environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEAT/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Proposed 30-year Ash Disposal Facility at Kendal Power Station, Mpumalanga

Specialist:	Airshed Planning Professionals		
Contact person:	Reneé von Gruenewaldt		
Postal address:	PO Box 5260, Halfway House		
Postal code:	1685	Cell:	083 222 6916
Telephone:	061 481 9649	Fax:	011 805 7010
E-mail:	renee@airshed.co.za		
Professional affiliation(s) (if any)	SACNASP		

Project Consultant:	Zitholele Consulting (Pty) Ltd		
Contact person:	Tania Oosthuizen		
Postal address:	PO Box 6002, Halfway House		
Postal code:	1682	Cell:	083 504 9881
Telephone:	011 207 2060	Fax:	086 676 9950
E-mail:	taniao@zitholele.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Reneé von Gruenewaldt, declare that --

General declaration:

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

Signature of the specialist:

Airshed Planning Professionals

Name of company (if applicable):

20/05/2016

Date:

AIRSHED PLANNING PROFESSIONALS

Noise Assessment for the Kendal 30 Year Ash Disposal Facility Project

Project done on behalf of **Zitholele Consulting**

Report Compiled by:
R von Gruenewaldt
N von Reiche

Report No: 13ZIT01N2 | **Date:** June 2016

Address: 480 Smuts Drive, Halfway Gardens | **Postal:** P O Box 5260, Halfway House, 1685
Tel: +27 (0)11 805 1940 | **Fax:** +27 (0)11 805 7010
www.airshed.co.za

Report Details

Reference	13ZIT01N2
Status	Final
Report Title	Noise Assessment for the Kendal 30 Year Ash Disposal Facility Project
Date	June 2016
Client	Zitholele Consulting
Prepared by	Reneé von Gruenewaldt *(Pr. Sci. Nat.)*, MSc (University of Pretoria) Nicolette von Reiche, BEng Hons (Mech) (University of Pretoria)
Notice	Airshed Planning Professionals (Pty) Ltd is a consulting company located in Midrand, South Africa, specialising in all aspects of air quality, ranging from nearby neighbourhood concerns to regional air pollution impacts as well as noise impact assessments. The company originated in 1990 as Environmental Management Services, which amalgamated with its sister company, Matrix Environmental Consultants, in 2003.
Declaration	Airshed is an independent consulting firm with no interest in the project other than to fulfil the contract between the client and the consultant for delivery of specialised services as stipulated in the terms of reference.
Copyright Warning	Unless otherwise noted, the copyright in all text and other matter (including the manner of presentation) is the exclusive property of Airshed Planning Professionals (Pty) Ltd. It is a criminal offence to reproduce and/or use, without written consent, any matter, technical procedure and/or technique contained in this document.

Revision Record

Revision Number	**Date**	**Reason for Revision**
Draft	28 February 2015	Client review
Final	June 2016	

Abbreviations

Airshed	Airshed Planning Professionals (Pty) Ltd
EHS	Environmental, Health and Safety
IFC	International Finance Organisation
ISO	International Organisation for Standards
SABS	South African Bureau of Standards
SANS	South African National Standards
SAWS	South African Weather Service
Δ	The increase in noise level

Note: All acoustic terminology are discussed in more detail in Section 2.1

Executive Summary

Airshed Planning Professionals (Pty) Ltd was appointed by Zitholele Consulting to undertake the noise impact assessment for the 30 year ash disposal Project (hereafter referred to as the proposed Project). The study included an assessment of receiving environment and the impacts likely to occur as a result of the Project.

In studying the receiving acoustic environment, the following was found:

- The closest noise sensitive receptors include included individual residences, homesteads and residential areas.
- Ground cover in the study area consists of shrubs and is considered 'acoustically mixed i.e. somewhat conducive to noise attenuation.
- A study of the wind field indicated that noise impacts will most likely be most notable towards the south-southeast.
- An increase of 3 dBA in ambient noise level is considered the indicator of noise impacts. This is the level at which individuals with average hearing acuity would be able to detect a change in noise level.
- Baseline monitoring results indicate pre-development environs ranging between 38.5 and 70.9 dBA during the day and 39.3 and 65.8 dBA during the night. These are typical of suburban to urban and industrial areas.
- In the estimation of cumulative noise levels, baseline day- and night-time noise levels of 47.3 dBA and 39.3 dBA respectively, were used (as obtained from measurements in close proximity to the proposed site).
- Sources observed to affect baseline noise levels included the mining activities, community activities, traffic on the N12 and the R555, railway noise, animals, birds and insects.

In terms of the Project's impact on environmental noise levels the following was found:

- The operational phase of the Project is expected to increase existing environmental noise levels such that IFC day- and night-time guidelines for residential areas (55 dBA and 45 dBA respectively) are exceeded at a distance of 120m and 280m from stacker operations.
- The increase in noise of 3 dBA above the baseline is expected to be 200m and 400m from stacker operations during day-and night-time conditions respectively. According to SANS 10103 (2008), an increase of between 1 and 10 dBA above the baseline may result in 'little' reaction with 'sporadic complaints' from nearby communities.
- The impact significance is provided as MODERATE to LOW due to construction and closure phases and LOW for operational phase. As no significant noise impacts are predicted due to the project, it is recommended that the project be approved from a noise perspective.

Table of Contents

1 Introduction ... 1

2 Approach to the Study ... 1

2.1 Noise Defined ... 1

2.1.1 Perception of Sound ... 1

2.1.2 Frequency Weighting ... 2

2.1.3 Adding Sound Pressure Levels ... 2

2.1.4 Environmental Noise Propagation ... 2

2.1.5 Environmental Noise Indices ... 3

2.2 Methodology ... 3

3 Assumptions and Limitations ... 4

4 Environmental Noise Regulations ... 4

4.1 IFC Guidelines on Environmental Noise ... 5

4.2 SANS 10103 ... 5

5 The Effected Noise Environment ... 6

5.1 Locality and Distance to Communities ... 6

5.2 Atmospheric Absorption and Meteorology ... 6

5.3 Terrain, Ground Absorption and Reflection ... 8

5.4 Baseline Noise Levels ... 8

6 Impact Assessment ... 21

6.1 Construction and Closure ... 21

6.2 Operation ... 21

6.2.1 Noise Sources and Sound Power Levels ... 21

6.2.2 Noise Propagation Modelling and Predicted Noise Levels ... 22

6.2.3 Extended Life –Footprint to Accommodate Ash Disposal until 2058 ... 25

6.3 Impact Significance Rating ... 26

7 Management, Mitigation and Recommendations ... 29

7.1 Good Engineering and Operational Practices ... 29

7.2 Operational Hours ... 29

7.3 Monitoring ... 29

8 Main Findings ... 29

9 References ... 31

List of Tables

Table 1: IFC noise level guidelines 5
Table 2: Typical rating levels for outdoor noise in districts........ 5
Table 3: Average meteorological data applied to calculations 7
Table 4: Summary of baseline noise level measurement results 10
Table 5: Equivalent continuous ratings........11
Table 6: Ash stacking/conveying sound power levels as calculated from source measurements........21
Table 7: Impact rating matrix for the construction phase for the proposed Project........27
Table 8: Impact rating matrix for the operational phase for the proposed Project........27
Table 9: Impact rating matrix for the closure phase for the proposed Project........28

List of Figures

Figure 1: Sensitive receptors (i.e. residential areas and individual houses/farmsteads), with respect to noise impacts due to operations from the proposed Project 7
Figure 2: Period, day-time and night-time wind roses for Kendal monitoring station (January 2009 – October 2012) 8
Figure 3: Kendal 30 Year Ash Disposal Facility and representative baseline noise measurement locations..... 11
Figure 4: Pictures of baseline noise measurement locations undertaken for the Kendal 30 Year Ash Disposal Facility Project 12
Figure 5: Pictures of previous baseline noise measurement locations undertaken for the Kendal Continuous Ash Disposal Facility Project 13
Figure 6: Baseline day-time noise measurement at site KMP1..... 14
Figure 7: Baseline night-time noise measurement at site KMP1..... 14
Figure 8: Baseline day-time noise measurement at site KMP2..... 15
Figure 9: Baseline night-time noise measurement at site KMP2..... 15
Figure 10: Baseline day-time noise measurement at site KMP3..... 16
Figure 11: Baseline night-time noise measurement at site KMP3..... 16
Figure 12: Baseline day-time noise measurement at site KMP4..... 17
Figure 13: Baseline night-time noise measurement at site KMP4..... 17
Figure 14: Adjusted baseline night-time noise measurement at site KMP4 18
Figure 15: Previous baseline day-time noise measurement at site 1 18
Figure 16: Previous baseline night-time noise measurement at site 1 19
Figure 17: Previous baseline day-time noise measurement at site 2 19
Figure 18: Previous baseline night-time noise measurement at site 2 20
Figure 19: Previous baseline day-time noise measurement at site 3 20
Figure 20: Previous baseline night-time noise measurement at site 3 21
Figure 21: Estimated cumulative day-and night-time noise levels (due to proposed Project operations and baseline noise levels)..... 22
Figure 22: Estimated increase in day-and night-time equivalent ratings above the baseline..... 23
Figure 23: Generalised noise impact with reference to IFC guidelines, irrespective of location of operational area 24
Figure 24: Generalised noise impact with reference to an increase in 3dBA, irrespective of location of operational area..... 24
Figure 25: Generalised noise impact with reference to IFC guidelines, irrespective of location of operational area 25
Figure 26: Generalised noise impact with reference to an increase in 3dBA, irrespective of location of operational area..... 26

Noise Assessment for the Kendal 30 Year Ash Disposal Facility Project

1 INTRODUCTION

Kendal Power Station is a coal-fired power generation facility on which construction started in mid-1982 and the last unit came online in 1993. The power station is located in the Nkangala District of Mpumalanga, approximately 10 km south-west of the town of Ogies. Kendal Power Station disposes of boiler- and fly-ash in a dry (8 to 15% moisture content conditioning) format, which is transported by means of conveyors. The ash will be distributed onto the ash disposal facility by means of a stacker at a rate of approximately 4.6 million tons per year for all six generating units.

Airshed Planning Professionals (Pty) Ltd was appointed by Zitholele Consulting to undertake the noise impact assessment for the 30 year ash disposal Project (hereafter referred to as the proposed Project).

2 APPROACH TO THE STUDY

2.1 Noise Defined

As background to a noise impact study, the reader should take note of some definitions and conventions used in the measurement, calculation and assessment of environmental noise.

Noise is generally defined as unwanted sound transmitted through a compressible medium such as air. Sound in turn, is defined as any pressure variation that the ear can detect. Human response to noise is complex and highly variable as it is subjective rather than objective.

Noise is reported in decibels (dB). "dB" is the descriptor that is used to indicate a logarithmic ratio of quantities that have the same units, in this case sound pressure. The relationship between sound pressure and sound pressure level is illustrated in Equation 1:

$$L_p = 20 \cdot \log_{10}\left(\frac{p}{p_{ref}}\right)$$

Equation 1

Where:

L_p is the sound pressure level in dB;
p is the actual sound pressure in Pa; and
p_{ref} is the reference sound pressure (p_{ref} in air is 20 µPa)

2.1.1 Perception of Sound

Sound has already been defined as any pressure variation that can be detected by the human ear. The number of pressure variations per second is referred to as the frequency of sound and is measured in hertz (Hz). The hearing of a young, healthy person ranges between 20 Hz and 20 000 Hz.

In terms of sound pressure level, audible sound ranges from the threshold of hearing at 0 dB to the pain threshold of 130 dB and above. Even though an increase in sound pressure level of 6 dB represents a doubling in sound pressure, an increase of 8 to 10 dB is required before the sound subjectively appears to be significantly louder. Similarly, the smallest perceptible change is about 1 dB (Brüel & Kjær Sound & Vibration Measurement A/S, 2000).

2.1.2 Frequency Weighting

As human hearing is not equally sensitive to all frequencies, a 'filter' has been developed to simulate human hearing. The 'A-weighting' filter simulates the human hearing characteristic, which is less sensitive to sounds at low frequencies than at high frequencies. "dBA" is the descriptor that is used to indicate a logarithmic ratio of quantities, that have the same units (in this case sound pressure) that has been A-weighted.

2.1.3 Adding Sound Pressure Levels

Since sound pressure levels are logarithmic values, the sound pressure levels as a result of two or more sources cannot just simply be added together. To obtain the combined sound pressure level of a combination of sources such as those at an industrial plant, individual sound pressure levels must be converted to their linear values and added using Equation 2.

$$L_{p\_total} = 10 \cdot \log\left(10^{\frac{L_{p1}}{10}} + 10^{\frac{L_{p2}}{10}} + 10^{\frac{L_{p3}}{10}} + \cdots 10^{\frac{L_{pn}}{10}}\right)$$

Equation 2

This implies that if the difference between the sound pressure levels of two sources is nil the combined sound pressure level is 3 dB more than the sound pressure level of one source alone. Similarly, if the difference between the sound pressure levels of two sources is more than 10 dB, the contribution of the quietest source can be disregarded (Brüel & Kjær Sound & Vibration Measurement A/S, 2000).

2.1.4 Environmental Noise Propagation

Many factors affect the propagation of noise from source to receiver. The most important of these are:

- The type of source and its sound power;
- The distance between the source and the receiver;
- The extent of atmospheric absorption (attenuation);
- Wind speed and direction;
- Temperature and temperature gradient;
- Obstacles such as barriers or buildings between the source and receiver;
- Ground absorption;
- Reflections;
- Humidity; and
- Precipitation

To arrive at a representative result from either measurement or calculation, all these factors must be taken into account (Brüel & Kjær Sound & Vibration Measurement A/S, 2000).

2.1.5 Environmental Noise Indices

In assessing environmental noise either by measurement or calculation, reference is generally made to the following indices:

- **L_{PA}** – The A-weighted instantaneous sound pressure level.
- **L_{Aeq} (T)** – The A-weighted equivalent sound pressure level, where T indicates the time over which the noise is averaged (calculated or measured). The International Finance Corporation (IFC) provides guidance with respect to L_{Aeq} (1 hour), the A-weighted equivalent sound pressure level, averaged over 1 hour.
- **L_{AIeq} (T)** – The A-weighted impulse corrected equivalent sound pressure level, where T indicates the time over which the noise is averaged (calculated or measured).
- **L_{Zeq} (T)** – The un-weighted equivalent sound pressure level, where T indicates the time over which the noise is averaged (calculated or measured).
- **L_{A90}** – The A-weighted 90% statistical noise level, i.e. the noise level that is exceeded during 90% of the measurement period. It is a very useful descriptor which provides an indication of what the LAeq could have been in the absence of noisy single events and is considered representative of background noise levels.
- **L_{A10}** – The A-weighted 10% statistical noise level, i.e. the noise level that is exceeded during 10% of the measurement period.
- **L_{Amax}** – The maximum level generated from a single noise event.

