DIGBY WELLS
ENVIRONMENTAL

Integrated Environmental Impact Assessment for the Proposed Palmietkuilen Coal Mining Project near Springs, Gauteng

Noise Impact Assessment Report

Project Number:

CNC4065

Prepared for:

Canyon Coal (Pty) Ltd

October 2016

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I, Lukas Sadler as duly authorised representative of Digby Wells and Associates (South Africa) (Pty) Ltd., hereby confirm my independence (as well as that of Digby Wells and Associates (South Africa) (Pty) Ltd.) and declare that neither I nor Digby Wells and Associates (South Africa) (Pty) Ltd. have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of Canyon Coal (Pty) Ltd, other than fair remuneration for work performed, specifically in connection with the proposed development of an opencast coal mine and associated infrastructure, located near Springs, Gauteng Province.

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EXECUTIVE SUMMARY

Pandospan (Pty) Ltd (Pandospan) concluded a contract with Anglo Operations (Pty) Limited (AOL) in support of the acquisition of a Prospecting Right for coal (DMR Ref. No. GP 30/5/1/1/2 (201/10026) PR). Pandospan forms part of the Canyon Group of Companies for which Canyon Coal functions as the operational division. The enviro-legal applications for the project will be managed by Pandospan on behalf of AOL, the Project applicant.

Pandospan is planning the development of a new open pit coal mining operation located near Springs within the Gauteng Province to be known as the Palmietkuilen Coal Mining Project. A coal processing plant and associated infrastructure will also be constructed. The Project is a greenfields development planned on Portions 1, 2, 4, 9, 13 and 19 of the Farm Palmietkuilen 241 IR.

Coal mining will be undertaken by conventional truck and shovel operations. Run of mine (RoM) coal will be processed at the proposed plant on site and sold to local and export markets.

The Project covers an area of approximately 3 422 hectares (ha), located entirely within the Sedibeng District Municipality. The northern Project boundary lies on the Mpumalanga and Gauteng provincial boundary, and the western boundary also lies on the boundary between the Ekurhuleni District Municipality and the Sedibeng District Municipality. The Site is on the border of Gauteng and Mpumalanga, in the Sedibeng District Municipality and the Lesedi Local Municipality. The project borders the Ekurhuleni Metropolitan Municipality (Gauteng) and the Nkangala District Municipality and the Victor Khanye Local Municipality (Mpumalanga).

This report relates specifically to the environmental noise impacts of the proposed project. The immediate area surrounding the project is classed as mainly rural because of the predominant agricultural activities that take place in the immediate area with urban and suburban areas towards the town of Springs. The approach used in investigating the noise impacts is based on the Gauteng Noise Control Regulations GenN 5479 of 1999 and the National Noise Control Regulations, R.154 of 10 January 1992 (the Noise Regulations) in terms of Section 25 of the Environmental Conservation Act, 1989 (Act No. 73 of 1989). Both the Gauteng and National Noise Control Regulations are relevant due to the project, which is located within the Gauteng Province, bordering the Mpumalanga Province. The Mpumalanga Province does not have Provincial Noise Control Regulations that are promulgated as yet and therefore adheres to the National Noise Control Regulations.

This environmental noise impact assessment report forms part of the Environmental Iimpat Assessment (EIA) and Environmental Management Plan (EMP) report and entails the following tasks:

- Identification of noise sources and potential noise sensitive receptors;
- Establishment of the existing noise climate at various locations surrounding the project through the undertaking of baseline noise measurements;
- Assessment of the anticipated noise impacts associated with the project activities during the construction, operational, decommissioning and post-closure phases; and
- Recommending mitigation and management plans to minimise the expected impact.

The baseline ambient day and night time soundscape ranges between 44dBA and 54dBA and mainly typical of rural districts with intermittent road traffic. Based on the daytime results from the noise measurements it is noted that the L_{Aeq} levels predominantly measured above the SANS guideline for the maximum allowable outdoor daytime rating level for ambient noise in rural districts (45dBA), with the background noise levels (L_{A90}) measuring below the daytime rating level guideline for rural districts (45dBA). Based on the night time results from the noise measurements it is noted that the L_{Aeq} levels predominantly measured above the SANS guideline for the maximum allowable outdoor night time rating level for ambient noise in suburban districts (40 dBA) as well as rural districts (35dBA), with the background noise levels (L_{A90}) ranging from below to similar to the night time rating level guideline for suburban districts (40dBA).

As per the results of the noise dispersion models, it is concluded that the noise from the proposed construction and operational activities, mainly the construction and operational activities related to the open cast pit and northernmost hard overburden dump footprint as well as haul route to the siding, is likely to impact on certain receptors in the Mpumalanga Province. The noise from the proposed construction and operational activities will not significantly increase the existing background noise levels at the surrounding chicken broiler and egg producing businesses and is therefore unlikely to impact on these receptors.

The construction and operational activities relating to the open cast pit and northernmost hard overburden dump is likely to impact on the homestead directly to the north adjacent to the gravel road on the provincial border. The construction and operational activities related to the haul route to the siding is likely to impact on the small holdings community (Prosperity AH) on route to the siding. The mentioned activities are likely to impact during the daytime as well as night time, with sleep disturbance being of concern.

If, however, the recommended mitigation and management measures are implemented the impact can be reduced to a minor significance.

It is recommended furthermore that Pandospan implement a noise monitoring plan to validate determine whether the post mitigation activities are with in compliance of the National Noise Control Regulations as well as to validate the noise modelling results.

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LIST OF ACOUSTIC TERMS & ACRONYMS

Abbreviation	Description
Acronyms and Abbreviations	
L_{eq}	It is the Sound Pressure Level in dB, equivalent to the total Sound Energy over a given period of time.
A-weighting	the A-weighting filter covers the full audio range - 20 Hz to 20 kHz and the shape is similar to the response of the human ear at the lower levels
L_{Aeq}	A-weighted, equivalent sound level. A widely used noise parameter describing a sound level with the same Energy content as the varying acoustic signal measured
L_{A90}	It is the noise level exceeded for 90% of the measurement period. This noise level is extensively used as indicator for the background noise as it excludes impulsive and erratic noise sources.
Ambient Noise	Is the noise from all sources combined − mining noise, traffic noise, birdsong, running water, etc.
Residual Noise	It is ambient noise without specific noise. The residual noise is the noise remaining at a point under certain conditions when the noise from the specific source is suppressed.
Intermittent Noise	When machinery operates in cycles, or when single vehicles or aeroplanes pass by, the noise level increases and decreases rapidly. A single passing vehicle or aircraft is called an event.
Impulsive Noise	The noise from impacts or explosions, e.g., from blasting, is called impulsive noise. It is brief and abrupt, and its startling effect causes greater annoyance than would be expected from a simple measurement of sound pressure level.
Specific Noise	It is the noise from the source under investigation. The specific noise is a component of the ambient noise and can be identified and associated with the specific source.
Noise Level	Means the reading on an integrating impulse sound level meter taken at a measuring point in the presence of any alleged disturbing noise at the end of a total period of at least 10 minutes, after such meter had been put into operation, and, if the alleged disturbing noise has a discernible pitch, to which 5 dab has been added.
Disturbing Noise	Means 'n noise level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more.

1 Introduction

Pandospan (Pty) Ltd (Pandospan) concluded a contract with Anglo Operations (Pty) Limited (AOL) in support of the acquisition of a Prospecting Right for coal (DMR Ref. No. GP 30/5/1/1/2 (201/10026) PR). Pandospan forms part of the Canyon Group of Companies for which Canyon Coal functions as the operational division. The enviro-legal applications for the project will be managed by Pandospan on behalf of AOL, the Project applicant.

Pandospan is planning the development of a new open pit coal mining operation located near Springs within the Gauteng Province to be known as the Palmietkuilen Coal Mining Project. A coal processing plant and associated infrastructure will also be constructed. The Project is a greenfields development planned on Portions 1, 2, 4, 9, 13 and 19 of the Farm Palmietkuilen 241 IR.

Coal mining will be undertaken by conventional truck and shovel operations. Run of mine (RoM) coal will be processed at the proposed plant on site and sold to local and export markets. Key infrastructure will include:

- Open pit mining;
- Processing plant and fuel storage;
- Haul roads from pit to plant and from plant to mine access point, and various conveyor belts;
- Various overburden dumps and ROM Stockpile Area;
- Pollution control dam, stormwater trenches and sewage management systems; and
- Site offices and security offices.

1.1 Project Overview

The Project covers an area of approximately 3 422 hectares (ha), located entirely within the Sedibeng District Municipality. The northern Project boundary lies on the Mpumalanga and Gauteng provincial boundary, and the western boundary also lies on the boundary between the Ekurhuleni District Municipality and the Sedibeng District Municipality. The site is on the border of Gauteng and Mpumalanga, in the Sedibeng District Municipality and the Lesedi Local Municipality. The project borders the Ekurhuleni Metropolitan Municipality (Gauteng) and the Nkangala District Municipality and the Victor Khanye Local Municipality (Mpumalanga).

The coordinates of the centre point of the Project area are 26° 15’ 07.073” S and 28° 33’ 39.643” E. The R29 regional road runs through Largo settlement and the south-western part of the Project area. The N12 and N17 national routes are situated approximately 6.8 kilometres (km) north and 260 m south of the Project area respectively. The R42 regional road is situated approximately 1.1 km east, the R51 is situated approximately 6.5 km west and the R555 is situated approximately 3.8 km north of the Project area.

1.2 Terms of Reference

This report relates specifically to the environmental noise impacts of the proposed project. The immediate area surrounding the project is classed as mainly rural because of the predominant agricultural activities that take place in the immediate area with urban and suburban areas towards the town of Springs. The approach used in investigating the noise impacts is based on the Gauteng Noise Control Regulations GN 5479 of 1999 and the National Noise Control Regulations, R.154 of 10 January 1992 (the Noise Regulations) in terms of Section 25 of the Environmental Conservation Act, 1989 (Act No. 73 of 1989). Both the Gauteng and National Noise Control Regulations are relevant due to the project, which is located within the Gauteng Province, bordering the Mpumalanga Province. The Mpumalanga Province does not have Provincial Noise Control Regulations that are promulgated as yet and therefore adheres to the National Noise Control Regulations.

The following additional legislation and standards were also considered during the assessment:

- The National Environmental Management Act, 1998 (Act No. 107 of 1998), NEMA;
- The National Environmental Management Air Quality Act, 2004 (Act No. 39 of 2004), NEMAQA; and
- The South African National Standards SANS 10103:2008 “The measurement and rating of environmental noise with respect to annoyance and to speech communication” (SANS 10103:2008).

The Environmental Noise Impact Assessment Report includes a baseline assessment and predicted noise impacts on the identified noise sensitive receptors by use of noise dispersion modelling as well as recommendations and mitigation measures for potential impacts.

2 Details of the Specialist

Lukas Sadler has a B.COM degree in Geography and Environmental Management, including short courses in Environmental Noise Assessments, Environmental Noise Control and Air Quality Management as well as local and international work experience in the environmental sciences field. This includes experience working with projects in accordance with the International Finance Corporation (IFC) and World Bank standards. Lukas has also gained experience working in Africa namely Mali, Senegal, Ghana, Sierra Leone, DRC, Liberia, Mozambique and Namibia. At Digby Wells, Lukas’ core focus is working on Environmental Noise impact assessments, which includes baseline noise monitoring surveys, noise dispersion modelling and noise management programmes as well as carrying out compliance monitoring programmes. A Curriculum Vitae (CV) and declaration of independence is attached in Appendix A.

