farmer) component. The second component is an urban one consisting of a number of smaller towns, most of which developed during the last 150 years or less.

Irrespective of this low density of habitation, a variety of heritage sites dating to all periods of the past are known to exist in the larger region. The aim of this survey was therefore to locate, identify, evaluate and document sites, objects and structures of cultural significance found within the area of the proposed development, to assess the significance thereof and to consider alternatives and plans for the mitigation of any adverse impacts.

Some grave sites have been identified to occur within a 200 m area around the preferred Phola-Kusile Coal Conveyor route (see Section 5.3.3.1). Depending on the final route alignment, some graves is expected to fall outside the fenced conveyor servitude and impact can therefore be avoided. Graves falling within the conveyor route will require mitigation and relocation, after consultation with family and other affected parties and the necessary permits have been obtained from the police, Department of Health as well as SAHRA.

Therefore, from a heritage point of view it is recommended that the proposed development be allowed to continue on acceptance of the recommended mitigation measures.

It is also requested that should archaeological sites or graves be exposed during construction work, it must immediately be reported to a heritage practitioner so that an investigation and evaluation of the finds can be made.

9. REFERENCES

9.1 Data bases

Chief Surveyor General
Environmental Potential Atlas, Department of Environmental Affairs and Tourism.
Heritage Atlas Database, Pretoria.
National Archives of South Africa
South African Heritage Resources Agency

9.2 Literature

Acocks, J.P.H. 1975. *Veld Types of South Africa.*Memoirs of the Botanical Survey of South Africa, No. 40. Pretoria: Botanical Research Institute.

Cloete, P.G. 2000. *The Anglo-Boer War: a Chronology.* Pretoria: JP van der Walt

De Jong, R. et al 2004. *Survey of heritage in the Nkangala area of Mpumalanga.*Unpublished report. Pretoria: BKS.

Hartdegen, P. (ed.) 1988. *Our building heritage.* Halfway House: Ryll's Publishing Co.

Holm, S.E. 1966.*Bibliography of South African Pre- and Protohistoric archaeology.* Pretoria: J.L. van Schaik.

Mason, R.J. 1962. *Prehistory of the Transvaal.* Johannesburg: Witwatersrand University Press.

Pelser, A., Van Schalkwyk, J., Teichert, F. &Masiteng, I. 2006.The archaeological investigation of an Iron Age site on the farm Rietfontein 101IS, Emalahleni district, Mpumalanga Province.*Research by the National Cultural History Museum*, Vol. 14.

Van Schalkwyk, J.A. 2002. *A survey of cultural resources for the Zondagsfontein mining development, Witbank district, Mpumalanga Province.* Unpublished report 2002KH28. Pretoria: National Cultural History Museum.

Van Schalkwyk, J. 2004a. *Heritage impact assessment for the Smithfield mining development, Witbank district, Mpumalanga.* Unpublished report 2004KH34C. Pretoria: National Cultural History Museum.

Van Schalkwyk, J. 2004b. *Heritage impact assessment for the Weltevreden, New Largo Underground and New Largo Pit 4 mining developments, Witbank district, Mpumalanga.* Unpublished report 2004KH34D. Pretoria: National Cultural History Museum.

Van Schalkwyk, J.A 2006. *Heritage impact assessment for the proposed new power station, Witbank Area.* Unpublished report 2006KH111. Pretoria: National Cultural History Museum.

9.3 Maps and aerial photographs

1:50 000 Topocadastral maps

Google Earth

APPENDIX 1: CONVENTIONS USED TO ASSESS THE SIGNIFICANCE HERITAGE RESOURCES

Significance
According to the NHRA, Section 2(vi) the **significance** of heritage sites and artefacts is determined by it aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

Matrix used for assessing the significance of each identified site/feature

1. Historic value	
Is it important in the community, or pattern of history	
Does it have strong or special association with the life or work of a person, group or organisation of importance in history	
Does it have significance relating to the history of slavery	
2. Aesthetic value	
It is important in exhibiting particular aesthetic characteristics valued by a community or cultural group	
3. Scientific value	
Does it have potential to yield information that will contribute to an understanding of natural or cultural heritage	
Is it important in demonstrating a high degree of creative or technical achievement at a particular period	
4. Social value	
Does it have strong or special association with a particular community or cultural group for social, cultural or spiritual reasons	
5. Rarity	
Does it possess uncommon, rare or endangered aspects of natural or cultural heritage	
6. Representivity	
Is it important in demonstrating the principal characteristics of a particular class of natural or cultural places or objects	
Importance in demonstrating the principal characteristics of a range of landscapes or environments, the attributes of which identify it as being characteristic of its class	
Importance in demonstrating the principal characteristics of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province, region or locality.	

7. Sphere of Significance	High	Medium	Low
International			
National			
Provincial			
Regional			
Local			
Specific community			

8. Significance rating of feature		
1.	Low	
2.	Medium	
3.	High	

APPENDIX 2. RELEVANT LEGISLATION

All archaeological and palaeontological sites, and meteorites are protected by the National Heritage Resources Act (Act no 25 of 1999) as stated in Section 35:

(1) Subject to the provisions of section 8, the protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority: Provided that the protection of any wreck in the territorial waters and the maritime cultural zone shall be the responsibility of SAHRA.

(2) Subject to the provisions of subsection (8)(a), all archaeological objects, palaeontological material and meteorites are the property of the State. The responsible heritage authority must, on behalf of the State, at its discretion ensure that such objects are lodged with a museum or other public institution that has a collection policy acceptable to the heritage resources authority and may in so doing establish such terms and conditions as it sees fit for the conservation of such objects.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

(4) No person may, without a permit issued by the responsible heritage resources authority-

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

In terms of cemeteries and graves the following (Section 36):

(1) Where it is not the responsibility of any other authority, SAHRA must conserve and generally care for burial grounds and graves protected in terms of this section, and it may make such arrangements for their conservation as it sees fit.

(2) SAHRA must identify and record the graves of victims of conflict and any other graves which it deems to be of cultural significance and may erect memorials associated with the grave referred to in subsection (1), and must maintain such memorials.

(3) No person may, without a permit issued by SAHRA or a provincial heritage resources authority-

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or

(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals.

(4) SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)(a) unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents of such graves, at the cost of the applicant and in accordance with any regulations made by the responsible heritage resources authority.

the dedet

Department:
Economic Development, Environment and Tourism
MPUMALANGA PROVINCIAL GOVERNMENT

Details of specialist and declaration of interest in respect of an application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Phola-Kusile Coal Conveyor, Mpumalanga

Specialist:	J A van Schalkwyk, Heritage Consultant		
Nature of specialist study compiled:	Heritage Impact Assessment		
Contact person:	J A van Schalkwyk		
Postal address:	62 Coetzer Avenue, Monument Park, Pretoria		
Postal code:	0181	**Cell:**	076 790 6777
Telephone:	012 347 7270	**Fax:**	086 611 3902
E-mail:	jvschalkwyk@mweb.co.za		
Qualifications & relevant experience:	D Litt et Phil; Principal Investigator		
Professional affiliation(s) (if any)	Association of Southern African Professional Archaeologists, Registration No. 168		

The specialist appointed in terms of the Regulations

I, J A van Schalkwyk declare that -

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in Regulation 8;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of specialist:

-
Name of company:

1 October 2011
Date:

Signature of Commissioner of Oaths

01/10/2011
Date:

Commissioner of Oaths - 290/8/10
Designation:

Official stamp (below)

YOLANDI WIRTH
COMMISSIONER OF OATHS 290/8/10 PRETORIA
PostNet Waterkloof Ridge
Shop 3 Waterkloof Lifestyle Centre
Cnr Cliff & Muskejaat
Waterkloof Ridge 0181

I certify that the DEPONENT has acknowledged that he/she knows and understands the contents of this affidavit, that he/she does not have any objection to taking the oath, and that he/she considers it to be binding on his/her conscience, and which was sworn to and signed before me at Pretoria on this the 01 day of October 2011 and that the administering oath complied with the regulations contained in Government Gazette No R1258 of 21 July 1972, as amended.

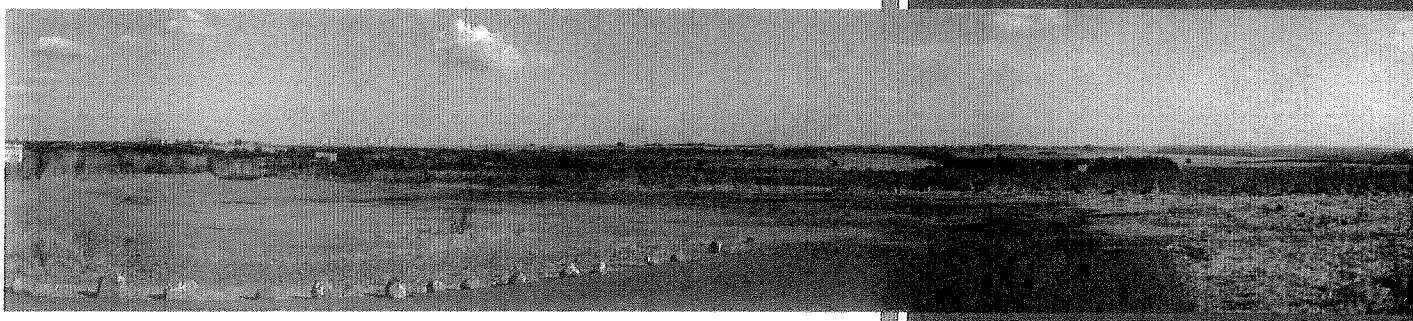
Appendix M:
Visual Specialist Assessment