2.2 Methodology

The Project has the potential to cause environmental noise impacts. The main objective of the noise assessment is to provide an estimate of potential impacts from the proposed Project on the surrounding environment. Based on the overall objective the following were included in the study:

- A review of local legislation and (or) guidelines pertaining to environmental noise impacts.
- A review of all available Project documentation and information.
- The assessment of existing environmental noise levels in the vicinity of the Project and nearby residences.
- The identification of sources of environmental noise associated with the construction, operational and closure phases of the Project.
- The quantification of sources of environmental noise associated with a representative operational phase of the Project.
- The preparation of meteorological data and site specific acoustic parameters for use in the calculation of noise propagation.
- Noise propagation calculations.
- The evaluation of estimated noise impacts based on legislation and (or) guidelines.
- A review of mitigation measures pertaining to environmental noise management.
- The compilation of a noise impact assessment report.

The assessment included a study of the legal requirements pertaining to noise impacts, a study of the physical environment of the area surrounding the Project and the analyses of existing noise levels in the area. The impact assessment focused on the estimation of sound power levels (noise source) and sound pressure levels (noise impacts) associated with one representative operational phase scenario. The findings of the assessment components informed recommendations of management measures, including mitigation and monitoring. Individual aspects of the noise impact assessment methodology followed in the study are discussed in more detail below.

Baseline noise measurements were conducted in accordance with the South African National Standards (SANS): 'The measurement and rating of environmental noise with respect to annoyance and to speech communication' (SANS 10103, 2008). Measurements were conducted during the day (between 07:00 to 22:00) and during the night (between 22:00 to 07:00) at locations representative of the noise climate in the vicinity of proposed Project area. The selection of measurement locations and durations were also informed by site access and safety considerations. Existing sources of noise and the physical environment, including weather conditions, were noted during measurements. Reference was also made to typical noise levels in rural, suburban, urban and industrial districts as defined by SANS (SANS 10103, 2008) in determining baseline noise levels.

Sound power levels from activities associated with the Project were calculated based on a measured noise sample obtained from stacker and conveyor activities at the current Kendal ash disposal facility.

The propagation of noise from proposed Project activities was calculated according to 'The calculation of sound propagation by the Concawe method' (SANS 10357, 2004). The Concawe method makes use of the International Organisation for Standardization's (ISO) air absorption parameters and equations for noise attenuation as well as the factors for barriers and ground effects. In addition to the ISO method, the Concawe method facilitates the calculation of sound propagation under a variety of meteorological conditions. Meteorological data obtained from the Kendal monitoring station and the South African Weather Service (SAWS) Station at eMalahleni was applied in calculations.

Noise impacts were calculated both in terms of total ambient noise levels as a result of proposed operations as well as the effective increase in ambient noise levels at community locations over the baseline. Impacts were assessed according to guidelines published by the IFC and SANS 10103.

3 Assumptions and Limitations

The following limitations and assumptions should be noted:

- The study only considered sound pressure levels from the Project as additional sources of noise to measured baseline noise pressure levels.
- Source sound power levels were measured at existing operations at the Kendal ash disposal facility. It was assumed that similar equipment would be used for the proposed Project and these sound power levels would be representative of these activities.
- Noise baseline measurements included attended 'spot' samples, ~30 minutes in duration during the day and 15 minutes in duration during the night. This gives an indication of what pre-development levels are. It should be noted that these measurements therefore do not take into account variable weather conditions or community activities.

4 Environmental Noise Regulations

Reference is made to guidelines published by the South African Bureau of Standards (SABS) (SANS 10103, 2008). Due to these guidelines being more descriptive, reference is also made to the IFC (IFC, 2007). Both these guidelines are in line with the World Health Organisation (WHO) Guidelines for Community Noise (WHO, 1999).

4.1 IFC Guidelines on Environmental Noise

The IFC General EHS Guidelines on noise address impacts of noise beyond the property boundary of the facility under consideration and provides noise level guidelines.

The IFC states that **noise impacts should not exceed the levels presented in Table 1**, or result in a maximum **increase above background levels of 3 dBA** at the nearest receptor location off-site (IFC, 2007). For a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level is not detectable. Δ = 3 dBA is, therefore, a useful significance indicator for a noise impact.

Table 1: IFC noise level guidelines

Noise Level Guidelines		
Area	One Hour L_{Aeq} (dBA) 07:00 to 22:00	One Hour L_{Aeq} (dBA) 22:00 to 07:00
Industrial receptors	70	70
Residential, institutional and educational receptors	55	45

4.2 SANS 10103

SANS 10103 (2008) successfully addresses the manner in which environmental noise is to be assessed in South Africa, and is fully aligned with the WHO guidelines of 1999. The values given in Table 2 are typical rating levels that should not be exceeded outdoors in the different districts specified. Outdoor ambient noise exceeding these levels will be considered annoying to the community.

The areas surrounding Kendal Power Station are considered a mix of rural and suburban districts.

Table 2: Typical rating levels for outdoor noise in districts

Type of district	Equivalent Continuous rating Level ($L_{Req,T}$) for Outdoor Noise (SANS 10103, 2008)		
	Day/night $L_{R,dn}$ (dBA)	Day-time $L_{Req,d}$ (dBA)	Night-time $L_{Req,n}$ (dBA)
Rural districts	45	45	35
Suburban districts with little road traffic	50	50	40
Urban districts	55	55	45
Urban districts with one or more of the following; business premises; and main roads	60	60	50
Central business districts	65	65	55
Industrial districts	70	70	60

SANS10103 (2008) also provides a useful guideline for estimating community response to an increase in the general ambient noise level caused by intruding noise. If Δ is the increase in noise level, the following criteria are of relevance:

- $\Delta \leq 0$ dB: There will be no community reaction.

- 0 dB <Δ≤ 10 dB: There will be 'little' reaction with 'sporadic complaints'. For a person with average hearing acuity an increase of less than 3 dBA in the general ambient noise level is not detectable. Δ = 3 dBA is, therefore, a useful significance indicator for a noise impact.
- 5 dB <Δ≤ 15 dB: There will be a 'medium' reaction with 'widespread complaints'. Δ = 10 dB is subjectively perceived as a doubling in the loudness of the noise.
- 10 dB <Δ≤ 20 dB: There will be a 'strong' reaction with 'threats of community action'.
- 15 dB <Δ: There will be a 'very strong' reaction with 'vigorous community action'.

The categories of community response overlap because the response of a community does not occur as a stepwise function, but rather as a gradual change.

5 THE EFFECTED NOISE ENVIRONMENT

5.1 Locality and Distance to Communities

The current land uses in the region include coal mining, farming, power generation facilities and small residential communities. Sensitive receptors in the study area included individual residences, homesteads and residential areas (Figure 1; Google EarthTM; imagery date: 2013-08-28). The general topography is characterised by gently rolling terrain with no steep inclines.

5.2 Atmospheric Absorption and Meteorology

Atmospheric absorption and meteorological conditions have already been mentioned with regards to its role in the propagation on noise from source to receiver (Section 2.1.4). Meteorological parameters affecting the propagation of noise, when calculated using the Concawe method, include wind speed, wind direction, temperature, relative humidity, air pressure, solar radiation and cloud cover. Average day and night-time wind speed, wind direction, temperature, relative humidity, pressure and solar radiation as obtained from Eskom monitoring station located at Kendal and the South African Weather Service Station at eMalahleni are provided in Table 3.

It is well known that wind speed increases with altitude. This results in the 'bending' of the path of sound to 'focus' it on the downwind side and creating a 'shadow' on the upwind side of the source. Depending on the wind speed, the downwind level may increase by a few dB but the upwind level can drop by more than 20 dB (Brüel & Kjær Sound & Vibration Measurement A/S, 2000).

Wind roses indicating prevailing wind directions in the area during the day and night are provided in Figure 2. Wind roses represent wind frequencies for the 16 cardinal wind directions. Frequencies are indicated by the length of the shaft when compared to the circles drawn to represent a frequency of occurrence. Wind speed classes are assigned to illustrate the frequencies with high and low winds occurring for each wind vector. The frequencies of calms, defined as periods for which wind speeds are below 1 m/s, are also indicated. The average day and night-time wind field is characterised by frequent moderate winds (3 to 5 m/s) from the east-south-east. During day-time the wind field includes more frequent wind from the west-north-west and east. It should be noted that at wind speeds of more than 5 m/s ambient noise levels are mostly dominated wind generated noise.

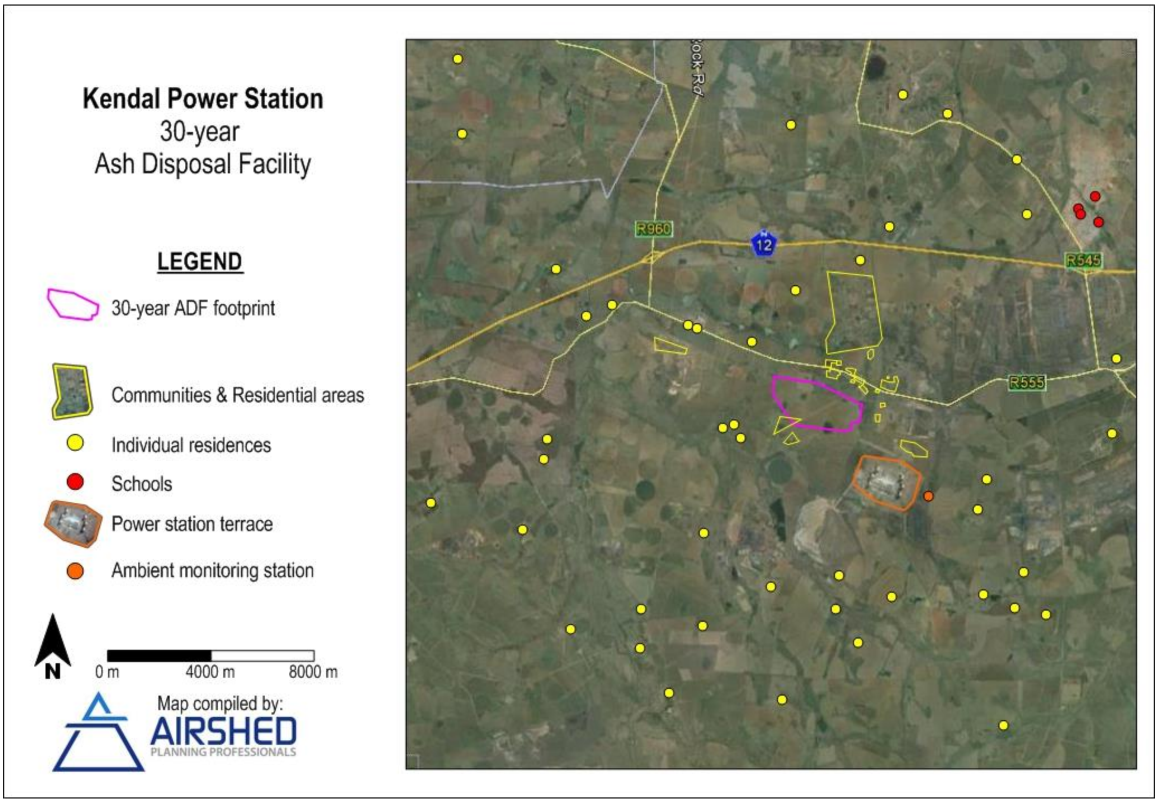

Figure 1: Sensitive receptors (i.e. residential areas and individual houses/farmsteads), with respect to noise impacts due to operations from the proposed Project

Table 3: Average meteorological data applied to calculations

Average Meteorological Data Applied in Calculations		
Meteorological Parameter	**Day-time (07:00 – 22:00)**	**Night-time (22:00 – 07:00)**
Average wind speed (m/s)	3.6	3.1
Wind direction to (°)	21	339
Average temperature (°C)	18	11
Average relative humidity (%)	49.1	69.7
Air pressure (kPa)	85.8	85.8
Solar radiation (W/m²)	700	Not applicable
Cloud cover (octas)	3.7	3.9

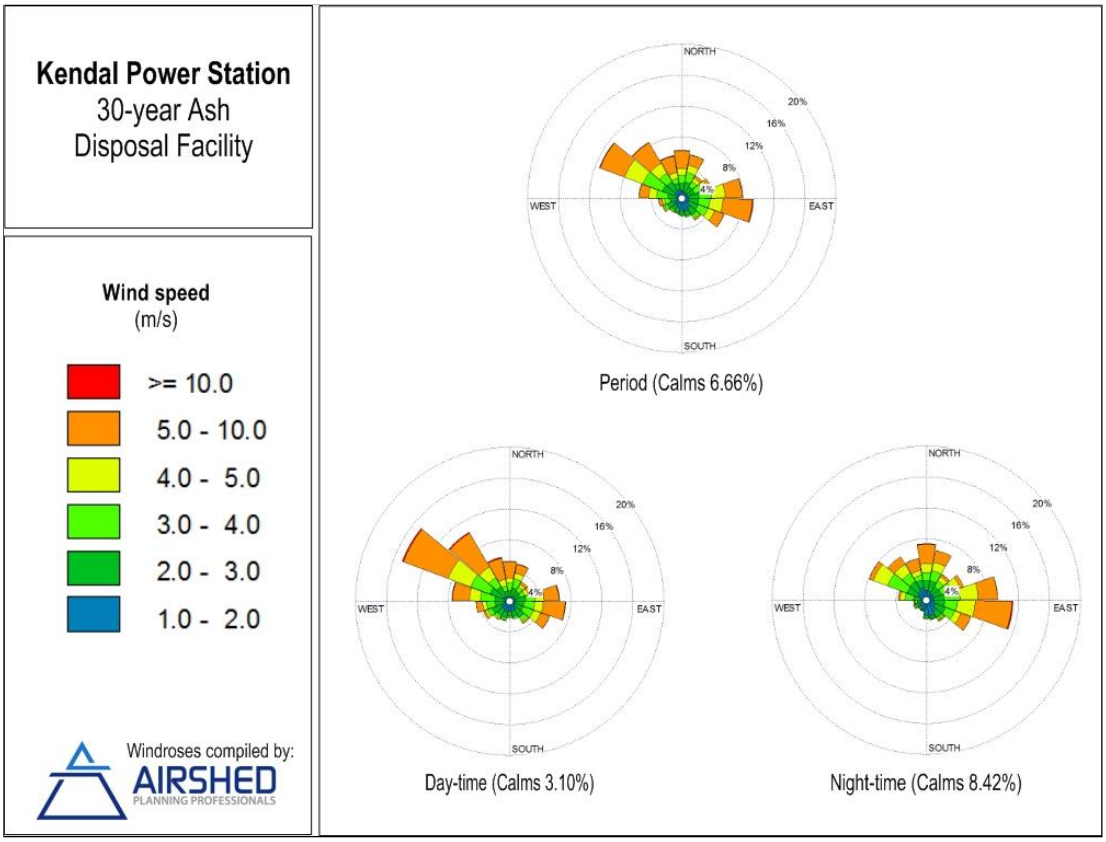

Figure 2: Period, day-time and night-time wind roses for Kendal monitoring station (January 2009 – October 2012)

Temperature gradients in the atmosphere create effects that are uniform in all directions from a source. On a sunny day with no wind, temperature decreases with altitude and creates a 'shadowing' effect for sounds. On a clear night, temperatures may increase with altitude thereby 'focusing' sound on the ground surface. Noise impacts are therefore generally more significant during the night.