3 Aims and Objectives

The objective of the study is to assess what the current ambient noise levels are in the area as well as what the significance of the noise impacts from the Project will be on the surrounding area. The study includes baseline noise measurements to establish the soundscape of the area surrounding the proposed project, as well as assess, via predictive noise dispersion modelling, the potential impact of the noise emissions from the proposed underground mining activities on the surrounding environment.

4 Methodology

4.1 Literature Review and Desktop Assessment

The approach used in investigating noise impacts is based on the National Noise Control regulations as well as the Gauteng Noise Control Regulations which in turn refers to the SANS 10103:2008 “The measurement and rating of environmental noise with respect to annoyance and to speech communication”. Based on the National Noise Control Regulations it is prohibited to make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, machine, device or apparatus or any combination thereof.

According to the National Noise Control Regulations "disturbing noise" means a noise level which exceeds the zone sound level or, if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more. According to the Gauteng Noise Control Regulations "disturbing noise" means a noise level that causes the ambient noise level to rise above the designated zone level, or if no zone level has been designated, the typical rating levels for ambient noise in districts, indicated in Table 4-1.

Table 4-1: Typical Rating Levels for Noise in Districts (SANS 10103, 2008)

Type of District	Equivalent continuous rating level ($L_{Reg.T}$) for noise (dBA)					
	Outdoors			Indoors, with open windows		
	Day-night	Day-time	Night-time	Day-night	Day-time	Night-time
	$L_{R,dn}$[a]	$L_{Req,d}$[b]	$L_{Req,n}$[b]	$L_{R,dn}$[a]	$L_{Req,d}$[b]	$L_{Req,n}$[b]
Residential Districts						
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
Non-Residential Districts						

Type of District	Equivalent continuous rating level ($L_{Reg.T}$) for noise (dBA)					
	Outdoors			Indoors, with open windows		
	Day-night	Day-time	Night-time	Day-night	Day-time	Night-time
	$L_{R,dn}$[a]	$L_{Req,d}$[b]	$L_{Req,n}$[b]	$L_{R,dn}$[a]	$L_{Req,d}$[b]	$L_{Req,n}$[b]
d) Urban districts with some workshops, with business premises, and with main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50
NOTE 1 If the measurement or calculation time interval is considerably shorter than the reference time intervals, significant deviations from the values given in the table might result.						
NOTE 2 If the spectrum of the sound contains significant low frequency components, or when an unbalanced spectrum towards the low frequencies is suspected, special precautions should be taken and specialist advice should be obtained. In this case the indoor sound levels might significantly differ from the values given in columns 5 to 7						
NOTE 3 In districts where outdoor LR,dn exceeds 55 dBA, residential buildings (e.g. dormitories, hotel accommodation and residences) should preferably be treated acoustically to obtain indoor LReq,T values in line with those given in table 1.						
NOTE 4 For industrial districts, the LR,dn concept does not necessarily hold. For industries legitimately operating in an industrial district during the entire 24 h day/night cycle, LReq,d = LReq,n =70 dBA can be considered as typical and normal.						
NOTE 5 The values given in columns 2 and 5 in this table are equivalent continuous rating levels and include corrections for tonal character, impulsiveness of the noise and the time of day.						
NOTE 6 The noise from individual noise sources produced, or caused to be produced, by humans within natural quiet spaces such as national parks, wilderness areas and bird sanctuaries, should not exceed a maximum Weighted sound pressure level of 50 dBA at a distance of 15 m from each individual source.						
a) The values given in columns 2 and 5 are equivalent continuous rating levels and include corrections for tonal character and impulsiveness of the noise and the time of day.						
b) The values given in columns 3, 4, 6 and 7 are equivalent continuous rating levels and include corrections for tonal character and impulsiveness.						

The probable community/group response to levels in excess of the acceptable rating levels are presented in Table 4-2, where LReq,T is the equivalent continuous A-weighted sound pressure level, in decibels (dBA), determined over a specific time period. ‘A-weighted’ is a standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.

Table 4-2: Categories of Community/Group Response (SANS 10103, 2008)

Excess ($\Delta L_{Req,T}$)[a]dBA	Estimated community/group response	
	Category	Description
0 – 10	Little	Sporadic complaints
5 – 15	Medium	Widespread complaints
10 - 20	Strong	Threats of action
>15	Very strong	Vigorous action
NOTE Overlapping ranges for the excess values are given because a spread in the community reaction might be anticipated.		
a ΔLReq,T should be calculated from the appropriate of the following:		
1) ΔLReq,T = LReq,T of ambient noise under investigation MINUS LReq,T of the residual noise (determined in the absence of the specific noise under investigation);		
2) ΔLReq,T = LReq,T of ambient noise under investigation MINUS the maximum rating level for the ambient noise given in table 1;		
3) ΔLReq,T = LReq,T of ambient noise under investigation MINUS the typical rating level for the applicable district as determined from table 2; or		
4) ΔLReq,T = Expected increase in LReq,T of ambient noise in an area because of a proposed development under investigation.		

4.2 Fieldwork

A baseline assessment was undertaken to determine the current ambient noise level at the nearest noise sensitive receptor to the project. The criteria that were used for the siting of the measurement locations were:

- The location of the nearest farmstead, residential community and poultry farms to the project and consequently the most likely to be impacted on by the proposed mining activities; and
- The location that serves as a suitable reference point for the measurement of ambient sound levels surrounding the project. The noise measurement locations cover four locations surrounding the project area (N1 – N4).

A Cirrus, Optimus Green, precision integrating sound level meter was used for the measurements. The instrument was field calibrated with a Cirrus, sound level calibrator. The baseline conditions are defined using the $L_{Aeq,T}$ as well as the L_{A90} noise levels.

The $L_{Aeq,T}$ level represents the 'average' noise level for the measurement period including impulsive and intermittent noise sources such as traffic and animal noise, while the L_{A90} level indicates the background noise level taking into consideration the continuous noise sources excluding intermittend noise.

The background noise is ultimately used to compare with the expected noise levels from the proposed project to rate the significance of the impact with regards to the receptors in the Mpumalanga Province, however to rate the significance of the impact on the receptors in the Gauteng Province, the expected noise levels will be compared to the typical rating levels for ambient noise in districts. The baseline locations are presented in Table 4-3 as well as on Plan 1 (refer to Appendix B). Photographs of the measurement locations are presented in Figure 4-1 to Figure 4-3.

Table 4-3: Noise Measurement Locations

Site ID	Farm/location	Category of Receiver	GPS Coordinates
1	Vischkuil 274 Ptn 6	Rural	26°15'39.77"S & 28°36'14.22"E
2	Droogefontein 242 Ptn 25	Rural	26°14'7.99"S & 28°34'29.80"E
3	Aston Lake community	Suburban	26°15'13.13"S & 28°31'32.91"E
4	Droogefontein 242 Ptn 39	Rural	26°13'14.59"S & 28°33'13.73"E

Figure 4-1: Measurement location 1

Figure 4-2: Measurement location 2

Figure 4-3: Measurement location 3

Figure 4-4: Measurement location 4

4.3 Noise Dispersion Modelling

Predictive modelling was performed for the proposed activities through the use of the modelling software SoundPlan. The software specialises in computer simulations of noise pollution dispersion. Estimates of the cumulative noise levels for the study were derived from the noise emissions from all the major noise-generating components and activities of the project.

The following table indicates the noise power levels used in the model simulations. The sound power levels were mainly derived from the SoundPlan database.

Table 4-4: Sound Power Levels from Main Noise Causing Sources

Noise source	**Sound power levels dB**						
Octave band frequencies, Hz	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**
Haul Truck	108	118	115	114	110	106	102
Excavators	113	117	107	108	106	101	95
Front end Loader	108	116	107	108	105	99	95
Drill	109	118	113	113	113	112	110
Dozer	110	122	113	114	110	108	104
Diesel Generator	105	120	116	108	107	108	108
Pneumatic tools	82	75	73	68	63	67	80

Noise source	Sound power levels dB						
Road planer	81	87	79	77	77	74	70
Grader	88	87	83	79	84	78	74

The noise dispersion modelling software was used to assess whether the noise from the proposed project activities will impact on the relevant noise sensitive receivers, by comparing the predicted propagating noise levels with the current ambient baseline noise levels as well as against the typical rating levels for ambient noise in districts. The significance of the impact was then rated according to the Impact Assessment Criteria (refer to Section 8 of this report).

Typical acoustical noise analyses, by use of noise modelling, for the purpose of assessing compliance with national noise regulations use A-weighted scales that discriminate against low frequency noise. Thus, A-weighted scales will usually record significantly lower levels of noise than linear scaled noise levels. For this reason, blast noise (dB) cannot be compared to national noise regulations that use a dBA scale. It is also difficult to model blasting noise due to its impulsive nature. Noise dispersion modelling was therefore not performed for the blasting activities. Blasting is rather assessed according to its linear pressure (dBLin) instead of its A-weighted pressure (dBA) to establish the overpressure strength of the blast. Refer to the blasting and vibration assessment report which assesses the impact of blasting according to its linear decibel level (dBLin).

5 Assumptions and Limitations

The following assumptions and limitations are included as part of this assessment:

- The construction phase is assumed to be carried out during daytime hours (06:00-22:00), therefore only a daytime scenario was modelled for the construction phase and the subsequent impact of the construction phase refers only to the daytime;
- The resulting noise contours represent worst case L_{Aeq} at any receiver located 360 degrees in the horizontal plane around the noise sources. The noise modelling software is limited to calculating the predominant wind direction (or downwind conditions of propagation) per single receptor only. Calm wind conditions have therefore been included in the model due to the number of surrounding receptors. Thus, the noise dispersion plots do not represent a typical seasonal scenario in the predominant wind direction but rather a yearly average of the area's meteorological conditions in all directions; and
- In essence the modelling follows a conservative worst case scenario approach assuming all activities for each phase are being carried out simultaneously; and
- As mentioned in Section 4.3 of this report, noise dispersion modelling was not performed for the blasting activities. Blasting is rather assessed according to its linear pressure (dBLin) instead of its A-weighted pressure (dBA) to establish the overpressure strength of the blast (refer to the blasting and vibration assessment report).

6 Baseline Environment

The results from the noise meter recordings for all the sampled points as well as the rating limits according to the SANS 10103:2008 guidelines are presented in Table 6-1, with the time history graphs presented in Figure 6-1 to Figure 6-3. The locations of the monitoring points can be viewed in Plan 1 (Appendix B).

