Tronox KZN Sands (Pty) Ltd

INTEGRATED ENVIRONMENTAL AUTHORISATION FOR THE PORT DURNFORD MINE, KWAZULU-NATAL

Environmental Acoustic Impact Assessment

FEBRUARY 2025

CONFIDENTIAL

Tronox KZN Sands (Pty) Ltd

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REPORT (VERSION 01) CONFIDENTIAL

PROJECT NO. 41106008

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GLOSSARY OF TERMS

Sound	Sound is small fluctuations in air pressure, measured in Newtons per square meter (N/m^2) or Pascals (Pa) that are transmitted as vibrational energy via a medium (air) from the source to the receiver. The human ear is a pressure transducer, which converts these small fluctuations in air pressure into electrical signals, which the brain then interprets as sound.
Noise	Noise is generally defined as unwanted sound.
Sound or noise level	A sound or noise level is a sound measurement that is expressed in decibels (dB or dB(A)).
dB or dB(A)	The human ear is a sensitive instrument that can detect fluctuations in air pressure over a wide range of amplitudes. This limits the usefulness of sound quantities in absolute terms. For this reason, a sound measurement is expressed as ten times the logarithm of the ratio of the sound measurement to a reference value, 20 micro (millionth) Pa. This process converts a scale of constant increases to a scale of constant ratios and considerably simplifies the handling of sound measurement quantities. The attached 'A' indicates that the sound measurement has been A-weighted.
dB(Z)	Historically sound levels were read off a hand-held meter and the noise levels were noted in dB, after the development of different weighting curves sound levels were noted as Z-weighting or dB(Z) to reduce the confusion with different type of weighting applied noise levels. dB(Z) refers to linear noise levels.
A-weighting	The human ear is not equally sensitive to sound of all frequencies, i.e., it is less sensitive to low pitched (or 'bass') than high pitched (or 'treble') sounds. In order to compensate when making sound measurements, the measured value is passed through a filter that simulates the human hearing characteristic. Internationally this is an accepted procedure when working with measurements that relate to human responses to sound/noise.
Ambient sound level	Ambient noise will be defined as the totally encompassing sound in a given situation at a given time, and is usually composed of sound from many sources, both near and far.
Annoyance	General negative reaction of the community or person to a condition creating displeasure or interference with specific activities.
Sound pressure	Sound pressure is the force of sound exerted on a surface area perpendicular to the direction of the sound and is measured in N/m^2 or Pa. The human ear perceives sound pressure as loudness and can

	also be expressed as the number of air pressure fluctuations that a noise source creates.
Sound pressure level	The sound pressure level is a relative quantity as it is a ratio between the actual sound pressure and a fixed reference pressure. The reference pressure is usually the threshold of hearing, namely 20 microPascals (µPa).
Sound power	Sound power is the rate of sound energy transferred from a noise source per unit of time in Joules per second (J/s) or Watts (W).
Sound power level	The sound power level is a relative quantity as it relates the sound power of a source to the threshold of human hearing (10^{-12} W). Sound power levels are expressed in dB(A), as they are referenced to sound detected by the human ear (A-weighted).
Noise nuisance	Noise nuisance means any sound which disturbs or impairs or may disturb or impair the convenience or peace of any person.
Octave bands	The octave bands refer to the frequency groups that make a sound. The sound is generally divided in to nine groups (octave bands) ranging from 32 Hertz (Hz) to 8,000 Hz. The lower frequency ranges of a sound have a vibrating character where the higher frequency of sound has the character of high-pitched sound. In viewing the total octave bands scale from 32 Hz to 8000 Hz the character of the sound can be described.

ACRONYMS AND ABBREVIATIONS

CadnaA	Computer Aided Noise Abatement
CPC	Central Processing Complex
dB	Decibel
dB(A)	A-weighted sound measurement
dB(C)	C-weighted sound measurement
dB(Z)	Z-weighted sound measurement
DTMU	Dozer Trap Mining Unit
EA	Environmental authorisation
ECA	Environmental Conservation Act 73 of 1989
EHS	Environmental Health and Safety
ha	Hectare
HMC	Heavy Mineral Concentrate
Hz	Hertz
IFC	International Finance Corporation
km	Kilometre
kV	Kilovolt
L_{A90}	Noise level exceeded for 90% of the measurement period
L_{Aeq}	Equivalent continuous sound pressure level
$L_{R,dn}$	Equivalent continuous day/night rating level
$L_{Req,d}$	Equivalent continuous rating level for day-time
$L_{Req,n}$	Equivalent continuous rating level for night-time
$L_{Req,T}$	Typical noise rating levels
LOM	Life of Mine
m	Metre
mamsl	Metres above mean sea level
m/s	Meters per second
MSP	Mineral Separation Plant
NEMA	National Environmental Management Act 107 of 1998
NEMAQA	National Environmental Management: Air Quality Act 39 of 2004
OECD	Organisation for Economic Co-operation and Development

PWL	Sound power level
PWP	Primary Wet Plant
ROM	Run-of-Mine
RSF	Residue storage facility
SACNASP	South African Council for Natural Scientific Professions
SANS	South African National Standards
TiO_2	Titanium dioxide
tph	Tons per hour
Tronox	Tronox KZN Sands (Pty) Ltd
WHO	World Health Organisation
WSP	WSP Group Africa (Pty) Ltd

EXECUTIVE SUMMARY

Tronox KZN Sands (Pty) Ltd (Tronox) currently operates the Fairbreeze Mine (Fairbreeze) which mines heavy mineral sands in the Richards Bay area. The mine is supported by a Mineral Separation Plant (MSP) and Smelter (collectively known as the Central Processing Complex (CPC)) in Empangeni. Tronox also holds a Prospecting Right for the Port Durnford mineral resource, located ~3.4 km northeast of Fairbreeze. This Prospecting Right has been renewed numerous times and Tronox now need to apply for a Mining Right.

Port Durnford is scheduled to be the replacement mine after Tronox completes mining at Fairbreeze in the next fifteen years. When the Mining Right for Port Durnford is approved, Tronox intend to initially develop a very low-rate (100 tons per hour (tph)) mining only operation (producing Run-of-Mine (ROM) to be sent to Fairbreeze for primary beneficiation (2025 – 2036)) (Phase 1), and then expanding operations (from 2036 to 2069) to operate as a full production (3,000 tph) standalone operation (Phase 2) where heavy mineral concentrate (HMC) will be produced and sent onto the CPC in Empangeni.

As part of the Mining Right application process, environmental authorisation (EA) is required. As part of the EA process, an Environmental Acoustic Impact Assessment is required to assess the acoustic impacts associated with the Port Durnford Project. This report details the findings of the Environmental Acoustic Impact Assessment undertaken to investigate noise associated with the proposed Project.

To assess the existing noise climate in the area surrounding the proposed Project, ambient noise monitoring was conducted at eight receptor locations surrounding the site. An acoustic inventory was developed to identify all potential sources of noise associated with the proposed Project. The acoustic impacts of the operation of the proposed Project during both Phase 1 (100 tph operations) and Phase 2 (3,000 tph operations) were then assessed using the CadnaA acoustic model. It is noted due to the erratic and transient nature of the construction and decommissioning phases, a quantitative assessment of acoustic impacts was not undertaken, but rather a qualitative discussion thereof.

Baseline monitoring indicated current day-time noise levels were below the suburban guideline rating level of 50 dB(A) at two of the eight receptor monitoring locations. At night, average noise levels at all of the eight monitoring locations exceeded the suburban guideline rating level of 40 dB(A). From the day-time and night-time monitoring campaigns it is evident that the current noise climate surrounding the site is predominantly traffic-related, with influences from natural sources like birds and insects.

For the operational phase acoustic modelling, six scenarios were considered (operational years indicated in brackets):

- Phase 1 (100 tph) Operations (2025 – 2036)
- Phase 2 (3,000 tph) Operations (2036 – 2047)
- Phase 2 (3,000 tph) Operations (2048 – 2053)
- Phase 2 (3,000 tph) Operations (2054 – 2057)

- Phase 2 (3,000 tph) Operations (2058 – 2061)
- Phase 2 (3,000 tph) Operations (2062 – 2069)

It is noted that all sources for the Phase 1 operations will be operational for twelve hours a day during a five-day work week, once a month only. As such, only daytime noise predictions were assessed. For Phase 2, operations will be 24 hours a day, hence the predicted day and night-time noise levels were identical.

For Phase 1, day-time noise levels at all the receptor locations are predicted to remain the same, with no increases in the current baseline noise levels as a result of the Port Durnford Phase 1 operations. As per the South African National Standards (SANS) 10103:2008 guidelines, this will result in “little” community/group response. Highest noise levels are predicted around the Phase 1 operational area. Noise levels decrease as distance from the sources increase, with levels dropping below the industrial guideline level (70 dB(A)) onsite. Offsite noise levels are below the suburban guideline level of 50 dB(A). Based on these results, acoustic impacts of the Port Durnford Phase 1 operations are not predicted and noise-related complaints from receptors are not anticipated.

For Phase 2 (all scenarios), current day-time noise levels (monitored) at three receptor locations are predicted to increase by between 0.1 and 0.9 dB(A) with the introduction of the Phase 2 mining operations. Noise levels at all other receptors are predicted to remain the same. It is noted that such increases at these three locations are well below the 7 dB(A) threshold for annoyance as per the Noise Control Regulations. Such increases are also well below the International Finance Corporation’s (IFC) threshold for annoyance of 3 dB(A).

For Phase 2 (all scenarios), current night-time noise levels (monitored) at two receptor locations are predicted to increase by between 0.1 and 0.8 dB(A) with the introduction of the Phase 2 mining operations. Noise levels at all other receptors are predicted to remain the same. It is noted that such increases at these locations are well below the 7 dB(A) threshold for annoyance as per the Noise Control Regulations. Such increases are also well below the IFC’s threshold for annoyance of 3 dB(A).

The highest noise levels are predicted at the Primary Wet Plant (PWP) and at the active pit where the Dozer Trap Mining Units (DTMUs) will be located. Noise levels decrease as distance from the sources increase, with levels dropping below the industrial guideline level (70 dB(A) (day) and 60 dB(A) (night)) onsite.

