Project done on behalf of
Exxaro Resources Limited

ADDENDUM:
AIR QUALITY IMPACT ASSESSMENT FOR THE PROPOSED BELFAST PROJECT, MPUMALANGA

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1 INTRODUCTION

Dispersion simulations were executed incorporating all significant sources for the proposed Belfast Project during 2011 construction phase and proposed 2016 operational phase. The predicted concentrations for thoracic particulates less than 10 µm in diameter (PM10) and dustfall levels were discussed in the main report. Compliance assessment was based on the available ambient standards published for South Africa. However, since the assessment of the Belfast Air Quality Study (undertaken in December 2009), updated ambient air quality standards for South Africa were published (Gazette No.: 32816, 24 December 2009). The updated PM10 standards issued nationally are documented in Table 1.

Table 1: National air quality standard for inhalable particulates less than 10 µm in diameter (PM10)

Authority	Maximum 24-hour Concentration (µg/m³)	Annual Average Concentration (µg/m³)
SA standards (Government Gazette No. 32816)	120 (a)	60
SA standards (Government Gazette No. 32816)	75 (b)	40

Notes:
(a) Not to be exceeded more than 4 times per year. Applicable immediately to 31 December 2014.
(b) Not to be exceeded more than 4 times per year. Applicable from 1 January 2015.

In addition, a number of air-quality related concerns and issues have been raised by interested and affected parties. These issues and concerns are addressed in the following section.

2 AIR-QUALITY RELATED ISSUES AND CONCERNS RAISED

Table 2 and Table 3 provides the air-quality related issues raised by interested and affected parties.

Table 2: Air-quality related issues and queries that were raised by Joubert (27/12/2009)

CONCERNS	COMMENTS
Scope change of mining activities	
In the previous public participation meeting that was held on the 4 of August 2009, the coal was to be transported by railway up to the northern side which seems not to be the case anymore, if it was transported up to the northern side it would have had a lesser impact on our farm and ourselves?	The impact assessment was undertaken assuming the coal would be transported via road. If the coal were to be transported via rail, the impacts from transport would be significantly reduced.
Air Quality	
What will be done regarding the smell? Since your activities are only +- 300m away from our home and with discard and coal stockpiles that might start burning. In the meeting I was told that there will be fly-overs with infra red cameras which will indicate heating up of stockpiles, as well as proper compaction. I am still concerned about what will be done, even if the chances are very slim, if the stockpiles or any other flammable material do start to burn?	There are various mitigation measures for the spontaneous combustion of coal and these include: 1. Avoidance of particle segregation as segregation encourages air introduction. 2. Proper pile compaction as this will reduce air movement within the pile. 3. Proper pile height. For short –term storage without compaction, a maximum pile height of about 8 metres is recommended. 4. Sealing the pile with pile sealers and encrusting agents to minimise air ingress and movement within the pile. 5. Storage site should be free of debris including combustible materials such as timber 6. A solid pile base without uncompacted material is critical to prevent air infiltration. 7. Coals of different ranks and propensities should not be stacked together. 8. Differently sized coals should not be stacked together unless fines content is sufficient to fill void spaces. 9. Shielding from the wind as a greater pile slope creates greater wind resistance, forcing air into the pile. Shielding the windward side of the pile will minimise air movement through the pile as spontaneous combustion typically occurs on the windward side of the pile. 10. Reducing initial coal temperature as higher initial coal

CONCERNS	COMMENTS
	temperatures reduce the amount of time required to reach critical temperatures where spontaneous combustion rapidly accelerates. It is not recommended to store coal above 35°C without compaction and a pile sealer. Correct stockpile formation and maintenance practices can largely eliminate the potential for spontaneous combustion during storage. However, if spontaneous combustion does occur even with the application of the above-mentioned mitigation measures, fire fighting measures that can be implemented include the use of the following: • Water can be effective at fighting coal fires. However, water alone is not recommended. The surface tension of water does not allow it to penetrate deep below the coal's surface and reach the fire unless large quantities are injected. • Wetting agents as these allow water to penetrate the material by reducing the surface tension of the water. They extinguish by cooling. • Micelle-encapsulating agents- these agents, when used with water, are the extinguishing media of choice for coal fires and for flammable liquids fires. They suppress fires by interrupting the free radical chain reaction of the fire tetrahedron. • Other agents such as CO_2 and N_2 have been tried as fire-suppression agents but have not proven effective. Reasons include their poor cooling capacity and their general inability to maintain proper concentration levels in bunkers and silos. Accordingly, these agents require extended use —for hours or even days—depending on the quantity of the coal burning and the complexity of the fire. Independent testing has shown that the effectiveness of gases is a function of fuel geometry, the stage of the fire, the tightness of the enclosure and the duration of application

CONCERNS	COMMENTS
	For spontaneous combustion within the mining area, the most effective form of control is by covering the area with soil so as to smother the combustion source.
According to your slide show/impact assessment findings dust will still be a problem to the people staying close by, even after mitigation measures will be put in place. What are the plans with people and animals residing in the dust area, especially the PM10 area?	The air quality impact assessment indicates that the predicted dust fallout levels with and without mitigation measures are below the SANS residential target of 600 mg/m²/day. The main objective for the mine, as stated in the impact study, will be to ensure that monitored dust fallout levels at the sensitive receptor areas do not exceed the SANS residential target and that mitigation measures should be applied to further reduce dust impacts and ensure compliance with this target. There are, however, exceedances of the SA daily PM10 standard at sensitive receptors within close proximity to the proposed mining operations (refer to Section 2.2 of the addendum). As these are legally binding ambient standards, these residences should be relocated or the mine must ensure compliance of the ambient standards at the sensitive receptors.
Clean air. According to the scoping report we are situated within the PM 10 region, even after mitigation, as founded in specialist report. What will be done if any person or animal do get sick as a result from the mining activities.	Mitigation measures should be applied as soon as the mining operations commence in order to reduce cumulative impacts due to background pollution levels and mining impacts. In addition, residences within predicted non-compliance areas (refer to Section 2.2 of the addendum) should be relocated or the mine must ensure compliance of the ambient standards at the sensitive receptors.

Table 3: Air-quality related issues and queries that were raised during a public meeting held in Belfast (03/03/2010)

NAME	DETAIL	RESPONSE	COMMENTS
KP	– How many litres/m^3/hour of water are required to achieve 75% dust suppression efficiency?	Marsh	Already included in specialist study. Section 9.5.4. (Issues and Response Report)
		Airshed	As calculated and provided in Section 9.5.4. of the Air Quality Assessment report, the watering rate required on in-pit and haul roads in order to obtain 75% control efficiency is 0.069 l/m²/hour.
RJ	– Indicated that the report showed three sensitive receptors. How were these chosen? – Indicated that he lives on the farm adjacent to where the crusher is planned and that the southern receptor in the report is located 3km to the south of his property.	Airshed	The sensitive receptors were provided for the air quality assessment. The assessment has since been updated with sensitive receptors identified from Google satellite imagery and cross-referenced with structural references from the blast specialist assessment. See Section 2.1 and Section 2.2 of the addendum.
LP	– Committed to the confirmation of the identification of sensitive receptors. – Indicated that the study would have to be updated to address the issue.	Airshed	The assessment has been updated with sensitive receptor map. See Section 2.1 and Section 2.2 of the addendum.
FK	– Queried what kind of study was undertaken.	Marsh	Included in specialist report. (Issues and Response Report)

NAME	DETAIL	RESPONSE	COMMENTS
		Airshed	Quantitative study that was undertaken, where dust dispersion was modelled.
FK	– Wanted to know that if the modelling is wrong, would the dust fallout be detrimental to humans, animals, plants. Indicated that plants were sensitive to dust deposition. – Concerned about the effects on plants, animals and sensitive ecosystems.	Airshed	Airshed provided a literature review of the effects of particulate matter on vegetation, animals and humans (refer to Section 2.3 of the addendum)
JN	– Indicated that animals and humans relied on vegetation and stated his concern that the specialist cannot give an answer with regards to the impacts of dust on vegetation.		
KP	– Asked how much water would be required for 75% dust suppression. – Indicated that the report mentioned 500m^3/day required for dust suppression and would like to know where the figure came from.	Marsh	Addressed in specialist report. Section 9.5.4 (Issues and Response Report)
		Airshed	As calculated and provided in Section 9.5.4. of the Air Quality Assessment report, the watering rate required on in-pit and haul roads in order to obtain 75% control efficiency is 0.069 l/m^2/hour is required. The figure of 500m^3/day did not come from the air quality report, and thus Airshed cannot comment on this figure.