Table 6-1: Results of Baseline Noise Measurements

Sample ID	SANS rating limit			Measurement details			
	Type of district	Period	Typical rating level dBA	$L_{Areq,T}$ dBA	Maximum/Minimum dBA	L_{A90}	Date
1	Rural	Daytime	45	52	77 / 44	46	21/09/2016
		Night time	35	48	69 / 34	40	21/09/2016
2	Rural	Daytime	45	54	88 / 39	42	22/09/2016
		Night time	35	50	84 / 22	25	22/09/2016
3	Suburban	Daytime	50	49	80 / 37	41	26/09/2016
		Night time	40	45	78 / 28	34	26/09/2016
4	Rural	Daytime	45	46	82 / 38	40	27/10/2016
		Night time	35	44	75 / 39	40	27/10/2016
	Indicates $L_{Aeq,T}$ levels above either the daytime rating limit or the night time rating limit						

Figure 6-1: Noise time history for 1

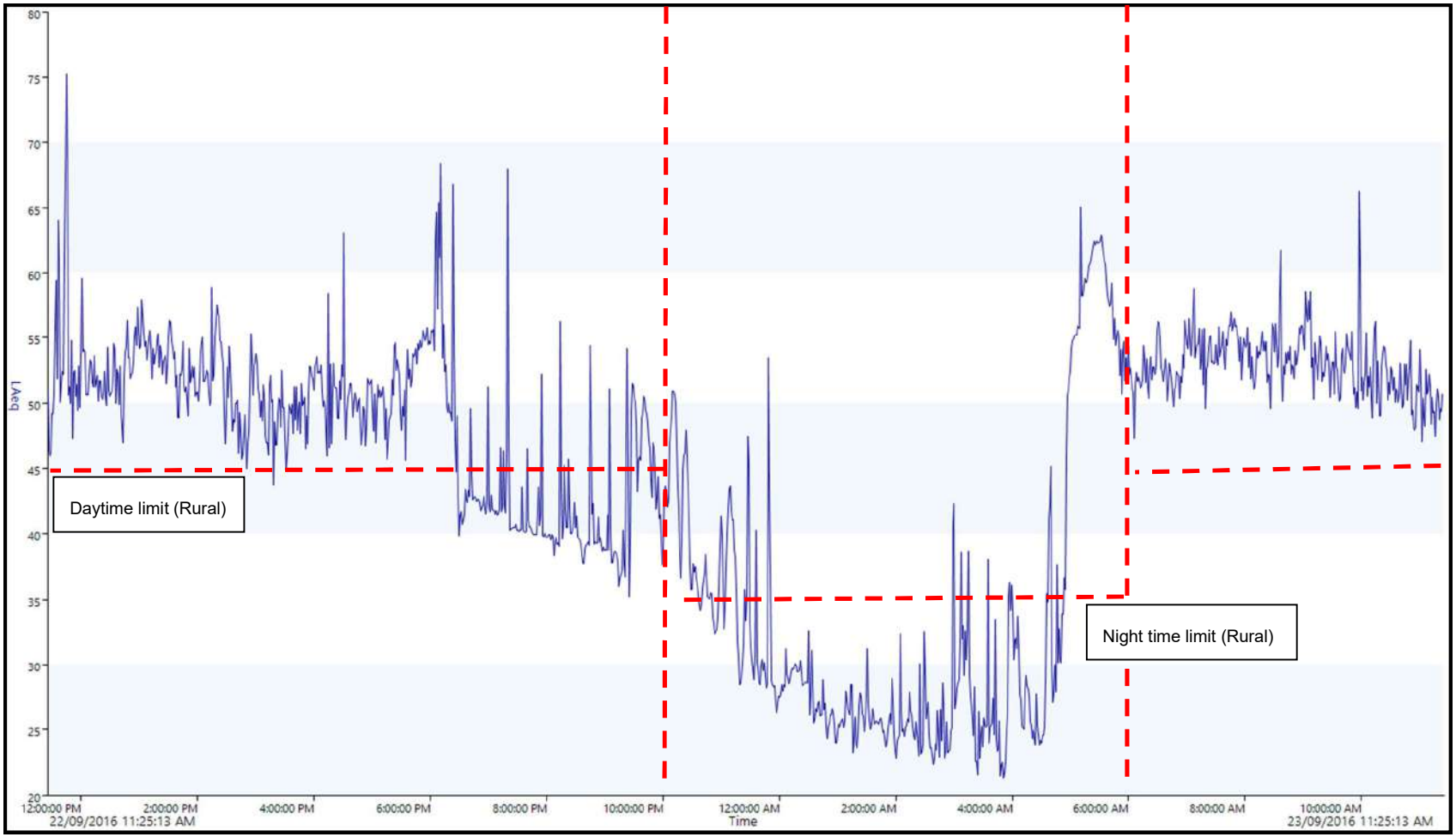


Figure 6-2: Noise time history for 2

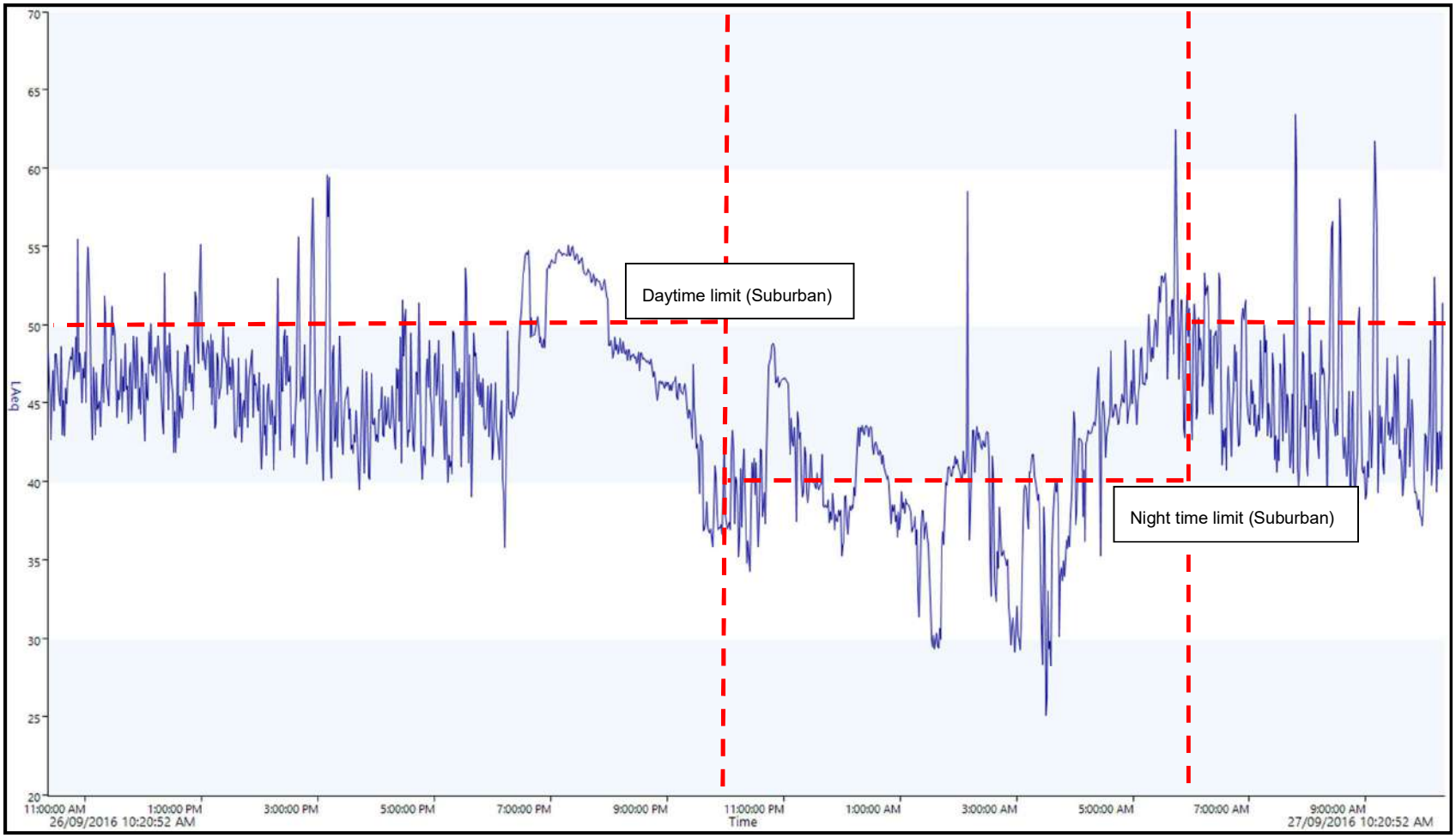


Figure 6-3: Noise time history for 3

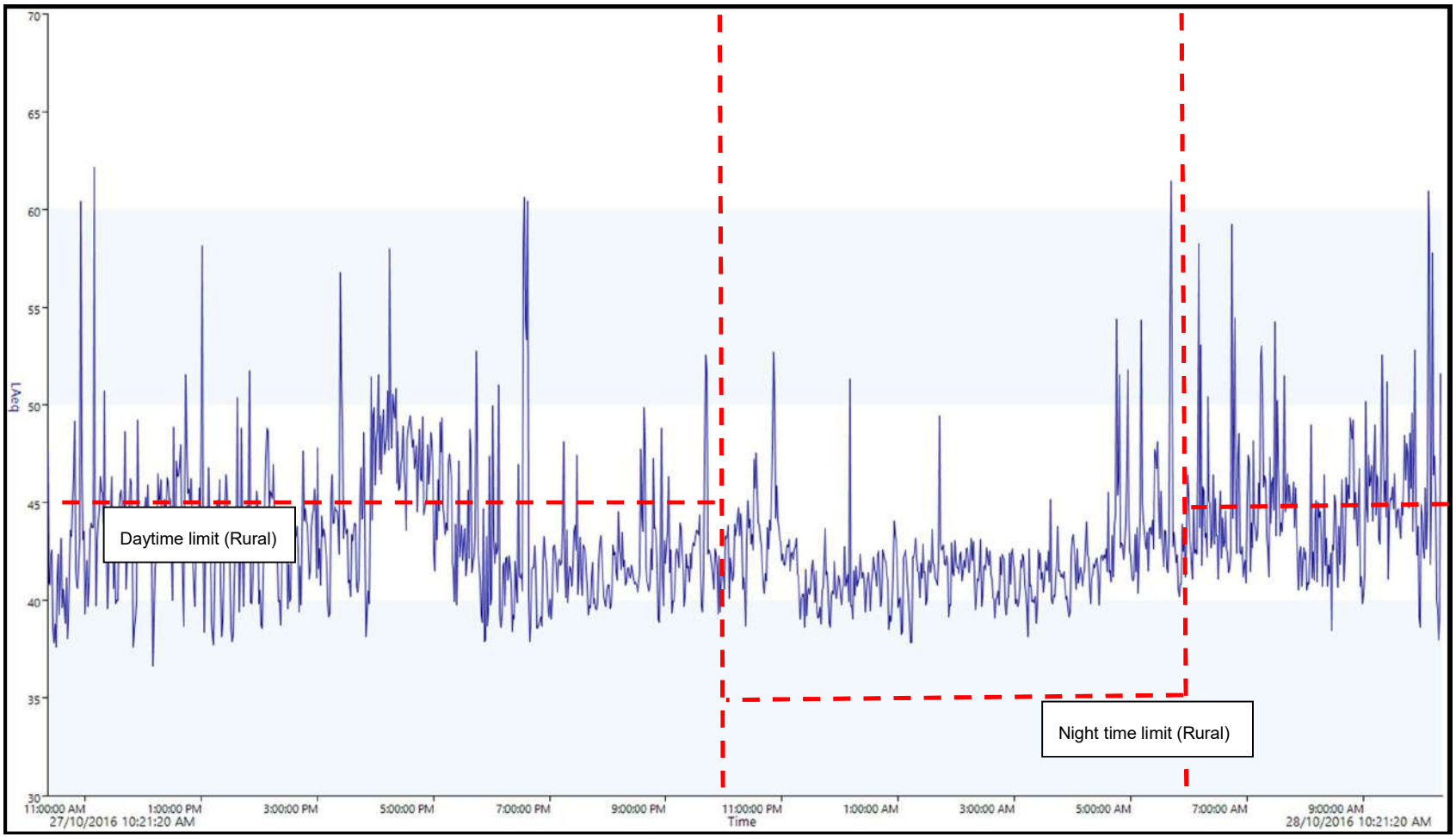


Figure 6-4: Noise time history for 4

6.1 Daytime Results

Based on the daytime results from the noise measurements it is noted that the L_{Aeq} levels predominantly measured above the SANS guideline for the maximum allowable outdoor daytime rating level for ambient noise in rural districts (45 dBA), with the background noise levels (L_{A90}) measuring below the daytime rating level guideline for rural districts (45 dBA).