Based on both the day and night-time results, acoustic impacts of the Phase 2 operations are not predicted and noise-related complaints from receptors are not anticipated. As such, mitigation options are not deemed compulsory, but various mitigation recommendations are provided in this report, should the need arise. It is, however, recommended that one round of environmental noise monitoring is conducted after commissioning of Phase 2 operations to confirm noise levels in the surrounding communities and identify the need for additional mitigation or additional monitoring campaigns. If elevated noise levels are detected then further monitoring campaigns will need to be considered.

All impacts of the proposed Project were evaluated using a risk matrix, which is a semi-quantitative risk assessment methodology. This system derives an environmental impact level on the basis of the nature, significance, consequence, extent, reversibility, duration and probability of occurrence. Based on the results of this Environmental Acoustic Impact Assessment, the significance of noise-related impacts are rated as “low” for the construction, operational and decommissioning phases of the Project. *From an environmental noise perspective, it is therefore advised that the Port Durnford Project be authorised.*

DETAILS AND DECLARATION OF THE SPECIALIST

DETAILS OF THE SPECIALISTS

Task	**Environmental Acoustic Impact Assessment**
Full Name	Kirsten Collett
Title/Position	Associate
Qualification	Master of Science
Professional Affiliations	SACNASP

DECLARATION OF INDEPENDENCE BY SPECIALIST

I, …Kirsten Collett…., a duly authorised representative of WSP (Pty) Ltd, declare that I –

- Act as the independent specialist in this application.
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed.
- Do not have nor will have a vested interest in the proposed activity proceeding.
- Have no, and will not engage in, conflicting interests in the undertaking of the activity; and
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document.

Collett, Kirsten (ZAKC02294) 2025.04.03 14:53:54 +02'00'

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1. INTRODUCTION

Tronox KZN Sands (Pty) Ltd (Tronox) currently operates the Fairbreeze mine which mines heavy mineral sands in the Richards Bay area. The mine is supported by a Mineral Separation Plant (MSP) and Smelter (collectively known as the Central Processing Complex (CPC)) in Empangeni. Tronox also holds a Prospecting Right for the Port Durnford mineral resource, located ~3.4 km northeast of Fairbreeze. This Prospecting Right has been renewed numerous times and Tronox now need to apply for a Mining Right.

Port Durnford is scheduled to be the replacement mine after Tronox completes mining at Fairbreeze in 2037. When the Mining Right for Port Durnford is approved, Tronox intend to initially develop a very low-rate (100 tons per hour (tph)) mining only operation (producing Run-of-Mine (ROM) to be sent to Fairbreeze for primary beneficiation (2025 – 2036)) (Phase 1), and then expanding operations (from 2036 to 2069) to operate as a full production (3,000 tph) standalone operation (Phase 2). Once mining at Fairbreeze is completed, Port Durnford will operate at full production, where heavy mineral concentrate (HMC) will be produced and sent onto the CPC in Empangeni.

As part of the Mining Right application process, environmental authorisation (EA) is required. As part of the EA process, an Environmental Acoustic Impact Assessment is required in order to assess any acoustic impacts associated with the Port Durnford Project. This report details the findings of the Environmental Acoustic Impact Assessment. The report contains a description of the Project; followed by a discussion on the fundamentals of noise; a description of the methodology utilised in the study; the results of the study; as well as the assessment of related impacts.

1.1. TERMS OF REFERENCE

The terms of reference, designed to best meet the Project requirements are summarised below:

- Identification of sensitive receptors (noise receivers) in the vicinity of the proposed site.
- A baseline assessment of the current noise climate in the vicinity of the proposed site which includes baseline sound level monitoring within the receiving environment.
- Compilation of a comprehensive acoustic inventory to account for all sources of noise during the operational phase of the Project.
- An acoustic modelling investigation to determine the impact of the noise associated with the operational phase of the proposed Project.
- Submission of an Environmental Acoustic Impact Assessment report (this report), detailing all findings from the baseline assessment, acoustic inventory and acoustic modelling simulations.
- Provide recommendations on the scope of any mitigation measures that may be applied to reduce noise associated with the proposed Project, if necessary.

1.2. DECLARATION OF INDEPENDENCE

Kirsten Collett is an air quality and acoustic consultant with a Master of Science (Atmospheric Sciences) degree obtained from the University of the Witwatersrand. She is currently employed by WSP and has worked on environmental acoustic impact assessments, monitoring and modelling for a variety of clients over the past twelve years. She has provided acoustic consulting support to various client industries including petrochemical, mining and production industries, among others. She is also a registered Professional Natural Scientist (Pr. Nat. Sci.) with the South African Council for Natural Scientific Professions (SACNASP). Please see **Appendix A** for a CV detailing project experience.

I hereby declare that I am fully aware of my responsibilities in terms of the National Environmental Management Act: Environmental Impact Assessment Regulations of 2014 and that I have no financial or other interest in the undertaking of the proposed activity other than the imbursement of consultant's fees.

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Contact Details:	+27 11 361 1372
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Signature:	KCollett

2. BACKGROUND

2.1. LOCALITY

The Port Durnford site is situated in the uMlalazi and uMhlathuze Local Municipalities which are part of the King Cetshwayo District Municipality in the KwaZulu-Natal Province (**Figure 1**). It is located approximately 15 km southwest of Richards Bay. The N2 highway as well as the R102 traverse the length of the Prospecting Right area, with the R102 being located to the northwest and the N2 running through the centre. There is also a railway line just south of the N2 that also traverses the Prospecting Right area. The proposed Mining Right area is approximately 4,734 ha, however, the mining footprint will cover an area of 2,013 ha only.

2.2. TOPOGRAPHY

The topography of the Project development area is characterised by moderately to strongly sloping incised valleys (average slopes of 13%) west of the Project area, which grades to gently undulating terrain (average slope of 6%) towards the coastline, with wide valleys that represent the floodplains of prominent drainage channels (**Figure 2**). The topography of the project area itself is rolling and exhibits gently sloping terrain, but in some areas significantly steeper slopes are encountered. Elevations within the project area range between 10 and 130 metres above mean sea level (mamsl), with an average elevation of 55 mamsl.

2.3. SURROUNDING RECEPTORS/COMMUNITIES

The Port Durnford site is surrounded by various communities that could be impacted by the proposed Project. These include the town of Port Durnford (immediately south of the site), the Zini River Estate and town of Mtunzini (southwest of the site), the rural residential areas of Msasandla, Ongoye and Khandisa (immediately north of the site), Gobandlovu (immediately northeast of the site) and the towns of Uzimgwenya, Sikhalasenkosi (formerly Esikhawini) and Mahunu (immediately southeast of the site), as presented in **Figure 3**. Due to the large number and extent of these communities, baseline monitoring could not be undertaken at all of them. As such, specific sensitive receptor points, located closest to the site boundary (i.e. closest to noise sources onsite), were selected for the monitoring campaign and acoustic modelling exercise. These are further discussed in **Section 5.1** and **Section 5.4**.

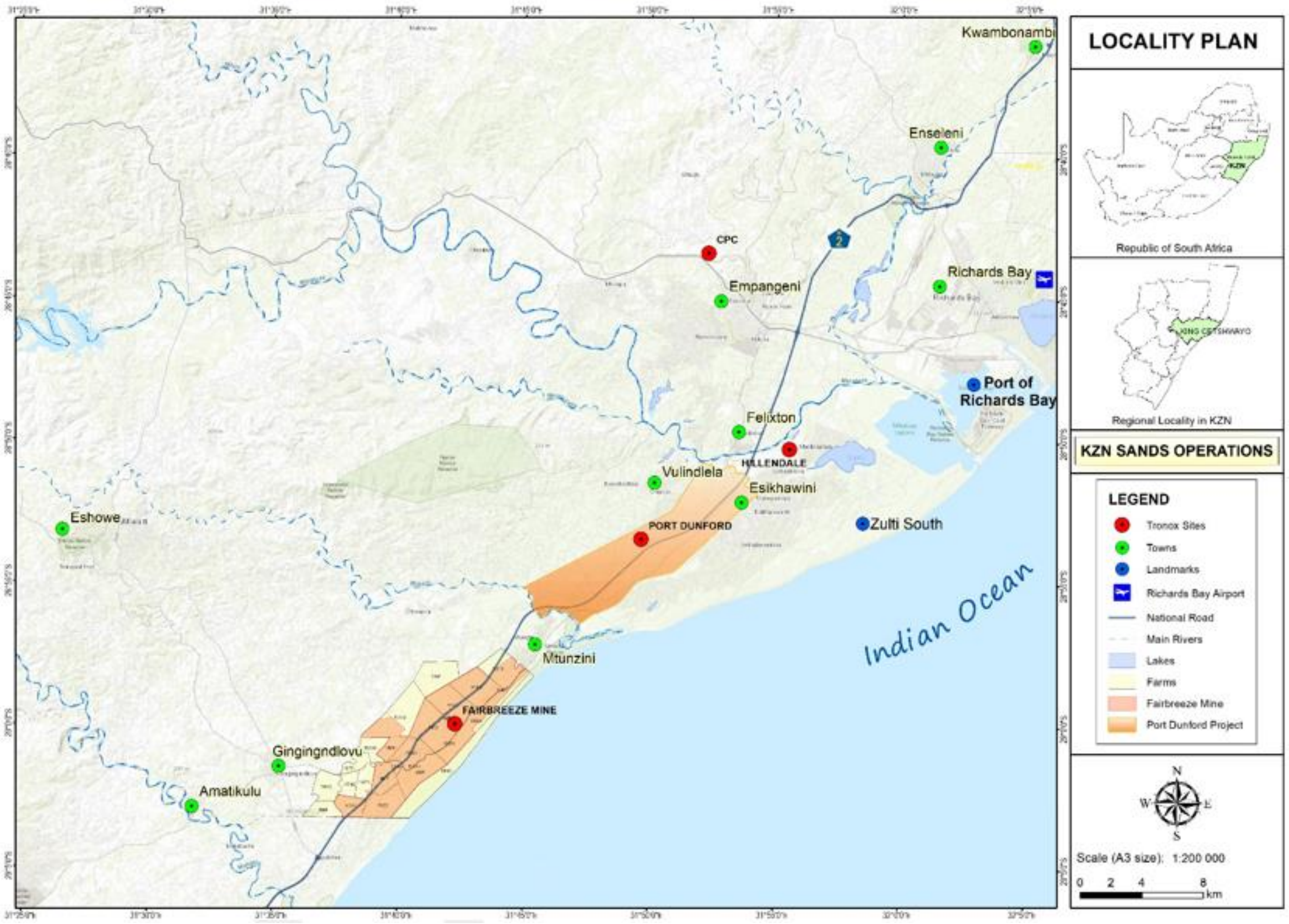

Figure 1: Location of the Project site (Tronox, MWP, current)