NAME	DETAIL	RESPONSE	COMMENTS
KP	– Asked whether the only method of dust suppression was using water.	Marsh	Addressed in meeting. (Issues and Response Report)
		Airshed	Airshed suggested that water suppression could be used to obtain control efficiencies on fugitive dust sources and provided watering rates that would be required. However, other mitigation measures such as chemical suppressants are also available as mentioned in Section 9.5.4.1 of the air quality study.
KP	– Indicates that the types of chemical suppressants to be used are not mentioned in the report. – Indicated that in the report stated that where there was more than 8mm of rain a 24-hour period then no dust	Marsh	Addressed in specialist report. Section 9.5.4. (Issues and Response Report)

NAME	DETAIL	RESPONSE	COMMENTS
	suppression would be required. Asked whether this amount would be sufficient for example if the amount of dew in the morning was 8mm, or is the 8mm considered over a period of time. – Wanted to know whether the specialist agree that if 8mm of rainfall in a 24-hour period is sufficient to suppress dust.	Airshed	The type of chemical suppressants that may be used is discussed in Section 9.5.4.1 of the air quality report. The rainfall of 8mm is not stated in the air quality report and airshed could thus not comment on this figure. In order to calculate the watering rate required for haul roads, evaporation and rainfall for the area is considered. This is then factored in with the amount of vehicles that will be travelling on roads to determine the amount of water required (refer to Section 9.5.4.1 of the air quality report).
		Exxaro	Dust suppression would be ongoing

NAME	DETAIL	RESPONSE	COMMENTS
KP	– Stated that weather data from the Rietvallei South African Weather Station (SAWS) was used in the modelling. Wanted to know if the specialist knew where the Rietvallei SAWS was situated and how far from the Belfast project area it was situated. – Wanted to know what the height difference between the Rietvallei SAWS and the mine was. – Wanted to know whether Airshed was 100% sure whether the weather data from Rietvallei was applicable to the Belfast Project area. – Indicated that there is a station on the other side of the N14. – Asked whether the information from the Glisa mine weather station was used.	Airshed	A detailed discussion of the meteorological data utilised for the assessment is given in Section 2.4 of the addendum.
KP	– Asked how the dust generated from blasting will be mitigated.	Airshed	Thoroughly wetting down an area surrounding the blast before a blast will help settle dust from previous operations from becoming airborne. Uniform rock moisture content of only 1% greatly reduces dust compared to dry rock both before and after a blast.

NAME	DETAIL	RESPONSE	COMMENTS
KP	– Indicated that the Belfast Project would not be the only mine in the area. Wanted to know what the current dust levels in the area are. – Asked whether the cumulative impacts of the dust from other mines were assessed.	Airshed	As discussed under the limitations section (Section 1.4) of the air quality study, no ambient monitoring data was available for the assessment. Cumulative impacts could therefore not be assessed for the current study with predicted concentrations limited to incremental impacts from the Belfast mining activities only.
KP	– Indicated that family member suffer from asthma and wanted to know whether sensitive receptors with asthma would be affected by high levels of PM10. – Understands how the guidelines are established, but wants to know whether high levels of PM10 generated by the operation would cause a sensitive receptor in the project area to have an asthma attack.	Airshed	Discussion on findings from literature is provided in Section 2.3.3 of the addendum.
KP	– Asked whether Airshed had received a study by Professor Naidoo on the impacts of coal dust on vegetation in Richards Bay terminal.	Airshed	Discussion on findings from the study is provided in Section 2.3.1 of the addendum.
KP	– Asked whether the roads on which the trucks would travel to and from the mine were assessed.	Marsh	Addressed in meeting. (Issues and Response Report)
		Airshed	The access road to the mine has been assessed (Section 7.1.2 of the air quality study)
KP	– Wanted to confirm that the Wonderfontein road had not been assessed.	Airshed	Confirmed that this was the case

NAME	DETAIL	RESPONSE	COMMENTS
KP	– Asked whether I&AP were consulted during the study. – Asked whether I&AP were asked about sensitive receptors.	Marsh and Specialists	Map of sensitive receptors to be prepared by Marsh and issued to all specialist for inclusion. Specialists to update report with this additional information. (see Section 2.1 and Section 2.2 of the addendum)
KP	– Asked whether there was uranium in the coal dust.	Airshed	Uranium content for the coal dust was not provided to Airshed for the air quality assessment. Analysis of the coal should be undertaken to confirm the Uranium content.

2.1 Sensitive Receptors

Sensitive receptors close to the proposed mine site include various scattered farmsteads and the larger residential area of Belfast (located ~10km to the north east). The locations of the sensitive receptors were obtained from Google satellite imagery and cross-referenced to structural locations provided by the Blast Specialist: Dannie Zeeman.

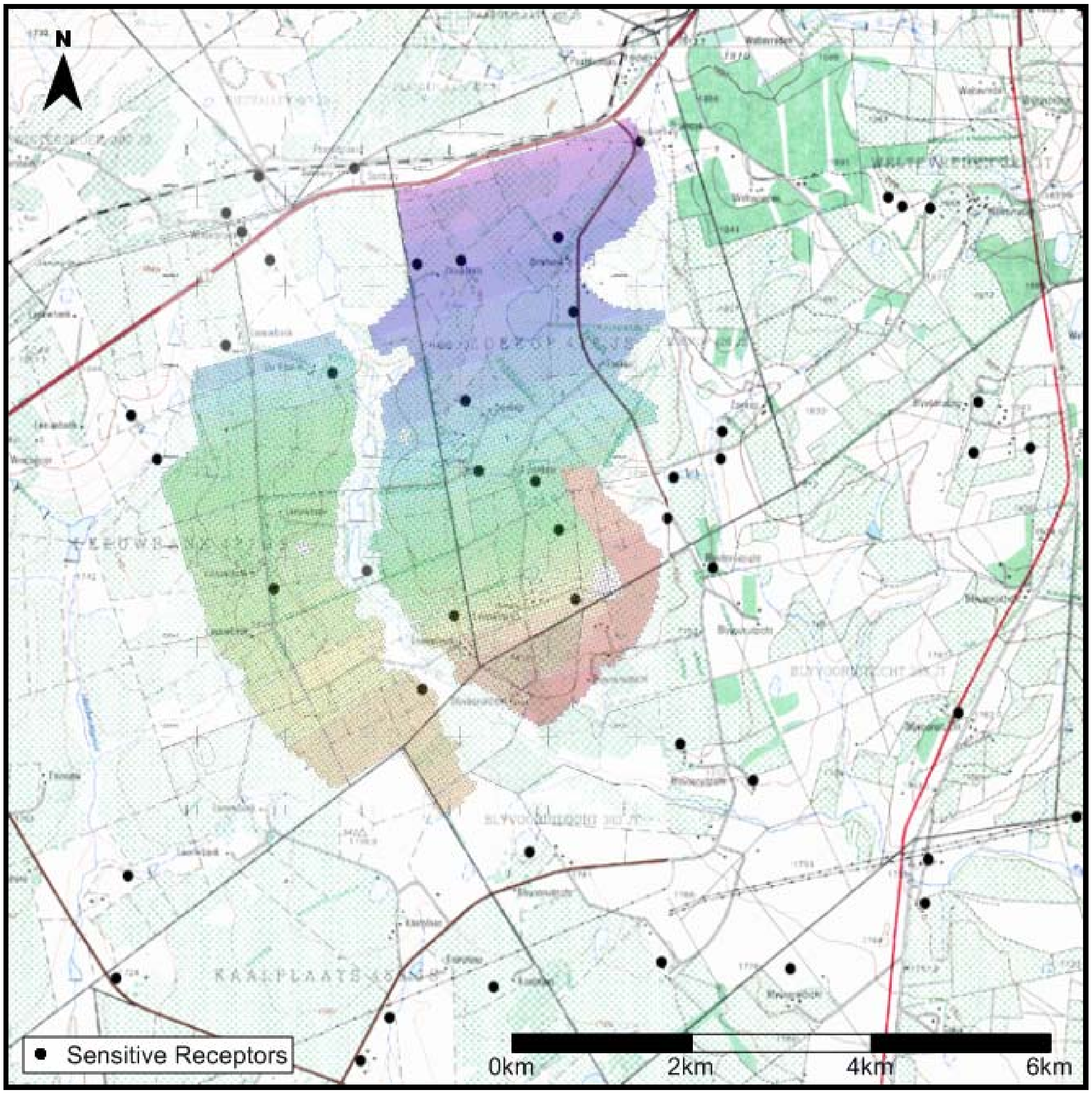

Figure 1: Location of the sensitive receptor areas in relation to the proposed Belfast Project mine site.

