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BRAKFONTEIN DUST MONITORING REPORT

UNIVERSAL COAL (PTY) LTD

DECEMBER 2012

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This document has been prepared by **Digby Wells Environmental**.

Report Title: **Brakfontein Dust Monitoring Report**

Project Number: **UNI1292**

Name	**Responsibility**	**Signature**	**Date**
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1 INTRODUCTION

Digby Wells Environmental (Digby Wells) is contracted by Universal Coal (Pty) Ltd Universal Coal to conduct dust monitoring at Brakfontein coal mining project. This report encompasses data for the months of July, August, September and October 2012. The exposure period falls within the recommended exposure period (30±2 days) set out in the new SANS 1137:2012 based on the ASTM D1739-98 (2004).

2 BACKGROUND INFORMATION

The development property is known as Brakfontein Farm 264 IR. The proposed mine is located between the N17 and N12 highways, just north of the R50 road, approximately 70 km east of Johannesburg, in the Nkangala District of the Mpumalanga province. The nearest town is Delmas.

The land-use surrounding the proposed mine is predominantly agriculture with the coal mines in the different stages of project life (in development phase, operational or closed).

3 SCOPE OF WORK

The objectives of the dust fallout monitoring programme are listed below:

- To collect the samples through the use of dust buckets from the various locations;
- To submit the samples for comprehensive analysis;
- To report on the compliance of the analytical results against standards and guidelines in order to identify problem areas and make recommendations for remedial actions;
- To identify areas and sources of pollution; and
- To routinely submit copies of the dust fallout monitoring reports to the client for submission to the relevant government authorities.

4 METHODOLOGY

As a general criterion, generated dust from a source like a factory, plant, or mine rises into the air due to thermal action, wind velocity or by other means. Depending on the particulate size and wind velocity, the dust begins to fall out as soon as the immediate thermal or other effects that lifted the dust are dissipated. The monitoring of fall-out dust utilising the bucket collection is internationally recognised and documented as an accepted method of determining fall-out dust from various sources.

The standard procedure accepted internationally is adopted by the South African National Standard (SANS 1137:2012) "Standard Test Method for Collection and Measurement of Dustfall" (Settleable Particulates Matter). This method uses a passive wet dust collector, which comprises of a vertical pole of ~2 meters above the ground, a 5 litre bucket with a surface area of 227 cm^2 (Lewis, 1983; Lodge 1988). Each bucket contains 4 litre of distilled water to which was added Copper Sulphate - $CuSO_4$ (25 mg-1 solution). The presence of $CuSO_4$ in solution prevents algae growth (Krah et al., 2004).

4.1 Monitoring Sites

The monitoring sites are depicted in the table below and are also presented on the plan in Appendix A.

- There are ten single bucket dust fall (DB) monitoring units (DB1, DB2, DB3, DB4, DB5, DB6, DB7, DB8, DB9, DB11),

The selection of sampling sites was in accordance with the latest SANS 1929:2011 guidelines, which stipulates that, the number of samplers that shall be sufficient to monitor dustfall at representative locations and criteria for site selection around the dust source. This will include monitors located at human residences and sensitive business, industrial or agricultural locations within a maximum distance of two kilometres (km) from the source boundary.

Figure 4-1: Single dust bucket

4.2 Dust Analysis

Gravimetric analysis of the exposed dust fallout buckets for dust deposition rates was completed by an accredited laboratory – Gondwana Environmental Solutions and sent through to Digby Wells Environmental (Pty) Ltd for interpretation. Exposed dust fallout buckets are collected at the end of each month and the dust filtered through a sub-micronic, pre-weighed filter using a vacuum filter bench. The filters are oven dried for about 90 min before cooling in a desiccator for at least an hour (SANS 1137:2012) and then reweighed to ascertain the collected mass (insoluble particulate).

For this monitoring period, the exposure period does comply with the standard operating procedure of 30±2 days (SANS 1137:2012). Data recovery was 100 %, as no incident of theft was recorded and the exposed buckets were all retrieved. The dust deposition records observed are compared against the relevant standard.