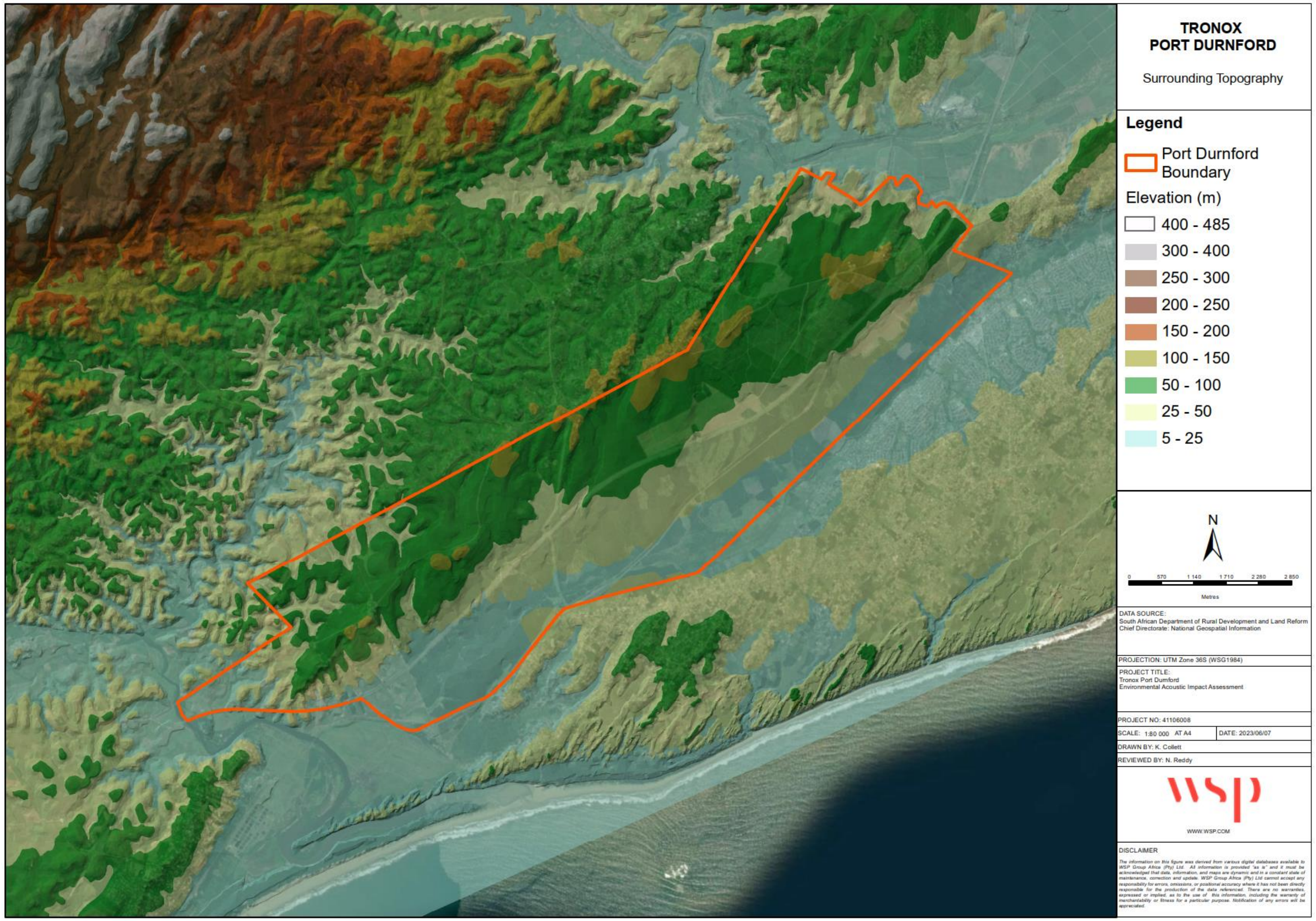

Figure 2: Topography of the Project area

Figure 3: Communities surrounding the Project site

2.4. PROJECT DESCRIPTION

At Fairbreeze, Tronox mines mineral sands containing ilmenite, rutile, zircon and other heavy minerals to produce titanium dioxide (TiO_2) and a variety of other secondary products. The TiO_2 product is sold for use by manufacturers of coatings, plastics and décor paper. Heavy minerals that are not used as feedstock to produce TiO_2, are processed to produce secondary products such as pig iron, staurolite, activated carbon and zircon.

Fairbreeze will conclude its Life of Mine (LOM) in 2037 and it is intended that the Port Durnford mining activities will facilitate the continuation of Tronox mining operations in the area. To achieve this, the existing Prospecting Right for the Port Durnford mineral resource needs to be converted into a Mining Right. Initially, it is intended to develop as Phase 1, a low-rate operation at approximately 100 tph for the period 2025 to 2036. It is anticipated that the mining operations will increase in throughput after 2035 when the Project enters Phase 2 (Full Scale), an operation with a mining rate of 3,000 tph to provide the continued feed of HMC to the MSP in Empangeni.

2.4.1. PHASE 1 MINING

The low-rate (Phase 1) operation will involve Port Durnford ROM material being mined mechanically with front end loaders (FELs) and hauled via trucks to the Fairbreeze mine for stockpile and processing. No processing facilities or tailings or fines disposal facilities will be developed on the Port Durnford lease area.

At Fairbreeze mine, the ROM will be stockpiled within a mined-out portion of the orebody. The stockpiled material with then be reclaimed via hydraulic mining methods as per the current practice at Fairbreeze and the material will be pumped to the Fairbreeze Primary Wet Plant (PWP) for processing. The processed material will then be trucked to the existing MSP located at the CPC in Empangeni. A process flow diagram for the Phase 1 operations is presented in **Figure 4**, while the site layout is depicted in **Figure 5**.

The proposed mine infrastructure for Phase 1 will include the mining areas as well as a temporary site with the following infrastructure to support this operation:

- Conservancy Septic tank system – 2 x 6,000 litre tanks placed under ground.
- Mining equipment parking area.
- Workshop laydown area.
- Water storage tanks (2 x 10 kilolitre tanks).
- Internal water reticulation (to offices & ablutions).
- Offices and ablution units.
- Internal electrical reticulation.
- External lighting.
- Light duty vehicle (LDV) parking area.
- Guard house.
- Security fence.
- A gravel access road (200 m access road) to connect the laydown yard to the District Road which connects to the R102.

- A general and hazardous waste storage area.
- Fuel and Lubricant Storage: it is anticipated that a 23 m^3 storage tank will be provided and it is estimated that 153,422 litres will be utilised per annum.

It is proposed that the ore mined at Port Durnford will be transported using highway road trucks to the Fairbreeze PWP. The preferred route at present is transport along a short gravel road from the site onto the R102, then left onto Hely Hutchinson Road and onto the N2 highway via the onramp closest to Mtunzini. Direct access to Fairbreeze is then possible from an offramp of the N2.