2.2 Impact and Compliance Assessment

2.2.1 Dispersion Model Results

Simulations were undertaken to determine particulate matter (PM10) concentrations and total daily dust deposition from proposed construction and operational activities at the proposed Belfast Mine. Unfortunately measured background ambient PM10 concentrations were not available for the current study and cumulative impacts could thus not be assessed. Impacts provided in the current section are thus due to Belfast operations only.

Two scenarios were assessed, i.e. construction operations (2011) and 5 years into operation (2016). Although the operational phase is only representative of operations during the period 2016, it captures the impacts from the main haul roads to the waste stockpiles as well as the crusher activities, which are the main sources of impact due to operational activities at Belfast Colliery. The plots provided for the relevant pollutants of concern during the construction and operational phases are given in Table 4.

Table 4: Isopleth plots presented in the current section.

Phase	Pollutant	Averaging Period	Figure
Construction	PM10	Highest daily	2,3
		Annual average	4,5
	TSP	Maximum deposition	6,7
Operation	PM10	Highest daily	8,9
		Annual average	10,11
	TSP	Maximum deposition	12,13

2.2.2 Compliance Assessment

In determining compliance of predicted PM10 impacts to SA standards, reference needs to be made to applicable limit values as well as allowable frequency of exceedances. The current and proposed SA standards allow for 4 exceedances per calendar year of the SA daily limit. Impacts due to construction phase (2011) were compared to current SA standards (applicable immediately to 31 December 2014) with impacts from operational phase (2016) compared to SA Standards (applicable 1 January 2015).

Areas of non-compliance for construction phase (2011) are provided in Figure 14 and Figure 15 with area of non-compliance for operation phase (2016) provided in Figure 16 and Figure 17.

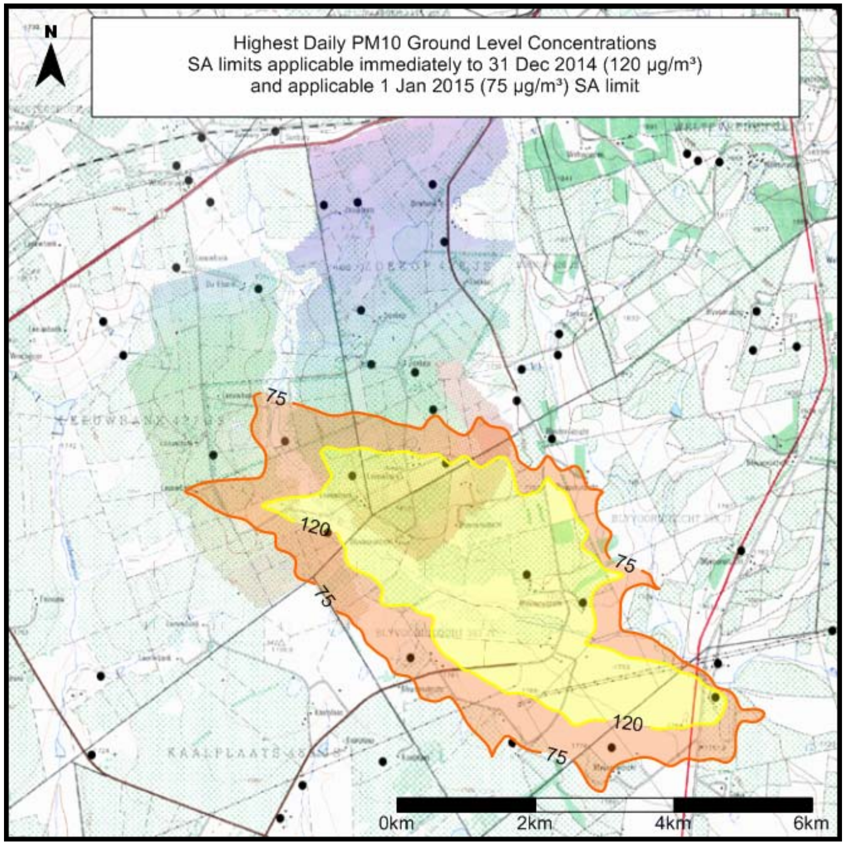

Figure 2: Highest daily PM10 ground level concentrations due to construction operations (2011), assuming uncontrolled emissions.

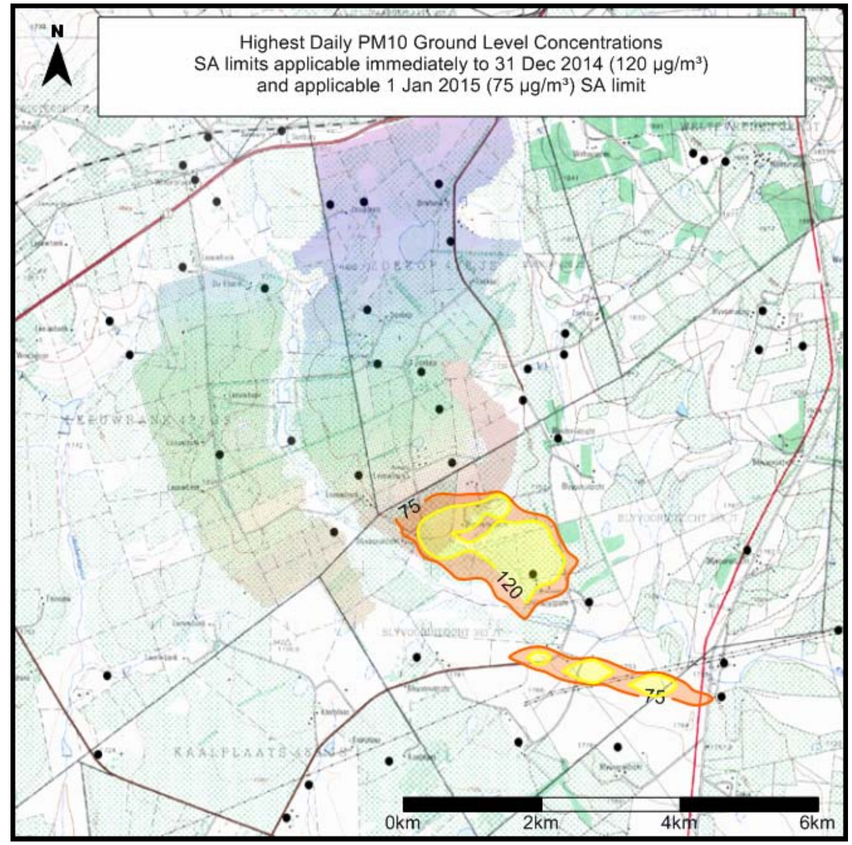

Figure 3: Highest daily PM10 ground level concentrations due to construction operations (2011), assuming 75% control efficiency on haul roads and controlled crusher emissions.