5.3 Terrain, Ground Absorption and Reflection

Noise reduction caused by a barrier (natural terrain or installed acoustic barrier) depends on two factors namely the path difference of the sound wave as it travels over the barrier compared with direct transmission to the receiver and the frequency content of the noise. Low frequency noise is difficult to reduce with barriers (Brüel & Kjær Sound & Vibration Measurement A/S, 2000). There are no topographical features or tall vegetation that may act as noise barriers between the proposed activities and the noise sensitive receptors.

Sound reflected by the ground interferes with the directly propagated sound. The effect of the ground is different for acoustically hard (e.g., concrete or water), soft (e.g., grass, trees or vegetation) and mixed surfaces. Ground attenuation is often calculated in frequency bands to take into account the frequency content of the noise source and the type of ground between the source and the receiver barriers (Brüel & Kjær Sound & Vibration Measurement A/S, 2000). Ground cover consists mostly of shrubs and is considered acoustically mixed.

5.4 Baseline Noise Levels

Previously, noise measurements were conducted in April 2013 at three representative baseline locations for the Kendal Continuous Ash Disposal Facility Project (Figure 3) (von Reiche, 2014). In addition to these three points, noise measurements at an additional four points were conducted in September 2013 for the Kendal 30 Year Ash Disposal Facility Project (Figure 3). Pictures of these locations and surround areas are presented in Figure 4 and Figure 5 respectively. Measurements were conducted in accordance with SANS 10103, 'The measurement and rating of noise and speech communication' (SANS 10103, 2008). Existing sources of noise and the physical environment, including weather conditions, were noted during measurements. A summary of measurement results is provided in Table 4.

To facilitate comparison with SANS Guidelines in Table 2, measured L_{Aleq} levels were used to determine equivalent continuous day-time ($L_{Req,d}$), night-time ($L_{Req,n}$) and day-night ($L_{R,dn}$) sound pressure levels that includes specified adjustments for tonal character and time of day (Table 5). Measurements at previous measurement locations 1 and 2 showed the presence of tones at 3 150 to 5 000 Hz respectively and a tonal character penalty of 5 dB was added accordingly.

For noise measurements conducted in September 2013, the noise levels at location KMP2 and KMP4 were comparable and correspond to typical noise levels prevalent in rural and suburban districts. The noise levels at location KMP3 were comparable and correspond to typical noise levels prevalent in rural and urban districts with noise levels at location KMP1 comparable to noise levels of industrial areas. For noise measurements conducted for the Kendal Continuous Ash Disposal Facility Project, noise levels at location 1 and 2 were comparable and correspond to typical noise levels prevalent in rural and suburban districts. Noise levels typically found in urban districts prevailed at location 3. This is as a result of fast travelling heavy vehicles on the R555.

Time series of measured baseline noise levels are provided in Figure 6 to Figure 20. Note that a passing train at location KMP4 during the night-time measurements resulted in high noise levels for a short duration. Figure 14, shows noise measurements at this location, excluding the incident to be representative background noise levels.

Table 4: Summary of baseline noise level measurement results

Time of Day	Location	Start Time	Elapsed Time	L_{Aleq} (dBA)	Notes
Additional measurements undertaken for the Kendal 30 Year Ash Disposal Facility					
Day-time	KMP1	17-Sep-13 12:22	00:30:00	70.9	Sunny, warm conditions with moderate wind. Measurements mostly affected by heavy and light vehicle traffic on the adjacent main road. Dogs, chickens and wind rustling through the leaves of trees contributed to measured noise levels.
	KMP2	17-Sep-13 09:17	00:30:00	43.2	Sunny, cool conditions with gusting moderate wind. Birds, insects, wind, continuous humming of distant mine vehicles and occasional air traffic contributed to measured noise levels.
	KMP3	17-Sep-13 10:21	00:30:00	44.9	Sunny, cool conditions with moderate to high winds. Noise generated by wind rustling through maize stalks on the ground, humming of farming equipment, birds and wind rustling through the leaves of trees ~100m from the measuring equipment.
	KMP4	17-Sep-13 11:16	00:30:00	46.3	Sunny with a cool moderate wind. Audible sources included: constant humming of mining equipment and mining vehicles reverse hooters.
Night-time	KMP1	20-Sep-13 00:43	00:30:00	62.6	Cold, cloudy conditions with moderate wind. Measurements mostly affected by heavy and light vehicle traffic on the adjacent main road. Mining activities, insects, birds and wind rustling through the leaves of trees contributed to measured noise levels.
	KMP2	19-Sep-13 23:19	00:30:00	43.1	Cold, partly cloudy conditions with low to moderate winds. Audible sources included constant humming of mining equipment and mining vehicle reverse hooters, insects, wind and a passing train in the distance.
	KMP3	20-Sep-13 00:05	00:24:28	44.5	Cold, partly cloudy conditions with strong wind. Wind blowing through maize stalks on the ground and constant humming of mining equipment contributed to the measures noise levels.
	KMP4	19-Sep-13 22:29	00:30:00	42.6	Cold clear conditions with low winds. Noise generated by constant humming of mining equipment and mining vehicle reverse hooters, insects, distant traffic on the N12 to the north, dogs barking in the distance, occasional calls from Jackals and a passing train.
Previous measurements undertaken for the Kendal Continuous Ash Disposal Facility (von Reiche, 2013)					
Day-time	1	15-Apr-13 12:39	00:15:00	47.3	Sunny, warm conditions with moderate wind. Noise generated by wind rustling maize crops. Trucks, light vehicles and air traffic
	2	15-Apr-13 12:13	00:15:00	38.5	Sunny, warm conditions with slight to moderate wind. Birds, insects, farm animals and occasional air traffic contributed to measured noise levels.
	3	15-Apr-13 11:36	00:15:00	55.7	Sunny, warm conditions with moderate wind. Measurements mostly affected by heavy and light vehicle traffic on the R555 and passing dirt roads. Insects and birds also audible.
Night-time	1	14-Apr-13 21:28	00:15:00	34.3	Cold with slight breeze. Audible sources included: occasional traffic, frogs, insects and birds, constant industrial rumbling, barking dogs.
	2	14-Apr-13 21:57	00:15:00	37.7	Cold with slight breeze. Audible sources included: frogs, insects and birds, constant industrial rumbling, cattle lowing.
	3	14-Apr-13 22:35	00:15:00	65.8	Cold, wind still conditions. Audible sources included: frogs and insects, distant reverse sirens, traffic on R555.

Table 5: Equivalent continuous ratings

Location	$L_{Req,d}$ (dBA)	$L_{Req,n}$ (dBA)	$L_{R,dn}$ (dBA)
From the additional measurements undertaken for the Kendal 30 Year Ash Disposal Facility			
KMP1	70.9	62.6	71.6
KMP2	43.2	43.1	49.1
KMP3	46.3	44.5	50.9
KMP4	46.3	42.6	49.5
From the previous measurements undertaken for the Kendal Continuous Ash Disposal Facility (von Reiche, 2013)			
1	47.3	39.3[(a)]	48.1
2	38.5	42.7[(a)]	48.3
3	55.7	65.8	71.1

Notes:

a) Includes a 5 dBA tonal character penalty

Figure 3: Kendal 30 Year Ash Disposal Facility and representative baseline noise measurement locations

Location KMP1
At the Kendal Forest Holding residential area (~300m west of Site F Ash Disposal Facility)

Location KMP2
Within boundary of Site C Ash Disposal Facility

Location KMP3
Along southern boundary of Site B Ash Disposal Facility

Location KMP4
Within boundary of Site B Ash Disposal Facility, adjacent to mining activities situated to the west

Figure 4: Pictures of baseline noise measurement locations undertaken for the Kendal 30 Year Ash Disposal Facility Project

Location 1
950 m north-west of extended ash facility footprint

Location 2
2.8 km south-west of extended ash facility footprint

Location 3
3.1 km north-east of extended ash facility footprint

Figure 5: Pictures of previous baseline noise measurement locations undertaken for the Kendal Continuous Ash Disposal Facility Project