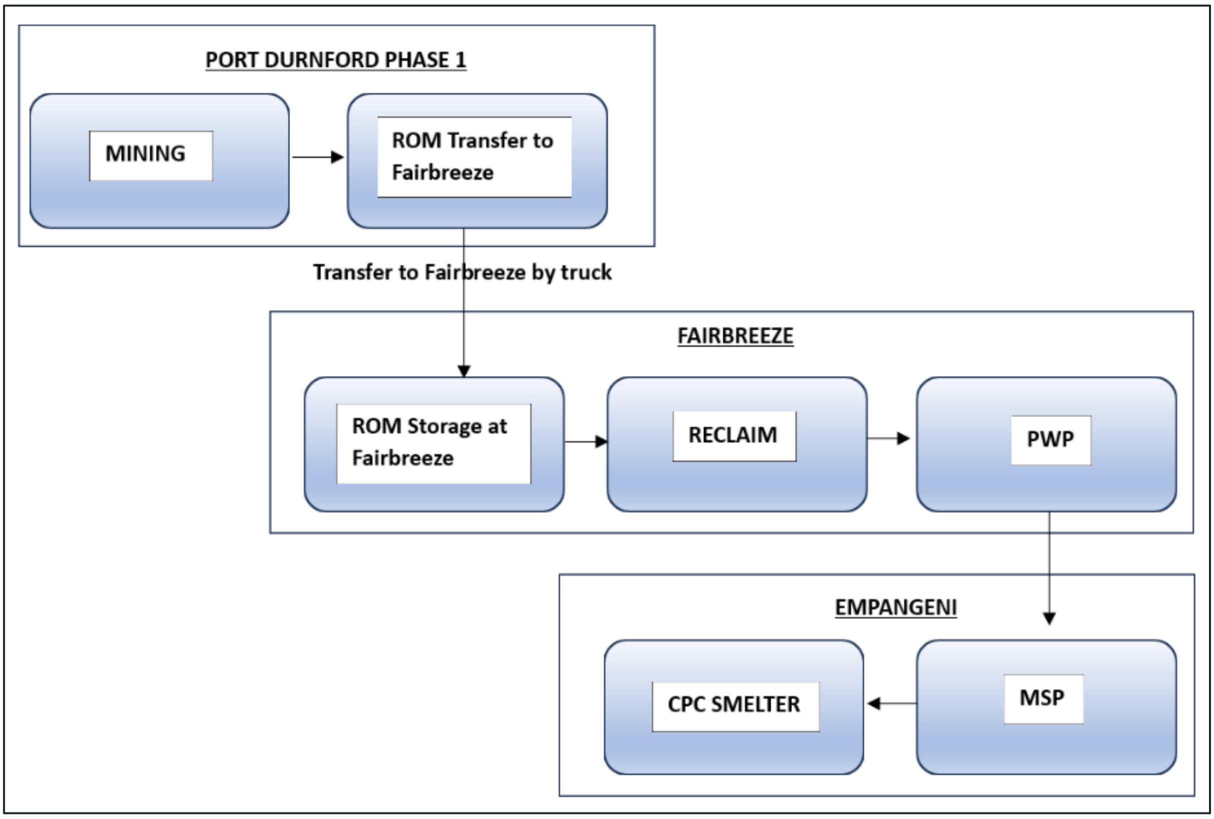

Figure 4: Phase 1 block flow diagram

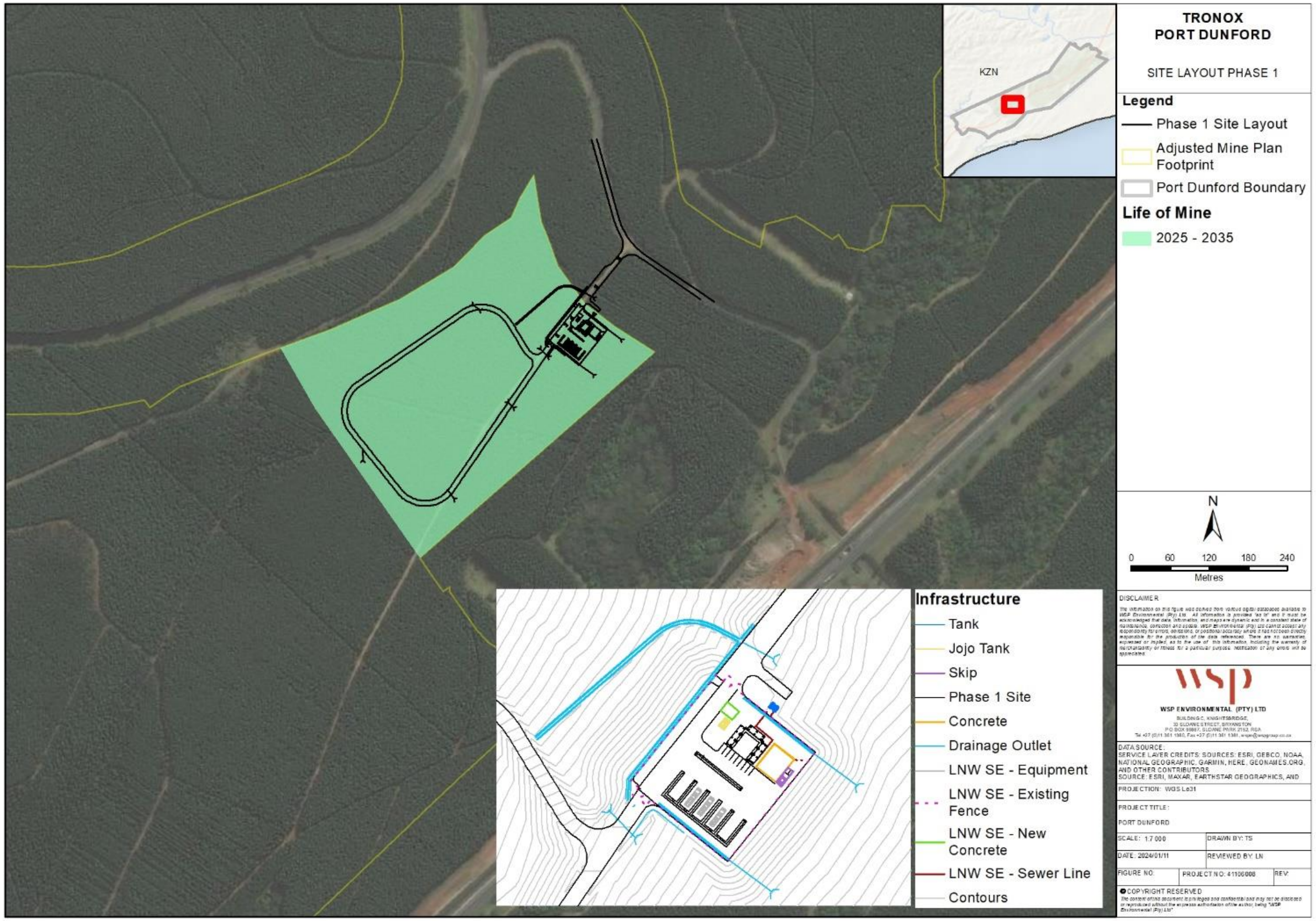

Figure 5: Phase 1 (100 tph) layout

2.4.2. PHASE 2 MINING

From 2036 to the end of the LOM, the low-rate truck and shovel mining method will be replaced by a high-rate 3,000 tph mining operation, utilizing two dozer trap mining units (DTMUs). The DTMUs will be fed via bulldozers and will operate in parallel to collect and prepare the ROM for further hydraulic transfer to Port Durnford's own PWP. The units will be skid-mounted and mobile and used to screen vegetation, rocks and oversized materials. The remaining ROM will then be slurried and pumped to the PWP where it will first pass through a trommel screen to remove further oversized material.

The 3,000 tph operation will involve a full production facility which will consist of a new PWP, constructed to process the Port Durnford ROM material and residue storage facilities (RSFs) will need to be constructed to contain the fines tailings produced from the PWP. All bulk services (such as power and raw water), and associated infrastructure to support this operation will also be required. All HMC produced at the PWP will then be transferred as feedstock via truck to the existing MSP in Empangeni.

At the PWP, the following processes will occur:

- Mined material (ROM) will be deslimed and placed through a spiral circuit to separate out the coarse tailings which will then be used for backfilling and for the establishment of the walls of the residue storage facilities.
- The spiral concentrate will be put through a magnetic separation circuit to remove the reject magnetite which is fed back into the coarse tailings circuit.
- The non-magnetic material forms the HMC.
- Fine tailings are collected from the desliming process, thickener is added and process water retrieved before disposal on the RSFs.

A process flow diagram for the Phase 2 operations is presented in **Figure 6**, while the site infrastructure layout and LOM plan are depicted in **Figure 7** and **Figure 8**, respectively.

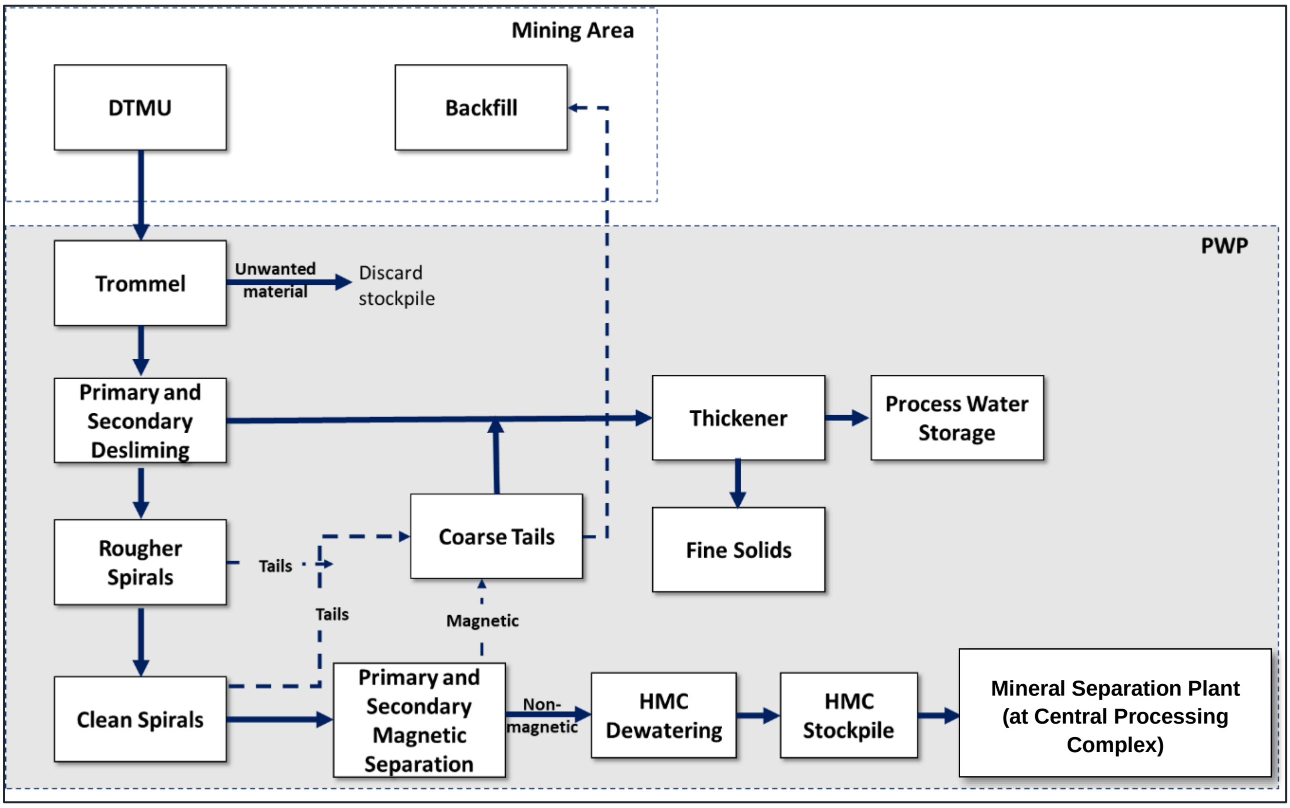

Figure 6: Phase 2 block flow diagram

For the Phase 2 operations, the following infrastructure is proposed:

- PWP: which will produce HMC to be the used as feedstock at the existing MSP. The infrastructure of the PWP will include:
  - Feed preparation and fines removal area.
  - Gravity separation area.
  - Magnetic separation area.
  - Fine tails dewatering and pumping area.
  - 33kV sub-station and power factor correction yards.
  - Eskom yard.
  - Raw and process water storage and distribution area.
  - Compressed air plant.
  - Potable water treatment plant.
  - Workshop and stores.
  - Fine tails treatment area.
  - HMC dewatering, stockpiling and reclaim area.
  - MSP tails handling.
  - Gypsum plants.
  - Mine Complex including administration office with parking, control room, change house, mess, security office, laboratory and sample room.

- A fit for purpose and legally compliant fire water pumping station and distribution system.

- Access and haul roads.
- Two RSFs (Site 9 and Site C).
- Sand tailings disposal.
- Temporary topsoil stockpiles.

The HMC processed at Port Durnford will be transported using highway road trucks to the MSP in Empangeni. The preferred route at present is from the Port Durnford PWP along the N2 and exiting the offramp at the R34 into Empangeni. It is understood that there is an existing underpass (about 3.5 km from the PWP) that will be changed into an intersection/ slipway onto the N2.