Structuring of the Specialist Studies in terms of GNR 543 Section 32 Requirements

Legal and Regulatory Requirement	Cross Reference to Report Section
GNR 543 Section 32	
Specialist reports and reports on specialized processes	
1. An applicant or the EAP managing an application may appoint a person to carry out a specialist study or specialized process.	Appendices to the EIA main report
2. The person referred to in sub-regulation (1) must comply with the requirements of regulation 17 [declaration of independence]	Declaration of independence signed by specialists provided at back of each specialist report
3. A specialist report or a report on a specialized process prepared in terms of these Regulations must contain-	
(a) Details of- (i) the person who prepared the report; and (ii) the expertise of that person to carry out the specialist study or specialized process;	Page after cover page
(b) A declaration that the person is independent in a form as may be specified by the competent authority;	Declaration of independence signed by specialists provided at back of each specialist report
(c) An indication of the scope of, and the purpose for which, the report was prepared;	Chapter 1, Section 1.5 - Terms and Reference / Scope of Work
(d) A description of the methodology adopted in preparing the report or carrying out the specialized process;	Chapter 2 - Approach And Methodology
(e) A description of any assumptions made and any uncertainties or gaps in knowledge;	Chapter 4, Section 4.1 - Visual Criteria and Assumptions
(f) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;	Chapter 5 - Visual Impact Assessment
(g) Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;	Chapter 6 - Mitigating Measures
(h) A description of any consultation process that was undertaken during the course of carrying out the study;	Consultation Process discussed in EIA main report
(i) A summary and copies of any comments that were received during any consultation process; and	All issues received to date included in Section 6 of the EIA main report
(j) Any other information requested by the competent authority.	Not applicable

Visual Impact Report

Proposed Anglo American Inyosi Phola – Kusile Overland Coal Conveyor



Mitha Cilliers PrLArch
Newtown Landscape Architects

NLA

PROPOSED ANGLO AMERICAN INYOSI COAL PHOLA – KUSILE OVERLAND COAL CONVEYOR, NKANGALA DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE

Specialist Study Report
VISUAL IMPACT ASSESSMENT

Submitted to:

SYNERGISTICS ENVIRONMENTAL SERVICES (PTY) LTD

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Prepared by:

Newtown Landscape Architects

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Project No:	739/E06J
Report Revision No:	02
Date Issued:	October 2011
Prepared By:	Mitha Cilliers PrLArch
Reviewed By:	Graham Young PrLArch
Reference:	New Largo Open Cast Coal Mine - Conveyor

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GLOSSARY OF TERMS

Aesthetic Value

Aesthetic value is the emotional response derived from the experience of the environment with its particular natural and cultural attributes. The response can be either to visual or non-visual elements and can embrace sound, smell and any other factor having a strong impact on human thoughts, feelings and attitudes (Ramsay, 1993). Thus aesthetic value encompasses more than the seen view, visual quality or scenery, and includes atmosphere, landscape character and sense of place (Schapper, 1993). Aesthetic value is always discussed within the context of the region.

Aesthetically significant place

A formally designated place visited by recreationists and others for the express purpose of enjoying its beauty. For example, tens of thousands of people visit Table Mountain annually. They come from around the country and even from around the world. By these measurements, one can make the case that Table Mountain (a designated National Park) is an aesthetic resource of national significance. Similarly, a resource that is visited by large numbers who come from across the region, probably has regional significance. A place visited primarily by people whose place of origin is local, is generally of local significance. Unvisited places either have no significance or are "no trespass" places. (after New York, Department of Environment 2000).

Aesthetic impact

Aesthetic impact occurs when there is a detrimental effect on the perceived beauty of a place or structure. Mere visibility, even startling visibility of a project proposal, should not be a threshold for decision making. Instead a project, by virtue of its visibility, must clearly interfere with or reduce (i.e. visual impact) the public's enjoyment and/or appreciation of the appearance of a valued resource e.g. cooling tower blocks a view from a National Park overlook (after New York, Department of Environment 2000).

Cumulative Effects

The summation of effects that result from changes caused by a development in conjunction with the other past, present or reasonably foreseeable actions.

Landscape Character

The individual elements that make up the landscape, including prominent or eye-catching features such as hills, valleys, woods, trees, water bodies, buildings and roads. They are generally quantifiable and can be easily described.

Landscape Impact

Landscape effects derive from changes in the physical landscape, which may give rise to changes in its character and how this is experienced (Institute of Environmental Assessment & The Landscape Institute, 1996).

Sense of Place *(genius loci)*

Sense of place is the unique value that is allocated to a specific place or area through the cognitive experience of the user or viewer. *Genius loci* literally means 'spirit of the place'.

Sensitive Receptors

Sensitivity of visual receptors (viewers) to a proposed development.

Viewshed analysis

The two dimensional spatial pattern created by an analysis that defines areas, which contain all possible observation sites from which an object would be visible. The basic assumption for preparing a viewshed analysis is that the observer eye height is 1,8m above ground level.

Visibility

The area from which project components would be potentially visible. Visibility depends upon general topography, aspect, tree cover or other visual obstruction, elevation and distance.

Visual Exposure

Visibility and visual intrusion qualified with a distance rating to indicate the degree of intrusion and visual acuity, which is also influenced by weather and light conditions.

Visual Impact

Visual effects relate to the changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes, and to the overall effects with respect to visual amenity.

Visual Intrusion

The nature of intrusion of an object on the visual quality of the environment resulting in its compatibility (absorbed into the landscape elements) or discord (contrasts with the landscape elements) with the landscape and surrounding land uses.

Worst-case Scenario

Principle applied where the environmental effects may vary, for example seasonally, to ensure the most severe potential effect is assessed.

Zone of Potential Visual Influence

By determining the zone of potential visual influence it is possible to identify the extent of potential visibility and views which could be affected by the proposed development. Its maximum extent is the radius around an object beyond which the visual impact of its most visible features will be insignificant, primarily due to distance.

***

EXECUTIVE SUMMARY

Anglo American, through its subsidiary Anglo American Inyosi Coal (AAIC), is proposing to develop an overland conveyor system to supply coal to Eskom's new Kusile Power Station, currently under construction. During the first years of operation, Kusile will utilize coal supplied via the proposed Phola-Kusile Coal Conveyor from the Phola Coal Processing Plant as well as coal from other parties. Three possible route alternatives were investigated in the EIA process and one was selected to be further investigated.

The proposed conveyor system will link the currently constructed Kusile Power Station, located just south of the N4 highway between Bronkhorstspruit and Ehmalahleni (Witbank), with the Phola Coal Processing Plant, located approximately 20km south-east of Kusile, between the Kendal Power Station, Ogies and Phola in the Mpumalanga Province. Refer to Figure 1 for the Locality Plan.

A method of elimination was followed in the comparative analysis process. Thereby it was established that route alignment option 3 would be the preferred alternative from a visual impact perspective. This option was then further analysed to determine the severity and significance of the visual impact of the proposed Phola-Kusile Coal Conveyor project on the receiving landscape.

The *severity* of the impact was rated as ***low*** for views from the N12 and as ***moderate*** for views from farmsteads and residences.

Using the impact assessment methodology based on the Hacking method of determination of the significance of impacts (Hacking, 1998) the *significance* of the visual impact from farmsteads and residences (sensitive viewers) during the different phases of the project, was rated as follows:

For farmsteads / residences	**Before Mitigation**	**After Mitigation**
Construction Phase	Moderate	Moderate
Operational Phase	Moderate	Low
Decommissioning Phase	Low	Low

And the significance for traveller's views from along the N12 was rated as follows:

For travelers along N12	**Before Mitigation**	**After Mitigation**
Construction Phase	Moderate	Low
Operational Phase	Moderate	Low
Decommissioning Phase	Low	Low

It can be concluded that negative visual impacts will arise from the implementation of the proposed

Phola-Kusile Coal Conveyor project. Possible sensitive viewers have been identified as farmsteads and residents along the proposed conveyor route alignments as well as travellers along the N12 road. However, where travelers would only be temporarily exposed to the negative visual effect, the negative visual impact would be permanent for the farmsteads and residents. The farmsteads' dwellers were therefore rated as *highly* sensitive viewers and the travellers as having a *moderate* sensitivity.

The correct and effective application of mitigation measures would significantly reduce the negative visual impact on both high and moderately sensitive viewers.

***

1.0 INTRODUCTION

1.1 Project Overview

Anglo American, through its subsidiary Anglo American Inyosi Coal (AAIC), is proposing to build an overland conveyor system to supply coal to Eskom's new Kusile Power Station, currently under construction. During the first years of operation, Kusile will utilise coal supplied via the proposed Phola-Kusile Coal Conveyor from the Phola Coal Processing Plant as well as coal from other parties. Three possible route alternatives were investigated in the EIA process and one was selected to be further investigated. In this route option, three proposed conveyor route alignments were identified to be further assessed in this document.

As part of the environmental impact assessment, Newtown Landscape Architects (NLA) was commissioned to conduct a specialist study on visual impact, which will form part of the EIA process. This visual environment scoping study is the first phase of the process and will form part of the Scoping Report for the project.

1.2 Project Location

The proposed conveyor system will link the currently constructed Kusile Power Station, just south of the N4 highway between Bronkhorstspruit and Ehmalahleni (Witbank), with the Phola Coal Processing Plant, located approximately 20km south-east of Kusile, between the Kendal Power Station, Ogies and Phola in the Mpumalanga Province. Refer to Figure 1 for the Locality Plan.