On the basis of the cumulative South African experience of dust fall-out measurements, two important new standards in terms of air quality underlying limits for dust fall-out rates have been published. In terms of dust deposition standards, a four-band scale as presented in **Error! Not a valid bookmark self-reference.**, and target, action and alert thresholds and permissible frequency of exceedances given in Table 4-2 is used.

Table 4-1: Four-band scale evaluation criteria for dust deposition (SANS 1929: 2011)

Band Number	Band Description Level	Dust fall rate (D) (mg.m^2.day, 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	2,440 < D	Immediate action and remediation required following the first incidence of dust fall rate being exceeded. Incident report to be submitted to the relevant authority.

Table 4-2: Target, action and alert thresholds for dust deposition (SANS 1929:2011)

Level	Dust fall rate (D) (mg.m^2.day, 30 day average)	Averaging Period	Comment
Target	300	Annual	N/A
Action Residential	600	30 days	Three within any year, no two sequential months.
Action Industrial	1200	30 days	Three within any year, not sequential months.
Alert Threshold	2,400	30 days	None. First incidence of dust fall rate being exceeded requires remediation and compulsory report to the authorities.

An enterprise may submit a request to the authorities to operate within band 3 (action band), for a limited time period, provided that this is essential in terms of the practical operation of the enterprise (for example the final removal of overburden stockpiles during decommissioning) and provided that an appropriate control technology is applied for the duration. No margin of tolerance will be granted for operation that results in dust fall rates which fall within band 4 (alert band).

Dust fallout that exceeds the specified rates, but that can be shown to be the result of some extreme weather or geological event shall be discounted for the purpose of enforcement and control. Such events might typically result in excessive dust fall rates across an entire metropolitan region and not be localized to a particular operation. Natural seasonal variation, for example, the naturally windy months each year, will not be considered extreme events for this definition.

5 RESULTS AND DISCUSSION

The dust deposition rates measured from July to October 2012 are tabulated and illustrated by means of a graph. These results were then further analysed, compared and interpreted according to SANS 1929:2011 “Ambient air quality – limit for common pollutants”.

In terms of dust deposition standards for this study, the guidelines classified the four-band scale evaluation (Gravimetric analysis of the exposed dust fallout buckets for dust deposition rates was completed by an accredited laboratory – Gondwana Environmental Solutions and sent through to Digby Wells Environmental (Pty) Ltd for interpretation. Exposed dust fallout buckets are collected at the end of each month and the dust filtered through a sub-micronic, pre-weighed filter using a vacuum filter bench. The filters are oven dried for about 90 min before cooling in a desiccator for at least an hour (SANS 1137:2012) and then reweighed to ascertain the collected mass (insoluble particulate).

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Table 4-1) and target, action and alert thresholds (Table 4-2) will be applicable in the assessment phase. With regards to the graphs, the purple line represents the limit which the dust fallout levels are permissible for residential and light commercial districts and the light blue line represents the limit which the dust fallout levels are permissible for heavy commercial and industrial districts

5.1.1 Dust fallout results

The results for July to October 2012 are presented in Table 5-1 . The monthly dust deposition rates for the monitoring period per site are illustrated in Figure 5-1. The following buckets were within the INDUSTRIAL threshold of 600 < D <1,200: DB9 (July, August and September), DB11 (July and August) and DB2 and DB7 (August). The remaining dust buckets were within the residential threshold of 600 $mg/m^2/day$ recommended by SANS 1929:2011 standards for the four months under survey.