2.5. EXISTING NOISE CLIMATE

The existing noise climate surrounding the Port Durnford site is predominantly influenced by natural sources such as birds and insects and anthropogenic sources like vehicle activity on nearby roads and activity of residents. The N2 highway that traverses the site is a major contributor to the current noise climate in and around the site due to the great volume of traffic experienced on this road. A baseline monitoring campaign was conducted for the Port Durnford Project, with the methodology and results presented in **Section 5.1** and **7.1**, respectively.

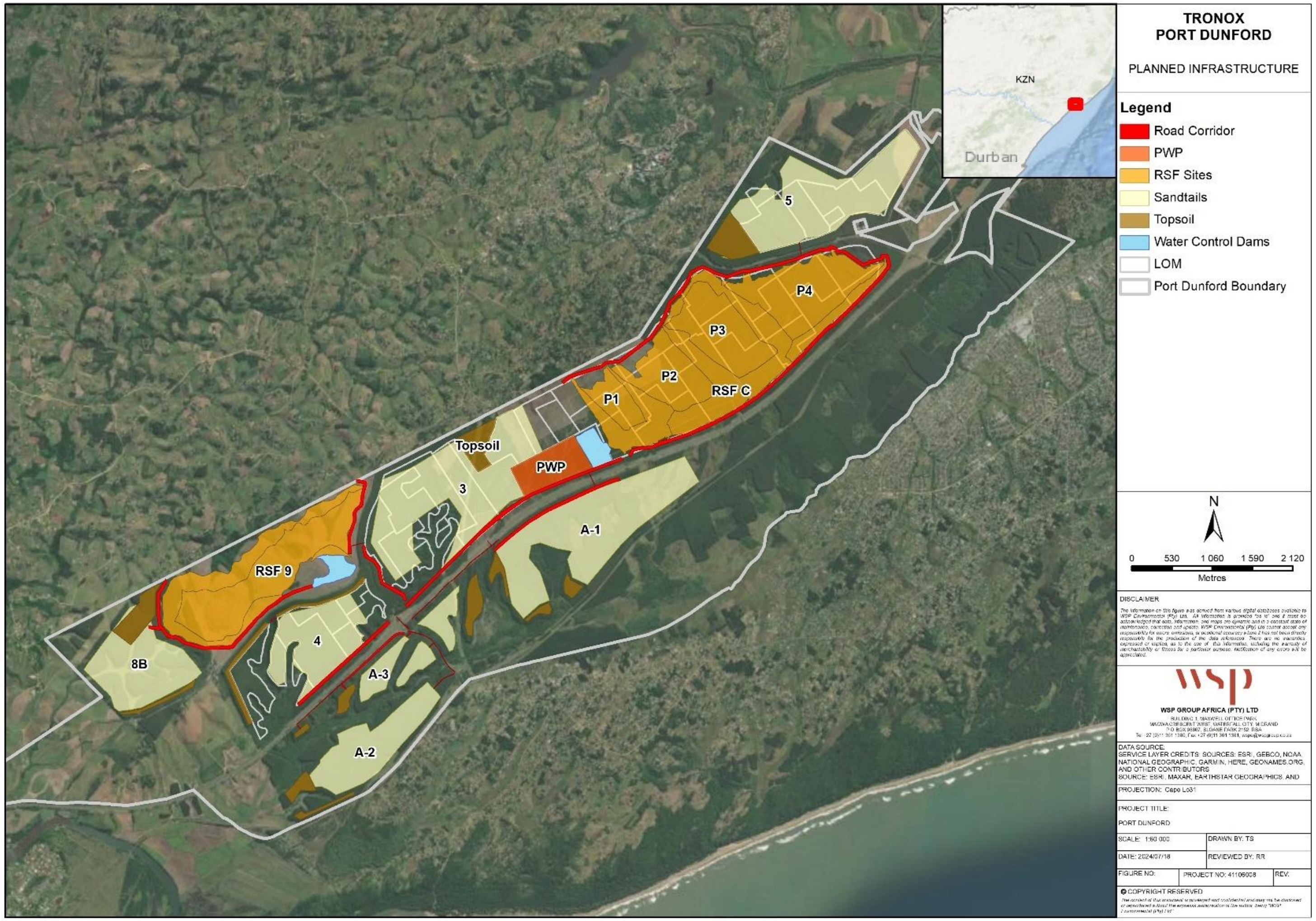

Figure 7: Phase 2 (3,000 tph) layout

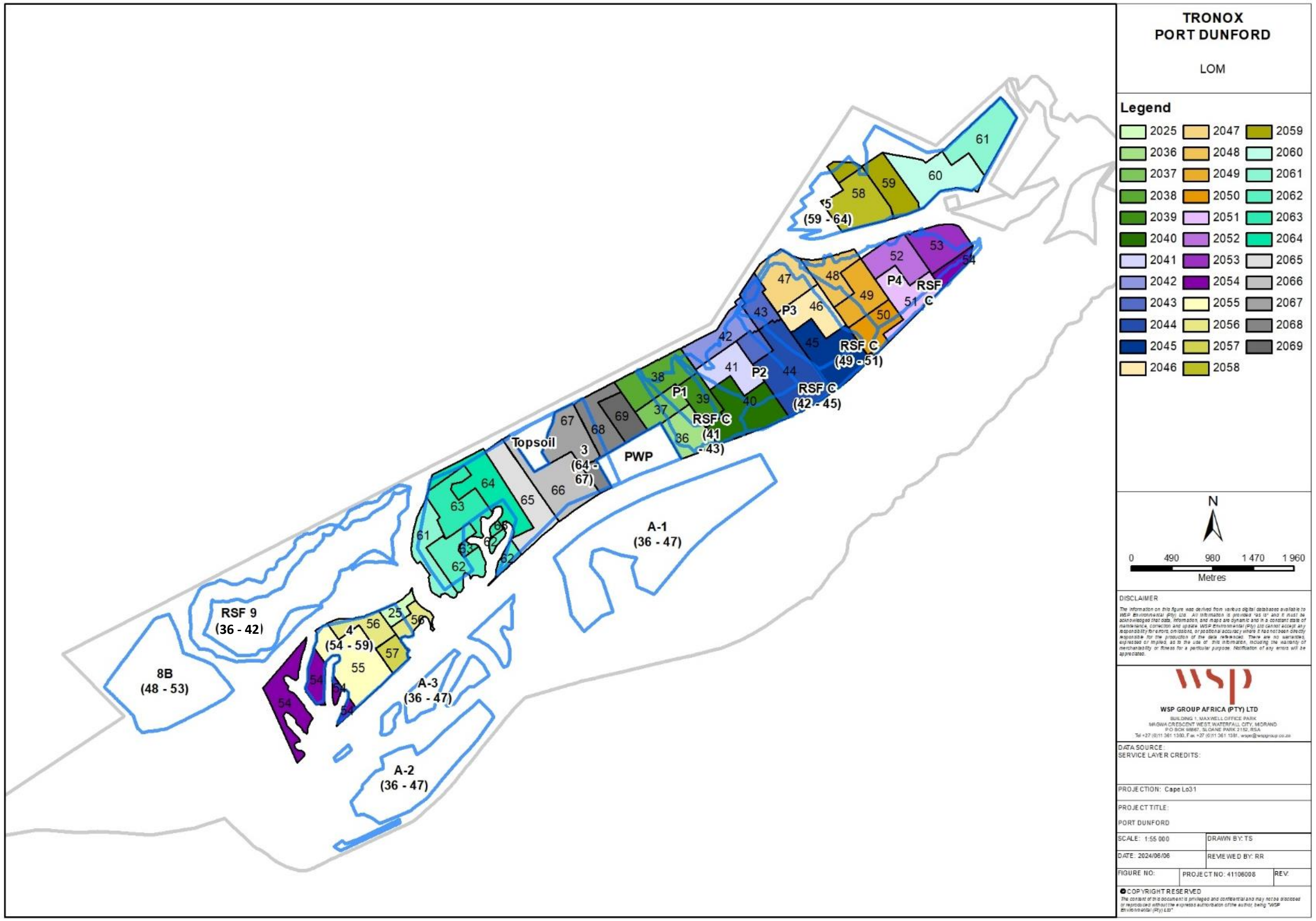

Figure 8: Phase 2 Life of Mine Plan

3. ACOUSTIC FUNDAMENTALS

3.1. PRINCIPLES

Sound is defined as any pressure variation (in air, water or other medium) that the human ear can detect. Noise is defined as “unwanted sound”. Noise can lead to health impacts and can negatively affect people’s quality of life. Hearing impairment is typically defined as a decrease in the threshold of hearing. Severe hearing deficits may be accompanied by tinnitus (ringing in the ears). Noise-induced hearing impairment occurs predominantly in the higher frequency range of 3,000 to 6,000 Hertz (Hz), with the largest effect at 4,000 Hz. With increasing L_{Aeq} and increasing exposure time, noise-induced hearing impairment occurs even at frequencies as low as 2,000 Hz. However, hearing impairment is not expected to occur at L_{Aeq} levels of 75 dB(A) or below, even for prolonged occupational noise exposure.

Speech intelligibility is adversely affected by noise. Most of the acoustical energy of speech is in the frequency range of 100 to 6,000 Hz, with the most important cue-bearing energy being between 300 and 3,000 Hz. Speech interference is basically a masking process in which simultaneous interfering noise renders speech incapable of being understood. Environmental noise may also mask other acoustical signals that are important for daily life such as doorbells, telephone signals, alarm clocks, music, fire alarms and other warning signals.

Sleep disturbance is a major effect of environmental noise. It may cause primary effects during sleep and secondary effects that can be assessed the day after night-time noise exposure. Uninterrupted sleep is a prerequisite for good physiological and mental functioning and the primary effects of sleep disturbance are: (a) difficulty in falling asleep; and (b) awakenings and alterations of sleep stages or depth. The difference between the sound levels of a noise event and background sound levels, rather than the absolute noise level, may determine the reaction probability.

The annoyance due to a given noise source is subjective from person to person and is also dependent upon many non-acoustic factors such as the prominence of the source, its importance to the listener’s economy (wellbeing), and his or her personal opinion of the source. Increased exposure to noise can have negative effects on individuals, both physiological (influence on communication, productivity and even impaired hearing) and psychological effects (stress, frustration and disturbed sleep). As such, noise impacts need to be understood to mean one or a combination of negative physical, physiological or psychological responses experienced by individuals, whether consciously or unconsciously, caused by exposure to noise.