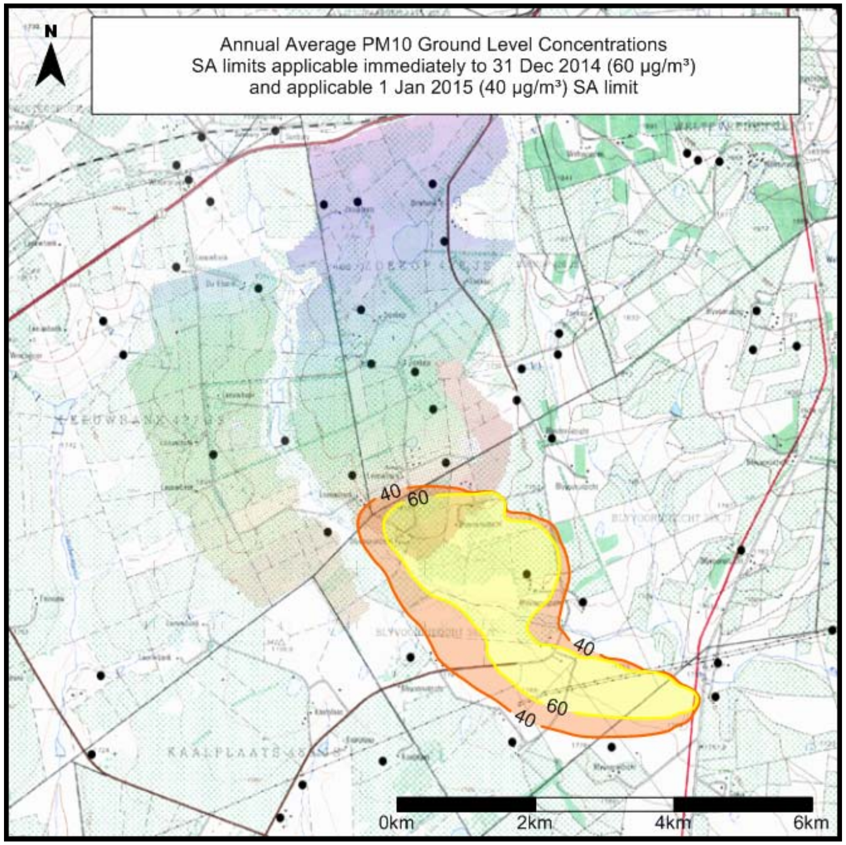

Figure 4: Annual average PM10 ground level concentrations due to construction operations (2011), assuming uncontrolled emissions.

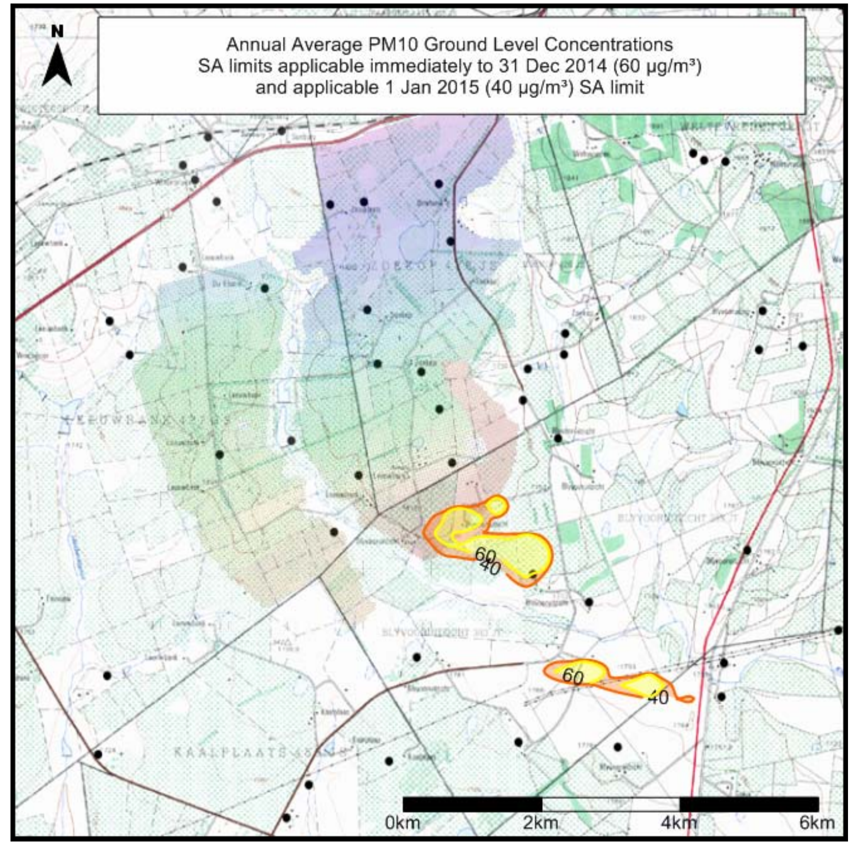

Figure 5: Annual average PM10 ground level concentrations due to construction operations (2011), assuming 75% control efficiency on haul roads and controlled crusher emissions.

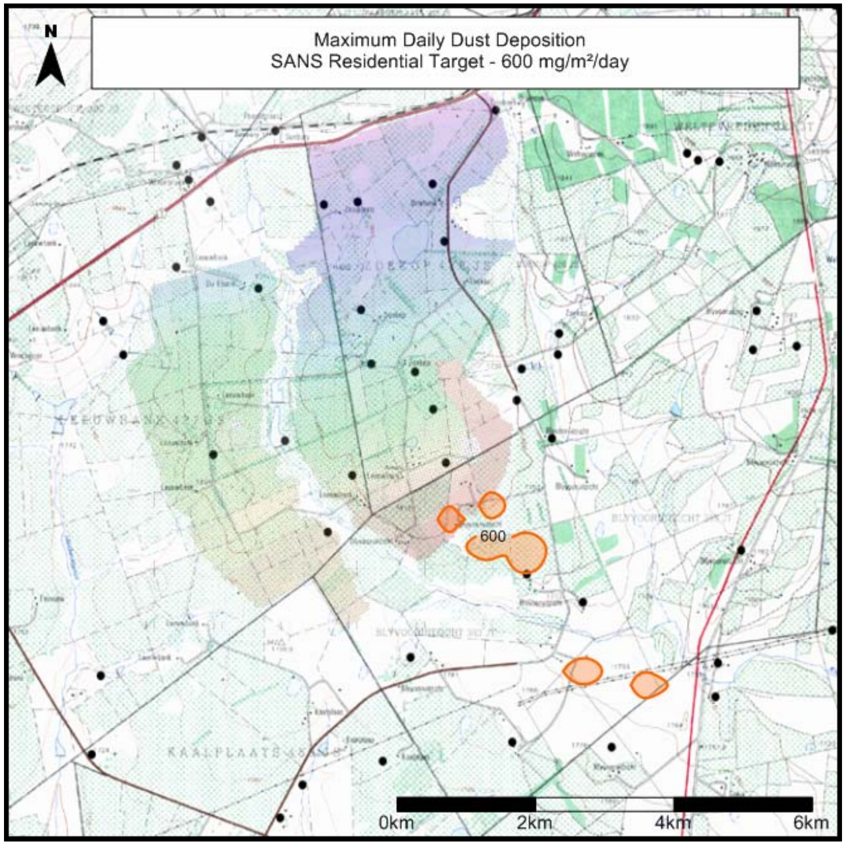

Figure 6: Maximum daily dust deposition due to construction operations (2011), assuming uncontrolled emissions.

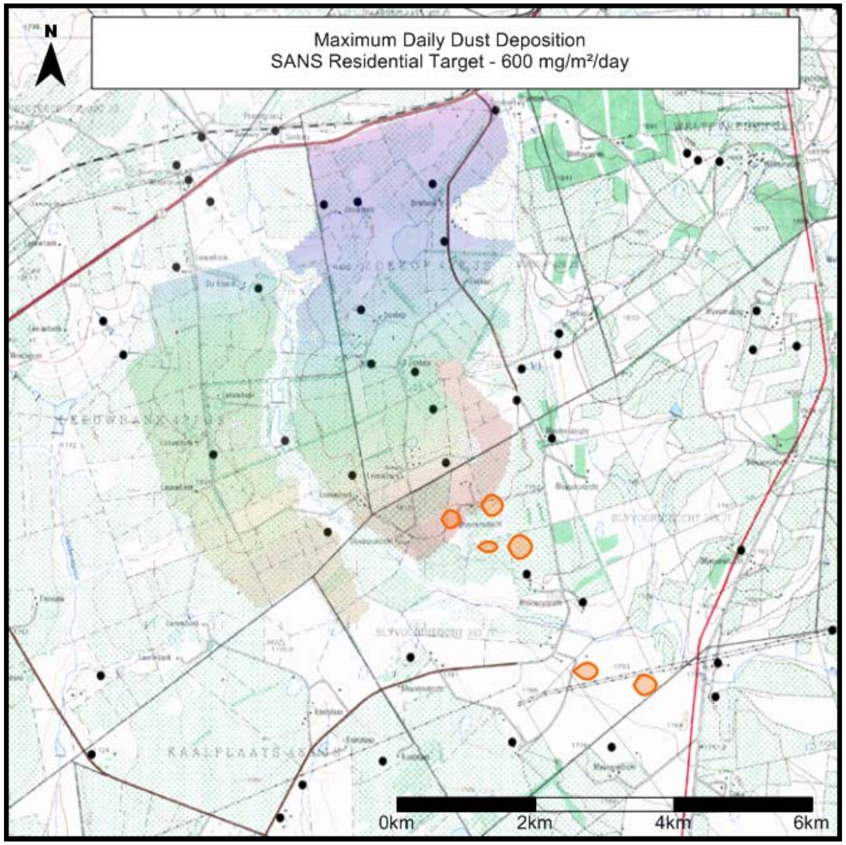

Figure 7: Maximum daily dust deposition due to construction operations (2011), assuming 75% control efficiency on haul roads and controlled crusher emissions.