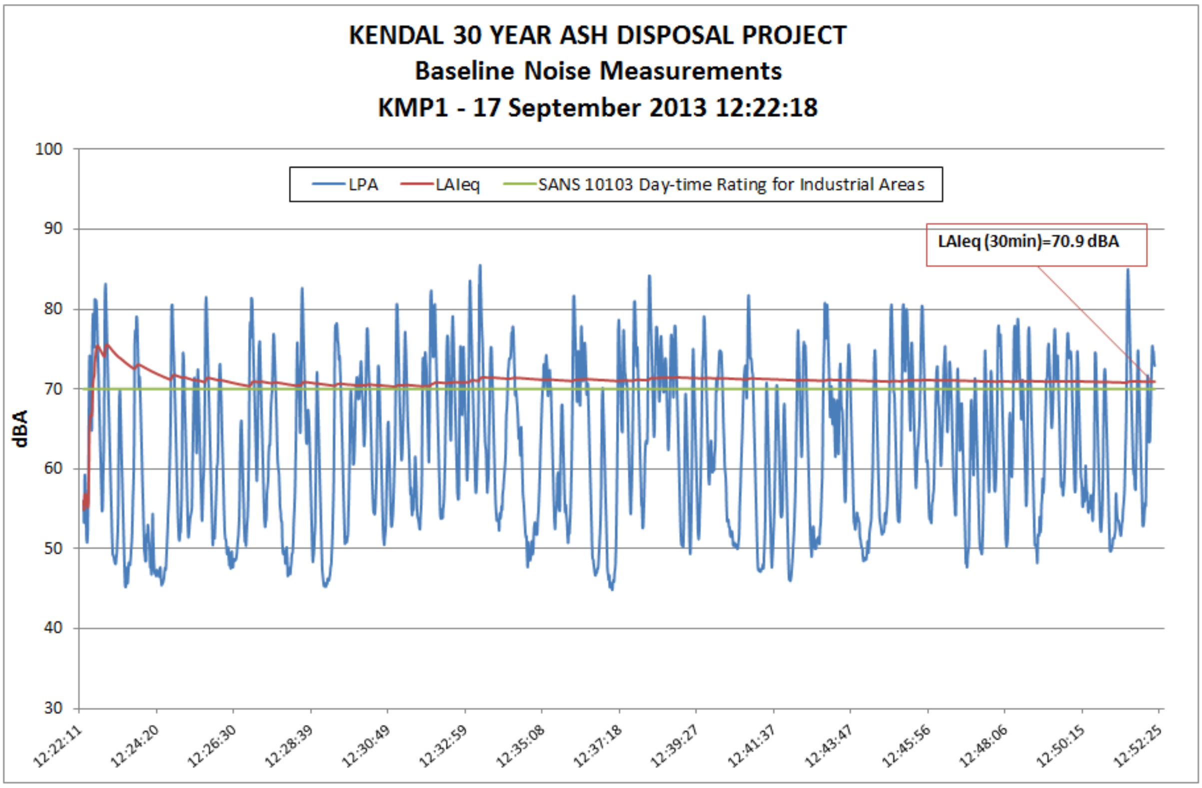

Figure 6: Baseline day-time noise measurement at site KMP1

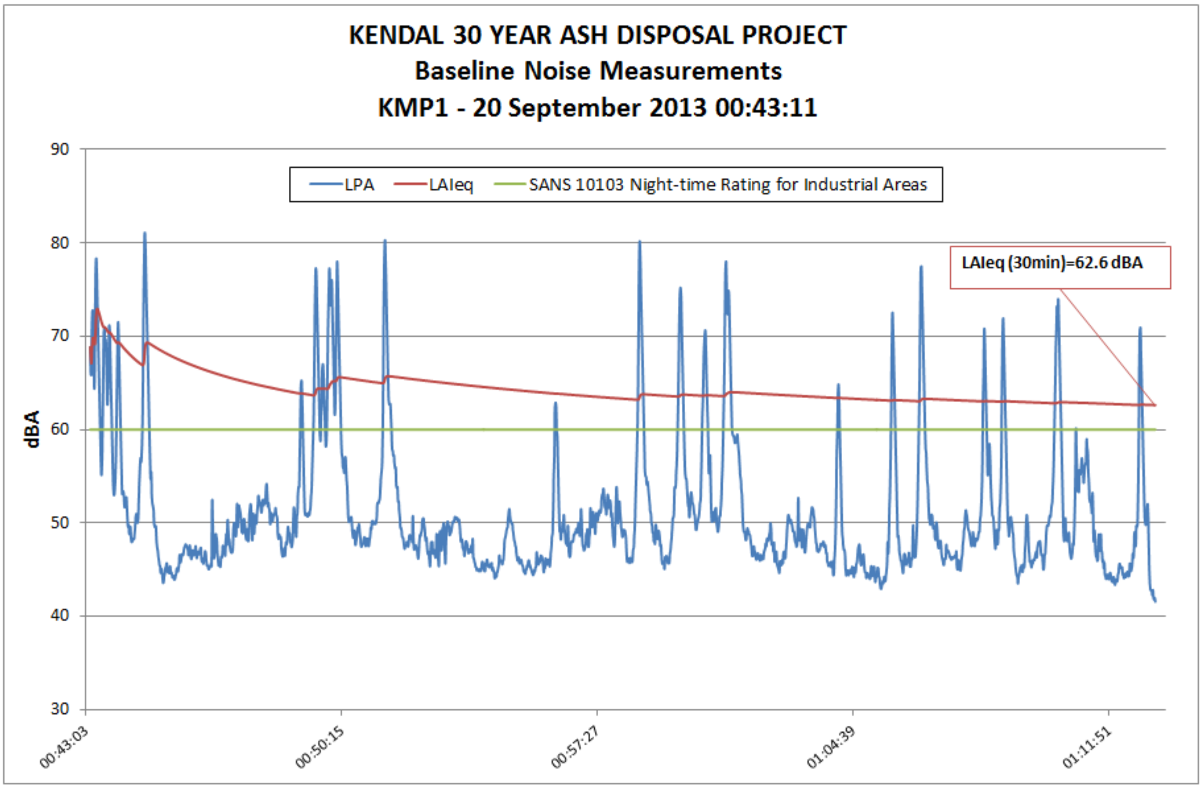

Figure 7: Baseline night-time noise measurement at site KMP1

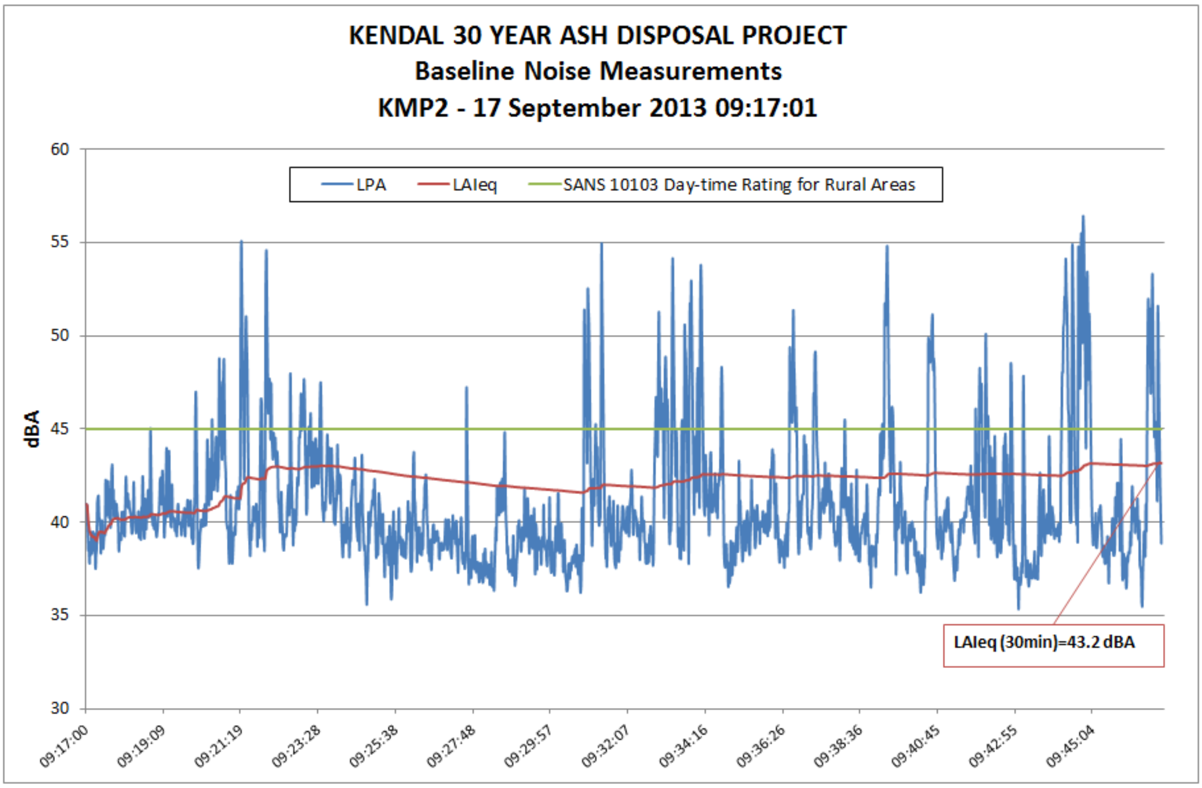

Figure 8: Baseline day-time noise measurement at site KMP2

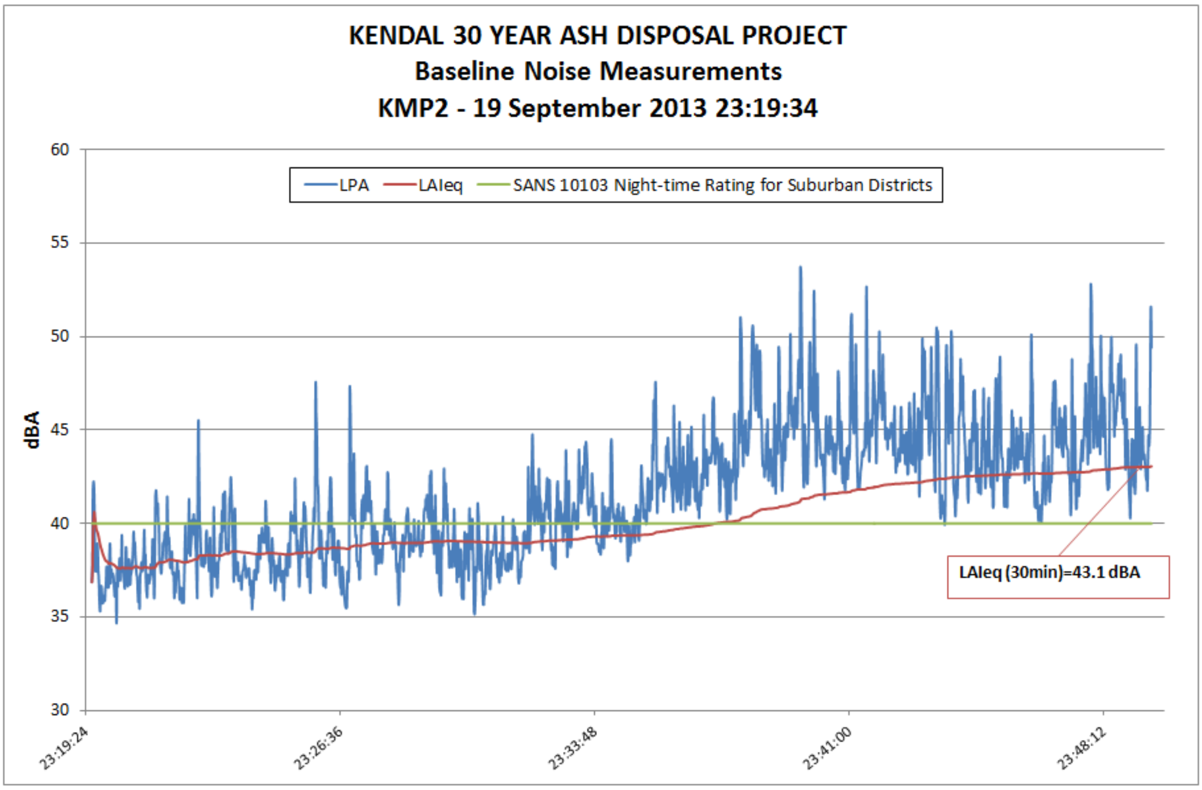

Figure 9: Baseline night-time noise measurement at site KMP2

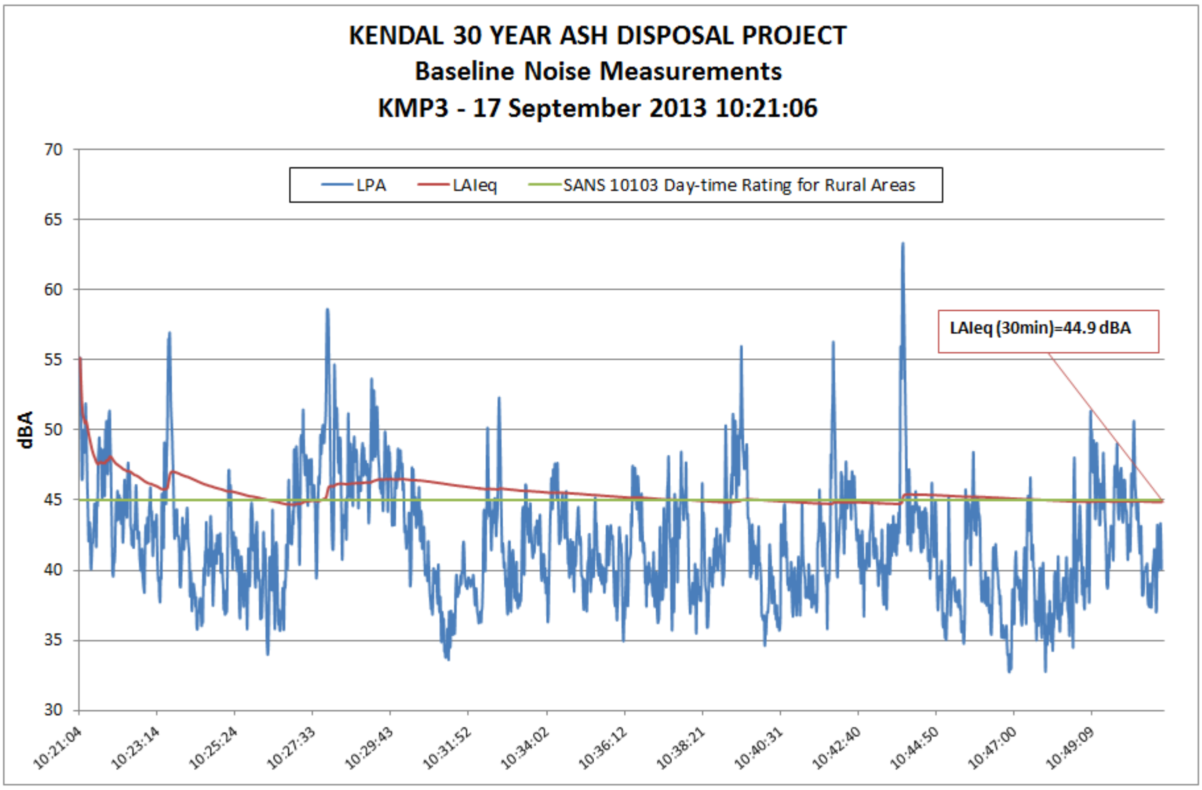

Figure 10: Baseline day-time noise measurement at site KMP3

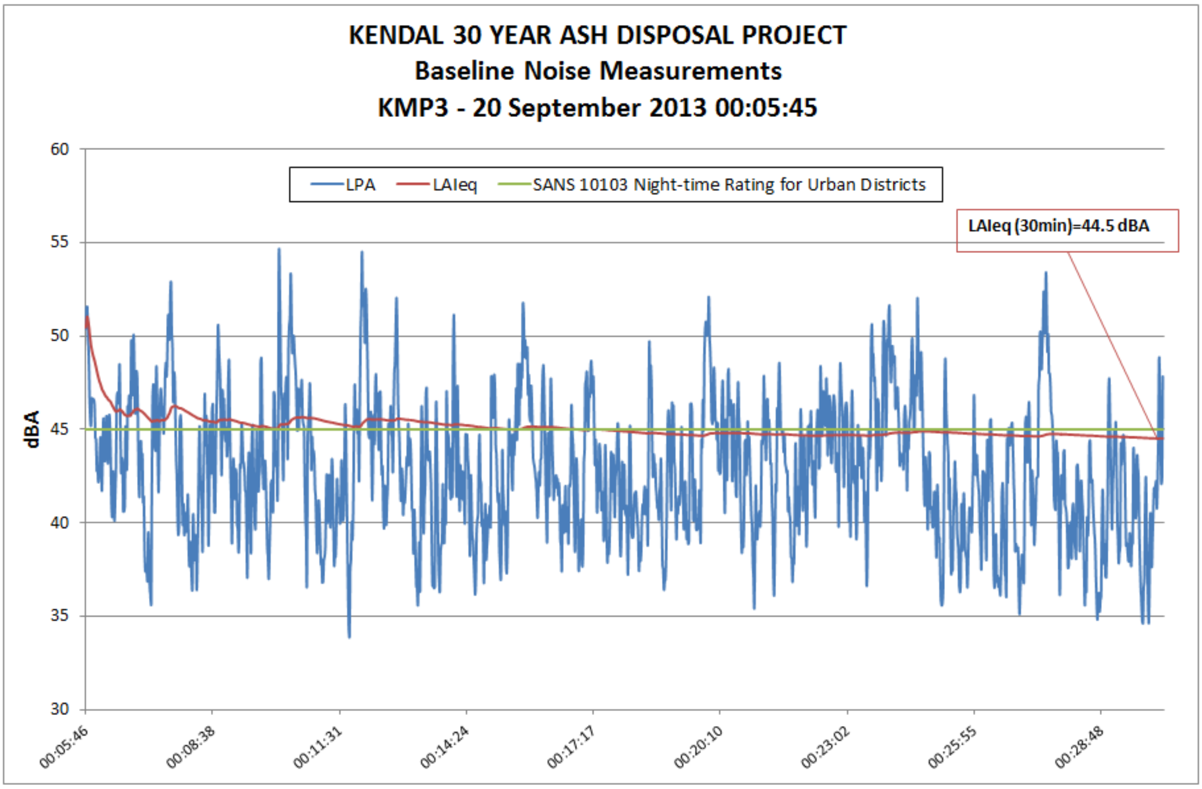

Figure 11: Baseline night-time noise measurement at site KMP3

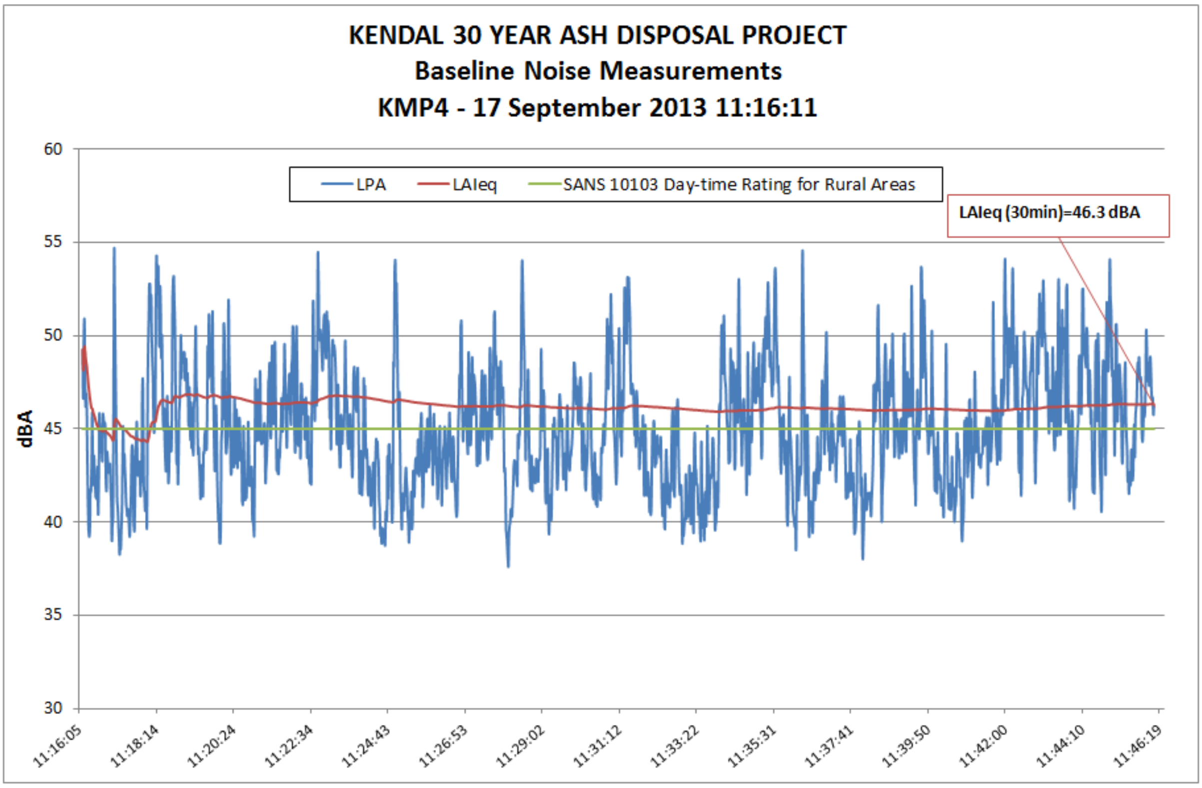

Figure 12: Baseline day-time noise measurement at site KMP4

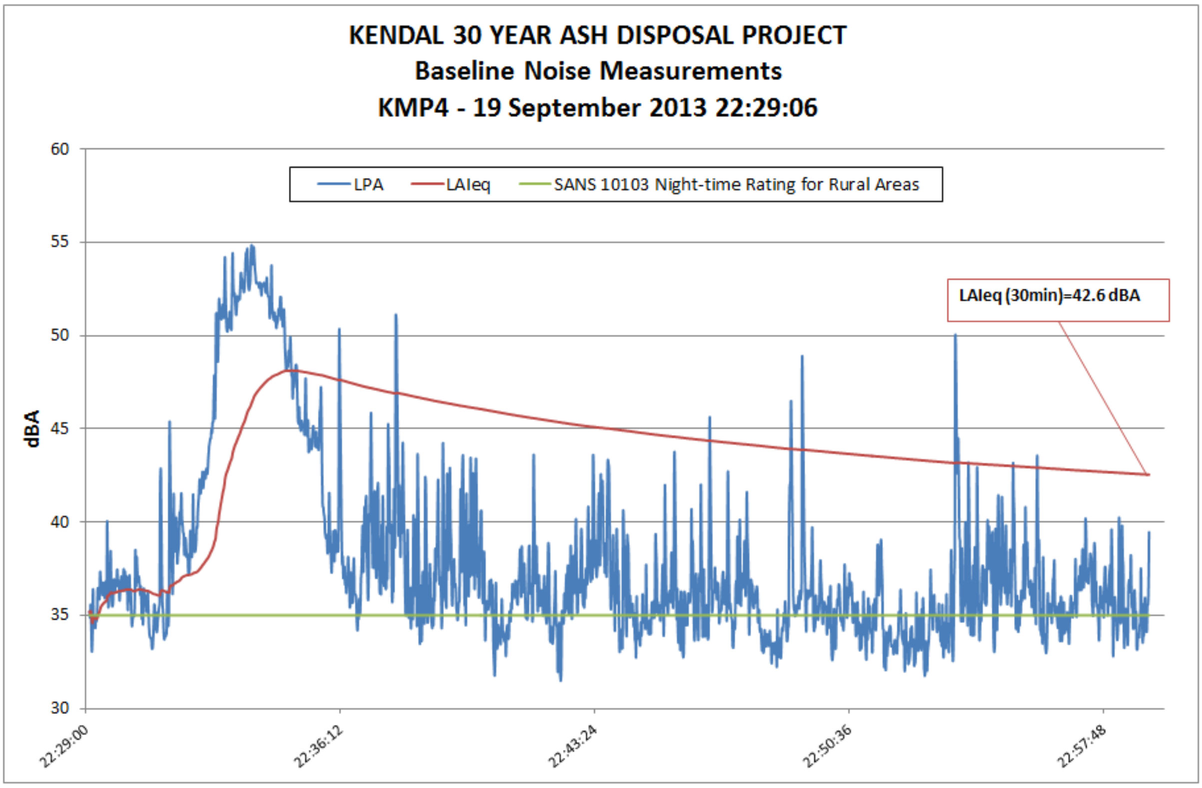

Figure 13: Baseline night-time noise measurement at site KMP4

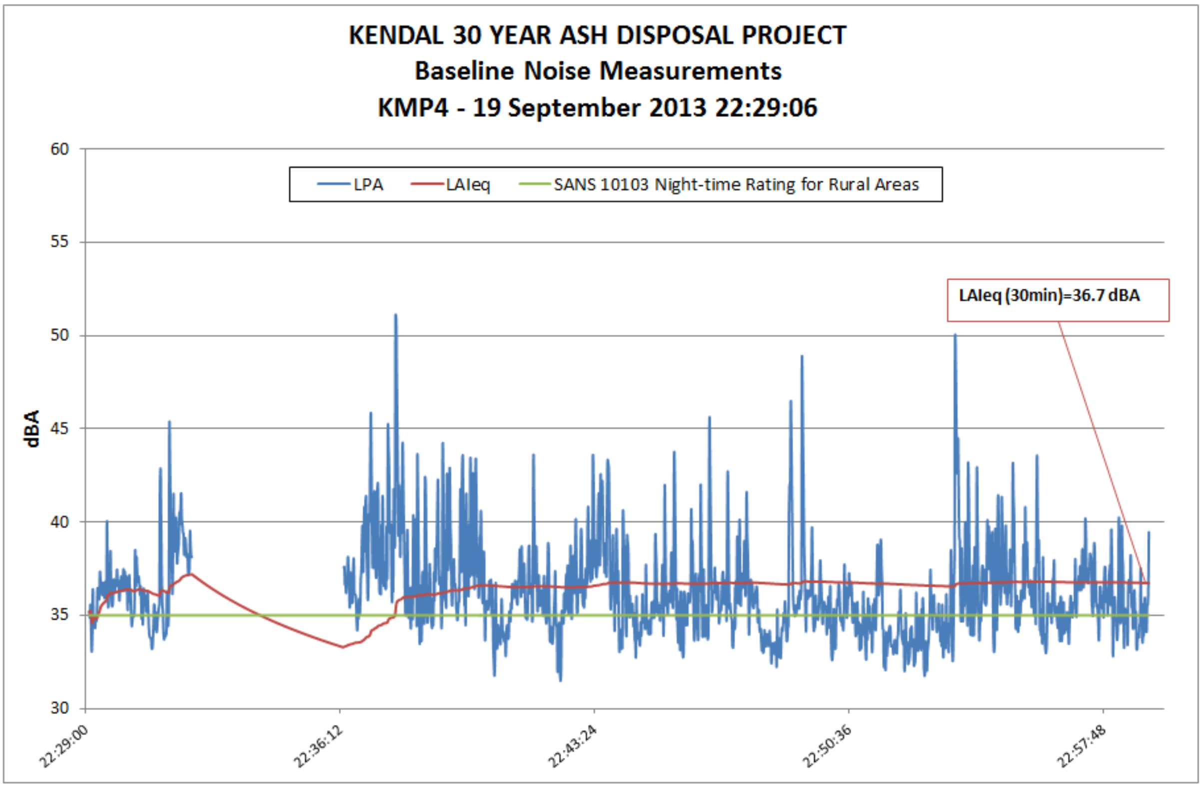