More technically, noise impacts are defined as the capacity of noise to induce annoyance depending upon its physical characteristics, including the sound pressure level, spectral characteristics and variations of these properties with time. During daytime, individuals may be annoyed at L_{Aeq} levels below 55 dB(A), while very few individuals are moderately annoyed at L_{Aeq} levels below 50 dB(A). Sound levels during the evening and night should be 5 to 10 dB(A) lower than during the day (World Health Organisation, 1999).

Table 1: Typical noise levels

Sound Pressure Level (dB(A))	Typical Source	Subjective Evaluation
130	threshold of pain	intolerable
120 110	heavy rock concert grinding on steel	extremely noisy
100 90	loud car horn at 3 m construction site with pneumatic hammering	very noisy
80 70	kerbside of busy street loud radio or television	loud
60 50	department store general office	moderate to quiet
40 30	inside private office inside bedroom	quiet to very quiet
20	unoccupied recording studio	almost silent

3.2. NOISE PROPAGATION

Sound is a pressure wave that diminishes with distance from source. Depending on the nature of the noise source, sound propagates at different rates. The three most common categories of noise are point sources (specified single point of noise generation), line sources (multiple linear noise generating points, such as a road) and area sources (specified single area of noise generation). The most important factors affecting noise propagation are:

- The type of source (point, line or area).
- Obstacles such as barriers and buildings.
- Distance from source.
- Atmospheric absorption.
- Ground absorption.
- Reflections.

Research has shown that doubling the distance from a noise source results in a proportional decline in noise level. Sound propagation in air can be compared to ripples on a pond. The ripples spread out uniformly in all directions, decreasing in amplitude as they move further from the source. An acoustically hard site exists where sound travels away from the source over a generally flat, hard surface such as water, concrete, or hard-packed soil. These are examples of reflective ground, where the ground cover provides little or no attenuation. The standard attenuation rate for hard site conditions is 6 dB(A) per doubling of distance for point sources. Thus, if you are at a position one meter from the source and move one meter further away from the source, the sound pressure level will drop by 6 dB(A), moving to 4 meters, the drop will be a further 6 dB(A), and so on. When ground cover or normal unpacked earth (i.e., a soft site) exists between the source and receptor, the ground becomes absorptive to sound energy. Absorptive ground results in an additional noise reduction of approximately 1.5 dB(A) per doubling of distance.

This methodology is only applicable when there are no reflecting or screening objects in the sound path. When an obstacle is in the sound path, part of the sound may be reflected, and part absorbed, and the remainder may be transmitted through the object. How much sound is reflected, absorbed and/or transmitted depends on many factors, including the properties of the object. When receptor locations are not in the line of sight of the noise source, there may be up to 20 dB(A) attenuation for broadband noise, with a further 10 to 15 dB(A) attenuation when inside the average residence and the windows are open.

3.3. CHARACTERISTICS OF NOISE

The human ear simultaneously receives sound (normal un-weighted sound or Z-weighting dB(Z)) at many frequencies (octave bands) at different amplitudes. The ear then adjusts its sensitivity based on the amplitude of the sound observed. This focuses the sound and makes it audible by adjusting the amplitude of the low, middle and high frequencies. To measure how a person experiences sound, an electronic weighting adjusted to the Z-weighted sound was developed, including three different weighting curves, namely:

- A-weighting - This measurement is often noted as dB(A) and this weighting curve attempts to make the noise level meter respond closely to the characteristics of a human ear. It adjusts the frequencies at low and high frequencies. Various national and international standards relate to measurements recorded in the A-weighting of sound pressure levels.
- B-weighting - is similar to A-weighting but with less attenuation. The B-weighting is very seldom, if ever, used. The B-weighting follows the C-weighted trend.
- C-weighting - is intended to represent how the ear perceives sound at high decibel levels. C-weighted measurements are reported as dB(C).
- Z-weighting - this refers to linear, un-weighted noise levels.

The weighting is employed by arithmetically adding a table of values (**Table 2**), listed by octave bands, to the measured linear sound pressure levels for each specific octave band. The resulting octave band measurements are logarithmically added to provide a single weighted value describing the sound, based on the applied weighting curve (**Figure 9**). Thus, if the A-weighted curve was applied to the sound, the noise level is noted as dB(A).

Table 2: Frequency weighting table for the different weighting curves

Frequency (Hz)	32 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz
A-weighting	-39.4	-26.2	-16.1	-8.6	-3.2	0	1.2	1	1.1
B-weighting	-17.1	-9.3	-4.2	-1.3	-0.3	0	-0.1	-0.7	-2.9
C-weighting	-3	-0.8	-0.2	0	0	0	-0.2	-0.8	-3
Z-weighting	0	0	0	0	0	0	0	0	0

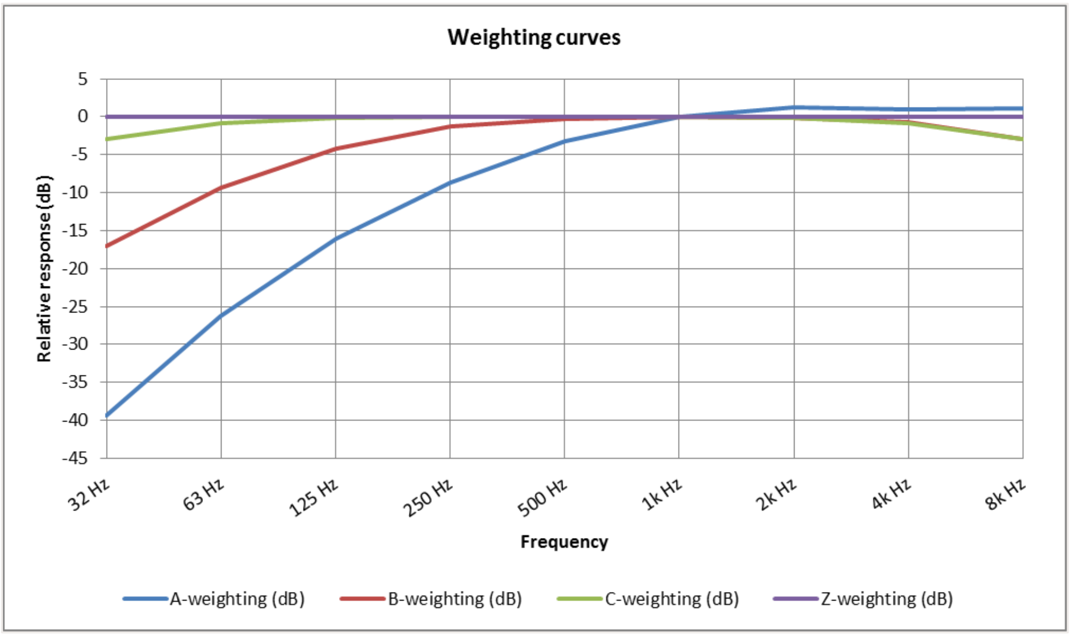

Figure 9: Weighting curves

4. LEGISLATIVE FRAMEWORK

4.1. SOUTH AFRICAN LEGISLATION

4.1.1. SOUTH AFRICAN NOISE CONTROL REGULATIONS

In South Africa, environmental noise control has been in place for three decades, beginning in the 1980s with codes of practice issued by the South African National Standards (formerly the South African Bureau of Standards, SABS) to address noise pollution in various sectors of the country. Under the previous generation of environmental legislation, specifically the Environmental Conservation Act 73 of 1989 (ECA), provisions were made to control noise from a national level in the form of the Noise Control Regulations (GNR 154 of January 1992). In later years, the ECA was replaced by the National Environmental Management Act 107 of 1998 (NEMA) as amended. The National Environmental Management: Air Quality Act 39 of 2004 (NEMAQA) was published in line with NEMA and contains noise control provisions under Section 34:

> *"(1) The minister may prescribe essential national standards –*
>
> *(a) for the control of noise, either in general or by specific machinery or activities or in specified places or areas; or*
>
> *(b) for determining –*
>
> *(i) a definition of noise; and*
>
> *(ii) the maximum levels of noise.*
>
> *(2) When controlling noise, the provincial and local spheres of government are bound by any prescribed national standards."*

Under NEMAQA, the Noise Control Regulations were updated and are to be applied to all provinces in South Africa. The Noise Control Regulations give all the responsibilities of enforcement to the Local Provincial Authority, where location specific by-laws can be created and applied to the locations with approval of Provincial Government. Where province-specific regulations have not been promulgated, acoustic impact assessments must follow the Noise Control Regulations. These regulations define the following:

- Ambient Sound Level: the reading on an integrating impulse sound level meter taken at a measuring point in the absence 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.
- Zone Sound Level: a derived dB(A) value determined indirectly by means of a series of measurements, calculations or table readings and designated by a local authority for an area.
- Disturbing Noise: 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 dB(A) or more.

With the above definitions in mind, regulation 4 of the Noise Control Regulations stipulate that no person shall 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.

Furthermore, NEMAQA prescribes that the Minister must publish maximum allowable noise levels for different districts and National noise standards. These have not yet been accomplished and as a result all monitoring and assessments are done in accordance with the SANS 10103:2008 and 10328:2008 as discussed in the sections that follow (SANS, 2008a and 2008b).

4.1.2. SOUTH AFRICAN NATIONAL STANDARDS (SANS)

The SANS 10328:2008 (*Methods for Environmental Noise Impact Assessments*) presently inform environmental acoustic impact assessments in South Africa. This standard defines that the purpose of an Environmental Acoustic Impact Assessment is to determine and quantify the acoustical impact of, or on, a proposed development. It also stipulates the methods used to assess impacts as well as the minimum requirements to be investigated and included in the Environmental Acoustic Impact Assessment report as part of the EIA. These minimum requirements include:

1) The purpose of the investigation.
2) A brief description of the planned development or the changes that are being considered.
3) A brief description of the existing environment including, where relevant, the topography, surface conditions and meteorological conditions during measurements.
4) The identified noise sources together with their respective sound pressure levels or sound power levels (or both) and, where applicable, the operating cycles, the nature of sound emission, the spectral composition and the directional characteristics.
5) The identified noise sources that were not taken into account and the reasons as to why they were not investigated.
6) The identified noise-sensitive developments and the noise impact on them.
7) Where applicable, any assumptions, with references, made with regard to any calculations or determination of source and propagation characteristics.
8) An explanation, either by a brief description or by reference, of all measuring and calculation procedures that were followed, as well as any possible adjustments to existing measuring methods that had to be made, together with the results of calculations.
9) An explanation, either by description or by reference, of all measuring or calculation methods (or both) that were used to determine existing and predicted rating levels, as

well as other relevant information, including a statement of how the data were obtained and applied to determine the rating level for the area in question.