Monitoring location 1 was taken near the poultry farming operations on Portion 6 of the Farm Vischkuil 274. The main continuous noise sources at monitoring location 1 were the ventilation fans at the chicken houses and birdsong from the common avifauna species in the area. Farm vehicles passing by were the intermittent noise sources with aircraft also occasionally flying by overhead. The specific L_{Aeq} level was 52 dBA, with the L_{A90} level measuring 46 dBA. With a 6 dBA difference between the L_{Aeq} and L_{A90} level, the intermittent noise sources had a significant impact on the overall average as indicated by the peaks on the graph (refer to Figure 6-1).

Monitoring location 2 was taken at the homestead on Portion 25 of the Farm Droogefontein 242. The main continuous noise source at monitoring location 2 was the birdsong from the common avifauna species in the area. The dog barking and vehicles passing by were the intermittent noise sources with aircraft also occasionally flying by overhead. The specific L_{Aeq} level was 54dBA, with the L_{A90} level measuring 42 dBA. With a 12 dBA difference between the L_{Aeq} and L_{A90} level, the intermittent noise sources, specifically the dog barking and the vehicles passing by, had a significant impact on the overall average as indicated by the peaks on the graph (refer to Figure 6-2).

Monitoring location 3 was taken at the community at Aston Lake. The main continuous noise source at monitoring location 3 was the birdsong from the common avifauna species in the area. The dog barking and vehicles passing by were the intermittent noise sources with aircraft also occasionally flying by overhead as well as the gusts of wind at times during the day. The specific L_{Aeq} level was 49 dBA, with the L_{A90} level measuring 41 dBA. With a 8 dBA difference between the L_{Aeq} and L_{A90} level, the intermittent noise sources had a significant impact on the overall average as indicated by the peaks on the graph (refer to Figure 6-3).

Monitoring location 4 was taken near the poultry farming operations on Portion 39 of the Farm Droogefontein 242. The main continuous noise source at monitoring location 4 was the birdsong from the common avifauna species in the area as well as the ventilation fans at the chicken houses. The vehicles and trucks passing by were the main intermittent noise sources with aircraft also occasionally flying by overhead as well as frequent gusts of wind. The specific L_{Aeq} level was 46dBA, which is slightly above the rural guidelines of 45 dBA. With a 6 dBA difference between the L_{Aeq} and L_{A90} level, the intermittent noise sources, specifically the trucks passing by, had a less significant impact on the overall average.

6.2 Night Time Results

Based on the night time results from the noise measurements it is noted that the L_{Aeq} levels predominantly measured above the SANS guideline for the maximum allowable outdoor night time rating level for ambient noise in suburban districts (40 dBA) as well as rural

districts (35 dBA), with the background noise levels (L_{A90}) ranging from below to similar to the night time rating level guideline for suburban districts (40 dBA).

The main continuous night time noise sources at monitoring location 1 were the ventilation fans at the chicken houses and high pitched sound from the insects, *Gryllidae*. A siren went off at around 04:30 (which is still classified as night time), which also impacted on the night time noise levels. The specific L_{Aeq} level was 48 dBA, with the L_{A90} level measuring 40 dBA. With a 8 dBA difference between the L_{Aeq} and L_{A90} level, the intermittent noise sources had a significant impact on the overall average as indicated by the peaks on the graph (refer to Figure 6-1).

The main continuous noise source at monitoring location 2 was the insect noise from the Grylliadae and Cicada. Gusts of wind for a short period just after 22:00, aircraft occasionally flying by overhead as well as birdsong from the avifauna starting just before 05:00 (which is still classified as night time) were the intermittent noise sources. The specific L_{Aeq} level was 50 dBA, with the L_{A90} level measuring 25 dBA. With a 25 dBA difference between the L_{Aeq} and L_{A90} level, the intermittent noise sources, specifically the birdsong creating the highest peak in the graph, had a very significant impact on the overall average as indicated by the peaks on the graph (refer to Figure 6-2).

The main continuous noise source at monitoring location 3 was the insect noise from the *Gryllidae* and *Cicada*. Aircraft occasionally flying by overhead as well as the gusts of wind at times during the day. The specific L_{Aeq} level was 40 dBA, with the L_{A90} level measuring 34 dBA. With a 6 dBA difference between the L_{Aeq} and L_{A90} level, the intermittent noise sources had a less significant impact on the overall average as indicated by the single peak on the graph (refer to Figure 6-3), the L_{Aeq} level however is similar to the rating level guideline for suburban districts which is expected of a receptor of this nature.

The main continuous noise source at monitoring location 4 was the insect noise from the *Gryllidae* as well as the ventilation fans at the chicken houses. The vehicles passing by, gusts of wind and birdsong were the main intermittent noise sources. The specific L_{Aeq} level was 44 dBA, with the L_{A90} level measuring 40 dBA. With a 4 dBA difference between the L_{Aeq} and L_{A90} level, the intermittent noise sources had a less significant impact on the overall average as indicated by the fewer peaks on the graph during the night time(refer to Figure 6-4).

The noise sources that were influential during the baseline measurements at the time of the noise survey and that were responsible for the day/night time levels are summarised in Table 6-2.

Table 6-2: Summary of Noise Sources Influencing Baseline Measurements around the Proposed Site

	Noise source description			
Monitoring location	**Day**	**Duration**	**Night**	**Duration**
1	Vehicle activity	Intermittent	Gryllidae	Continuous
	Ventilation system	Continuous	Ventilation system	Continuous
	Birdsong	Continuous	Siren	Intermittent
2	Vehicle activity	Intermittent	Birdsong	Intermittent
	Dog	Intermittent		
	Aircraft	Intermittent	Aircraft	Intermittent
	Birdsong	Continuous		
3	Birdsong	Continuous	Gryllidae	Continuous
	Dogs	Intermittent	Cicada	Continuous
	Aircraft	Intermittent	Aircraft	Intermittent
	Vehicles	Intermittent	Wind	Intermittent
	Wind	Intermittent		
4	Birdsong	Continuous	Gryllidae	Continuous
	Ventilation system	Continuous	Ventilation system	Continuous
	Wind	Intermittent	Wind	Intermittent
	Aircraft	Intermittent	Vehicles	Intermittent
			Birdsong	Intermittent

7 Sensitivity Analysis and No-Go Areas

In terms of the current project location and infrastructure layout it is expected that noise impacts are likely to occur at certain receptors within the Mpumalanga Province. The 'No-Go' areas should include an alternative location for the northernmost hard overburden footprint as well as alternative haul route towards the siding (at least a 250 meters buffer south of the current proposed haul route section that follows the existing gravel road running past the small holdings community towards the siding). Additionally, in terms of the sensitivity analysis, 20m to 30m berms are recommended in the locations indicated on the mitigation plan (refer to Plan 5 for all mitigation recommendations).

8 Impact Assessment

8.1 Methodology used in Determining and Ranking the Nature, Significance, Consequence, Extent, Duration and Probability of Potential Environmental Impacts and Risks

Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below.

The significance rating process follows the established impact/risk assessment formula:

Significance = Consequence x Probability x Nature

Where

Consequence = Intensity + Extent + Duration

And

Probability = Likelihood of an impact occurring

And

Nature = Positive (+1) or negative (-1) impact

Note: In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts and -1 for negative impacts.

The matrix calculates the rating out of 147, whereby Intensity, Extent, Duration and Probability are each rated out of seven as indicated in Table 8-3. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts.

Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in this environmental noise impact assessment report. The significance of an impact is then determined and categorised into one of eight categories, as indicated in Table 8-2, which is extracted from Table 8-1. The description of the significance ratings is discussed in Table 8-3.

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e. there may already be certain types of mitigation measures included in the design (for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

Table 8-1: Impact Assessment Parameter Ratings

Rating	Intensity/Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
7	Irreplaceable loss or damage to biological or physical resources or highly sensitive environments. Irreplaceable damage to highly sensitive cultural/social resources.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or moderate to highly sensitive environments. Irreplaceable damage to cultural/social resources of moderate to highly sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur. <80% probability.

Rating	Intensity/Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
5	Serious loss and/or damage to physical or biological resources or highly sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.
4	Serious loss and/or damage to physical or biological resources or moderately sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures / items of cultural significance.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.

Rating	Intensity/Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
3	Moderate loss and/or damage to biological or physical resources of low to moderately sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local extending only as far as the development site area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	Minor loss and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited to the site and its immediate surroundings.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.

Rating	Intensity/Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
1	Minimal to no loss and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	Very limited/Isolated Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Table 8-2: Probability/Consequence Matrix

Probability \ Significance	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
7	-147	-140	-133	-126	-119	-112						-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114							-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5								-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4				-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Consequence

Table 8-3: Significance Rating Description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and / or social) environment	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to long-term effect on the natural and / or social environment	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and / or social environment	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and / or social environment	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and / or social environment	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)

8.2 Project Activities

The project activities that have been assessed in terms of the noise impact are divided into the three project phases, namely, the Construction Phase, the Operational Phase and the Decommissioning Phase and provided in Table 8-4.

Table 8-4: Description of Activities to be Assessed

Project Phase	Project Activity
Construction Phase	Site establishment; Site clearing, including the removal of topsoil and vegetation; Construction of mine related infrastructure, including haul roads, pipes, dams; Construction of washing plant; Relocation of Infrastructure (gravel road diversion); and Development of initial box-cut for mining, including stockpiling of material from initial box-cuts.
Operational Phase	Stripping topsoil and soft overburden; Removal of overburden, including drilling and blasting of hard overburden; Loading, hauling and stockpiling of overburden; Load, haul and stockpiling of RoM coal; and Use and maintenance of haul roads for the transportation of coal to the washing plant.
Decommissioning Phase	Demolition and removal of all infrastructure, including transporting materials off site; and Rehabilitation, including spreading of soil, re-vegetation and profiling or contouring.

8.3 Impact Assessment

8.3.1 Construction Phase

8.3.1.1 Project Activities Assessed

The following construction phase activities indicated in Table 8-5 below, may cause a noise disturbance at the surrounding rural and suburban receptors such as farmsteads, poultry farms and suburban communities at Aston Lake.