1.3 Project Description

The Phola – Kusile Overland Coal Conveyor will be designed to transport between 8.4 to 11.5 million tons of coal, per year, over the life of the Kusile Power Station. It's origin will be at the existing Phola Processing Plant and will terminate at coal stock yards in the vicinity of the Kusile Power Station. And from the coal stock yards, via feed conveyors into the Kusile Power Station.

The conveyor system will be approximately 23km in length, depending on the final route selection. There will be up to five conveyor flights and a total of six transfer stations. Transfer stations and stream crossings will be Supplied with bunded concrete floors and will be linked to local pollution control systems. The conveyor will be approximately 1.35 meters wide. It will have a sheeted metal cover, open on one side. The conveyor belt will be equipped with on-line quality and mass monitoring equipment. The fenced conveyor servitude will be approximately 25 meters wide and will include a service road and a storm water management system along the length of the conveyor. Refer to Figure 2 for images of conveyor components.

Lighting will be provided at the transfer points. Pedestrian and road crossings will be provided where required. Power will be supplied via a 22kV power line.

1.4 Aim of the Study

The aim of this study is to provide a comparative analysis based on the aesthetic value of the visual resource (receiving environment) as described in the baseline document and to identify a preferred conveyor route option

from a visual impact perspective.

1.5 Terms and Reference / Scope of Work

The following scope of work has been established for the assessment report:

- Describe the characteristics of the existing landscape
- Define and describe the nature and scale of the proposed project
- Describe the environmental setting (visual resource)
- Define landscape character, quality and sense of place
- Compare the alignment options and establish a preferred alignment option
- Simulate the visual intrusion of the preferred conveyor alignment and its infrastructure from viewing points, using photographic simulation techniques
- Describe and assess the visual impacts. The visual impact will be described as the change to the existing visual environment (caused by the physical presence of the proposed conveyor system) and the extent to which that change compromises (negatively impacts) the visual quality and sense of place of the study area
- Recommend and evaluate management measures to mitigate the negative visual impacts

1.6 Concerns

The primary visual concerns are as follows:

- the impact of construction vehicles, equipment and machinery in the landscape during construction
- The impact of the presence of the conveyor belt and transfer stations in the landscape during operations
- Visibility of the conveyor at the N12 highway crossing

2.0 APPROACH AND METHODOLOGY

In order to prepare a comparative analysis, a field survey was undertaken on 27 July 2011 and the area scrutinised. Sensitive viewing areas were visited and photographs taken from these areas towards the proposed conveyor corridor. The study area is defined as a 3 km radius about the proposed project site / corridor (Refer to zone as indicated on Figure 3). Beyond this distance the proposed conveyor would be 'absorbed' into the landscape setting and would therefore have an insignificant impact on sensitive views.

Because of the close locations of the conveyor route options to be assessed, within and relative to the landscape setting, the approach was to find criteria that would identify a preferred route and then to assess the significance of that specific route option on the receiving visual environment. During the assessment process, it was established that 'distance through green fields' would be the determining factor because all three options would be visible to the same number of sensitive viewers, refer to Figure 4.

In terms of significance of the visual impact the following methodology was followed:

Landscape character, landscape quality and sense of place were used to evaluate the *visual resource.* A qualitative evaluation of the landscape is essentially a subjective matter. In this study the evaluation is determined using the criteria discussed in Appendix B, as well as the professional opinion of the author.

The *landscape impact* of the selected conveyor route was measured as the change to the fabric and character of the landscape, caused by the physical presence of the conveyor system.

Visual impacts are a subset of landscape impacts. They relate solely to changes in available views of the landscape, and the effects of those changes on people. The severity of that change (i.e. *visual impact*) is the degree to which the change compromises, enhances or maintains the visual quality of a particular area.

Visual impact is determined using *visual intrusion, visibility* and *visual exposure* criteria and is concerned with:

- The direct impacts of the project upon views of the landscape through intrusion or obstruction;
- The overall impact on visual amenity, which can range from degradation through to enhancement;

To arrive at a significance rating the severity of impact is qualified with spatial, duration and probability criteria (refer to Appendix C). The visual impact process is graphically illustrated in the diagram below.

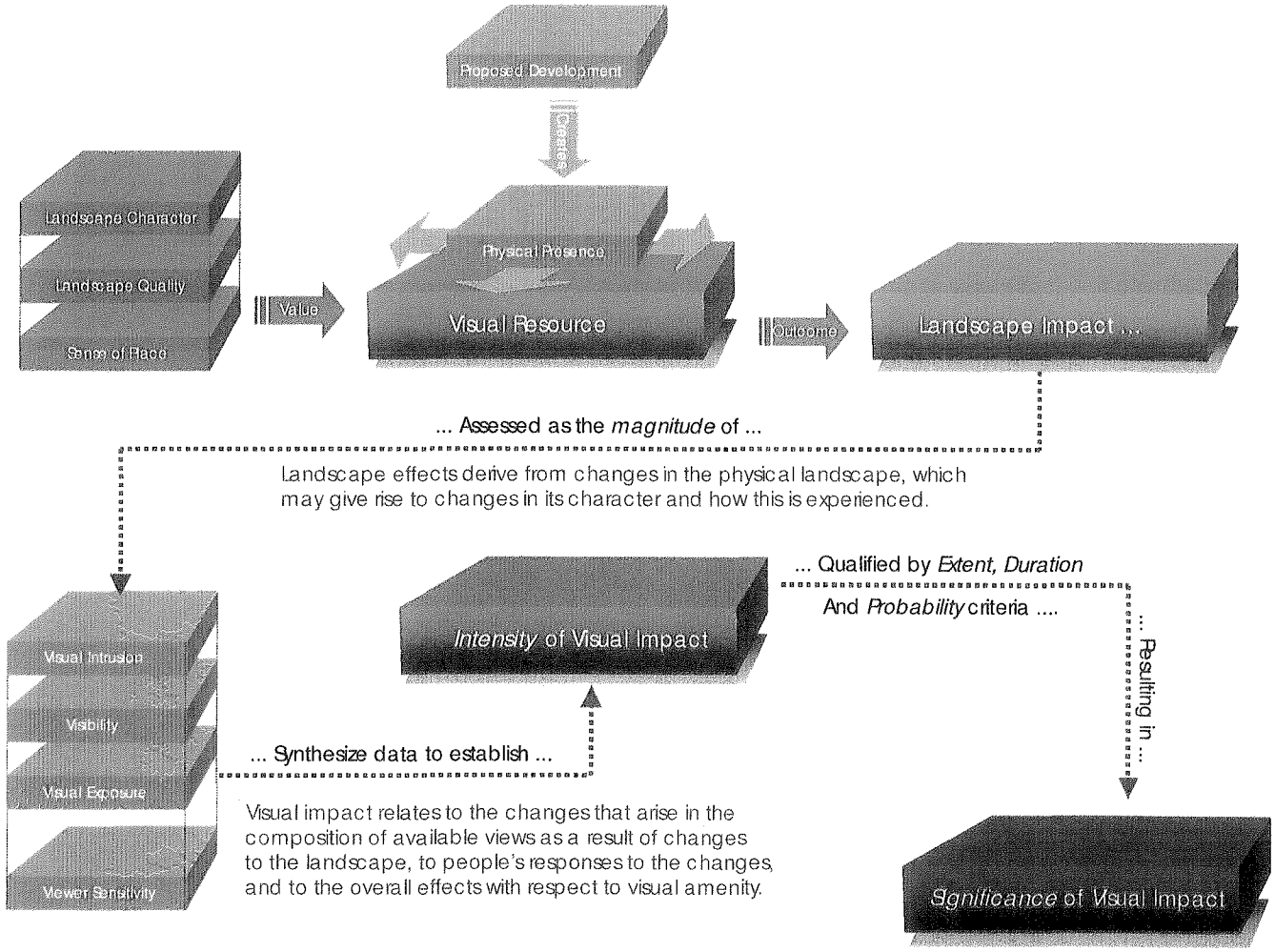


Diagram 1: Visual Impact Process

3.0 VISUAL RESOURCE DESCRIPTION

3.1 Landscape Character

Landscape character types are landscape units defined from the regional physiographic and cultural data derived from 1:50 000 maps and information gathered on the site visit. Dominant landform / land use features (e.g., hills, rolling plains, valleys and urban areas) of similar physiographic and visual characteristics, typically define landscape character types.

The study area consists of three dominant natural landscape types: hills and koppies, flat rolling plains and valleys, which form part of the Saalklapspruit sub catchment. Two other types, mainly derived from man-made intervention, also occur within the study area, they are the built up areas (towns) and cultivated farmland. The study area occurs within the Grassland biome and therefore has warm, wet summers followed by cold, dry winters with heavy frosts.

The visual character of the study area is largely cultivated land, or natural grasslands with concentrations of manmade features along the R545 and in the settlements of Wilge, Phola and Kendal Forest Holdings. Other manmade interventions include the existing railway and road servitudes, as well as the infrastructure and buildings associated with the farmsteads. Furthermore, the entire study area is traversed by a number of power lines. Figure 5 illustrates the spatial distribution of the various land types.

The western and the eastern side of the R545 as well as the southern part have more or less the same landscape character. The western section of the study area (Figures 4 and 5) consists primarily of agricultural land and grassland, mainly used for grazing. The landscape is flat to rolling and includes a valley, which has a disturbed character (Figure 7). The western section of the study area also includes a chicken farm, (Figure 8), sand quarry and brickworks (Figure 5) as well as the Kusile Power Station that is currently under construction. Once completed, the power station would be highly visible in the landscape and will play an important role in determining the landscape character.