Figure 14: Adjusted baseline night-time noise measurement at site KMP4

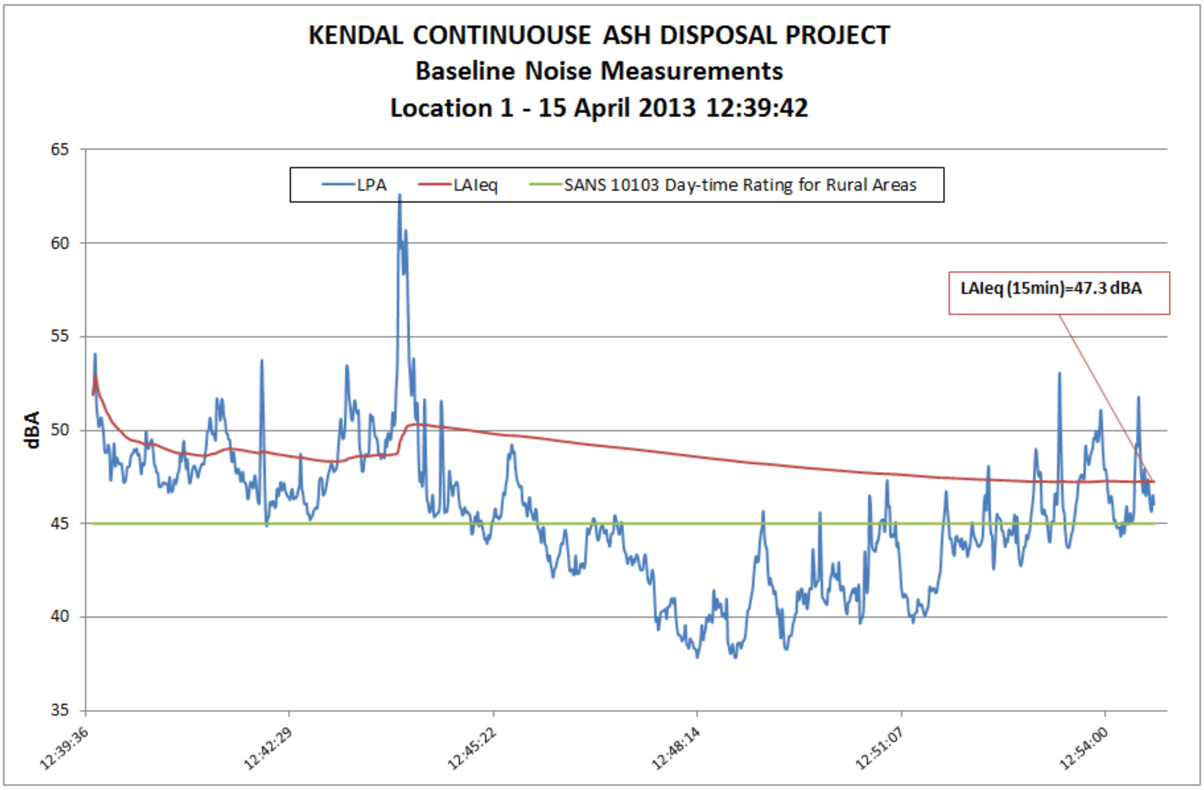

Figure 15: Previous baseline day-time noise measurement at site 1

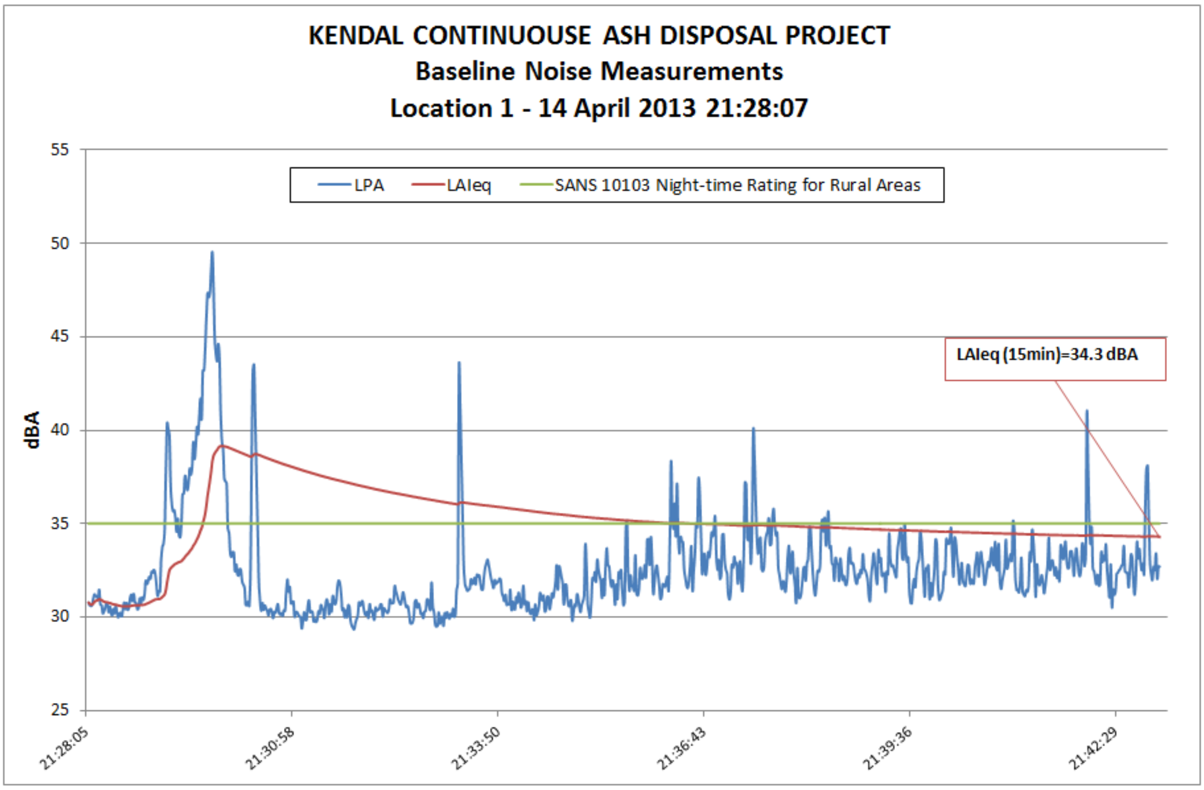

Figure 16: Previous baseline night-time noise measurement at site 1

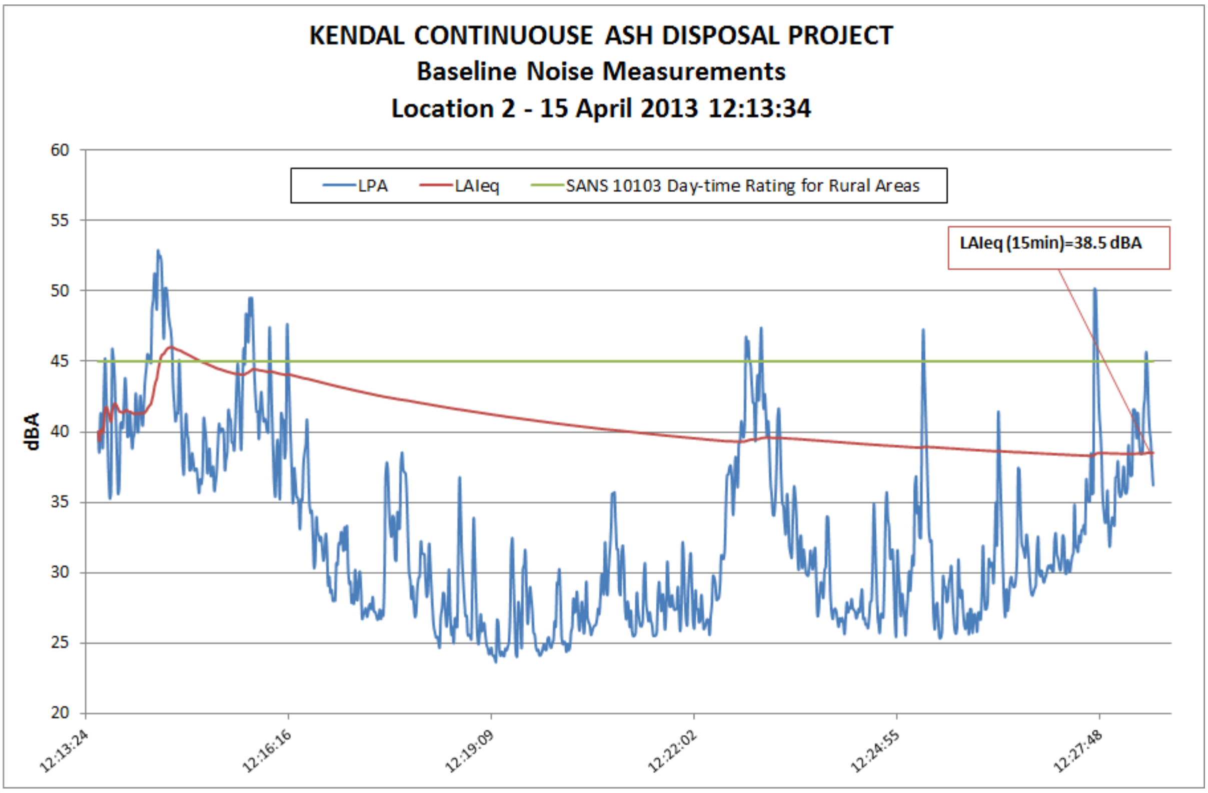

Figure 17: Previous baseline day-time noise measurement at site 2

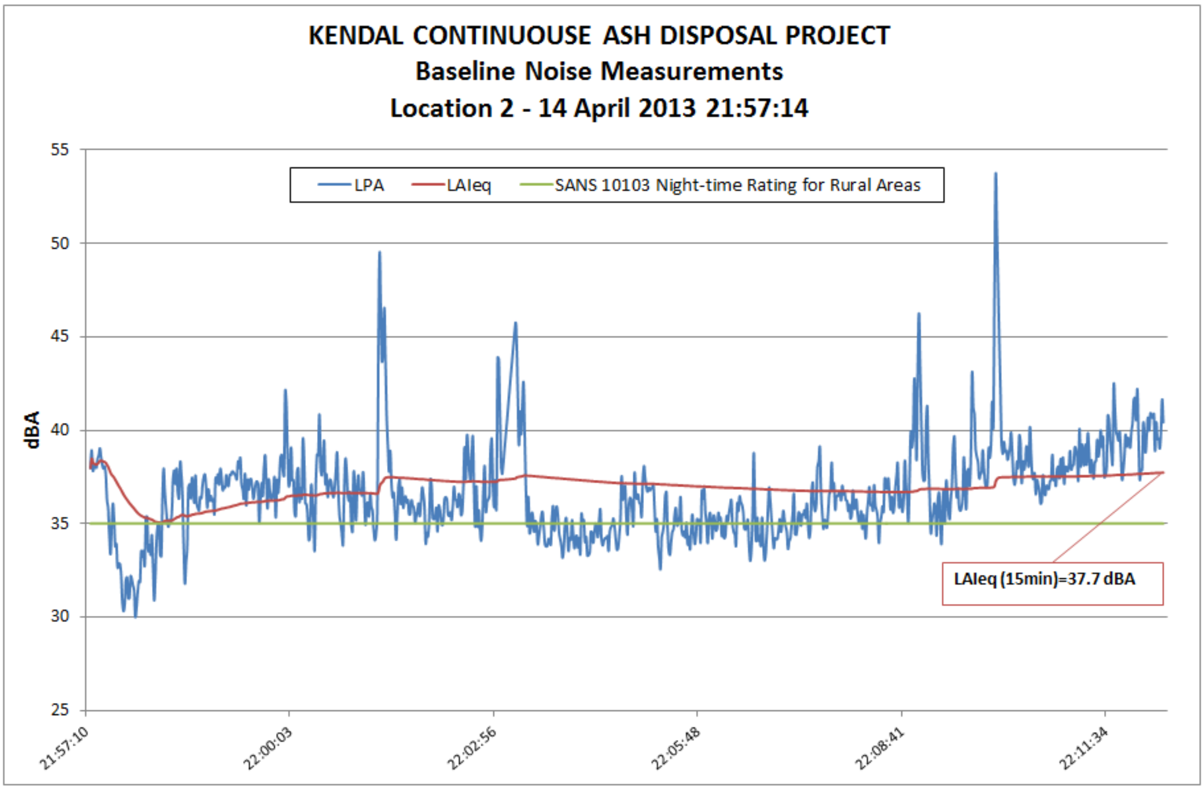

Figure 18: Previous baseline night-time noise measurement at site 2

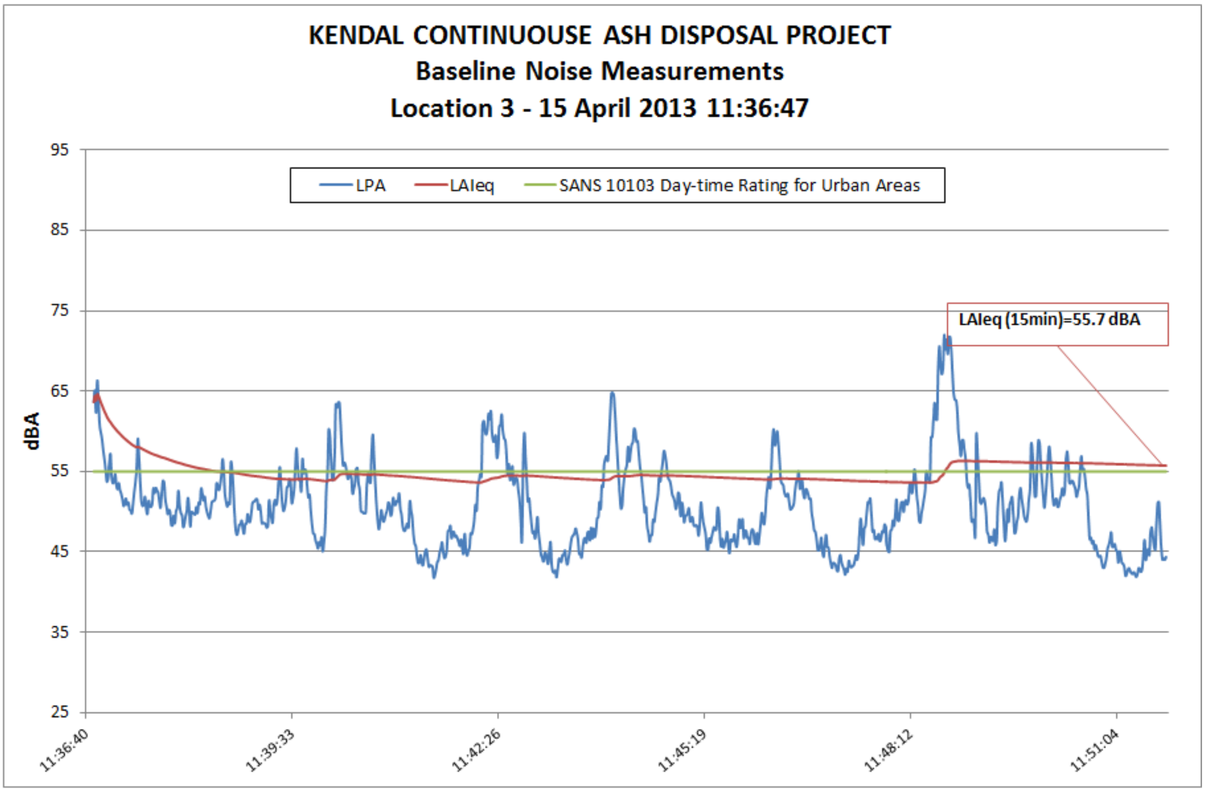

Figure 19: Previous baseline day-time noise measurement at site 3

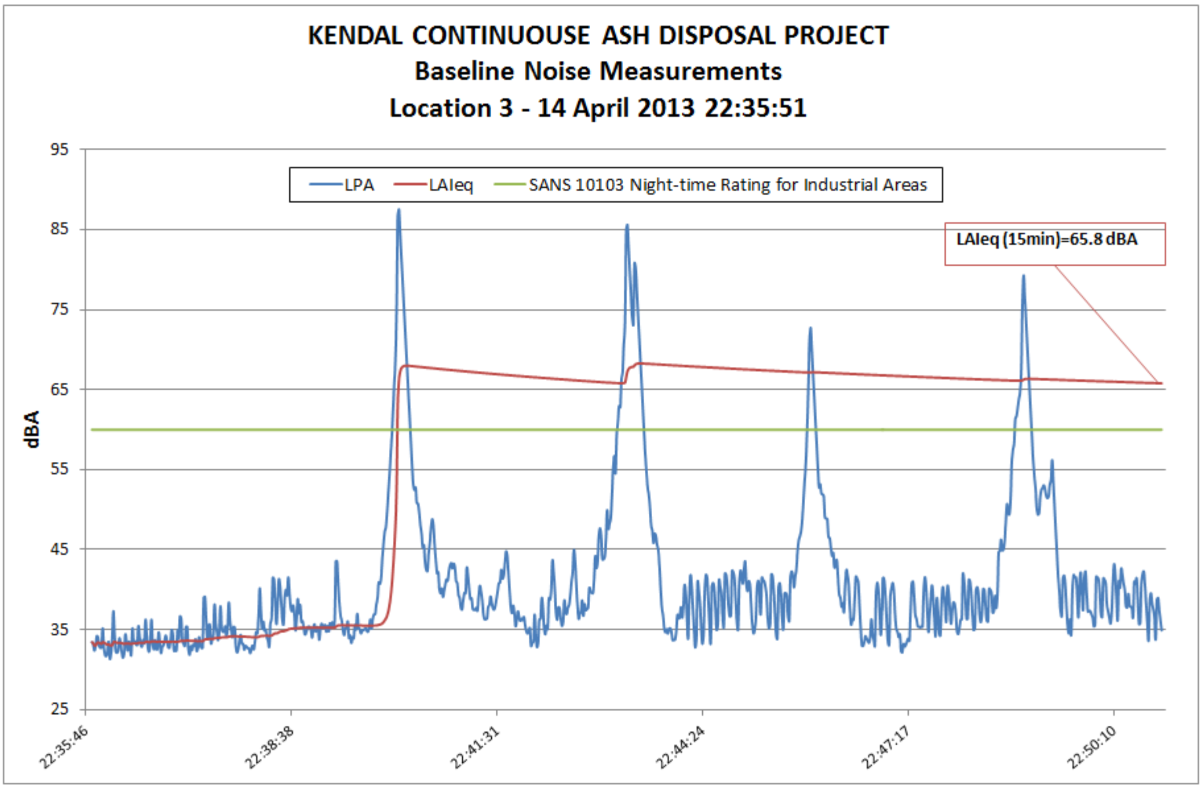

Figure 20: Previous baseline night-time noise measurement at site 3

6 Impact Assessment

6.1 Construction and Closure

The extent and character of construction/closure phase noise will be highly variable as different activities with different equipment will take place at different times, over different periods, in different combinations, in different sequences and on different parts of the construction site. Construction will include vehicle and machinery operations. The closure phase is usually characterised by noise from earthworks for rehabilitation.

6.2 Operation

6.2.1 Noise Sources and Sound Power Levels

The most significant sources of noise associated with ashing include conveyor transfer and ash stacking. A noise sample was taken for the Kendal Continuous Ash Disposal Facility Project (von Reiche, 2013) at a distance of 10 m from stacking operations on the existing Kendal Power Station ash disposal facility in April 2013. The stacker/conveyor system's sound power levels (noise 'emissions') were calculated and are presented in Table 6.