Table 8-5: Interactions and Impacts of Construction Activities

Interaction	Impact
Site establishment; Site clearing, including the removal of topsoil and vegetation; Construction of mine related infrastructure, including haul roads, pipes, dams; Construction of washing plant; Relocation of Infrastructure (gravel road diversion); and Development of initial box-cut for mining, including stockpiling of material from initial box-cuts.	Noise disturbance by the construction vehicles and machinery in operation during the construction phase

8.3.1.2 Impact Description

The construction noise dispersion model is indicated on Plan 2 (refer to Appendix B). The results indicate that the expected noise during the construction activities will not likely cause a noise disturbance in terms of the Gauteng Noise Control Regulations at any receptor within the Gauteng Province. The reason for this is that the construction noise is not likely to measure above 45 dBA at any rural receptor nor measure above 50 dBA at any suburban receptor. The construction phase is likely to measure between 25 dBA and 45 dBA to the east and south east towards the rural receptors such as poultry farms and general farmsteads and is likely to measure between 25 dBA and 50 dBA to the south and west towards the suburban receptors.

The results indicate however, that the expected noise during the construction activities will likely cause a noise disturbance in terms of the National Noise Control Regulations at certain receptors within the Mpumalanga Province. The reason for this is that the construction noise is likely to exceed the existing background noise levels by more than 7 dBA.

The specific receptors that will be impacted on include the small holdings residential area called Prosperity AH, due to the close proximity to the proposed haul route towards the siding as well as the farmstead (indicated as monitoring location 2), due to the close proximity of the house to the proposed footprint of the open cast area and overburden dumps. The background noise levels at the small holdings and farmstead in question range from 40 dBA to 42 dBA and the likely construction noise will measure between 50 dBA and 57 dBA.

8.3.1.3 Management Objectives

To minimise/prevent the noise impact from causing a noise disturbance at the surrounding receptors as a result of the construction activities and subsequently comply with the National and Gauteng Noise Control Regulations.

8.3.1.4 Management Actions and Targets

Due to the close proximity of the above mentioned receptors and the subsequent non-compliance that the project's noise levels will have with respect to the National Noise Control Regulations, vigorous mitigation measures need to be implemented to decrease the significance of the impact. The mitigation and management measures for the construction phase are informed by the likely impact from the operational phase during the night time due to this phase being the longest in duration as well as the night time weather conditions being more favourable for the propagation of sound, especially the impact on sleep disturbance.

An alternative location for the northernmost hard overburden dump needs to be considered (to try and avoid noise causing activities at the original proposed location) such as being located just south of the proposed product stockpile. An alternative location for the route towards the siding also needs to be considered such as being located at least 250 meters south of the current proposed section that follows the existing gravel road running past the mentioned small holdings.

Implementing the recommendations put forward above, it is likely that the construction noise will comply with the National Noise Control Regulations.

8.3.1.5 Impact Ratings

The rating table below summarises and calculates the impact significance of the construction phase in terms of the duration, extent, intensity and probability (refer to Table 8-6).

Table 8-6: Potential Impacts of the Construction Phase Activities

Dimension	Rating	Motivation	Significance
Activity and Interaction (construction phase activities as per Table 8-5**)**			
Impact Description: Noise will emanate from the machinery and vehicles operating during the construction activities			
Prior to Mitigation/Management			
Duration	Medium term (3)	Noise will be produced for the duration of the construction phase of 12 months	Moderate (negative) – 84

Dimension	Rating	Motivation	Significance
Extent	Municipal area (4)	It is expected that during construction noise will extend beyond the site area with exceedances between 50 dBA and 57 dBA expected at adjacent farmsteads and small holdings in Mpumalanga Province and therefore given the rating of 4. The noise impact however will not affect the entire municipal area.	
Intensity x type of impact	High - negative (-5)	It is expected that during construction noise will have a serious impact	
Probability	Definite (7)	There are sound scientific reasons to expect that that noise will not comply with the National Noise Control Regulations by the likelihood of the proposed project's construction noise exceeding the current background noise levels outside the mining right boundary by more than 7 dBA.	
Nature	negative		
Mitigation/Management Actions			
▪ Alternative location of the northernmost hard overburden dump; ▪ Alternative location of the haul route towards the siding; ▪ Restricting construction activities to daylight hours (06:00 – 18:00) and not during weekends and public holidays; ▪ Locating of diesel generator away from noise sensitive receptors, as well as placing generators on isolation mounts and installation of secondary silencers; ▪ Mining related machines and vehicles to be serviced to the designed requirements of the machinery/vehicles to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers; ▪ Reversing alarms on vehicles should be broadband reversing alarms which emit directional, lower, less intrusive sound; ▪ Environmental noise monitoring to establish compliance with the regulations and to verify the predicted noise levels; and ▪ Switching off equipment when not in use.			
Post-Mitigation			
Duration	Medium term (3)	Noise will be produced for the duration of the construction phase of 12 months	Negligible (negative) – 14
Extent	Local (3)	The noise levels are expected to extend only as far as the development site area	

Dimension	Rating	Motivation	Significance
Intensity x type of impact	Minimal - negative (-1)	It is expected that during construction noise will have a minimal impact post mitigation	
Probability	Rare (2)	A <10% probability is expected post mitigation.	

8.3.2 Operational Phase

8.3.2.1 Project Activities Assessed

The following operational phase activities indicated in Table 8-7 below, may cause a noise disturbance at the surrounding rural and suburban receptors such as farmsteads, poultry farms and suburban communities at Aston Lake.

Table 8-7: Interactions and Impacts of Operational Activities

Interaction	Impact
Stripping topsoil and soft overburden; Removal of overburden, including drilling and blasting of hard overburden; Loading, hauling and stockpiling of overburden; Load, haul and stockpiling of RoM coal; and Use and maintenance of haul roads for the transportation of coal to the washing plant.	Noise disturbance by the mining vehicles and machinery in operation during the operational phase.

8.3.2.2 Impact Description

The operational noise dispersion models for the day and night time scenarios are indicated on Plan 3 and Plan 4 (refer to Appendix B). The daytime results indicate that the expected noise during the operational activities will not likely cause a noise disturbance in terms of the Gauteng Noise Control Regulations at any receptor within the Gauteng Province. The reason for this is that the operational noise is not likely to measure above 45 dBA at any rural receptor and subsequently not measure above 50 dBA at any suburban receptor. The operational phase daytime levels are likely to measure between 25 dBA and 40 dBA to the east and south east towards the rural receptors such as poultry farms and general farmsteads and are likely to measure between 25 dBA and 40 dBA to the south and west towards the suburban receptors.

The night time results with respect to the Gauteng receptors indicates that the operational noise levels will unlikely comply with the Gauteng Noise Control Regulations due to the noise levels likely exceeding the rural guideline level of 35 dBA towards the east and south east. The likely noise level will measure between 40 dBA and 42 dBA at the nearest poultry farm (approximately 650m from the opencast footprint). The specialist/author of this report is

of the opinion that the actual impact will be negligible. The reason being that the current background level at this receptor is 40 dBA, which is already exceeding the rural guideline of 35 dBA, with an expected increase of only between 3 dBA and 4d BA to the overall noise level with the impact of the expected noise levels from the mining activities.

Furthermore the day and night time results indicate that the expected operational levels will likely cause a noise disturbance in terms of the National Noise Control Regulations at certain receptors within the Mpumalanga Province similar to the scenario during the construction phase. The reason for this is that the noise is likely to exceed the existing background noise levels by more than 7 dBA.

The specific receptors that will be impacted are the same as for the construction phase due to the close proximity. The daytime background noise levels at the small holdings and farmstead in question range from 40 dBA to 42 dBA and the night time background noise levels range from 25 dBA to 40 dBA. The most significant increase will be at N2, with the likely operational noise levels exceeding the night time background by 25 dBA, probably causing sleep disturbance at this location.

According to the World Health Organisation (WHO) in terms of adverse health effects of noise, if negative effects on sleep are to be avoided the equivalent sound pressure level should not exceed 30 dBA indoors for continuous noise. If the noise is not continuous, sleep disturbance correlates best with L_{Amax} and effects have been observed at 45 dBA or less. This is particularly true if the background level is low. Noise events exceeding 45 dBA should therefore be limited if possible. For sensitive people an even lower limit would be preferred. It should be noted that it should be possible to sleep with a bedroom window slightly open (a reduction from outside to inside of 15 dBA).

8.3.2.3 Management Objectives

To minimise/prevent the noise impact from causing a noise disturbance at the surrounding receptors as a result of the construction activities and subsequently comply with the National and Gauteng Noise Control Regulations.

8.3.2.4 Management Actions and Targets

Due to the close proximity of the above mentioned receptors and the subsequent non-compliance that the project's noise levels will have with respect to the National Noise Control Regulations, especially during the night time in terms of sleep disturbance, vigorous mitigation measures need to be implemented to decrease the significance of the impact.

A 20meter berm is recommended to be located along the northern boundary of the open cast footprint to further decrease the noise levels experienced at N2 to limit the noise from exceeding above 45 dBA. A second 20m berm is recommended along the diagonal south east boundary of the open cast footprint to decrease the operational noise to below the existing night time background levels at the poultry farms towards the east and south east. An alternative location for the northernmost hard overburden dump needs to be considered (to try and avoid noise causing activities at the original proposed location) such as being

located just south of the proposed product stockpile. An alternative location for the route towards the siding also needs to be considered such as being located at least 250 meters south of the current proposed section that follows the existing gravel road running past the mentioned small holdings.

Implementing the recommendations put forward above, it is likely that the operational noise will comply with the National Noise Control Regulations.

8.3.2.5 Impact Ratings

The rating table below summarises and calculates the impact significance of the operational phase in terms of the duration, extent, intensity and probability (refer to Table 8-8).

Table 8-8: Potential Impacts of the Operational Phase Activities

Dimension	Rating	Motivation	Significance
Activity and Interaction (operational activities as per Table 8-7)			
Impact Description: Noise will emanate from the machinery and vehicles operating during the operational activities			
Prior to Mitigation/Management			
Duration	Project life (5)	Noise will be produced for the duration of the operational phase of 47 months	Moderate (negative) – 98
Extent	Municipal area (4)	It is expected that during operations, noise will extend beyond the site area with exceedances between 50dBA and 57dBA expected at adjacent farmsteads and small holdings in Mpumalanga Province and therefore given the rating of 4. The noise impact however will not affect the entire municipal area.	
Intensity x type of impact	High - negative (-5)	It is expected that during construction noise will have a serious impact	
Probability	Definite (7)	There are sound scientific reasons to expect that that noise will not comply with the National Noise Control Regulations by the likelihood of the proposed project's operational noise exceeding the current background noise levels outside the mining right boundary by more than 7 dBA during the day and night time.	
Nature	negative		
Mitigation/Management Actions			

Dimension	Rating	Motivation	Significance
▪ Constructing 20m berm along the northern boundary of the opencast pit footprint to act as an additional barrier to sound; ▪ Construction 20m berm along the diagonal south east boundary of the opencast pit footprint; ▪ Alternative location of the northernmost hard overburden dump; ▪ Alternative location of the haul route towards the siding; ▪ Locating of diesel generator away from noise sensitive receptors, as well as placing generators on isolation mounts and installation of secondary silencers; ▪ Mining related machines and vehicles to be serviced to the designed requirements of the machinery/vehicles to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers; ▪ Reversing alarms on vehicles should be broadband reversing alarms which emit directional, lower, less intrusive sound; ▪ Environmental noise monitoring to establish compliance with the regulations and to verify the predicted noise levels; and ▪ Switching off equipment when not in use.			
Post-Mitigation			
Duration	Project life (5)	Noise will be produced for the duration of the operational phase of 47 months	Minor (negative) – 44
Extent	Local (3)	The noise levels are expected to extend only as far as the development site area	
Intensity x type of impact	Moderate - negative (-3)	It is expected that during operations, noise will have a moderate impact post mitigation due to the likelihood of the noise still exceeding the night time background noise levels at N2	
Probability	Probable (4)	A <50% probability is expected post mitigation.	