The eastern section of the study site has the same landscape character and includes the settlements of Wilge and Phola. The area is flat to rolling and includes valleys and a pan area (Figures 4 to 7). Most of the land in this section is used for agriculture and grazing. The eastern section also includes a sand quarry, brickworks, (Figure 5) and a dam (Figure 7). The R545 runs past Wilge Village (Figure 8) located near the old New Largo underground mine (Figure 8) and the former Wilge power station. This area includes the rehabilitated power station ash dump and foundations of the demolished cooling towers (Figure 9).

The southern section of the proposed study area is situated just south of the N12. The southern section consists primarily of agricultural land (Figures 11 and 12) and the dominant landform is the flat agricultural lands but there are a number of coal mines in the area to the south of the N12. The section also includes the Kendal Forest Holdings (Figure 11). The Kendal Power Station and Phola Coal Processing Plant are important manmade features in the landscape.

The conveyor alignment options to be assessed are all located mostly within the western section of the study area and the eastern side of the southern section (refer to Figure 1 'Locality').

3.2 Current Land Use

Most of the land in the study area is owned by Anglo American Inyosi Coal but there are properties that are owned by Eskom and other third-party landowners. The N12 and R686 road servitudes are crossed. The primary land uses in the area include farmlands, sand mines, a brick industry, quarries, roads, agricultural holdings, poultry farms and the settlements of Wilge, Kendal Forest Holdings and Phola as well as the Kusile Power Station and Phola Coal Processing Plant.

3.2.1 Residential

Residences are concentrated in the settlements of Wilge, Kendal Forest Holdings, and Phola. Furthermore, a number of dispersed farmsteads and farm worker dwellings are located throughout the study area.

3.2.2 Agricultural

The larger part of the study area consists of farmlands that can be divided into two types of agricultural activities. The first type is cultivated land, used for intensive agriculture and the second type is land used for grazing by beef or dairy herds. Two chicken farms for egg production are also located within the mining area.

3.2.3 Transportation systems

The Phola Coal Processing Plant (conveyor start point) is situated to the south of the N12 highway and Kusile Power Station (conveyor end point) lies to the south of the N4 highway. The majority of the conveyor route is therefore situated between the N4 and the N12, with a small portion to the south of the N12.

The R545 provincial tar road currently provides a north-south link between the N4 and the N12 highways. Approximately 12 km to the south of the N4 interchange the R545 diverts to the east, towards Wilge Village. The D686 continues to the south to form the north-south link between the R545 (from the point of diversion) to the N12 interchange, and Kendal further south (the D686 is also known the southern extension of the R545).

A new road, known as the Kusile road, is currently under construction to the west of the Kusile Power Station. The road will provide future access to the Kusile Power Station.

3.3 Sense of Place and Aesthetic Value

Landscapes with greater diversity or containing "distinctive" features are classified as having a higher scenic value than landscapes with low diversity, few distinctive features, or more "common" elements. Generally, the greater the diversity of form, line, texture and colour in a landscape unit or area, the greater the potential for high scenic value. Scenic quality classifications are:

- High - distinctive landscape and strong sense of place
- Moderate - common landscape
- Low - minimal landscape and weak sense of place

'Land types' each with its dominant landscape characteristic, sense of place and aesthetic value within the study

area, have been identified as follows: the *highest* value is assigned to the rivers and streams. The combinations of natural features, characteristic of these areas, stand out within the context of the region and evoke distinct and unique images to produce a strong sense of place. However, most of these areas have already been compromised by the presence of farming infrastructure, industries and power lines. Effectively, this results in this landscape type being awarded a *moderate* value. The landscape type with the *lowest* scenic quality rating is the built up area associated with the settlement Phola.

The remainder of the study area, spatially the largest component, comprises disturbed grasslands and agricultural lands. This landscape type has a ***moderate to low*** aesthetic value. Typical views of this landscape type are illustrated in Figures 4 to 7.

Based on the discussion in this section, the specialist experience of the author and the criteria in Appendix C, scenic quality values for the various landscape types are rated in Table 1 below.

Table 1: Value of the Visual Resource - Scenic Quality

High *Natural Areas*	**Moderate** *Rivers and Streams, gently sloping grassland and cultivated farmland*	**Low** *Built up / settlements*
This landscape type is considered to have a high value because it is a:	This landscape type is considered to have a moderate value because it is a:	This landscape type is considered to have a low value because it is a:
Distinct landscape that exhibits a very positive character with valued features that combine to give the experience of unity, richness and harmony. It is a landscape that may be considered to be of particular importance to conserve and which has a strong sense of place. It may be sensitive to change in general and may be detrimentally affected if change is inappropriately dealt with.	Common landscape that exhibits some positive character but which has evidence of alteration /degradation/erosion of features resulting in areas of more mixed character. It is potentially sensitive to change in general and change may be detrimental if inappropriately dealt with but change may not require special or particular attention to detail.	Minimal landscape generally negative in character with few, if any, valued features. Scope for positive enhancement could occur.

3.4 Views

In the larger context, the vast, flat, undisturbed areas and the presence of distinctive natural landscape elements (hills and stream valleys) generally create a setting for expansive panoramic views, albeit from low vantage points. Views of the conveyor would be most prominent when crossing either the N12 or both the N12 and current alignment of the D686 (southern extension of the R545).

Farmsteads and residences that could possibly be affected by the visual impact from the proposed conveyor, are generally concentrated in the southern section as well as the southern part of the western section. These include privately owned portions of the farms Klipfontein 568 JR, Vlakfontein 569 JR, Bankfontein 216 IR, Heuvelfontein 215 IR as well as Smaldeel 1 IS. The visual impact from residences would depend on the distance from the residence to the conveyor, as well as the absence of visual obstructions between the conveyor and residence.

3.4.1 Sensitive viewer locations

Views from residences and farmsteads are typically more sensitive of the conveyor since views from a residence are considered to be frequent and of long duration. Residences and farmsteads are regarded as high sensitivity viewpoints. Refer to Figure 4 'Sensitive Viewers'

Other viewpoints, such as those from the N4, N12, D686 and R545 and local farm roads dispersed throughout the study area, are considered moderate sensitivity viewpoints.

4.0 COMPARATIVE STUDY OF THE PROPOSED CORRIDOR ROUTE ALIGNMENTS

4.1 Visual Criteria and Assumptions

The following criteria were used to do draw a comparative analysis between the three proposed route alignments in order to determine the preferred route alignment discussed in this report.

- Length of route alignment through 'greenfields'
- Length of route alignment along existing utilities corridors

The following limitations were set and assumptions made:

- A 'greenfield' site will, for the purpose of this exercise, be regarded as a dam, wetland, river / stream and agricultural field
- A 'brownfield' site will, for the purpose of this exercise, be regarded as a utility corridor or industrial area
- It is more desirable to run a route alignment adjacent to an existing utility corridor, as the cumulative impact of this approach would be less than a new route alignment going through a 'greenfield' site.
- Farmsteads and residences were all regarded as having the same level of sensitivity
- The zone of potential impact (the area defined as the radius about the centre point of the project beyond which the visual impact of the most visible features will be insignificant) for this project was established at 3.0 km. Over 3.0 km the impact of the proposed conveyor would have diminished considerably due to the diminishing effect of distance and atmospheric conditions (haze) on visibility.

4.2 Comparison of Conveyor Route Alignment Options

The findings of the criteria as stated above are tabulated below.

Table 2: Route Comparison

	Option 1	Option 2	Option 3
'Greenfield' Distance	80%	80%	65%
Existing Utilities Corridor Distance	20%	20%	35%

NOTE:

* the distances are expressed as an approximate percentage of the total distance of the alignment option

From Table 2 it can be concluded that Options 1 and 2 would have more or less the same significance in terms of negative visual impact, having the same percentages of distances through 'greenfields' as well as following existing utilities corridors. Option 3 is the only option to follow a greater distance in an existing utilities corridor and would thus, from the determined criteria, be the preferred option, from a visual perspective. Therefore this option will be further discussed to determine the severity and significance of the visual impact of the proposed coal conveyor project.

5.0 VISUAL IMPACT ASSESSMENT

As stated above, Option 3 will be assessed, based on the methodology described in Item 2.0 of this report.

5.1 Visibility and Visual Exposure

The 'zone of potential influence' i.e. the distance beyond which views to the project sites would not be greatly influenced by the presence of its proposed structures, was set at 3.0 km. The study area used to determine visual impact is therefore limited to a radius of 3.0 km on both sides of the proposed corridor route alignment.

Visual exposure relates directly to the distance of the view. It is a criterion used to account for the limiting effect of increased distance on visual impact. The impact of an object diminishes at an exponential rate as the distance between the observer and the object increases. Thus, the visual impact at 1000 m would be 25% of the impact as viewed from 500 m. At 2000 m it would be 10% of the impact at 500 m. Refer to graphic on Figure 12.

The viewshed analysis, depicted in Figure 12, confirms this and illustrates that the proposed conveyor would be visible from farmsteads and residences located on privately owned portions of the farms Klipfontein 568 JR, Heuvelfontein 215 IR, Bankfontein 216 IR as well as Smaldeel 1 JS. It also confirms that the proposed conveyor would potentially be visible from over half the zone of potential influence, resulting in a ***high*** visibility. However, views are partially obstructed by vegetation and other existing structures - consequently the visibility would be ***moderate to high***. Table 3 below summarises this.