10) The location of measuring or calculating points in a sketch or on a map.

11) Quantification of the noise impact with, where relevant, reference to the literature consulted and the assumptions made.

12) Alternatives that were considered and the results of those that were investigated.

13) A list of all the interested or affected parties that offered any comments with respect to the environmental noise impact investigation.

14) A detailed summary of all the comments received from interested or affected parties as well as the procedures and discussions followed to deal with them.

15) Conclusions that were reached.

16) Proposed recommendations.

17) If remedial measures will provide an acceptable solution which would prevent a significant impact, these remedial measures should be outlined in detail and included in the final record of decision if the approval is obtained from the relevant authority. If the remedial measures deteriorate after time and a follow-up auditing or maintenance programme (or both) is instituted, this programme should be included in the final recommendations and accepted in the record of decision if the approval is obtained from the relevant authority.

18) Any follow-up investigation which should be conducted at completion of the project as well as at regular intervals after the commissioning of the project so as to ensure that the recommendations of this report will be maintained in the future.

The SANS 10103:2008 document (*The measurement and rating of environmental noise with respect to speech communication*) provides methods and guidelines to assess working and living environments with respect to acoustic comfort as well as respect to possible annoyance by noise. As applicable to this assessment, SANS 10103 provides guideline typical rating levels for noise in different districts. These rating levels are presented in **Table 3**.

Table 3: Typical rating levels for noise in districts (adapted from SANS 10103:2008)

Type of District	Classification	Equivalent Continuous Rating level for Noise ($L_{Req,T}$) (dB(A)) Outdoors	
		Daytime ($L_{Req,d}$)	Night-time ($L_{Req,n}$)
a) Rural	A	45	35
b) Suburban (with little road traffic)	B	50	40
c) Urban	C	55	45
d) Urban (with one or more of the following: workshops, business premises and main roads)	D	60	50
e) Central Business Districts	E	65	55
f) Industrial District	F	70	60

As stipulated in SANS 10103:2008, noise can pose as an annoyance to a community if the increase in average noise levels exceeds the ambient noise by a certain degree. These specified increases together with the relevant estimated community responses are presented in **Table 4**.

Table 4: Categories of community/group response (adapted from SANS 10103:2008)

Excess ($\Delta L_{Req,T}$)[a] dB(A)	Estimated Community or Group Response	
	Category	Description
0 – 10	Little	Sporadic Complaints
5 – 15	Medium	Widespread Complaints
10 – 20	Strong	Threats of community/group action
>15	Very Strong	Vigorous community/group action

Overlapping ranges for the excess values are given because a spread in the community reaction might be anticipated.

[a] $\Delta L_{Req,T}$ should be calculated from the appropriate of the following:

1) $L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS $L_{Req,T}$ of the residual noise (determined in the absence of the specific noise under investigation);
2) $L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the maximum rating level of the ambient noise given in Table 1 of the code;
3) $L_{Req,T}$ = $L_{Req,T}$ of ambient noise under investigation MINUS the typical rating level for the applicable district as determined from Table 2 of the code; or
4) $L_{Req,T}$ = Expected increase in $L_{Req,T}$ of ambient noise in the area because of the proposed development under investigation.

4.2. WORLD HEALTH ORGANISATION GUIDELINES FOR COMMUNITY NOISE

The World Health Organisation (WHO) together with the Organisation for Economic Co-operation and Development (OECD) are the main international bodies that have collected data and developed assessments on the effects of exposure to environmental noise. This has provided the following summary of thresholds for noise nuisance in terms of the outdoor day-time equivalent continuous A-weighted sound pressure level (L_{Aeq}) in residential districts:

- At 55 - 60 dB(A) noise creates annoyance.
- At 60 - 65 dB(A) annoyance increases considerably.
- Above 65 dB(A) constrained behaviour patterns, symptomatic of serious damage caused by noise.

The WHO therefore recommends a maximum outdoor daytime (07:00 – 22:00) L_{Aeq} of 55 dB(A) in residential areas and schools in order to prevent significant interference with normal activities. It further recommends a maximum night-time (22:00 – 07:00) L_{Aeq} of 45 dB(A) outside dwellings. No distinction is made as to whether the noise originates from road traffic, from industry, or any other noise source.

The WHO guideline for industrial noise is set at 70 dB(A) over a period of 24 hours. Anything above this level would cause hearing impairment, however, a peak noise level of 110 dB(A) is allowable on a fast response measurement.

4.3. INTERNATIONAL FINANCE CORPORATION GUIDELINES

From the International Finance Corporation (IFC) Environmental, Health and Safety (EHS) Guidelines, the impacts of noise beyond the property boundary of a facility are addressed in section 1.7 (IFC, 2007). The noise guidelines stipulated by the IFC are grouped into two categories, namely “Residential; institutional; educational” and “Industrial; commercial” (**Table 5**). Such guidelines are in-line with the WHO guidelines as discussed above and are as such applicable to this assessment. Noise impacts should not exceed these levels or result in a maximum increase in background noise levels of 3 dB(A) at the nearest off site receptor location.

Table 5: IFC Environmental Noise Level Guidelines

Receptor	One-hour L_{Aeq} (dB(A))	
	Daytime (07:00 – 22:00)	Night-time (22:00 – 07:00)
Residential; institutional; educational	55	45
Industrial; commercial	70	70

The guideline also states that highly intrusive noise, such as noise from aircraft flyovers and passing trains should not be included when establishing background noise levels.

5. METHODOLOGY

To assess the environmental acoustic impacts of the operation of the proposed Project, both baseline (monitored) and proposed (modelled) noise levels were assessed. Comparisons of the existing and proposed noise levels at various specified sensitive receptors (noise receivers) enabled an assessment of changes in noise levels at these locations as a result of the operation of the proposed Project. Such changes were then assessed against the SANS community or group responses (**Table 4**) to assess the anticipated impacts/responses as a result of such increases.

It is noted that detailed construction phase plans and equipment specifications are not yet available. It is also understood that this phase is very erratic in nature. As such, a quantitative assessment of construction phase acoustic impacts was not undertaken, but rather a qualitative discussion thereof.

5.1. ACOUSTIC MONITORING

Ambient sound level measurements were undertaken on 06 to 08 February 2023 at eight off-site sensitive receptor locations (**Table 6** and **Figure 10**). All sound level measurements were free-field measurements (i.e. at least 3.5 m away from any vertical reflecting surfaces). Measurement procedures were undertaken according to the relevant South African Code of Practice, namely SANS 10103:2008. This guides the selection of monitoring locations, microphone positioning and equipment specifications. Sound level measurements were taken with a SABS-calibrated Type 1 Integrating Sound Level Meter. The sound level meter was calibrated before and after measurements were conducted and no significant drifts (differences greater than 0.5 dB(A)) were found to occur. The make and model as well as serial number and calibration validity of the sound level meter and calibrator are presented in **Table 7**.

Day-time and night-time measurements were conducted for fifteen minutes each, allowing monitoring to be adequately representative. The monitoring was conducted during the relevant timeframe for day (06:00 to 22:00) and night (22:00 to 06:00) in accordance with the SANS methodology. As per GNR 320 of the NEMA, night-time monitoring took place over a minimum of two nights. However, due to the size of the Project area, only one sample was taken on each night. The noise parameters recorded included:

- L_{Aeq} The equivalent continuous sound pressure level, normally measured (A-weighted).
- L_{Amax} The maximum sound pressure level of a noise event measured (A-weighted).
- L_{Amin} The minimum sound pressure level of a noise event measured (A-weighted).
- L_{A50} The average noise level a receptor is exposed to for 50% of the monitoring period.
- L_{A90} The average noise level a receptor is exposed to for 90% of the monitoring period.

Table 6: Noise monitoring locations

ID	Description	Latitude (°S)	Longitude (°E)	Distance from Mine Boundary (m)	Direction from Mine Boundary	SANS Classification*
Rec 01	Zini River Estate Residential	28.9356	31.7678	510	S	Suburban B
Rec 02	Port Durnford Residential	28.9203	31.8211	40	SE	Suburban B
Rec 03	Sikhalasenkosi Residential	28.8956	31.8683	100	SE	Suburban B
Rec 04	Uzimgwenya Residential	28.8672	31.9011	15	SE	Suburban B
Rec 05	Gobandlovu Residential	28.8561	31.9053	620	NE	Suburban B
Rec 06	Khandisa Residential	28.8539	31.8619	90	NW	Suburban B
Rec 07	Ongoye Residential	28.8742	31.8450	95	NW	Suburban B
Rec 08	Msasandla Residential	28.8906	31.8069	235	NW	Suburban B

* As per **Table 3**

Table 7: Sound level meter and calibrator specifications

Sound level meter	Calibrator
Make & model: CEL 63X	**Make & model:** CEL-120/1
Serial number: 3134723	**Serial number:** 3939145
Date calibrated: June 2022	**Date calibrated:** June 2022
Calibration due date: June 2023	**Calibration due date:** June 2023

Figure 10: Noise monitoring locations surrounding the Port Durnford site

5.2. ACOUSTIC INVENTORY

5.2.1. PHASE 1 MINING

The sources of noise identified during the Phase 1 mining operations are presented in **Table 8**. These sources and sound power level (PWL) specifications (BSI, 2009; Ultraspin, 2014; Berger *et al.*, 2016) were used as input into the acoustic model. It is noted that all sources for the Phase 1 operations will be operational for twelve hours a day during a five-day work week, once a month only. As such, only daytime noise predictions were assessed.