Table 5-1: Dust fallout results from July – October 2012

Dust levels measured in $mg/m^2/day$				
	July 2012	**August 2012**	**September 2012**	**October 2012**
DB1	75	409	509	522
DB2	426	**841**	332	416
DB3	442	91	259	338
DB4	276	469	166	258
DB5	290	91	309	233
DB6	402	146	588	281
DB7	550	**779**	450	266
DB8	525	547	305	451
DB9	**920**	**770**	**673**	155
DB11	**688**	**644**	361	378

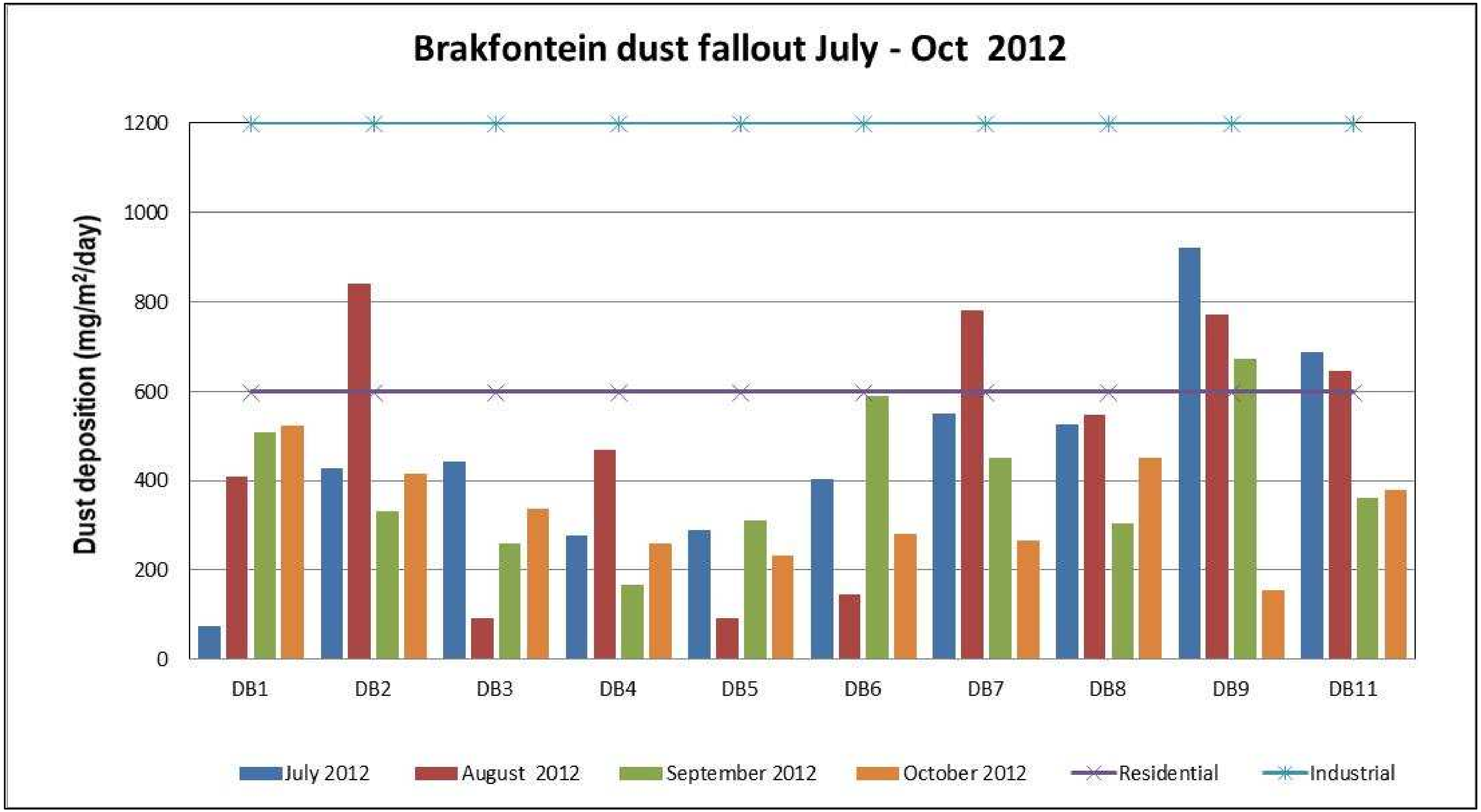

Figure 5-1: Average dust fall out data from July to October 2012

5.1.1.1 July 2012

According to the SANS 1929:2011 standard all the dust buckets recorded levels that fell within the residential threshold except for DB9 and DB11 that were within the INDUSTRIAL threshold recording dust fall rates of **920** mg/m^2/day and **688** mg/m^2/day respectively. The residential threshold level represents the appropriate level for residential districts (Figure 5-1).