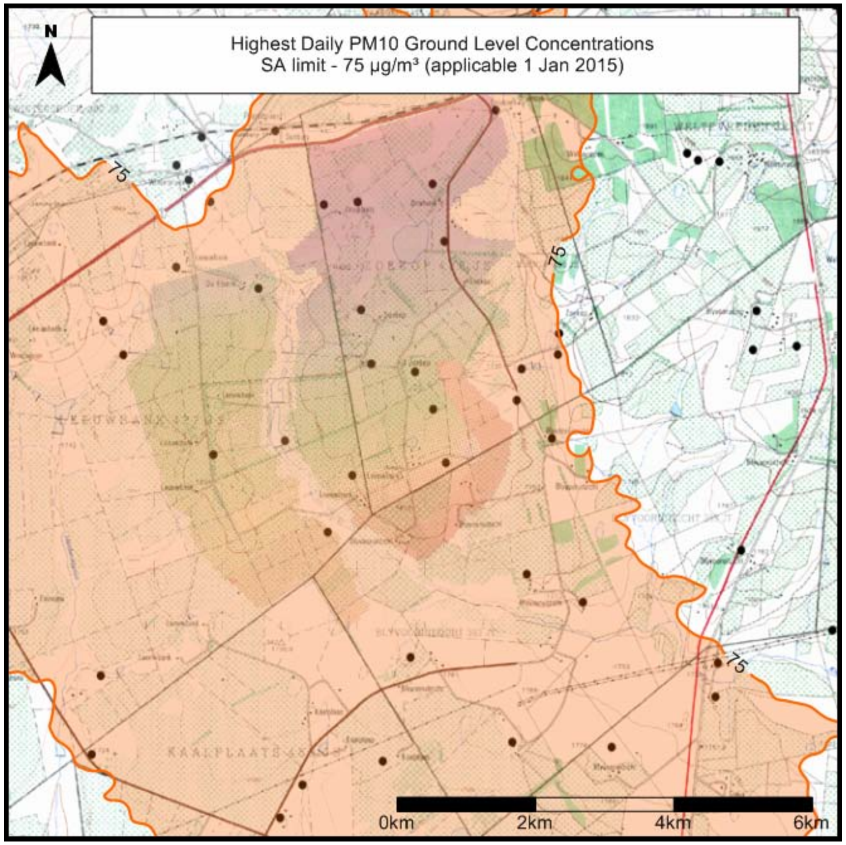

Figure 8: Highest daily PM10 ground level concentrations due to operations at Belfast Colliery (2016), assuming uncontrolled emissions.

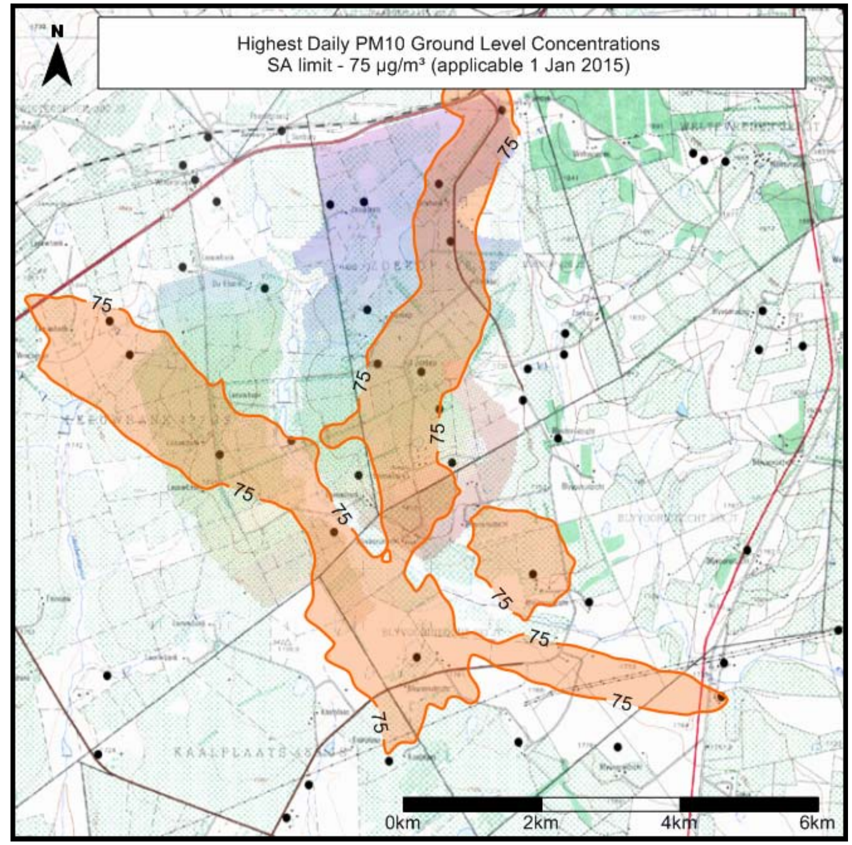

Figure 9: Highest daily PM10 ground level concentrations due to operations at Belfast Colliery (2016), assuming 75% control efficiency on haul roads and controlled crusher emissions.

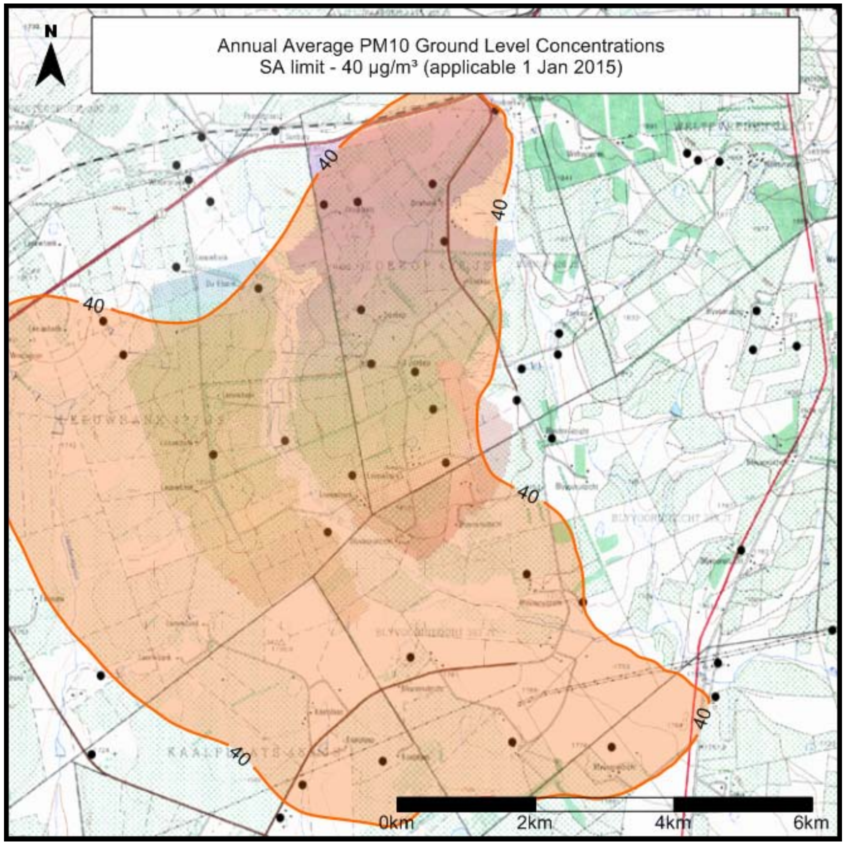

Figure 10: Annual average PM10 ground level concentrations due to operations at Belfast Colliery (2016), assuming uncontrolled emissions.