8.3.3 Decommissioning Phase

8.3.3.1 Project Activities Assessed

The following construction phase activities indicated in Table 8-5 below, may cause a noise disturbance at the surrounding rural and suburban receptors such as farmsteads, poultry farms and suburban communities at Aston Lake.

Table 8-9: Interactions and Impacts of Construction Activities

Interaction	Impact
Demolition and removal of all infrastructure, including transporting materials off site; and Rehabilitation, including spreading of soil, re-vegetation and profiling or contouring.	Noise disturbance by the construction vehicles and machinery in operation during the construction phase

8.3.3.2 Impact Description

The demolition of the infrastructure and surface rehabilitation activities may cause a noise disturbance at surrounding farmsteads. Due to the relatively small footprint of the infrastructure as well as the concurrent rehabilitation during the operational phase decreasing the overall footprint needed to be rehabilitated, it is expected that the decommissioning activities will have a similar negligible impact as the post-mitigated rating for the construction phase.

8.3.3.3 Management Objectives

To minimise/prevent the noise impact from causing a noise disturbance at the surrounding receptors as a result of the construction activities and subsequently comply with the National and Gauteng Noise Control Regulations.

8.3.3.4 Management Actions and Targets

Decommissioning activities should be restricted to daylight hours (this will keep the night time noise levels to a minimum) and not be permitted on weekends and public holidays. Mining related machinery and vehicles should be switched off when not in use. Generators should be fitted with silencers and installed on isolation mounts.

8.3.3.5 Impact Ratings

The rating table below summarises and calculates the impact significance of the closure and rehabilitation phase in terms of the duration, extent, intensity and probability (refer to Table 8-10).

Table 8-10: Potential Impacts of the Decommissioning Phase Activities

Dimension	Rating	Motivation	Significance
Activity and Interaction (the closure phase requires removal of infrastructure and surface rehabilitation)			
Impact Description: Noise will emanate from the machinery and vehicles operating during the decommissioning activities.			
Prior to Mitigation/Management			
Duration	Medium term (3)	Noise will be produced for the duration of the construction phase of 12 months	Negligible (negative) – 24
Extent	Local (3)	It is expected that during decommissioning noise will extend only as far as the development site area.	

Dimension	Rating	Motivation	Significance
Intensity x type of impact	Minor - negative (-2)	It is expected that during decommissioning noise will have a minor impact due to the project footprint and the closure phase being less machinery intensive than the construction and operational phases.	
Probability	Unlikely (3)	It is unlikely that noise will measure above 45 dBA at the surrounding farmsteads.	
Nature	Negative		
Mitigation/Management Actions			
▪ Restricting decommissioning activities to daylight hours (06:00 – 18:00) and not during weekends and public holidays; ▪ Mining related machines and vehicles to be serviced to the designed requirements of the machinery/vehicles to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers; and ▪ Switching off equipment when not in use.			
Post-Mitigation			
Duration	Medium term (3)	Noise will be produced for the duration of the construction phase of 12 months	Negligible (negative) – 16
Extent	Local (3)	It is expected that during decommissioning noise will extend only as far as the development site area.	
Intensity x type of impact	Minimal - negative (-2)	It is expected that during decommissioning noise will have a minor impact due to the project footprint and the closure phase being less machinery intensive than the construction and operational phases.	
Probability	Improbable (2)	It is improbable that noise will measure above 45 dBA at the surrounding farmsteads.	

9 Cumulative Noise Impacts

Cumulative impacts should be considered for the overall improvement of ambient noise levels. The proposed project is considered a causative source of noise pollution of a moderate significance, meaning that the impact could potentially hamper the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe changes due to the close proximity of certain receptors to the proposed mine infrastructure layout and haul route.

The existing anthropogenic noise sources in the area of the proposed project are typical rural agricultural noise sources such as intermittent vehicle activity on the surrounding district and farm roads and the farming activities such as ploughing and harvesting machinery. The insects and birds are the natural noise sources. The existing background noise levels range from 25 dBA to 40 dBA which is typical for rural areas.

With the low ambient soundscape the proposed project's operational noise will dominate at certain receptors. However, if the recommendations with regards to the mitigation and managements measures are followed, the impact significance can be decreased to a minor significance.

10 Unplanned Events and Low Risks

Low risks can be monitored to gauge if the baseline changes and mitigation is required, however unplanned events may happen at any moment. Table 10-1 provides information on the potential impacts of those events and how to manage them, if they occur.

Table 10-1: Unplanned Events, Low Risks and their Management Measures

Unplanned event	Potential risk	Mitigation/ Management/ Monitoring
Ineffectiveness or failure of fitted silencers on generators and ventilation fans.	Increased noise disturbance	Implement monitoring programme to assess effectiveness of noise abatement measures; Regular servicing of generators as per maintenance manual; and

11 Environmental Management Plan

The objective of an EMP is to present mitigation to (a) manage undue or reasonably avoidable adverse impacts associated with the development of a project and (b) to enhance potential positives.

Mitigation measures will sometimes be built into the base of a project and should be considered as part of the "pre-mitigation" scenario; additional mitigation must be recommended if the impact assessment indicates it is necessary.

The key objectives of environmental and social management plans are to give S.M.A.R.T. mitigation measures to:

- Identify the actual environmental, socio-economic and public health impacts of the project and check if the observed impacts are within the levels predicted in the EIA;
- Determine that mitigation measures or other conditions attached to project approval (e.g. by legislation) are properly implemented and work effectively;
- Adapt the measures and conditions attached to project approval in the light of new information or take action to manage unanticipated impacts if necessary;
- Provide an auditable management plan that can follow the Deming Cycle;
- Gauge if predicted benefits of the project are being achieved and maximized; and
- Gain information for improving similar projects and EIA practice in the future.

The EMP must consider each activity and its potential (significant) impacts during the construction, operational and decommissioning phases. The EMP should be structured as described in Section 11.2.

11.1 Project Activities with Potentially Significant Impacts

The noise dispersion models were run as a conservative worst case scenario approach, as previously mentioned. The activities per phase were accounted for simultaneously and therefore cumulatively contribute to the significance of the noise impact. However, certain activities do emerge as impacting significantly on certain receptors and they are listed below.

Table 11-1: Potentially Significant Project Impacts

Activities	Potentially Significant Project Impacts
Construction phase	
Site establishment (only open cast pit footprint, northernmost hard overburden dump and haul route to siding); Site clearing, including the removal of topsoil and vegetation (only open cast pit footprint, northernmost hard overburden dump and haul route to siding); Construction of mine related infrastructure, including haul roads, pipes, dams (only haul route to siding); Development of initial box-cut for mining, including stockpiling of material from initial box-cuts (only northernmost hard overburden dump).	Noise disturbance
Operational phase	

Stripping topsoil and soft overburden (only open cast pit footprint and northernmost hard overburden dump); Removal of overburden, including drilling and blasting of hard overburden; Loading, hauling and stockpiling of overburden (only northernmost overburden dump); Load, haul and stockpiling of RoM coal; and Hauling coal to siding	Noise disturbance

11.2 Summary of Mitigation and Management

Table 11-2 provides a description of the mitigation and management options for the environmental impacts anticipated during the construction, operational and closure and rehabilitations phases. Additionally it also provides a summary of the project activities, environmental aspects and impacts on the receiving environment as well as the frequency of mitigation.

Table 11-2: Mitigation and Management Plan

Activities	Potential Impact	Size and scale of disturbance	Aspects Affected	Phase	Mitigation Type/Measures	Compliance with standards/Standard to be achieved	Time period for Implementation
Site establishment (only open cast pit footprint, northernmost hard overburden dump and haul route to siding); Site clearing, including the removal of topsoil and vegetation (only open cast pit footprint, northernmost hard overburden dump and haul route to siding); Construction of mine related infrastructure, including haul roads, pipes, dams (only haul route to siding); Development of initial box-cut for mining, including stockpiling of material from initial box-cuts (only northernmost hard overburden dump).	Noise Impact	Impacting only on certain receptors in the Mpumalanga Province	Noise disturbance (noise levels in excess of 7 dBA at certain Mpumalanga receptors)	Construction phase	▪ Alternative location of the northernmost hard overburden dump; ▪ Alternative location of the haul route towards the siding; ▪ Restricting construction activities to daylight hours (06:00 – 18:00) and not during weekends and public holidays; ▪ Locating of diesel generator away from noise sensitive receptors, as well as placing generators on isolation mounts and installation of secondary silencers; ▪ Mining related machines and vehicles to be serviced to the designed requirements of the machinery/vehicles to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers; ▪ Reversing alarms on vehicles should be broadband reversing alarms which emit directional, lower, less intrusive sound; ▪ Environmental noise monitoring to establish compliance with the regulations and to verify the predicted noise levels; and ▪ Switching off equipment when not in use.	National Noise Control Regulations Gauteng Noise Control Regulations	Upon commencement of the construction phase
Stripping topsoil and soft overburden (only open cast pit footprint and northernmost hard overburden dump); Removal of overburden, including drilling and blasting of hard overburden; Loading, hauling and	Noise Impact	Impacting on certain receptors in the Mpumalanga Province during the day and night time as well as measuring above the night time rural guideline (35dBA) towards the east and south east within 650m	Noise disturbance (noise levels in excess of 7 dBA at certain Mpumalanga receptors and noise levels in excess of night time guideline at Gauteng rural receptor)	Operational phase	▪ Stripping topsoil and soft overburden (only open cast pit footprint and northernmost hard overburden dump); ▪ Removal of overburden, including drilling and blasting of hard overburden; ▪ Loading, hauling and stockpiling of overburden (only northernmost overburden dump);	National Noise Control Regulations Gauteng Noise Control Regulations	Upon commencement of the operational phase

Activities	Potential Impact	Size and scale of disturbance	Aspects Affected	Phase	Mitigation Type/Measures	Compliance with standards/Standard to be achieved	Time period for Implementation
stockpiling of overburden (only northernmost overburden dump); Load, haul and stockpiling of RoM coal; and Hauling coal to siding		from opencast pit footprint			▪ Load, haul and stockpiling of RoM coal; and ▪ Hauling coal to siding		
Removal of infrastructure and surface rehabilitation	Noise Impact	Local, not extending beyond project area	NA	Decommissioning phase	▪ Restricting decommissioning activities to daylight hours (06:00 – 18:00) and not during weekends and public holidays; ▪ Mining related machines and vehicles to be serviced to the designed requirements of the machinery/vehicles to ensure noise suppression mechanisms are effective e.g. installed exhaust mufflers; and ▪ Switching off equipment when not in use.	National Noise Control Regulations Gauteng Noise Control Regulations	Upon commencement of the closure phase

11.3 Monitoring Plan

It is recommended that a noise monitoring programme be implemented upon commencement of the project in order to assess the project's noise levels on certain surrounding receptors as well as to validate the modelling results. Components to be included when monitoring are presented in Table 11-3 below.