Table 6: Ash stacking/conveying sound power levels as calculated from source measurements

Source	Sound Power Levels, L_{Wi} (dB), at Octave Band Centre Frequencies							A-weighted Sound Power Level, L_{WA} (dBA)
	63 Hz	125 Hz	250 Hz	500 Hz	1 000 Hz	2 000 Hz	4 000 Hz	
Conveying and Stacking of Ash	108.1	103.4	102.3	103.1	99.9	97.3	89.6	**104.9**

6.2.2 *Noise Propagation Modelling and Predicted Noise Levels*

The propagation of noise from the operational phase was calculated in accordance with SANS 10103 and SANS 10357. Meteorological and site specific acoustic parameters as discussed in Section 5 along with source data discussed in Section 6.2.1, were applied in the model.

The propagation of noise was calculated over a 4 km east-west by 4 km north-south area at 40 m intervals. Due to the nature of the ash stacker (mobile source), the results are presented as expected increase in ambient noise level over the average measured baseline as a function of distance from the source.

To facilitate comparison with IFC and SANS 10103 guidelines, results are presented as follows:

- Cumulative day and night-time noise levels as a result of the Project (cumulative refers to noise levels as a result of the Project superimposed on baseline noise levels) (Figure 21).
- The increase in day- and night-time noise levels over the baseline as a result of the Project (Figure 22).

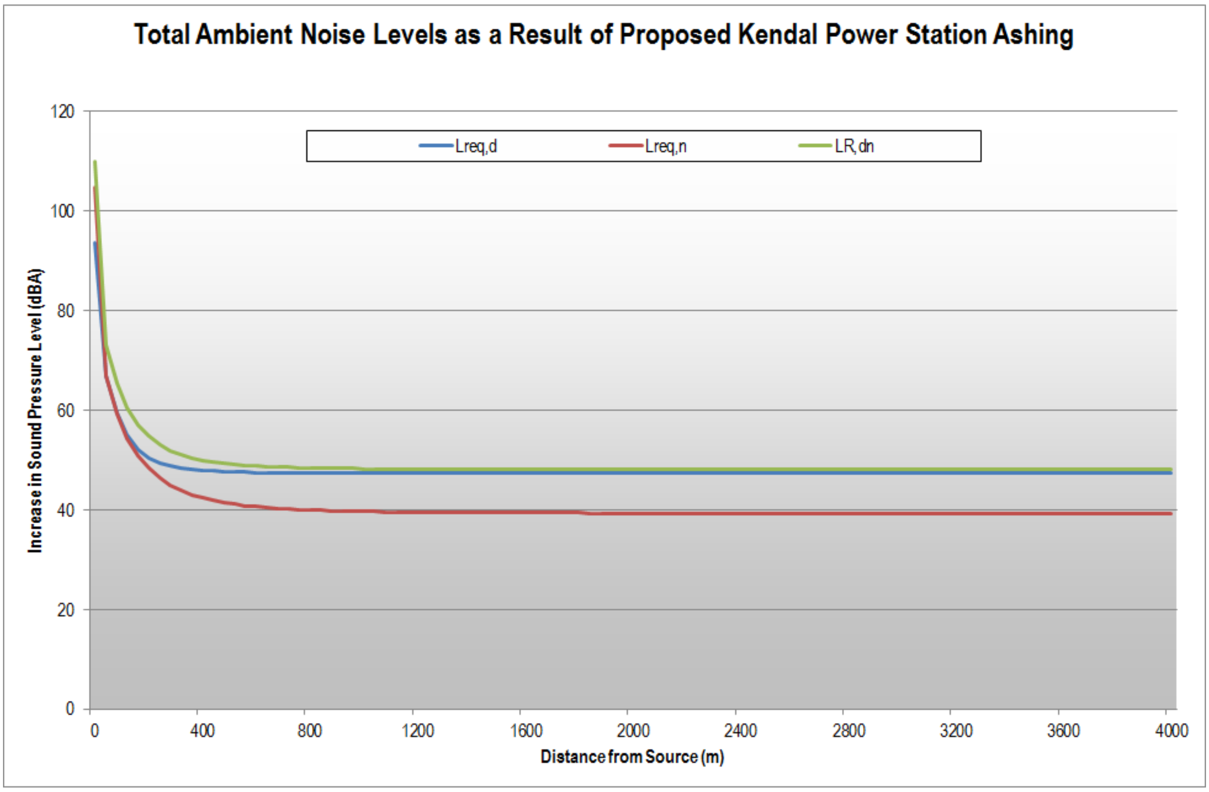

Figure 21: Estimated cumulative day-and night-time noise levels (due to proposed Project operations and baseline noise levels)

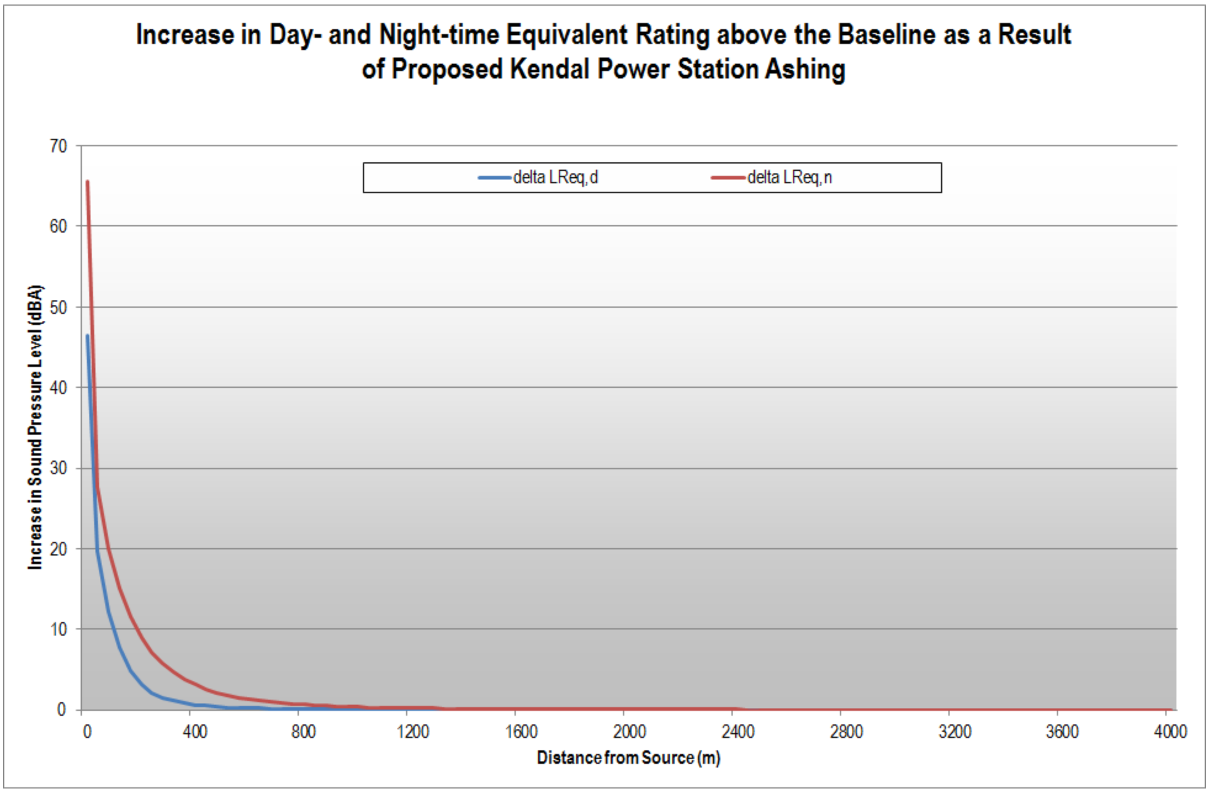

Figure 22: Estimated increase in day-and night-time equivalent ratings above the baseline

Simulations indicate exceedances of the IFC day-time guideline of 55 dBA up to a distance of 120 m and night-time guideline of 45 dBA up to a distance of 280m. An increase of 3 dBA due to the proposed Project operations is up to 200m during day-time conditions and 400m during night-time conditions.

The noise impact will be dependent on the specific location of the operations. Figure 23 and Figure 24, however, provide a distance from the ash disposal facility boundary in order to understand sensitive receptors that may be affected at any one time as operations progress.

According to SANS 10103 (2008) 'little' reaction with 'sporadic complaints' can be expected from noise sensitive receptors during the day.

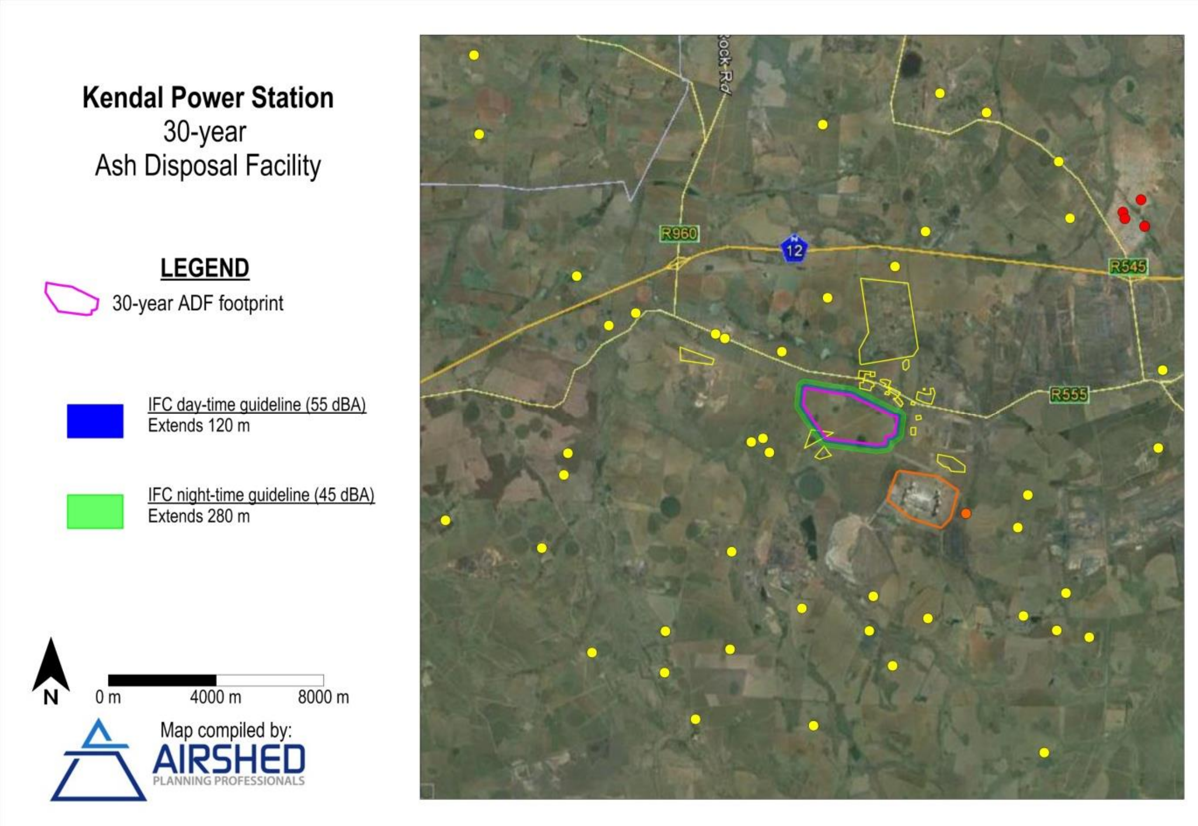

Figure 23: Generalised noise impact with reference to IFC guidelines, irrespective of location of operational area

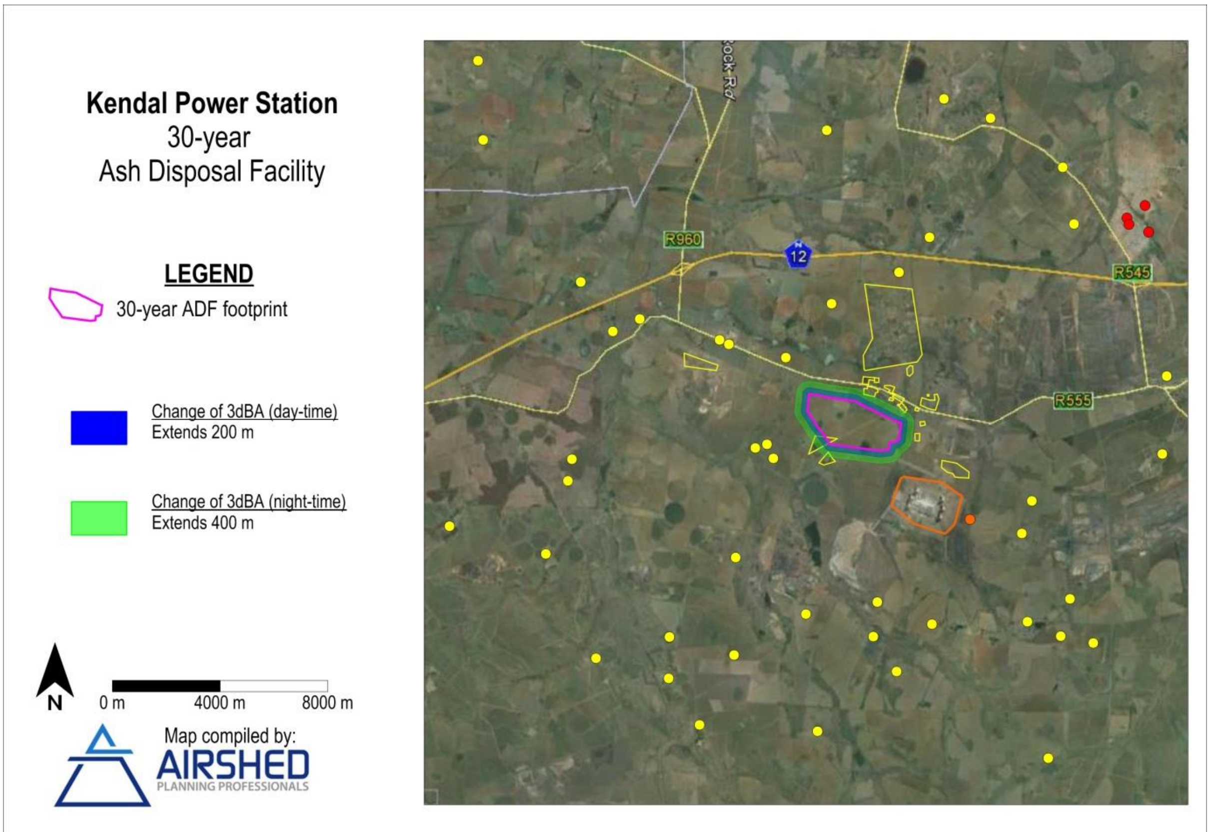

Figure 24: Generalised noise impact with reference to an increase in 3dBA, irrespective of location of operational area

6.2.3 Extended Life –Footprint to Accommodate Ash Disposal until 2058

During the assessment process a contingency period for the decommissioning of the power generating units at the Kendal Power Station was added to extend the life of the power station to 2058. This contingency period (5 years) would require an additional 45 ha for ash disposal.