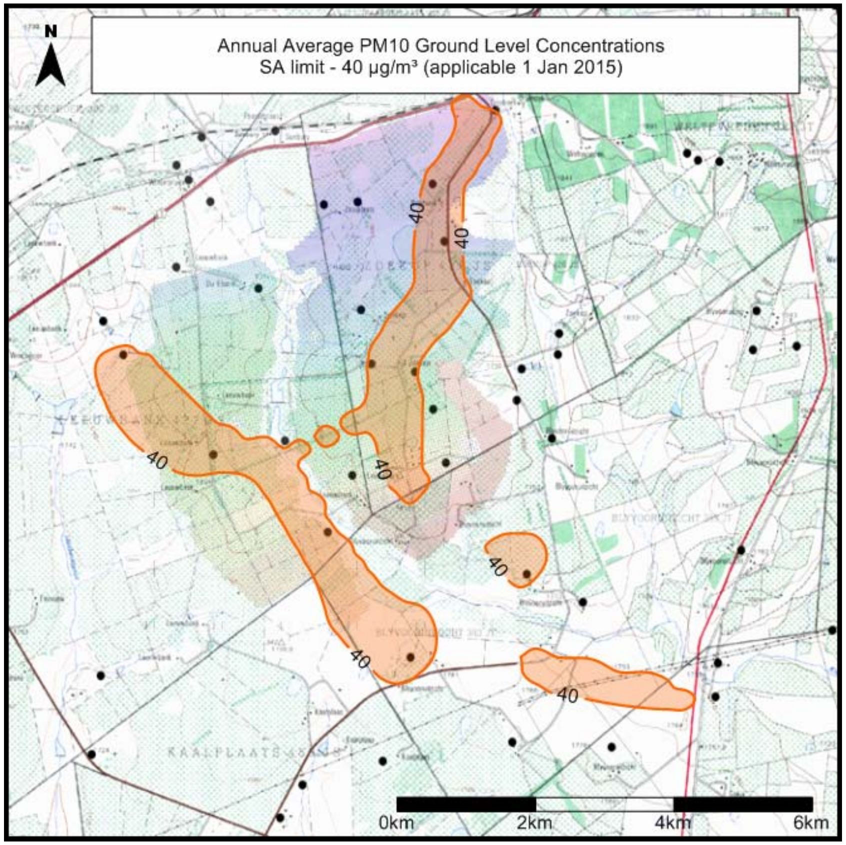

Figure 11: Annual average PM10 ground level concentrations due to operations at Belfast Colliery (2016), assuming 75% control efficiency on haul roads and controlled crusher emissions.

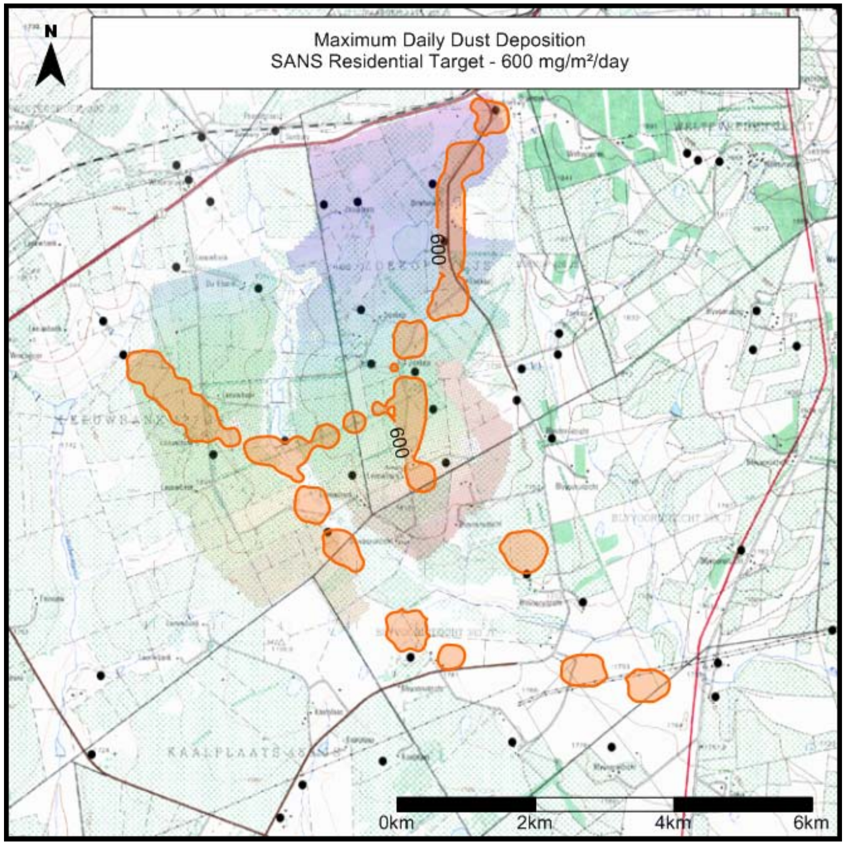

Figure 12: Maximum daily dust deposition due to operations at Belfast Colliery (2016), assuming uncontrolled emissions.

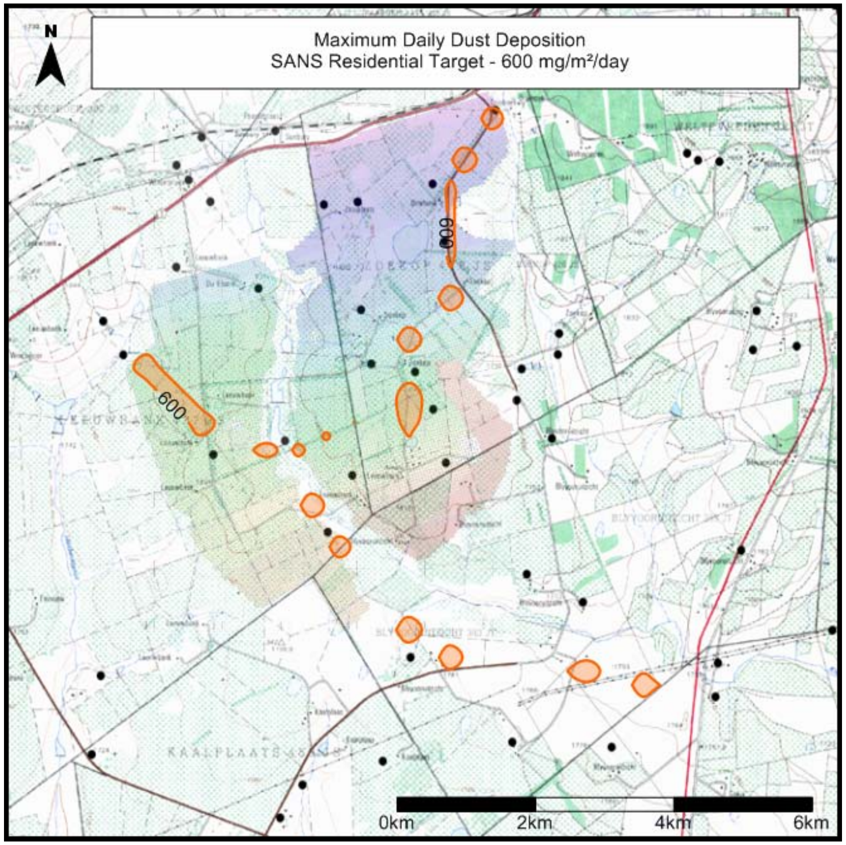

Figure 13: Maximum daily dust deposition due to operations at Belfast Colliery (2016), assuming 75% control efficiency on haul roads and controlled crusher emissions.