5.1.1.2 August 2012

In August, the monitoring sites DB2, DB7, DB9 and DB11 were within the INDUSTRIAL threshold recording dust fall rates of **841** mg/m^2/day, **779** mg/m^2/day, **770** mg/m^2/day and **644** mg/m^2/day respectively. The remaining monitoring sites were within the residential threshold (Figure 5-1).

5.1.1.3 September 2012

In the month of September, the monitoring site DB9 was within the INDUSTRIAL threshold recording dust fall rates of **673** mg/m^2/day. The remaining monitoring sites were within the residential threshold prescribed by SANS 1929:2011 standards (Figure 5-1).

5.1.1.4 October 2012

In the month of October, the dust deposition levels of the monitoring sites were within residential threshold of 600 mg/m^2/day. There was no violation of the prescribed SANS 1929:2011 standards (Figure 5-1).

5.2 Wind field conditions

Wind field plays vital roles in the erosion, dispersion and deposition of dust of fugitive dust i.e. the generation potential, the extent dust can travel downwind and the dilution potential. When wind velocities are higher, elevated dust deposition rates are common.

The wind roses for the monitoring period can be seen in Appendix B and C. Appendix B shows wind direction using average three year modelled data obtained from a point in Brakfontein site. This data has been tested extensively and has been found to be extremely accurate. Appendix C shows wind direction for the months July to October 2012 obtained from the Springs weather station from the South African Weather Services which is approximately 40 km from site.

There is a discrepancy during the monitoring period between the weather directions. Appendix B, the main wind directions are from north, north north west, east and south east with the highest wind speed greater than 8.8 m/s while from Appendix C the main wind directions are from north, north west, south south west and south west with the highest wind speed between 5.7- 8.8 m/s. The calm periods between the two wind roses vary greatly, Appendix B is 7.7% and Appendix C is 23.8%, it is unlikely to have calm winds as high as 24% during this monitoring period in the Highveld area.

5.3 Rainfall

Precipitation reduces erosion potential by increasing the moisture content of materials. This represents an effective mechanism for removal of atmospheric pollutants and is therefore considered during air pollution studies. Rain-days are defined as days experiencing 0.1 mm or more rainfall. The total amount of rainfall received during the monitoring period is 189 mm. The majority of the monitoring sites experienced higher dust fallout during July and August mainly due to lack of precipitation and generally higher wind speeds. The observed trends of lower dust fallout during September and October can be related to the above average precipitation for this time of the year.