Table 3: Visibility of project components

High	Moderate	Low to Insignificant
Visual Receptors If the proposed project is potentially visible from over half the zone of potential influence, and / or views are mostly unobstructed and / or the majority of viewers are affected.	*Visual Receptors* If the proposed project is potentially visible from less than half the zone of potential influence, and / or views are partially obstructed and or many viewers are affected	*Visual Receptors* If the proposed project is potentially visible from less than a quarter of the zone of potential influence, and / or views are mostly obstructed and / or few viewers are affected.

Views from the identified farmsteads / residences as well as from the N12, would mostly appear in the foreground and thus would result in a ***high*** visual exposure.

5.2 Visual Intrusion

Visual intrusion is directly related to *landscape impact* and the nature of intrusion (physical characteristics) of a project component on the visual quality of the environment and its compatibility / discord with the landscape and surrounding land use.

Section 3.4 describes the sensitive viewing sites from which the project sites would potentially be visible. Although *visibility* is *high*, the aesthetic value of the landscape had been rated as ***moderate to low***. The most dramatic change to the existing scene would be in the southern part of the western section where the conveyor would pass in the fore- to middle ground of the existing farmsteads / residences and along the N12.

Table 3 below summarises the visual intrusion criteria and rates the worst case scenario for the project components on the sensitive viewing areas.

Table 4: Visual Intrusion

High	**Moderate** *For farmsteads / residences*	**Low** *For the N12*	**Positive**
If the project: - Has a substantial negative effect on the visual quality of the landscape; - Contrasts dramatically with the patterns or elements that define the structure of the landscape; - Contrasts dramatically with land use, settlement or enclosure patterns; - Is unable to be 'absorbed' into the landscape.	If the project: - Has a moderate negative effect on the visual quality of the landscape; - Contrasts moderately with the patterns or elements that define the structure of the landscape; - Is partially compatible with land use, settlement or enclosure patterns. - Is partially 'absorbed' into the landscape.	If the project: - Has a minimal effect on the visual quality of the landscape; - Contrasts minimally with the patterns or elements that define the structure of the landscape; - Is mostly compatible with land use, settlement or enclosure patterns. - Is 'absorbed' into the landscape.	If the project: - Has a beneficial effect on the visual quality of the landscape; - Enhances the patterns or elements that define the structure of the landscape; - Is compatible with land use, settlement or enclosure patterns.
Result Notable change in landscape characteristics over an extensive area and/or intensive change over a localised area resulting in major changes in key views.	*Result* Moderate change in landscape characteristics over localised area resulting in a moderate change to key views.	*Result* Imperceptible change resulting in a minor change to key views.	*Result* Positive change in key views.

Visual intrusion would be rated as ***moderate*** for farmsteads and residences in the Zone of Potential Influence and ***low*** for travellers along the N12. Refer to photo simulations on Figures 13 to 15.

5.3 Severity of Visual Impact

Visual impact is measured as the change to the existing visual environment (caused by the physical presence of a new development) and the extent to which that change compromises (negatively impacts) or enhances (positively impacts) or maintains the quality of views in the area as perceived by people visiting, working or living in the area.

5.3.1 Impact on Sense of Place

As can be concluded from the landscape character description in Item 3.0, the project is expected to have a cumulative impact on the sense of place of the study area. The presence of mining and processing activities contributes to the current sense of place, albeit a negative contribution, and therefore helps establish the aesthetic characteristics for the study area. The proposed new conveyor will therefore have a negative impact on the visual quality of the study area but to a far lesser degree than would have been the case if no other mining processing activities were present. Nevertheless, this does not mean that methods to reduce the impact of project should not be considered.

Perhaps the feature that would have the greatest visual impact is the impact of the project at night. The lights associated with the activities at the proposed transfer stations would contribute to the already prevalent light pollution generated by existing mining activities.

5.3.2 Severity of Visual Impact

The *severity* of the visual impact is assessed using the worst-case scenario, the synthesis of the criteria given in Appendix C and the discussion in the body of this report. In synthesising these criteria a numerical or weighting system is avoided. Attempting to attach a precise numerical value to qualitative resources is rarely successful, and should not be used as a substitute for reasoned professional judgement (Institute of Environmental Assessment & The Landscape Institute (1996).

The severity of the impact with regards the farmsteads and residences would be rated as ***moderate*** due to the introduction of elements that may be prominent but may not necessarily be considered to be substantially uncharacteristic when set within the attributes of the receiving landscape. For travellers along the N12 the severity would be rated as ***low*** due to the conveyor only causing a minor loss or alteration to the characteristic of the baseline environment. Refer to Table 5 below for Severity rating.

Table 5: Severity of Visual Impact

High	Moderate	Low	Negligible
	For farmsteads / residences	*For travellers along the N12*	
A major alteration to key elements / features / characteristics of the baseline.	Partial loss of or alteration to key elements / features / characteristics of the baseline.	Minor loss of or alteration to key elements / features / characteristics of the baseline.	Very minor loss or alteration to key elements / features / characteristics of the baseline.
I.e. Pre-development landscape or view and the introduction of elements considered to be uncharacteristic when set within the attributes of the receiving landscape.	I.e. Pre-development landscape or view and the introduction of elements that may be prominent but may not necessarily be considered to be substantially uncharacteristic when set within the attributes of the receiving landscape.	I.e. Pre-development landscape or view and the introduction of elements that may not be uncharacteristic when set within the attributes of the receiving landscape.	I.e. Pre-development landscape or view and the introduction of elements that are not uncharacteristic with the surrounding landscape – approximating the 'no change' situation.
High scenic quality impacts would result.	Moderate scenic quality impacts would result	Low scenic quality impacts would result.	Negligible scenic quality impacts would result.

6.0 MITIGATING MEASURES

When considering mitigation measures to reduce the visual impact, three rules should be considered. Mitigation measures should be:

- Economically feasible
- Effective (time allowed for implementation and provision for management/maintenance)
- Visually acceptable (within the context of the existing landscape)

To address these measures the following principles should be considered:

- Mitigation should be planned to fit into the existing landscape character or to enhance it. It should respect and build upon landscape distinctiveness
- Mitigation should primarily aim to blend the proposed development into its surroundings and generally reduce its visibility
- It should be recognised that many mitigation measures, especially planting / rehabilitation, are not immediately effective

The following actions are proposed for each site:

6.1 Site Development

- Ensure that all existing vegetation, especially along the periphery of the activity, is retained during the construction phase to act as visual screens and dust collectors and to break the monotony that would be evident of vast expanses of exposed earth
- With the construction of the proposed components, the minimum amount of existing vegetation and topsoil should be removed. Ensure, wherever possible, that all existing natural vegetation be retained and incorporated into the site rehabilitation, especially in line of sight from sensitive viewers

6.2 Earthworks

- Dust suppression techniques should be in place at all times during the construction and operational phases
- Only the footprint of the proposed site should be exposed. In all other areas the vegetation should be retained

6.3 Screening

Screening - to screen close-up views - should be introduced along the periphery of the conveyor route as described below:

- Where the vegetation intrudes onto the site it should be retained where possible
- An ecological approach to landscaping is recommended. Should plants be introduced into the project, choice should be guided by ecological rather than horticultural principles
- Indigenous small trees and shrubs could be planted in clumps to screen views from farmsteads, residences and other residential areas e.g. from the Kendal Agricultural Holdings
- The application of vegetation screens or a low berm along the N12 could also screen temporary views from travellers along this road

6.4 Access Roads

- Internal roads should be surfaced to minimise dust. During the construction phase all dirt roads will require an effective dust suppression management programme such as regular watering and / or the use of non-polluting chemicals that will retain moisture in the road surface
- Where a paved road surface is required, paving materials with 'earthy' tones that complement the natural red/brown colours and textures of the soils in the area should be used

6.5 Lighting

The negative impact of night lighting, glare and spotlight effects, can be mitigated using the following methods:

- Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the sites – this is especially relevant where the conveyor runs close to farmsteads or residences
- Avoid high pole top security lighting along the periphery of the site and use only lights that are activated on illegal entry to the site

7.0 SIGNIFICANCE OF VISUAL IMPACT

Tables 6 and 7 summarise the activities that will have an impact on the visual environment. It also describes the type of impact during the construction, operational and decommissioning phases. The severity of impact, rated in Table 5, is qualified with spatial, duration and probability criteria to determine the *significance* of the visual impact. The criteria used in Tables 6 and 7 are summarised in Appendix D (Hacking Method). The significance of the impact is predicted using the worst-case scenario of an activity. Mitigation measures are possible and could substantially reduce the visual impacts resulting from the proposed conveyor. This is primarily due to the nature (form and structure) of the proposed conveyor. The ratings with mitigation assume that the measures as proposed in Item 6.0 are effectively applied.