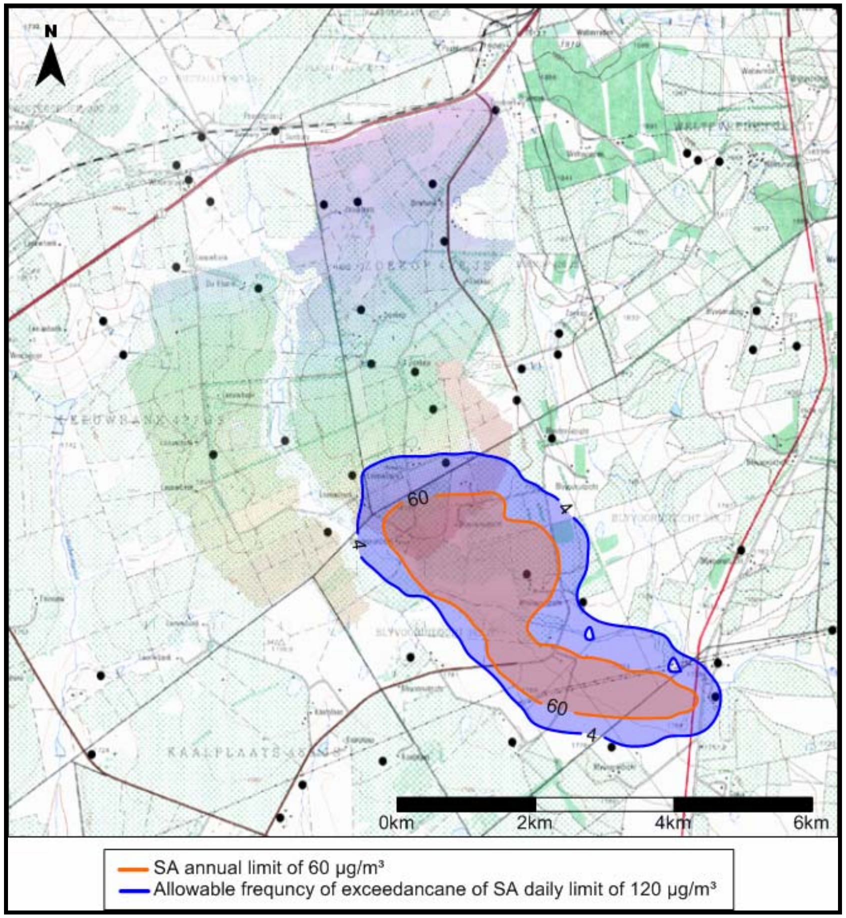

Figure 14: Area of non-compliance of the SA standard for construction phase (2011), assuming uncontrolled emissions.

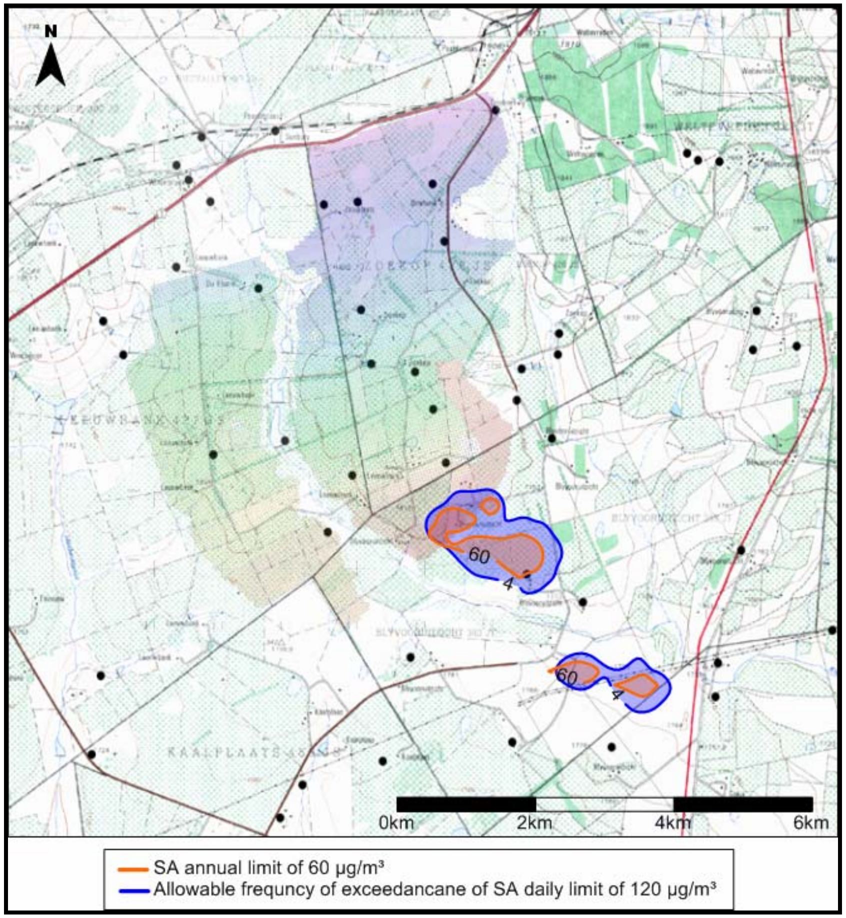

Figure 15: Area of non-compliance of the SA standard for construction phase (2011), assuming 75% control efficiency on haul roads and controlled crusher emissions.

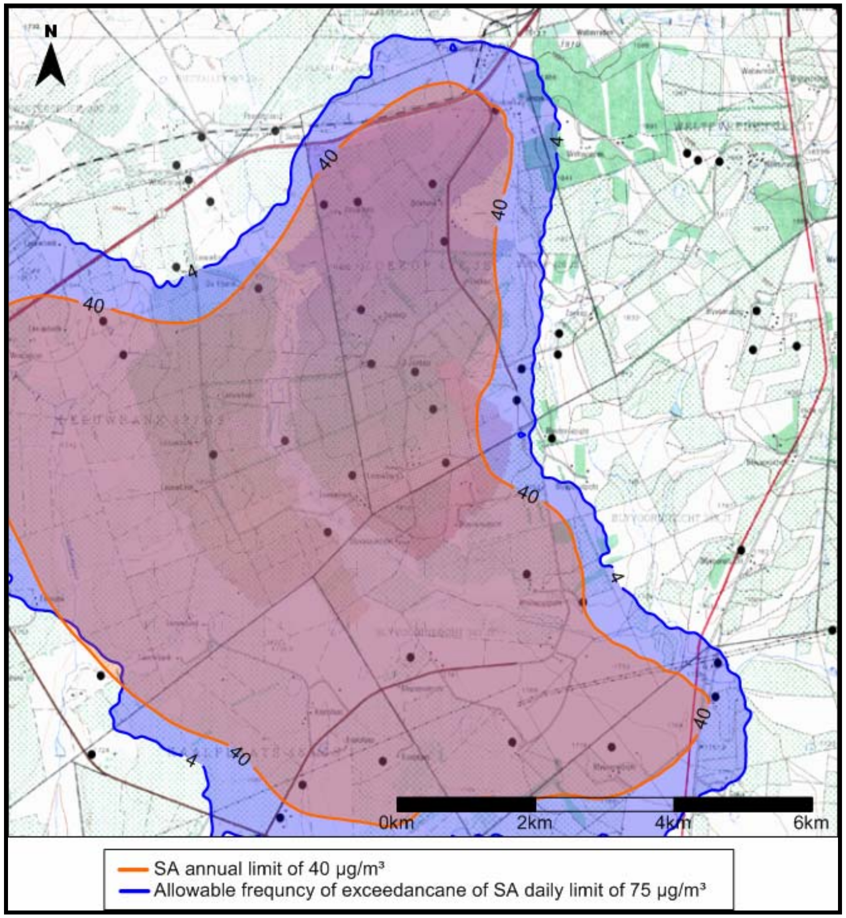

Figure 16: Area of non-compliance of the SA standard for operation phase (2016), assuming uncontrolled emissions.