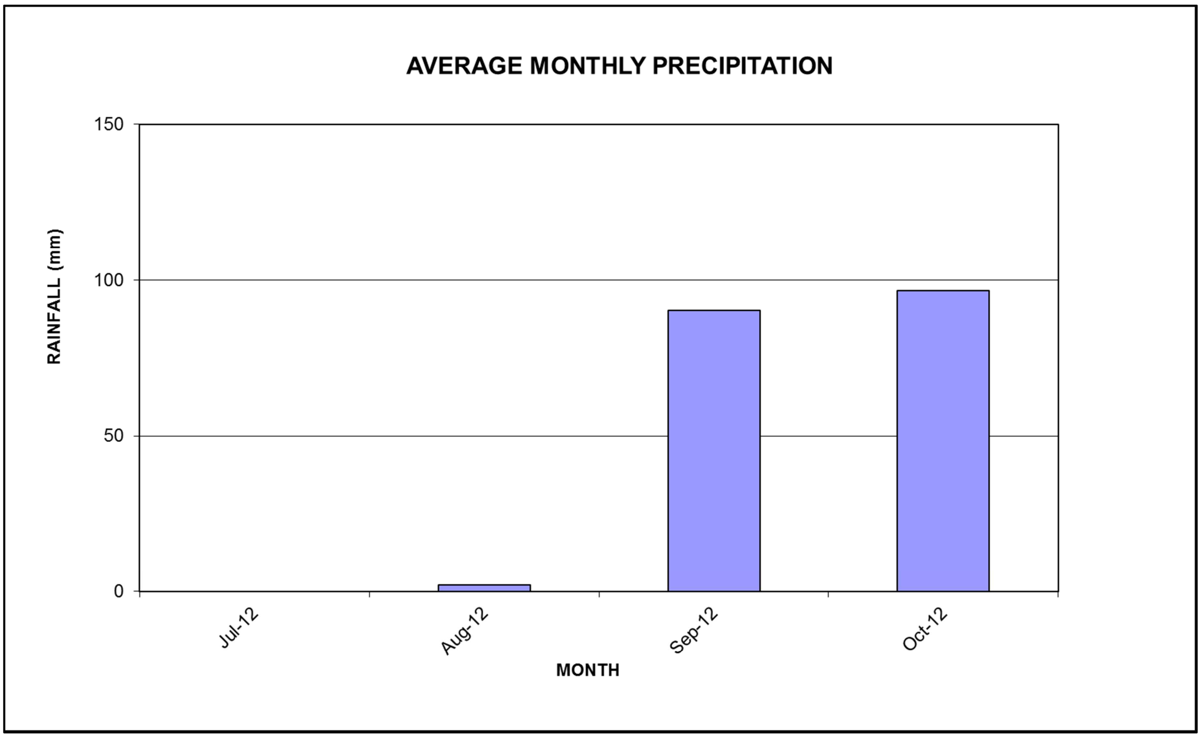

Figure 5-2: Average monthly rainfall July to October 2012

6 CONCLUSION AND RECOMMENDATIONS

During the monitoring period July to October 2012, most monitoring sites were within the residential threshold except for DB2, DB7, DB9 and DB11. DB9. Monitoring site DB9 was within the INDUSTRIAL threshold three of the four monitoring months (July, August and September) and DB11 was within the INDUSTRIAL threshold two of the four monitoring months (July and August). According to the standards, ACTION should be taken as the limit of 600 mg/m^2/day is exceeded three times during a year, DB9 has exceeded the limit for more than two consecutive months already. It is recommended to have a weather station on site.

7 REFERENCE

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Lewis, W. M. (1983). The collection of airborne materials by a water surface. *Limnology and Oceanography* 28, 1242-1246.