Table 11-3: Monitoring Plan

Activities	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (For the execution of the monitoring programmes)	Monitoring and reporting frequency and time periods for implementing impact management actions
Construction and operational	Noise disturbance	Noise Monitoring should be conducted by an independent specialist; Monitoring should be undertaken in accordance with the National Noise Control Regulations in conjunction with the SANS 10103:2008 guidelines; The locations to be monitoring are N1 and N2 as per the baseline assessment (refer to Plan 1) as well as additional noise monitoring location at the small holdings district (Prosperity AH)	The client's Environmental Coordinator to implement and manage the recommended monitoring programme; and Independent specialist to carry out the monitoring programme.	Monitoring to be conducted on a quarterly basis. Noise levels propagating from the project should not have an exceedance of 7 dBA or more at Mpumalanga receptors as well as not exceed the daytime rural guideline of 45 dBA and night time rural guideline of 35 dBA at the poultry farms to the east and south east. A report must be compiled after the monitoring has been carried out then submitted to management to ascertain compliance with the required regulations and standards.

12 Consultation Undertaken

The relevant landowners and occupiers on whose property the noise measurements were taken were contacted by the noise specialist. This was to obtain the required permission to enter the property and explain the purpose of the study.

12.1 Comments and Responses

Table 12-1 below presents the scoping comments raised thus far.

Table 12-1: Comments and Response Table

Comment raised	Contributor	Organization/ community	Date	Method	Response
Concerns surrounding dust, noise, groundwater availability and possible crime.	Anne Gillman	Landowner	22 August 2016	Written comment	The Environmental Noise Impact Assessment indicates that the noise levels are likely to impact on certain receptors within the Mpumalanga Province, however if the mitigation measures are followed the impact will be minor
Concerns surrounding noise generation from site	Mrs Hazel Morris	Landowner	31 August 2016	Written comment	The Environmental Noise Impact Assessment indicates that the noise levels are likely to impact on certain receptors within the Mpumalanga Province, however if the mitigation measures are followed the impact will be minor
Should the mine be established close the residential area there	GJ Lombard	Landowner	09 September 2016	Written comment	According to the Environmental Noise Impact Assessment

Comment raised	Contributor	Organization/ community	Date	Method	Response
be a lot of safety and environmental health risks – Air pollution (health and environmental risk), noise pollution (health risk), possible water contamination (health and environmental risk)					it is unlikely that the noise levels will impact on the suburban residential districts at the Largo, Aston Lake and Endicott areas
It is placed on record in the interim that dust emanating from the construction and mining operations, coal dust emanating from mining, transporting and processing of coal, industrial noise emanating from mining machinery, haul trucks, conveyor belts and blasting will have a destroying effect on my client's broiler business;	Johann Minnaar (on behalf of Rossgro)	Lawyer representing Rossgro	12 September 2016	Written comment	The Environmental Noise Impact Assessment indicates that the noise levels are likely to impact on certain receptors within the Mpumalanga Province, however if the mitigation measures are followed the impact will be minor
It will be shown that clean air, minimum noise and uncontaminated water are the key components to a chicken broiler and egg producing business;	Johann Minnaar (on behalf of Rossgro)	Lawyer representing Rossgro	12 September 2016	Written comment	Noted; According to the Environmental Noise impact assessment for the Palmietkuilen Project, it can be concluded that the noise from the mining machinery and vehicles will not impact on the chicken broiler and egg producing business

Comment raised	Contributor	Organization/ community	Date	Method	Response
There are Environmental Specialist Reports available which will indicate that noise pollution, blasting and dust will have a serious and deadly effect on chickens (they are likely to die from heart attacks) and their egg-laying capabilities	Johann Minnaar (on behalf of Rossgro)	Lawyer representing Rossgro	12 September 2016	Written comment	The specialist reports referred to are likely project and site specific not related to the Palmietkuilen Project; According to the Environmental Noise impact assessment for the Palmietkuilen Project, it can be concluded that the noise from the mining machinery and vehicles will not impact on the chicken broiler and egg producing The environment

13 Conclusion and Recommendations

The aim of the environmental noise impact assessment is to ultimately assess whether the proposed project will impact on the surrounding noise sensitive receptors by causing disturbing noise as defined by the national and provincial noise control regulations. The objectives of the assessment are to firstly measure the current ambient baseline noise levels and then compare it with the noise dispersion modelling results.

The baseline ambient day and night time soundscape ranges between 44 dBA and 54 dBA and mainly typical of rural districts with intermittent road traffic. Based on the daytime results from the noise measurements it is noted that the L_{Aeq} levels predominantly measured above the SANS guideline for the maximum allowable outdoor daytime rating level for ambient noise in rural districts (45 dBA), with the background noise levels (L_{A90}) measuring below the daytime rating level guideline for rural districts (45 dBA). Based on the night time results from the noise measurements it is noted that the L_{Aeq} levels predominantly measured above the SANS guideline for the maximum allowable outdoor night time rating level for ambient noise in suburban districts (40 dBA) as well as rural districts (35 dBA), with the background noise levels (L_{A90}) ranging from below to similar to the night time rating level guideline for suburban districts (40 dBA).

Due to the project, which is located within the Gauteng Province, bordering the Mpumalanga Province, the environmental noise impacts are assessed in accordance with both the National as well as Gauteng Noise Control Regulations.

As per the results of the noise dispersion models, it is concluded that the noise from the proposed construction and operational activities, mainly the construction and operational activities related to the open cast pit and northernmost hard overburden dump footprint as well as haul route to the siding, is likely to impact on certain receptors in the Mpumalanga Province. The noise from the proposed construction and operational activities will not significantly increase the existing background noise levels at the surrounding chicken broiler and egg producing businesses and is therefore unlikely to impact on these receptors.

The construction and operational activities relating to the open cast pit and northernmost hard overburden dump is likely to impact on the homestead directly to the north adjacent to the gravel road on the provincial border. The construction and operational activities related to the haul route to the siding is likely to impact on the small holdings community (Prosperity AH) on route to the siding. The mentioned activities are likely to impact during the daytime as well as night time, with sleep disturbance being of concern.

If, however, the recommended mitigation and management measures are implemented the impact can be reduced to a minor significance (refer to Plan 5).

It is recommended furthermore that Pandospan implement a noise monitoring plan to validate determine whether the post mitigation activities are with in compliance of the National Noise Control Regulations as well as to validate the noise modelling results.

14 References

National Conservation Act, Act 73 of 1989;

National Environmental Management Act, Act no 107 of 1998;

National Environmental Management Air Quality Act, Act no 39 of 2004;

National Noise Control Regulations;

South African National Standard - Code of practice, SANS 10103:2008, Edition Six, *The measurement and rating of environmental noise with respect to annoyance and to speech communication*. Available [online] http://www.sabs.co.za.

Appendix A: Curriculum Vitae

Appendix B: Plans

Plan 1: Noise Monitoring Locations

Plan 2: Construction Noise Dispersion

Plan 3: Operational Daytime Noise Dispersion

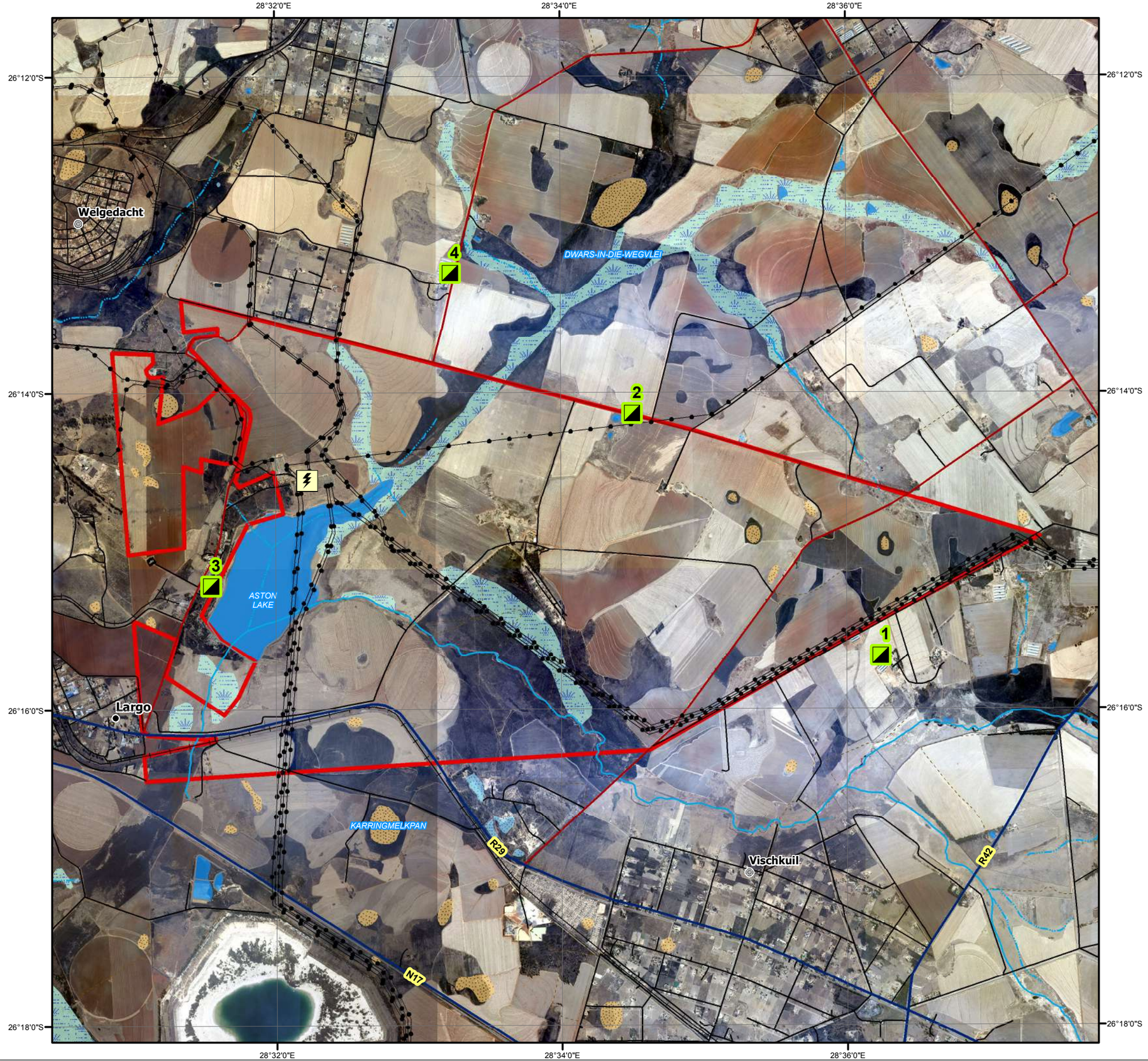
Plan 4: Operational Night Time Noise Dispersion

Plan 5: Recommended Mitigation Measures

Plan 1

Palmietkuilen Project EIA

Noise Monitoring Locations



Legend

- Mining Right Boundary
- Noise Monitoring Location
- Other Town
- Settlement
- Sub-Station
- Power Line
- Arterial / National Route
- Main Road
- Minor Road
- Track
- Railway Line
- Non-Perennial Stream
- Perennial Stream
- Dam Wall
- Dam / Lake
- Wetland
- Perennial Pan
- Non-Perennial Pan / Stream