Table 6: Visual Impact Assessment – Construction / Operational Phase / Closure
From sensitive viewer locations

Potential Visual Impact	ENVIRONMENTAL SIGNIFICANCE							
	Before mitigation				After mitigation			
	Consequence	x	Probability	Significance	Consequence	x	Probability	Significance
Construction Phase								
Construction activities, topographical change, removal of vegetation, surface disturbance, dust, visual disturbance, conveyor structures , contractors lay down area, workshops & storage areas, temporary access roads, temporary services (water & electricity), earthworks.	M		H	**M**				
Suggested mitigation:								
Dust suppression techniques.					M		M	**M**
Operational Phase								
Normal operational activities, maintenance and repair activities.	M		H	**M**				
Suggested mitigation:								
Application of vegetation screens towards sensitive viewer locations.					M		L	**L**
Decommissioning								
Removal of structures and rehabilitating land to pre-mining potential.	L		L	**L**	L		L	**L**

NOTE:
L = Low
M = Medium
H = High

Table 7: Visual Impact Assessment – Construction / Operational Phase / Closure

From N12

Potential Visual Impact	ENVIRONMENTAL SIGNIFICANCE							
	Before mitigation				After mitigation			
	Consequence	x	Probability	Significance	Consequence	x	Probability	Significance
Construction Phase								
Construction activities, topographical change, removal of vegetation, surface disturbance, dust, visual disturbance, conveyor structures , contractors lay down area, workshops & storage areas, temporary access roads, temporary services (water & electricity), earthworks.	L		H	**M**				
Suggested mitigation:					L		M	**L**
Dust suppression techniques.								
Operational Phase								
Normal operational activities, maintenance and repair activities.	L		M	**M**				
Suggested mitigation:								
Application of vegetation screen or berm along N12.					L		L	**L**
Decommissioning								
Removal of structures and rehabilitating land to pre-mining potential.	L		L	**L**	L		L	**L**

8.0 CONCLUSION

It can be concluded that negative visual impacts will arise from the implementation of the proposed Phola-Kusile Coal Conveyor project. Possible sensitive viewers have been identified as farmsteads and residents along the proposed conveyor route alignments as well as travellers along the N12 road. However, where travellers would only be temporarily exposed to the negative visual effect, the negative visual impact would be permanent for the farmsteads and residents. The farmstead were therefore rated as *highly* sensitive viewers and the travellers as having a *moderate* sensitivity.

A method of elimination was followed in the comparative analysis process. Thereby it was established that route alignment option 3 would be the preferred alternative from a visual impact perspective. This option was then further analysed to determine the severity and significance of the visual impact of the proposed Phola-Kusile Coal Conveyor project on the receiving landscape.

The *severity* of the impact was rated as ***low*** for views from the N12 and as ***moderate*** for views from farmsteads and residences.

Using the impact assessment methodology based on the Hacking method of determining the significance of impacts, (Hacking, 1998) the *significance* of the visual impact from farmsteads and residences (sensitive viewers) during the different phases of the project, was rated as follows:

For farmsteads / residences	**Before Mitigation**	**After Mitigation**
Construction Phase	Moderate	Moderate
Operational Phase	Moderate	Low
Decommissioning Phase	Low	Low

And the significance for views from travellers along the N12 was rated as follows:

For travelers along N12	**Before Mitigation**	**After Mitigation**
Construction Phase	Moderate	Low
Operational Phase	Moderate	Low
Decommissioning Phase	Low	Low

The correct and effective application of mitigation measures could thus significantly reduce the negative visual impact on both high and moderately sensitive viewers.

NLA

8.0 REFERENCES

Crawford, D., (1994), Using remotely sensed data in landscape visual quality assessment, *Landscape and Urban Planning.* 30: 71-81.

Hull, R.B. and Bishop, I.E. (1988), Scenic Impacts of Electricity Transmission Towers: The Influence of Landscape Type and Observer Distance. *Journal of Environmental Management.* 1988 (27) 99-108.

Institute of Environmental Assessment & The Landscape Institute (1996), *Guidelines for Landscape and Visual Impact Assessment.* E & FN Spon, London (117)

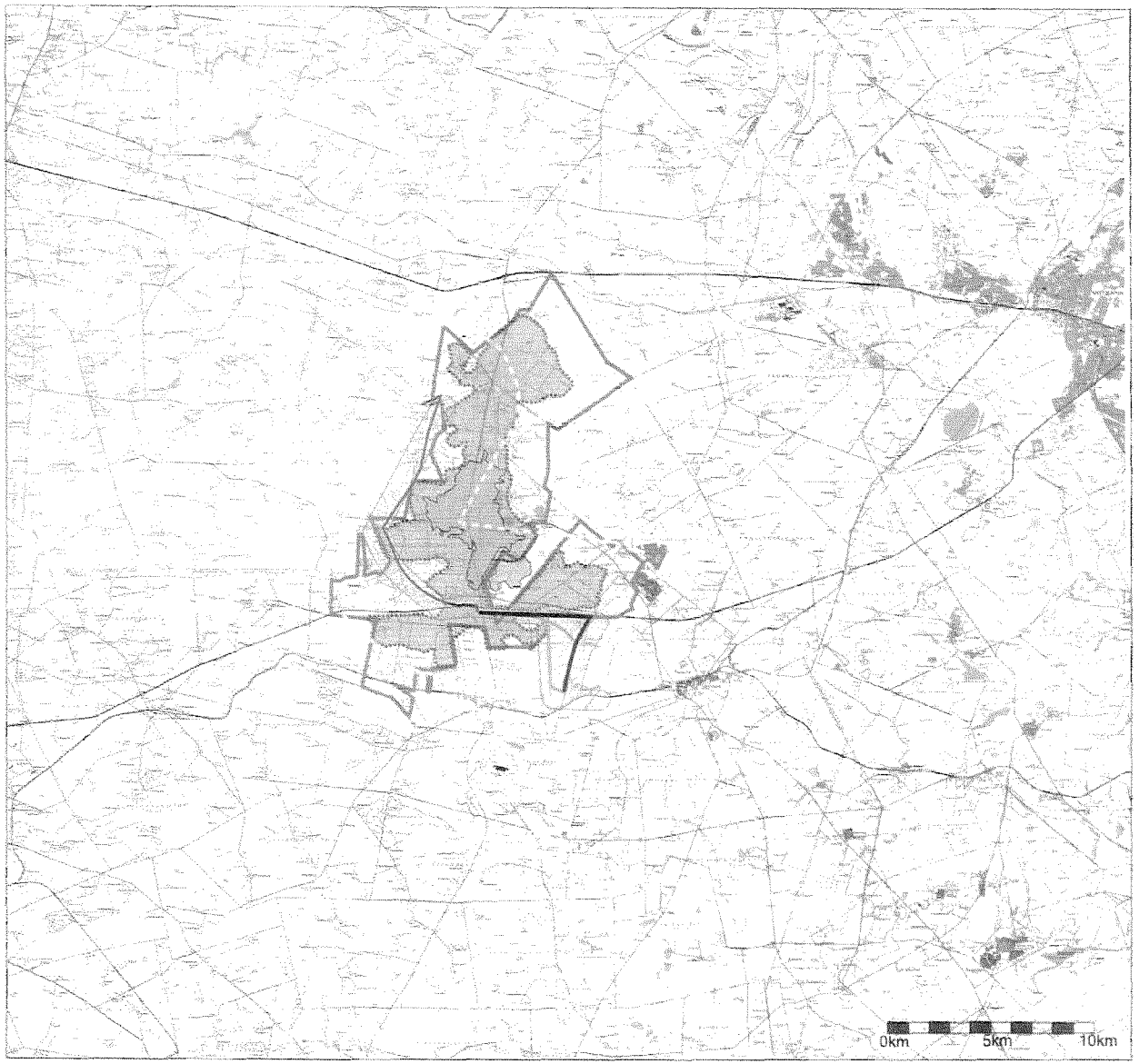
Ittelson, W.H., Proshansky, H.M., Rivlin, L.g. and Winkel, G.H. (1974). *An Introduction to Environmental Psychology.* Holt, Rinehart and Winston, New York.

Lange, E. (1994), Integration of computerized visual simulation and visual assessment in environmental planning. *Landscape and Environmental Planning.* 30: p 99-112.

Mucina, L. & Rutherford, M.C. (eds) (2006). *The vegetation of South Africa, Lesotho and Swaziland.* Strelitzia 19. South African National Biodiversity Institute. Pretoria. p 477

Warnock, S. & Brown, N., Putting Landscape First. *Landscape Design.* No. 268 March 1998. p 44-46.

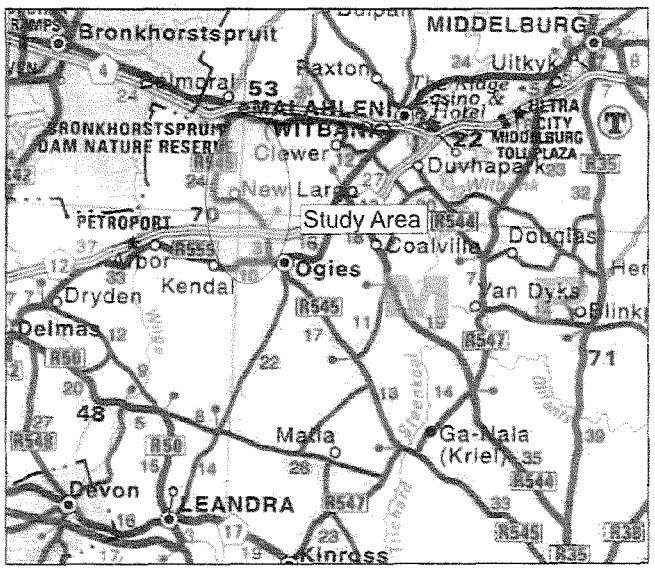
APPENDIX A: FIGURES



LEGEND

- 3.0km Zone of Potential Visual Impact
- Anglo American Inyosi Coal Prospecting Right Area
- Mining Reserve Boundary
- Old Underground Workings
- Conveyor Route Corridor for Further Investigation
- Proposed Conveyor Route Option 1
- Proposed Conveyor Route Option 2
- Proposed Conveyor Route Option 3

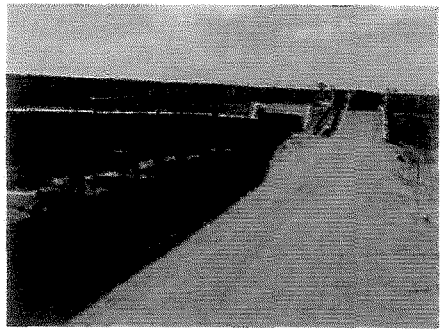
North



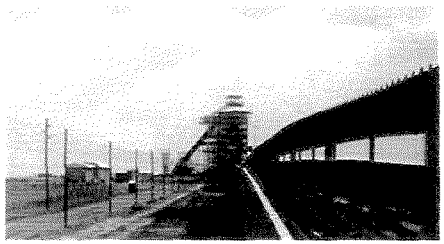
Reference Map (n.t.s.)