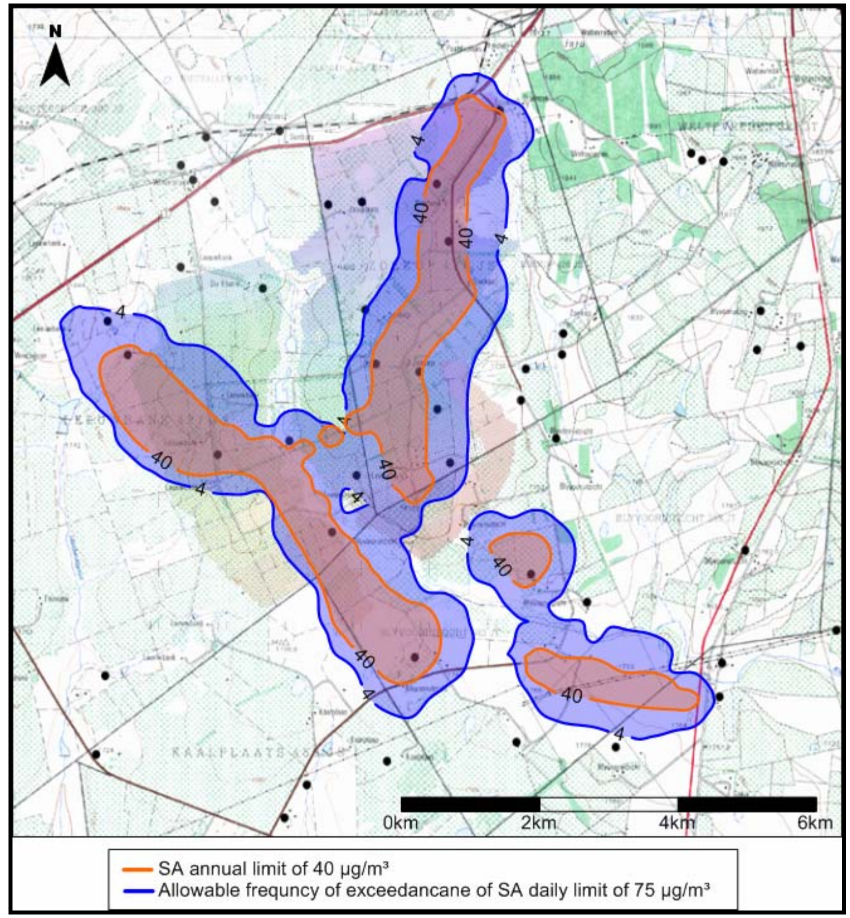

Figure 17: Area of non-compliance of the SA standard for operation phase (2016), assuming 75% control efficiency on haul roads and controlled crusher emissions.

2.2.3 Recommendations

Areas of non-compliance of the SA PM10 standards are provided in Figure 14 to Figure 16. As these are legally binding ambient standards, residences that are in non-compliance areas should be relocated or the mine must ensure compliance of the ambient standards at the sensitive receptors. It is therefore recommended that ambient PM10 monitoring be undertaken at sensitive receptors in the vicinity of mining operations to verify that these areas are within compliance of SA standards.

2.3 Effect of Dust on Vegetation, Animals and Human Health

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 et al, 2005). Heavy loads of particle can also result in reduced light transmission to the chloroplasts and the occlusion of stomata (Harmens et al, 2005; Naidoo and Chirkoot, 2004, Hirano et al, 1995, Ricks and 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).

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).

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);
- 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;
- production of lung cancer (a particle and/or chemical effect).

The epidemiological finding of an association between 24 hour ambient particle levels below 100 µg/m^3 and mortality has not been substantiated by animal studies as far as PM10 and PM2.5 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 PM2.5 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.

2.3.3 Effect of Particulate Matter on Human Health (Specifically for Asthmatics)

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

PM10 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 PM10, which is a complex mixture of particle types. PM10 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 PM10- 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 5.

Table 5: 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, influenze 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 astma, 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 cancer	Observed in broad-based cohorts or samples of adults and children (including infants). All chronically exposed are potentially affected.	Long-term repeated exposure appears to increase the risk of cardiopulmonary disease and mortality. May result in lower 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)

2.4 Meteorological data

Meteorological data from the Rietvallei South African Weather Service (SAWS) station was used in the dispersion modelling for the proposed Belfast Project. The weather station is located ~6.5km to the north of the proposed site.

Glisa Colliery (located ~8km to the northeast of the proposed Belfast Project site) also has an operational weather station. However, meteorological data from this weather station was not utilised as it is located further north from the proposed Belfast Project site (Figure 18). It has also been stated that Exxaro has a weather station located on the other side of the N14. This data however, is of poor quality with calibration of the station not undertaken on a regular basis.

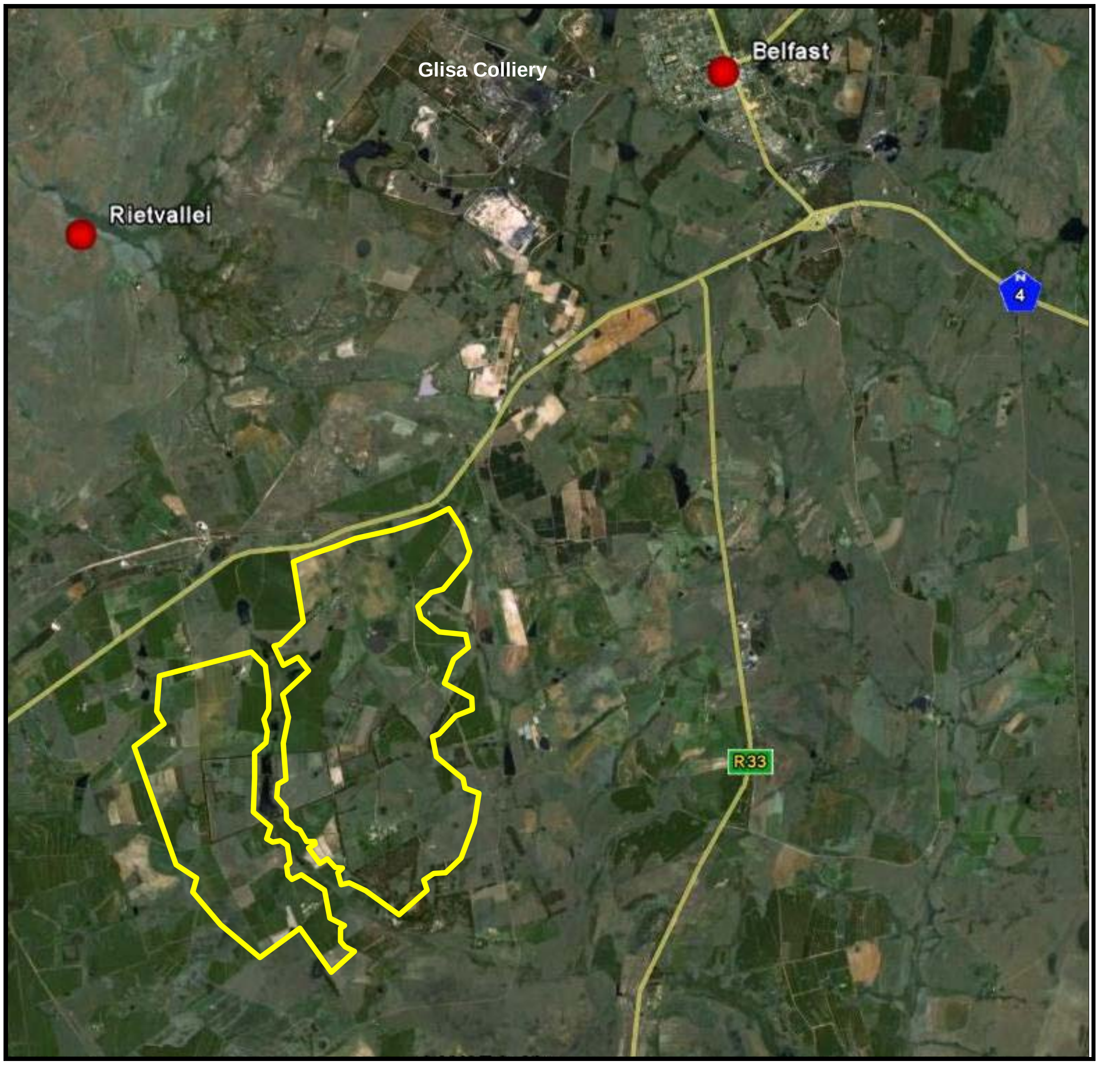

Figure 18: Locations of the proposed Belfast Project site, Rietvallei SAWS and Glisa Colliery.

Concern was raised as to the Rietvallei data being representative of the meteorological conditions of the Belfast mining site. The difference in altitude between the Rietvallei SAWS station site (1674 masl) and the proposed Belfast site (~1825 masl) is ~150m. The slope between the two sites is thus ~0.023. The study area is therefore not representative of complex terrain and thus will not experience topographically induced airflow. The meteorological data at Rietvallei (having high data quality and availability) will thus be representative of the study site.

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