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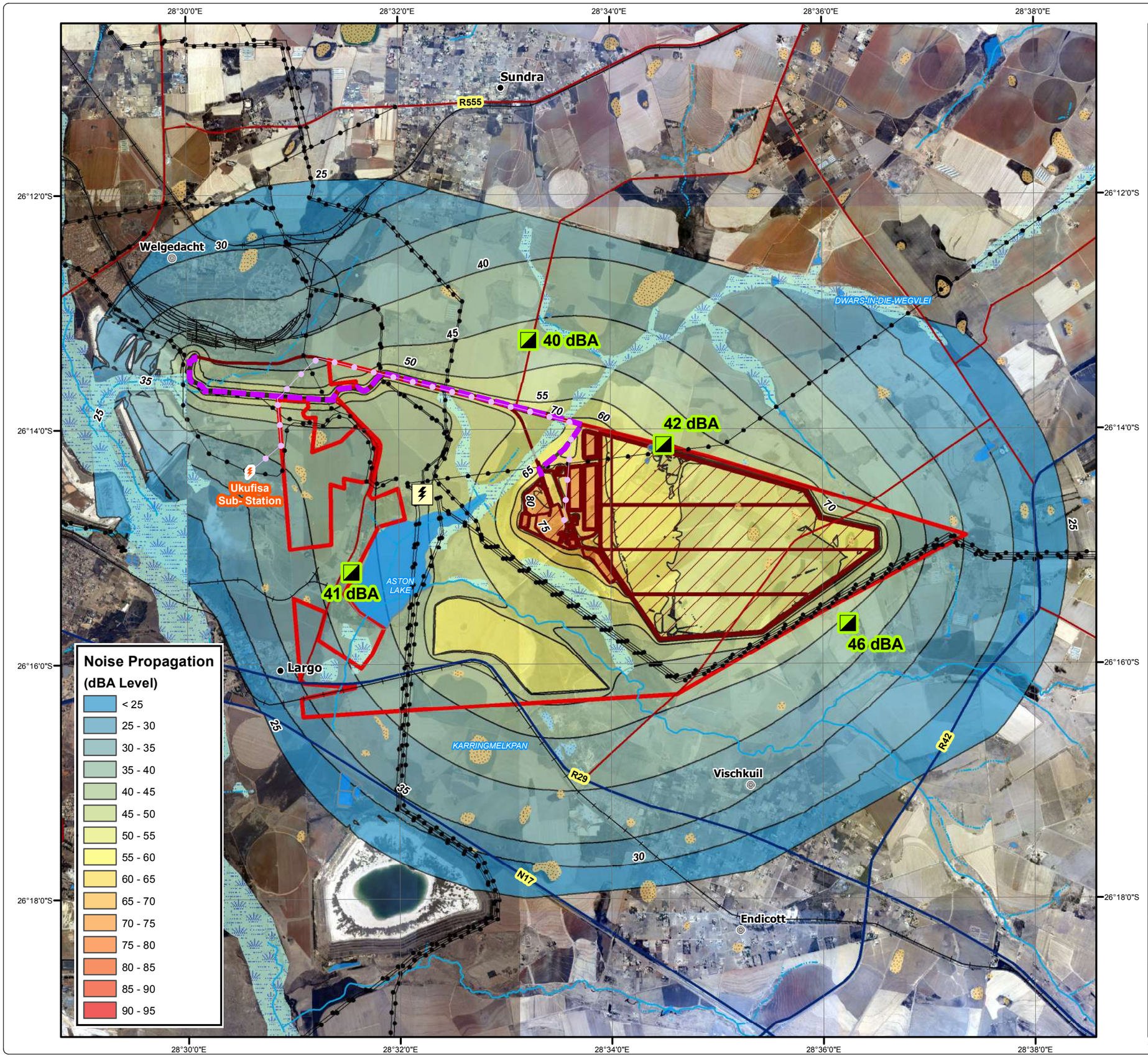
Plan 2

Palmietkuilen Project EIA

Construction Noise Propagation



Noise Propagation (dBA Level)

- < 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- 85 - 90
- 90 - 95

Legend

- Mining Right Boundary
- Preferred Power Line Route
- Preferred Access Road Route
- Infrastructure Footprint
- Noise Monitoring Location
- Other Town
- Settlement
- Sub-Station
- Ukufisa Sub-Station
- Power Line
- Arterial / National Route
- Main Road
- Railway Line
- Non-Perennial Stream
- Perennial Stream
- Dam Wall
- Dam / Lake
- Wetland
- Perennial Pan
- Non-Perennial Pan / Stream

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Plan 3

Palmietkuilen Project EIA

Operational Daytime Noise Propagation

28°30'0"E 28°32'0"E 28°34'0"E 28°36'0"E 28°38'0"E

26°12'0"S 26°14'0"S 26°16'0"S 26°18'0"S

Sundra
R555
Welgedacht
Ukufisa Sub-Station
ASTON LAKE
DWARS-IN-DIE-WEGVLEI
KARRINGMELKPAN
Largo
Vischkuil
Endicott
R29
R42
N17

40 dBA
42 dBA
41 dBA
46 dBA

25 30 35 40 45 50 55 60 65 70

Noise Propagation (dBA Level)

- < 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- 85 - 90
- 90 - 95

Legend

- Mining Right Boundary
- Preferred Power Line Route
- Preferred Access Road Route
- Infrastructure Footprint
- Noise Monitoring Location
- Other Town
- Settlement
- Sub-Station
- Ukufisa Sub-Station
- Power Line
- Arterial / National Route
- Main Road
- Railway Line
- Non-Perennial Stream
- Perennial Stream
- Dam Wall
- Dam / Lake
- Wetland
- Perennial Pan
- Non-Perennial Pan / Stream

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Plan 4

Palmietkuilen Project EIA

Operational Night Time Noise Propagation

28°30'0"E 28°32'0"E 28°34'0"E 28°36'0"E 28°38'0"E

26°12'0"S 26°14'0"S 26°16'0"S 26°18'0"S

Sundra
R555
Welgedacht
DWARS-IN-DIE-WEGVLEI
40 dBA
25 dBA
34 dBA
40 dBA
Ukufisa Sub-Station
ASTON LAKE
Largo
KARRINGMELKPAN
Vischkuil
Endicott
R29
R42
N17

25 30 40 45 50 70 65 60 55 35

Noise Propagation (dBA Level)

- < 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75
- 75 - 80
- 80 - 85
- 85 - 90
- 90 - 95

Legend

- Mining Right Boundary
- Preferred Power Line Route
- Preferred Access Road Route
- Infrastructure Footprint
- Noise Monitoring Location
- Other Town
- Settlement
- Sub-Station
- Ukufisa Sub-Station
- Power Line
- Arterial / National Route
- Main Road
- Railway Line
- Non-Perennial Stream
- Perennial Stream
- Dam Wall
- Dam / Lake
- Wetland
- Perennial Pan
- Non-Perennial Pan / Stream

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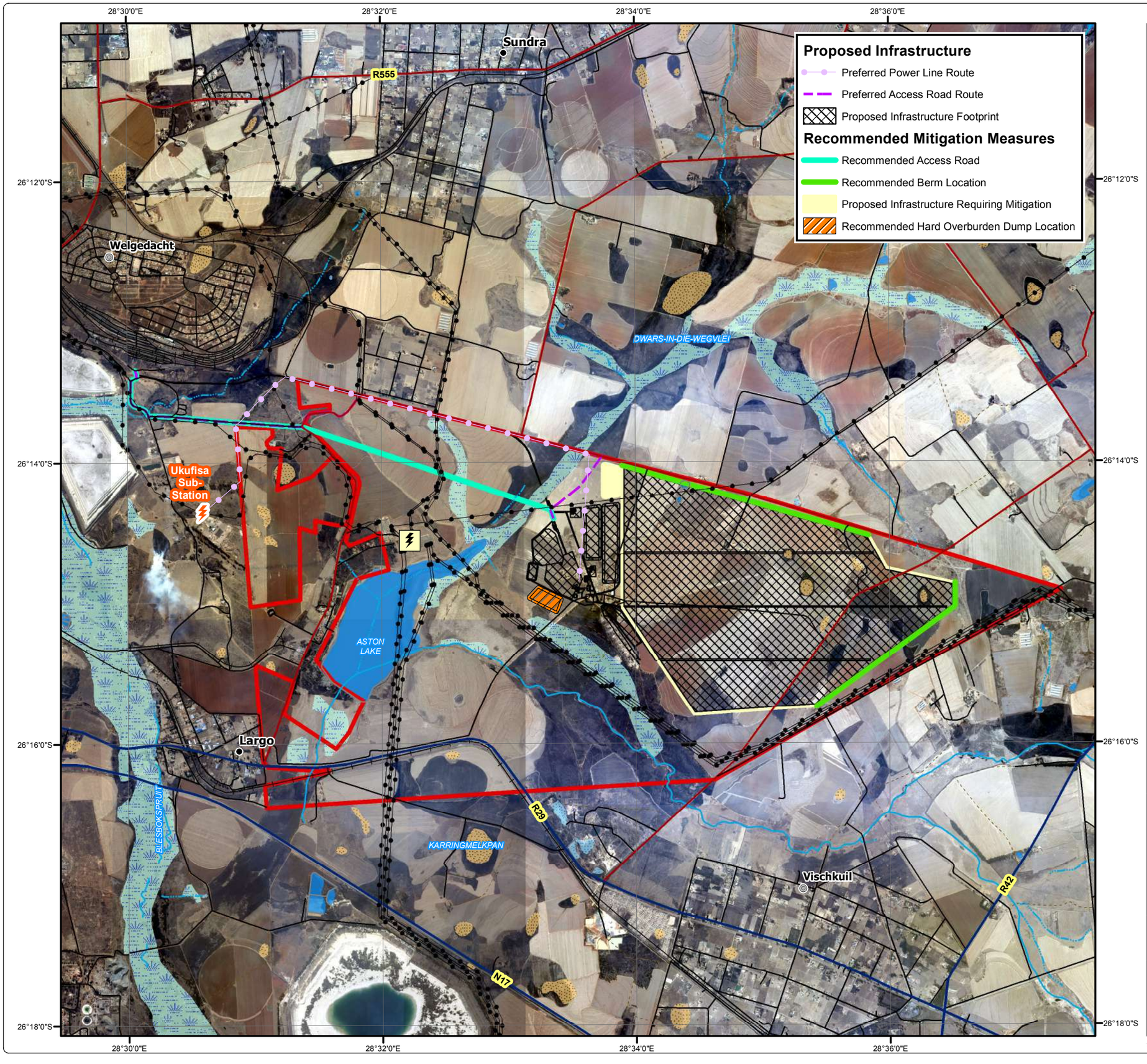
Plan 5

Palmietkuilen Project EIA

Recommended Mitigation Measures



Legend

- Mining Right Boundary
- Other Town
- Settlement
- Sub-Station
- Ukufisa Sub-Station
- Power Line
- Arterial / National Route
- Main Road
- Minor Road
- Track
- Railway Line
- Non-Perennial Stream
- Perennial Stream
- Dam Wall
- Dam / Lake
- Wetland
- Perennial Pan
- Non-Perennial Pan / Stream

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