Figure 1: LOCALITY - Phola-Kusile Coal Conveyor

September 2011

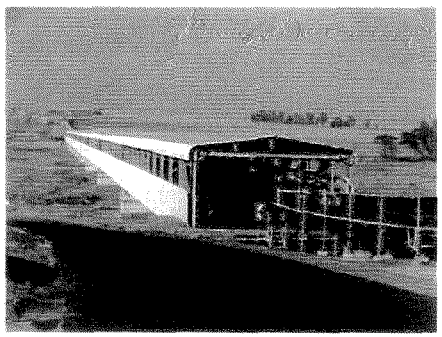


Example of typical farm road crossing over conveyor



Example of typical transfer station with pollution control infrastructure

Example of typical metal cover for conveyor belt



Example of typical wetland crossing (conveyor suspended on pillars, covered and with solid floor for collection of coal spills)

Example of typical coal conveyor from the side

Example of typical stream crossing with impermeable floor

Typical example of a fenced servitude and service road

Images from Synergistics New Largo Scoping Reports

Figure 2: PROJECT COMPONENTS - Phola-Kusile Coal Conveyor

September 2011

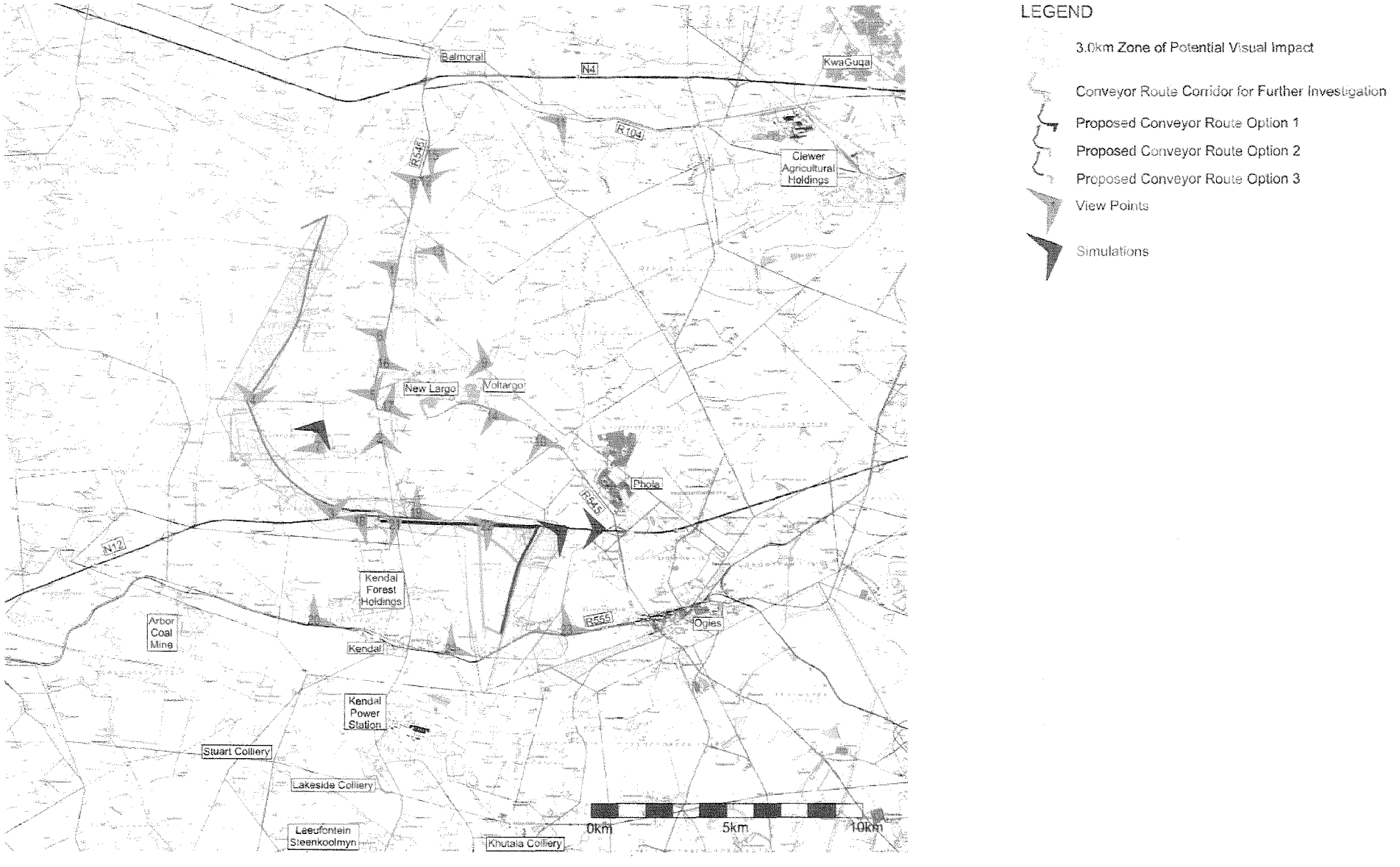


Figure 3: VIEWS - Phola-Kusile Coal Conveyor

September 2011

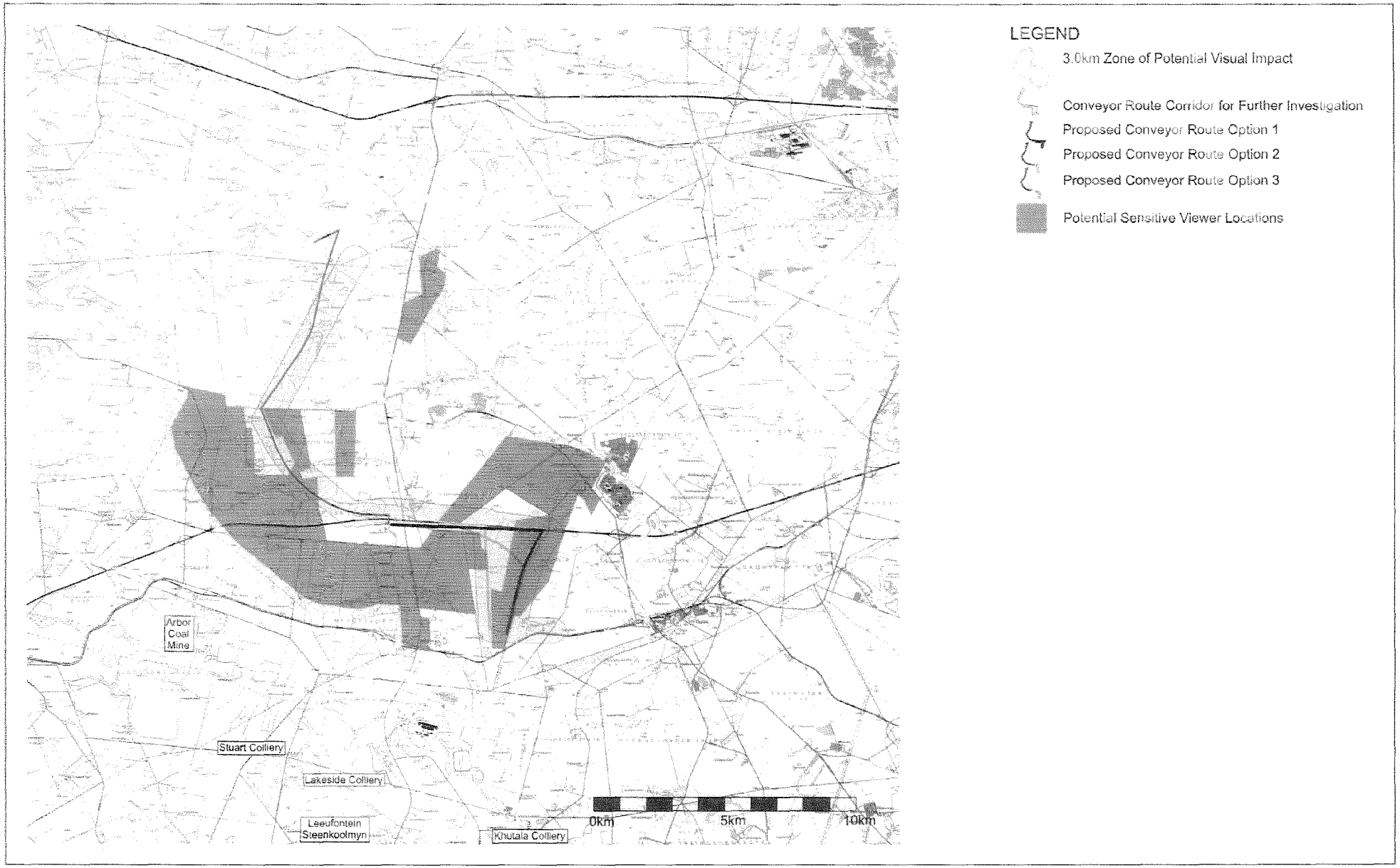
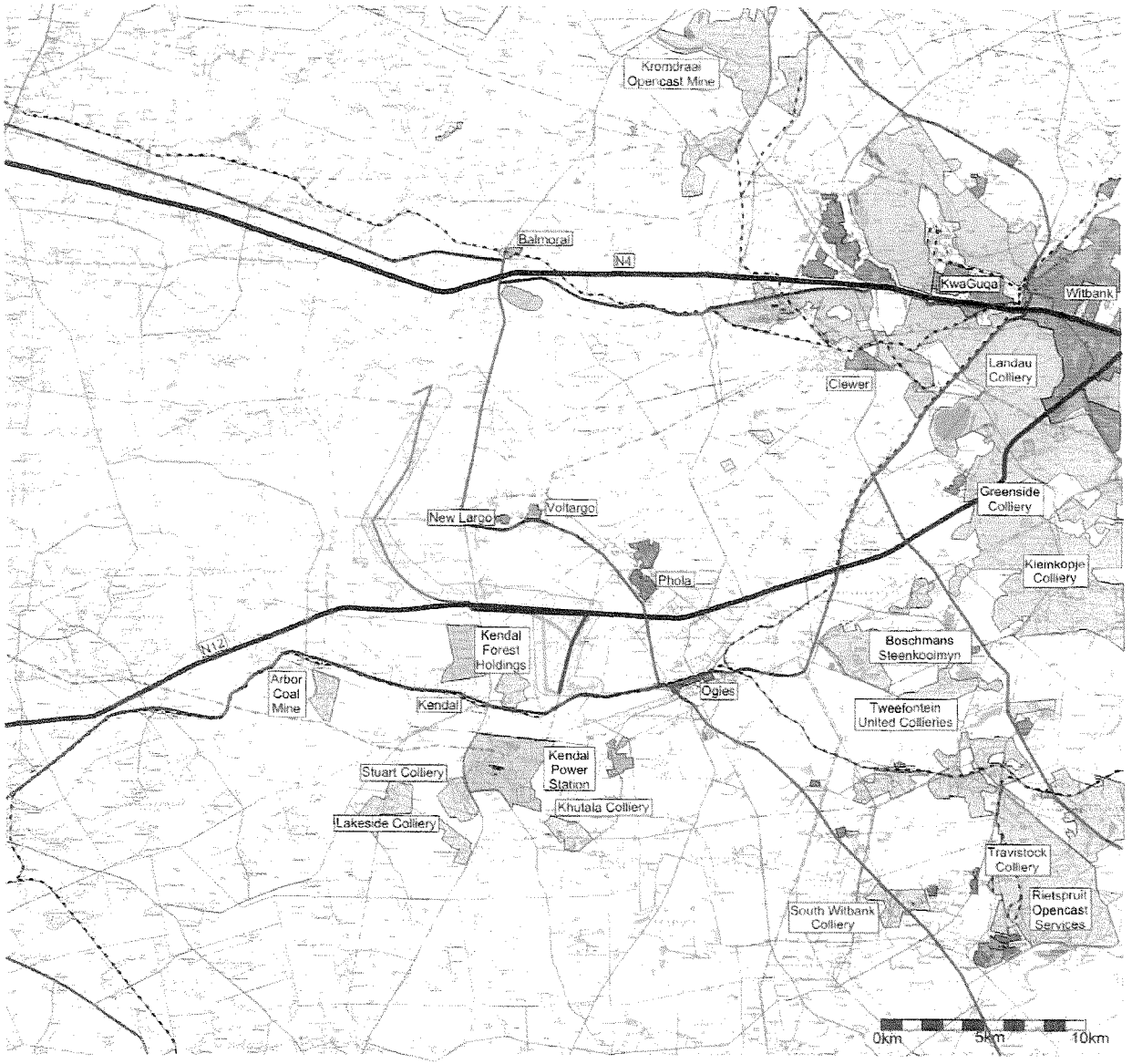


Figure 4: SENSITIVE VIEWERS - Phola-Kusile Coal Conveyor

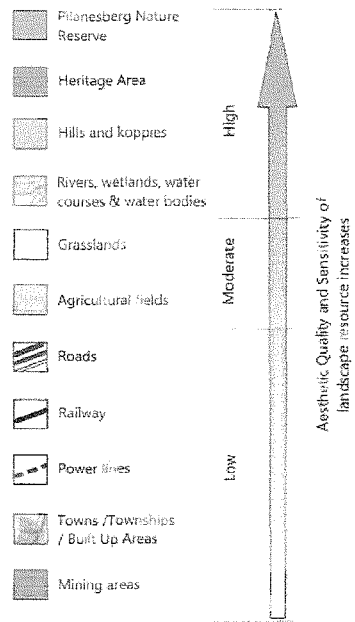
September 2011



LEGEND

- 3.0km Zone of Potential Visual Impact
- Conveyor Route Corridor for Further Investigation
- Proposed Conveyor Route Option 1
- Proposed Conveyor Route Option 2
- Proposed Conveyor Route Option 3

Landscape type characterization



Relative scenic quality rating

Figure 5: VISUAL RESOURCE - Phola-Kusile Coal Conveyor

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View 1: from R545, looking south-west, agricultural fields

View 2: from R545, looking south, agricultural fields to the right (west)

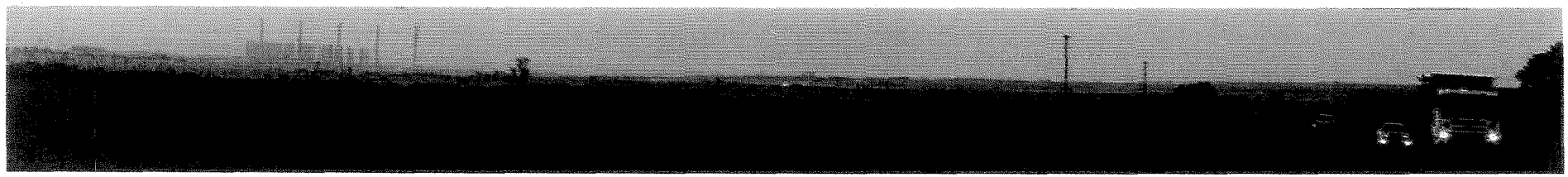
View 3: from N14, looking north, disturbed grasslands, agricultural fields, chicken batries to the right (east)

View 4: from local dirt road, looking north-east, agricultural fields in foreground, disturbed grasslands in middle ground, Kusile Power Station to the far left (west)

Refer to Figure 3 for location of views