The extended potential noise levels due to this increase footprint are slight and are provided in Figure 25 and Figure 26.

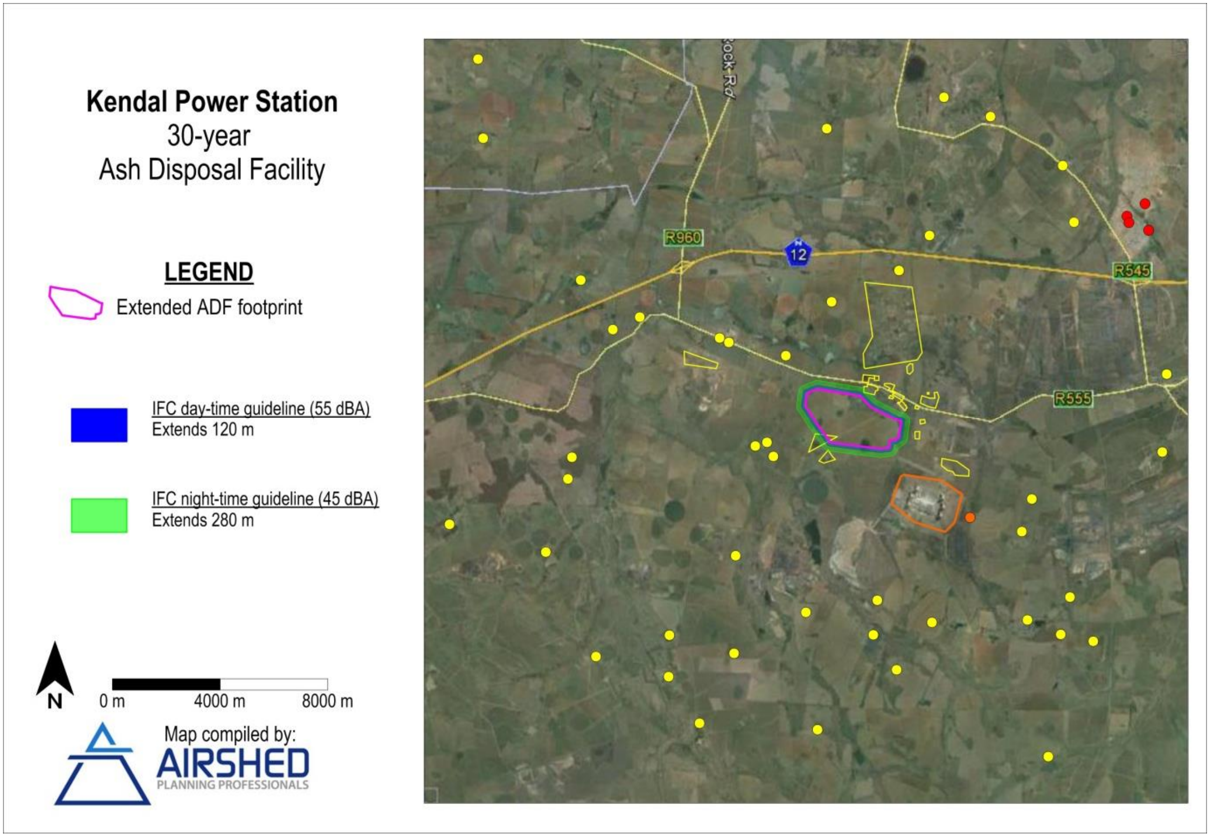

Figure 25: Generalised noise impact with reference to IFC guidelines, irrespective of location of operational area

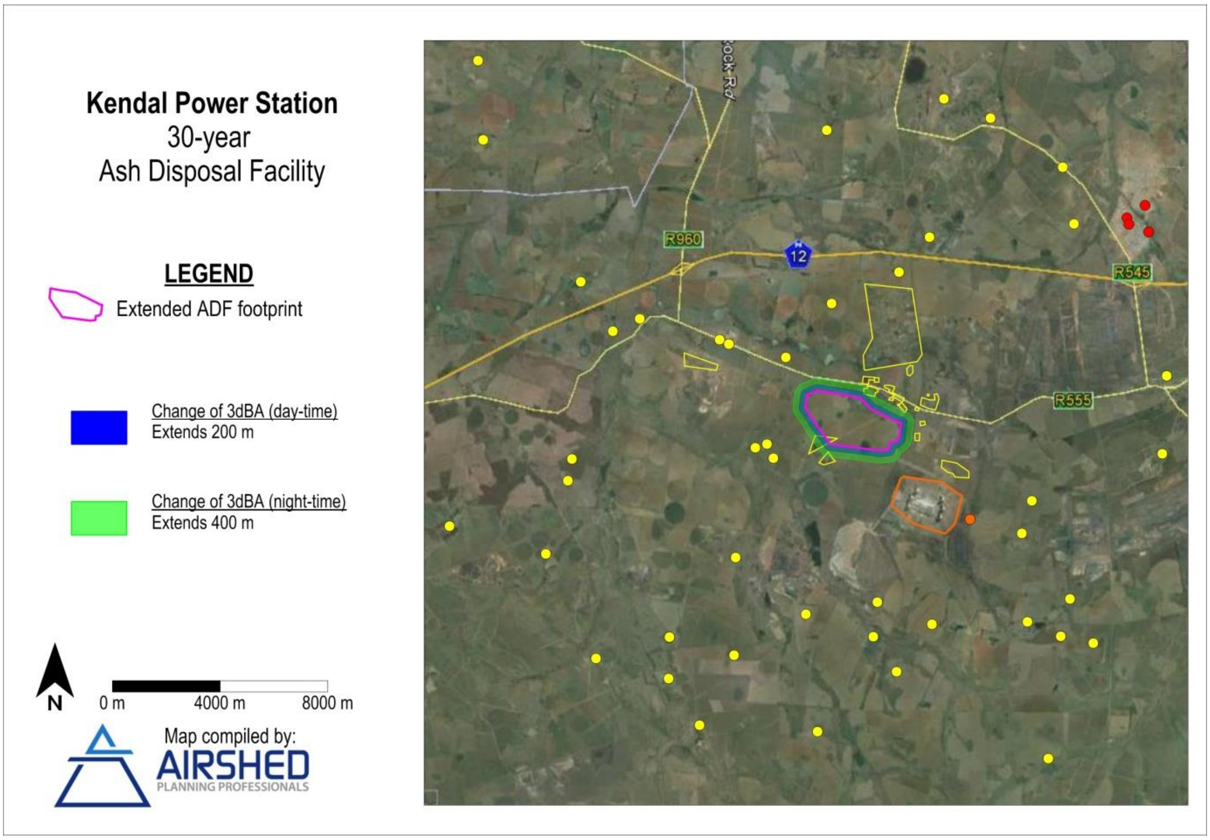

Figure 26: Generalised noise impact with reference to an increase in 3dBA, irrespective of location of operational area

6.3 Impact Significance Rating

The impact significance rating for the construction, operation and closure phases is provided in Table 7, Table 8 and Table 9 respectively.

The impact significance is provided as MODERATE to LOW due to construction and closure phases and LOW for operational phase.

Table 7: Impact rating matrix for the construction phase for the proposed Project

PRE-CONSTRUCTION & CONSTRUCTION PHASE								
Activity	Description of Impact	Impact type	Spatial Scale	Duration	Significance	Probability	Rating	Mitigation Measures
Disposal of ash	Exceedence of IFC guidelines at closest noise sensitive receptors	Existing	2	2	2	4	1.6 - LOW	Mitigation measures provided in Section 7
		Cumulative	3	2	3	4	2.1 - MOD	
		Residual	2	2	2	3	1.2 - LOW	
	Change in noise levels of 3dBA at closest noise sensitive receptors	Existing	2	2	2	4	1.6 - LOW	
		Cumulative	3	2	3	4	2.1 - MOD	
		Residual	2	2	2	3	1.2 - LOW	

Table 8: Impact rating matrix for the operational phase for the proposed Project

OPERATIONAL PHASE								
Activity	Description of Impact	Impact type	Spatial Scale	Duration	Significance	Probability	Rating	Mitigation Measures
Disposal of ash	Exceedence of IFC guidelines at closest noise sensitive receptors	Existing	2	3	2	4	1.9 - LOW	Mitigation measures provided in Section 7
		Cumulative	2	3	2	4	1.9 - LOW	
		Residual	2	3	2	3	1.4 - LOW	
	Change in noise levels of 3dBA at closest noise sensitive receptors	Existing	2	3	2	4	1.9 - LOW	
		Cumulative	2	3	2	4	1.9 - LOW	
		Residual	2	3	2	3	1.4 - LOW	

Table 9: Impact rating matrix for the closure phase for the proposed Project

CLOSURE AND POST-CLOSURE PHASE								
Activity	**Description of Impact**	**Impact type**	**Spatial Scale**	**Duration**	**Significance**	**Probability**	**Rating**	**Mitigation Measures**
Disposal of ash	Exceedence of IFC guidelines at closest noise sensitive receptors	Existing	2	2	2	4	1.6 - LOW	Mitigation measures provided in Section 7
		Cumulative	3	2	3	4	2.1 - MOD	
		Residual	2	2	2	3	1.2 - LOW	
	Change in noise levels of 3dBA at closest noise sensitive receptors	Existing	2	2	2	4	1.6 - LOW	
		Cumulative	3	2	3	4	2.1 - MOD	
		Residual	2	2	2	3	1.2 - LOW	

7 MANAGEMENT, MITIGATION AND RECOMMENDATIONS

The assessment quantified noise impacts as a result of the Project's operational phase. It was shown that the Project will little disturbance to residents during the day and night. The measures recommended in this section should however be considered to minimise impacts on the community during all phases of the Project.

7.1 Good Engineering and Operational Practices

For general construction, operational and decommissioning activities the following good engineering practice should be applied:

- All diesel powered equipment must be regularly maintained and kept at a high level of maintenance. This must particularly include the regular inspection and, if necessary, replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment must serve as trigger for withdrawing it for maintenance.
- To minimise noise generation, vendors can be required to guarantee optimised equipment design noise levels.
- A mechanism to monitor noise levels, record and respond to complaints and mitigate impacts should be developed.

7.2 Operational Hours

It is recommended that, as far is as practicable, noise generating activities be limited to day-time hours (considered to be between 07:00 and 22:00) since noise impacts are most significant during the night.

7.3 Monitoring

Short term 'spot' sampling may be conducted at residences closest to the Project. The analyser should comply with Type 1 sound level meter requirements and measurements should be conducted in accordance with procedures specified by the IFC (IFC, 2007). It is recommended that samples, at least 24-hours in duration be taken annually and as a minimum, include the following parameters:

- L_{Aeq}
- L_{A90}
- Un-weighted octave band sound pressure levels (L_{Zeq})

In the interpretation and reporting of sampled environmental noise levels, use should be made of a trained specialist.

8 MAIN FINDINGS

Airshed Planning Professionals (Pty) Ltd was appointed by Zitholele Consulting to undertake the noise impact assessment for the 30 year ash disposal Project. The study included an assessment of receiving environment and the impacts likely to occur as a result of the Project.

In studying the receiving acoustic environment, the following was found:

- The closest noise sensitive receptors include included individual residences, homesteads and residential areas.

- Ground cover in the study area consists of shrubs and is considered ‘acoustically mixed i.e. somewhat conducive to noise attenuation.
- A study of the wind field indicated that noise impacts will most likely be most notable towards the south-southeast.
- An increase of 3 dBA in ambient noise level is considered the indicator of noise impacts. This is the level at which individuals with average hearing acuity would be able to detect a change in noise level.
- Baseline monitoring results indicate pre-development environs ranging between 38.5 and 70.9 dBA during the day and 39.3 and 65.8 dBA during the night. These are typical of suburban to urban and industrial areas.
- In the estimation of cumulative noise levels, baseline day- and night-time noise levels of 47.3 dBA and 39.3 dBA respectively, were used (as obtained from measurements in close proximity to the proposed site).
- Sources observed to affect baseline noise levels included the mining activities, community activities, traffic on the N12 and the R555, railway noise, animals, birds and insects.

In terms of the Projects impact on environmental noise levels the following was found:

- The operational phase of the Project is expected to increase existing environmental noise levels such that IFC day- and night-time guidelines for residential areas (55 dBA and 45 dBA respectively) are exceeded a distance of 120m and 280m from the stacker operations.
- The increase in noise of 3 dBA above the baseline is expected to be 200m and 400m from stacker operations during day-and night-time conditions respectively. According to SANS 10103 (2008), an increase of between 1 and 10 dBA above the baseline may result in ‘little’ reaction with ‘sporadic complaints’ from nearby communities.
- The impact significance is provided as MODERATE to LOW due to construction and closure phases and LOW for operational phase. As no significant noise impacts are predicted due to the project, it is recommended that the project be approved from a noise perspective.

9 REFERENCES

Brüel & Kjær Sound & Vibration Measurement A/S. (2000). *www.bksv.com.* Retrieved October 14, 2011, from Brüel & Kjær: http://www.bksv.com

IFC. (2007). *General Environmental, Health and Safety Guidelines.*

SANS 10103. (2008). *The measurement and rating of environmental noise with respect to annoyance and to speech communication.* Pretoria: Standards South Africa.

SANS 10357. (2004). *The Calculation of Sound Propagation by the Concawe Method.* Standards South Africa.

von Reiche, N (2014). Professional Opinion on the Potential for Environmental Noise Impacts as a Result of the Continuous Disposal of Ash at Kendal Power Station. Report No.: 12ZIT07

WHO. (1999). *Guidelines to Community Noise.*