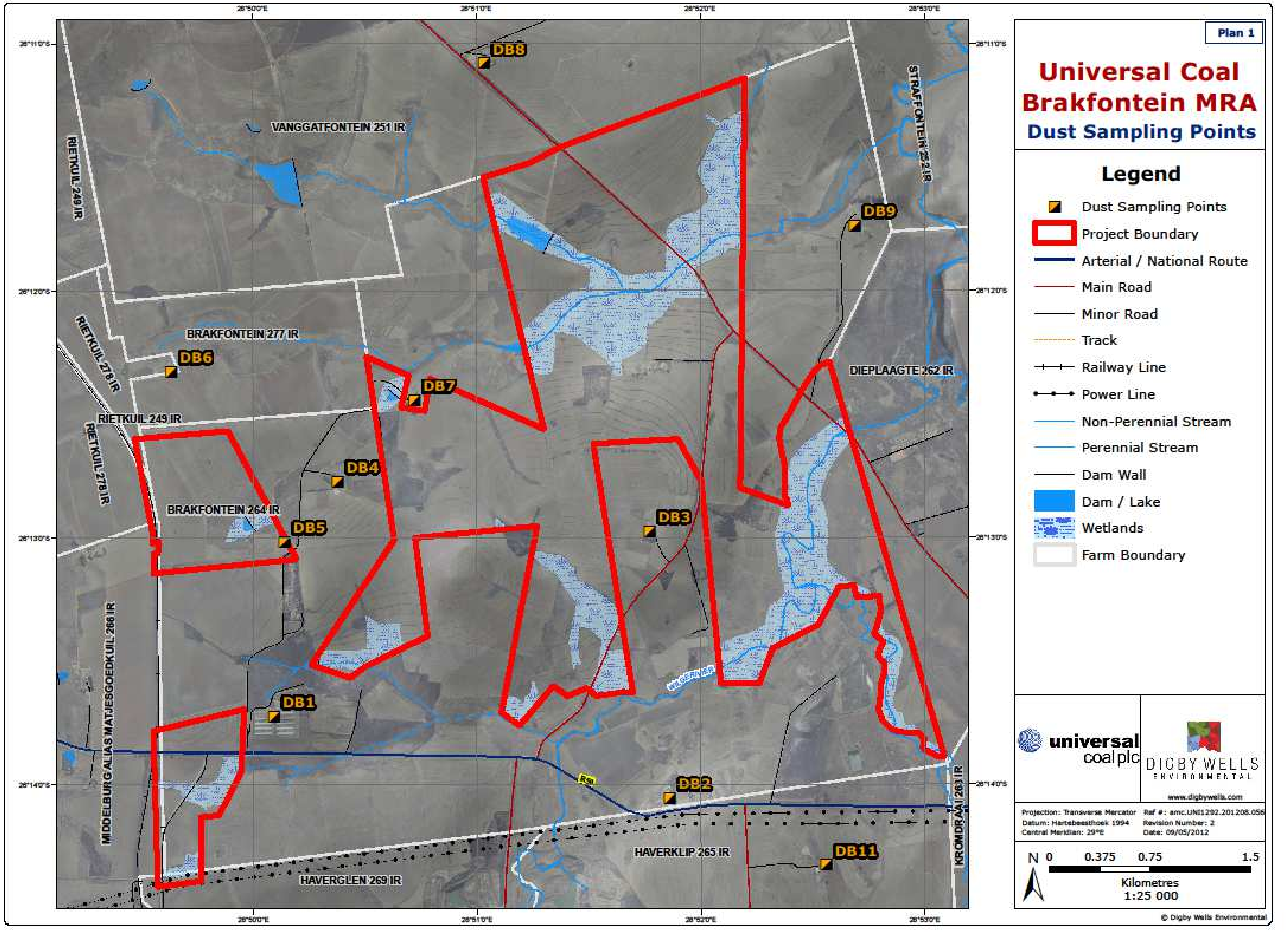
Lodge, J. P. (1998). *Methods of Air Sampling and Analysis*. Lewis Publishers, Chelsea.

National Environmental Management: Air Quality Act, 2004 (Act.39 of 2004) (NEMAQA)