Figure 6: LANDSCAPE CHARACTER (Views 1 - 4) - Phola-Kusile Coal Conveyor

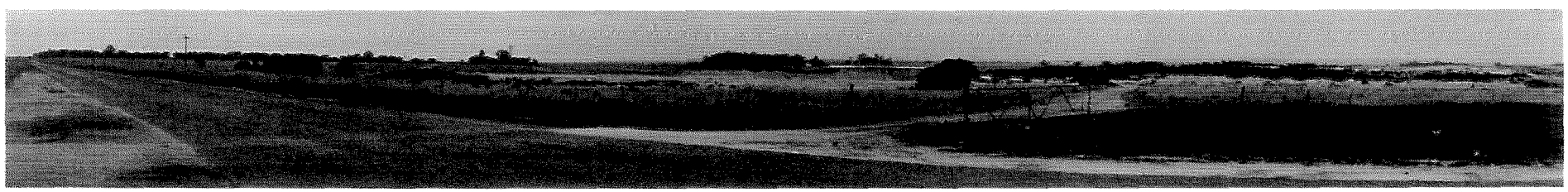
September 2011



View 5: from R545, looking north-west, agricultural fields with disturbed grasslands, Kusile Power Station in center and to the left (west)

View 6: from R545, looking south-west, disturbed grasslands

View 7: from local dirt road, looking north-west, disturbed grasslands



View 8: R545 looking south-west, sand and brick works

Refer to Figure 3 for location of views

Figure 7: LANDSCAPE CHARACTER (Views 5 - 8) - Phola-Kusile Coal Conveyor

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View 9: from local dirt road north of Voltargo, looking west, rehabilitated power station ash dump and foundations of the demolished cooling towers as well as the settlement of Voltargo

View 10: R545 south-west of Phola, looking south-east, across agricultural fields with the settlement of Phola in the middle ground in center and to the left

View 11: from R104, looking south-west towards study site in middle- to background, typical topography of study site

View 12: from R545, looking east, pan (in the middle ground) with typical flat topography of study site

Refer to Figure 3 for location of views

Figure 8: LANDSCAPE CHARACTER (Views 9 - 12) - Phola-Kusile Coal Conveyor

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View 13: from local dirt road in northern section of AAIC Prospecting Area, looking south-west, agricultural fields typical of the study site

View 14: from R545, looking south-west, typical flat topography with agricultural fields

View 15: from R545 near N4, looking south-east, sand mining activities

View 16: from R545, looking north-east across a dam just east of R545

Refer to Figure 3 for location of views

Figure 9: LANDSCAPE CHARACTER (Views 13 - 16) - Phola-Kusile Coal Conveyor

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