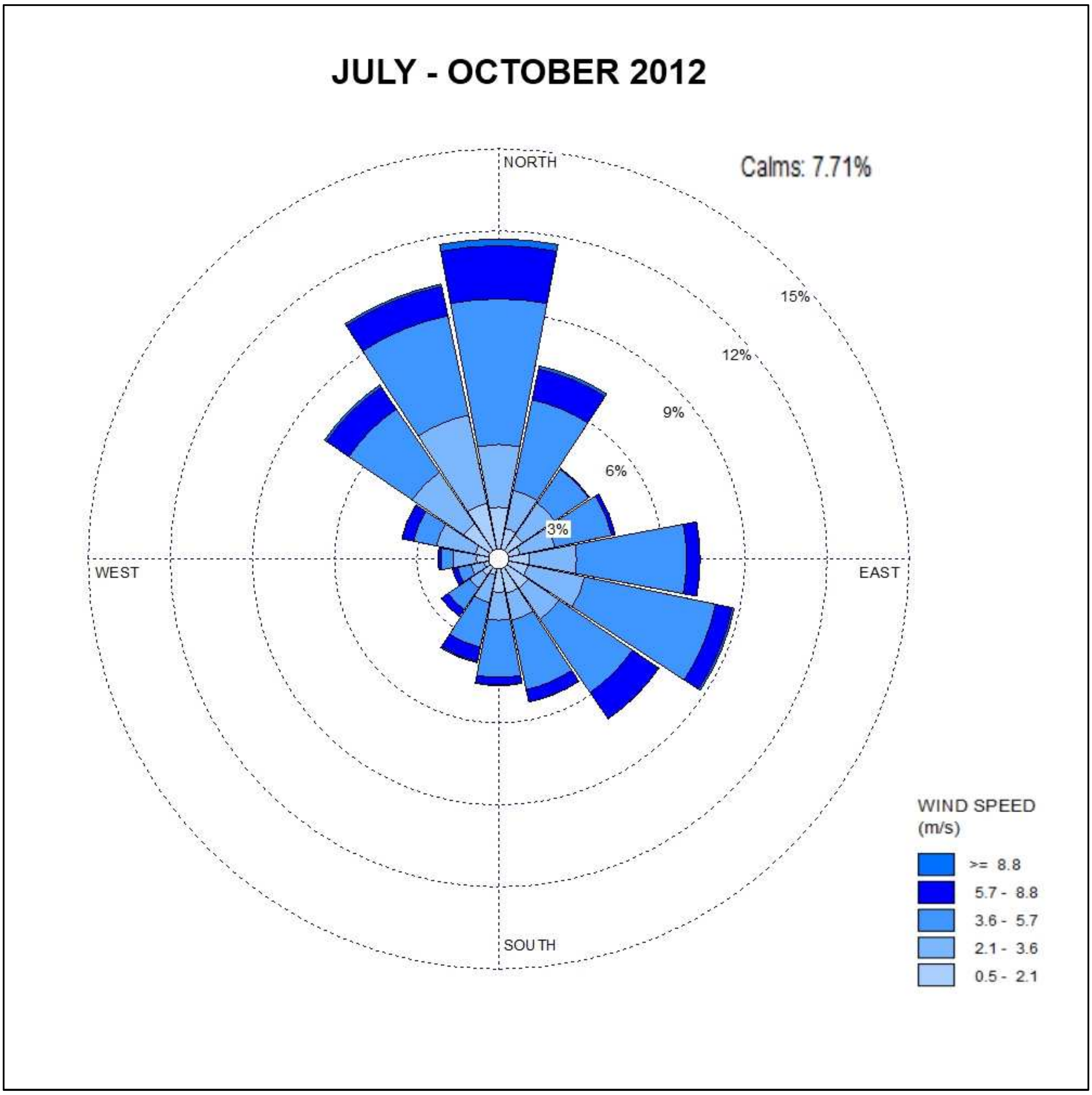
SANS D113:2012 - Standard Test Method for Collection and Measurement of Dust fall (Settleable Particulate Matter).

South African National Standard (SANS) code of practice, SANS 1929:2011, Ambient Air Quality – Limits for common pollutants.

Appendix A: Dust Sampling Points


Plan 1
Universal Coal
Brakfontein MRA
Dust Sampling Points
Legend
Dust Sampling Points
Project Boundary
Arterial / National Route
Main Road
Minor Road
Track
Railway Line
Power Line
Non-Perennial Stream
Perennial Stream
Dam Wall
Dam / Lake
Wetlands
Farm Boundary
universal coal plc
DIGBY WELLS ENVIRONMENTAL
N 0 0.375 0.75 1.5
Kilometres
1:25 000
© Digby Wells Environmental
DB1
DB2
DB3
DB4
DB5
DB6
DB7
DB8
DB9
DB11
VANGGATFONTEIN 251 IR
BRAKFONTEIN 277 IR
BRAKFONTEIN 264 IR
RIETKUIL 249 IR
RIETKUIL 278 IR
DIEPLAAGTE 262 IR
STRAFFONTEIN 252 IR
HAVERKLIP 265 IR
HAVERGLEN 269 IR
KROMDRAAI 263 IR
MIDDELBURG ALIAS MATJESGOEDKUIL 266 IR

Appendix B: Wind Rose (3 year modelled data 2009 - 2011)



Appendix C: Wind Roses (South African Weather Services July – October 2012)