5.2.2. PHASE 2 MINING

The sources of noise identified during the Phase 2 mining operations are presented in **Table 9**. These sources and PWL specifications (City of Carlsbad, 2005; Lloyd Acoustics, 2006; URS Australia, 2006; BSI, 2009; CAT, 2016; WSP, 2016; CAT, 2018; Berger *et al.*, 2016; Encon Associates, 2017) were used as input into the acoustic model. It is noted that all sources for the Phase 2 operations will be operational for 24 hours a day, hence the predicted day and night-time noise levels will be identical.

5.3. ACOUSTIC MODELLING

Acoustic modelling was used to calculate noise contours indicating the spatial extent of predicted noise levels from the proposed Project within a specified grid area (30 km x 30 km) as well as the noise levels at specific receivers (sensitive receptors). The acoustic modelling software used in this study is the internationally recognised package, CadnaA (Computer Aided Noise Abatement). The CadnaA software provides an integrated environment for noise predictions under varying scenarios and calculates the cumulative effects of various sources. The model uses ground elevations in the calculation of the noise levels in a grid and uses standard meteorological parameters that have an effect on the propagation of noise. CadnaA has been utilised in many countries across the globe for the modelling of environmental noise and town planning. It is comprehensive software for three-dimensional calculations, presentation, assessment and prediction of environmental noise emitted from industrial plants, parking lots, roads, railway schemes or entire towns and urbanized areas.

For Phase 2, mining is expected to progress across the site (from 2036 – 2069) and as such, the modelling scenarios have been split into key periods (based on location of noise sources) for ease of assessment. For the acoustic modelling, the following scenarios were considered (operational years are indicated in brackets):

- Phase 1 (100 tph) Operations (2025 – 2036)
- Phase 2 (3,000 tph) Operations (2036 – 2047)
- Phase 2 (3,000 tph) Operations (2048 – 2053)
- Phase 2 (3,000 tph) Operations (2054 – 2057)
- Phase 2 (3,000 tph) Operations (2058 – 2061)
- Phase 2 (3,000 tph) Operations (2062 – 2069)

Table 8: Phase 1 noise sources and sound levels

Source	Specifications	Activity	Quantity	Location	Source Height (m)	Operational time	Sound Power Level (dB(A)	Sound Pressure Level @ 1 m (dB(A))
Front End Loader	D966 FEL	Loading of ore to truck	2	At pit	1	12 hr/day	110.0	102.0
Highway Trucks	34t end tipper	Transport of ore to Fairbreeze for beneficiation	4 trucks (9 trips per day each)	R102 onto N2 and to Fairbreeze	2	12 hr/day	114.5	106.5
Dozer		Levelling	1	At pit	1	12 hr/day	117.0	109.0
Grader	140 H Leomat	Grade roads	1	Haul roads	1.5	12 hr/day	114.0	106.0
Water Bowser	23,000 L ADT Water tanker	Wet roads	1 truck (6 trips per day)	Haul roads	1.5	12 hr/day	109.0	101.0
Service truck			1	Access road	1.5	12 hr/day	70.0	62.0
Diesel Bowser		Provide diesel to other vehicles	1	Haul roads	1.5	12 hr/day	117.0	109.0
Water truck	10 - 18 kL	Provide water to the laydown area	1 truck (6 trips per day)	Access road to laydown area	1.5	12 hr/day	109.0	101.0
Pumps	Ultraspin electric pump	Skimming system	1	Laydown area	1	12 hr/day	77.0	69.0

Table 9: Phase 2 noise sources and sound levels

Source	Specifications	Activity	Quantity	Location	Source Height (m)	Operational time	Sound Power Level (dB(A)	Sound Pressure Level @ 1 m (dB(A))
Pit Sources								
Dozer Trap Mining Unit (DTMU)	2,500 tph	Mining material to the plant	2	Pit	2	24 hr/day	106.0	98.0
Bulldozers	D11	Dozing ore material to the DTMU	4	2 at each DTMU	1	24 hr/day	116.0	108.0
Excavator	CAT390	Creating benches behind dozers	1	50% of time at each DTMU	2	24 hr/day	89.0	81.0
Booster pump station	Warman Pump Complete 16/14 Metal	ROM slurry from DTMU to PWP (hydraulic transfer)	2	At each DTMU	1	24 hr/day	98.0	90.0
Primary Wet Plant (PWP) Sources								
Booster pumps		Pumping water from PWP to DTMU	2	At PWP - one pump for each DTMU	1	24 hr/day	98.0	90.0
Trommel screens	Multitec	Screening	1	Feed preparation section of PWP	1	24 hr/day	92.5	84.5
Air Compressors			2	At PWP -compressed air plant	1	24 hr/day	120.0	112.0
Pumps	Two-stage cyclone circuit (primary and secondary)	Screening - fines removal	2	Fines removal section of PWP	1	24 hr/day	109.0	101.0
Pumps	Two-stage concentrator spiral configuration	Wet gravity circuit	2	Wet gravity circuit of PWP	1	24 hr/day	109.0	101.0
Flock dosing pumps	Wear mineral	Dosing	22	Thickeners and flocculant plant of PWP	1	24 hr/day	109.0	101.0

Source	Specifications	Activity	Quantity	Location	Source Height (m)	Operational time	Sound Power Level (dB(A)	Sound Pressure Level @ 1 m (dB(A))
Positive displacement (PD) pumps	MHWORTH	Fines transport from PWP to RSF	4	At PWP	1	24 hr/day	109.0	101.0
Sand tailings Pumps	Warman	Sandtails transported from PWP to deposition areas	11	At PWP	1	24 hr/day	92.0	84.0
Fire Water Pump Station			1	At PWP	1	24 hr/day	109.0	101.0
Residue Storage Facilities (RSF) Sources								
RSF 9								
Water Transfer Pump	200 SP Warman	Transfer Pump	4	At RSF 9	1	24 hr/day	109.0	101.0
Water return pump	10/8 G AH-WRT Warman	Transfer Pump	2	At RSF 9	1	24 hr/day	109.0	101.0
Residue containment dam pump	200RC-DWU Warman	Transfer Pump	2	At RSF 9	1	24 hr/day	109.0	101.0
RSF C								
Water Transfer Pump	200 SP Warman	Transfer Pump	4	At RSF C	1	24 hr/day	109.0	101.0
Water return pump	10/8 G AH-WRT Warman	Transfer Pump	2	At RSF C	1	24 hr/day	109.0	101.0
Residue containment dam pump	200RC-DWU Warman	Transfer Pump	2	At RSF C	1	24 hr/day	109.0	101.0

Source	Specifications	Activity	Quantity	Location	Source Height (m)	Operational time	Sound Power Level (dB(A)	Sound Pressure Level @ 1 m (dB(A))
Sandtails Sources								
Stacker	With cyclone systems	Loads sandtails to stockpile	2	At active sandtails area (changes throughout LOM)	4	24 hr/day	90.0	82.0
Return water pump		Pump sandtails water back to PWP	2	At active sandtails area (changes throughout LOM)	1	24 hr/day	109.0	101.0
MSP Return Tails Sources								
Tipper trucks		MSP coarse tails received back from the MSP (Empangeni) for disposal		Based on the provided information, it is assumed the number of trucks from Empangeni will be minimal and the resultant additional noise levels will be insignificant. Therefore these sources have not been included in the acoustic model.				
Trucks		Gypsum filter cakes received from CPC						
Fleet Sources								
Grader	140 H Leomat	Grade roads	3	Haul roads	1.5	24 hr/day	117.0	109.0
Water Truck	23,000 L ADT Water tanker	Wet roads	1	Haul roads	1.5	24 hr/day	109.0	101.0
Diesel Bowser		Provide diesel to other vehicles	1	Haul roads	1.5	24 hr/day	117.0	109.0
Product (HMC) trucks	42 T PBS trucks	HMC transfer offsite	8 (totalling 70 trips per day)	Offsite to MSP in Empangeni	2	24 hr/day	114.5	106.5

5.4. SENSITIVE RECEPTORS

Sensitive receptors are identified as areas that may be impacted negatively due to noise associated with the proposed Project. Examples of receptors include, but are not limited to, schools, shopping centres, hospitals, office blocks and residential areas. The specific sensitive receptors considered in this study are the same as those locations selected in the monitoring campaign as presented in **Table 6** and **Figure 10**.

6. ASSUMPTIONS AND LIMITATIONS

In this Environmental Acoustic Impact Assessment, various assumptions were made and limitations experienced that may impact on the results obtained. These include:

- The information provided regarding the proposed operational activities is assumed to be representative of what will occur in reality.
- Due to lack of construction phase specifications and the erratic nature of such a phase, a qualitative assessment of construction phase acoustic impacts was rather undertaken.
- As per GNR 320 of the NEMA, night-time monitoring took place over a minimum of two nights. However, due to the size of the Project area, only one sample was taken on each night. Due to the limited noise sources in the area and the similar noise levels recorded on each night, the data is deemed representative of the night-time noise climate of the area.
- It was assumed that the truck route for Phase 1 will be from the Port Durnford ROM stockpile, onto the R102 and onto the N2, turning off at Fairbreeze.
- It was assumed that the truck route for Phase 2 will be from Port Durnford PWP, onto the N2 (using option 2: change existing underpass into an intersection) and to Empangeni for further processing. For the acoustic model, however, the road was only modelled up to the edge of the site boundary.
- It was assumed, as a worst case, that all sources at the PWP will be unenclosed.
- The exact locations of equipment in each active mining pit or RSF or sandtails area were assumed. Where feasible, sources were placed in closest proximity to the Project boundary nearest to a sensitive receptor in order to represent a worst-case situation.
- As a worst-case scenario, it was assumed during Phase 2 that one heavy duty vehicle (either grader, diesel bowser or water truck) will be operational on the haul roads every hour.
- In line with the air quality emissions inventory information, it was assumed that of the eight product trucks in Phase 2, a total of 70 return trips to the MSP in Empangeni will occur per day.
- Based on the provided information, it is assumed the number of trucks from Empangeni (MSP coarse tails and gypsum filter cakes) during Phase 2 will be minimal and the resultant additional noise levels will be insignificant. Therefore these sources have not been included in the acoustic model.

7. RESULTS

7.1. CURRENT NOISE CLIMATE

It is important to note that wind speed and direction play a vital role in determining baseline noise levels. Noise monitoring is usually discouraged when wind speeds exceed 5 m/s (>18 km/h) as wind noise distorts the baseline noise levels by masking other noise sources. However, no wind speeds exceeding 5 m/s were recorded during the monitoring period.

7.1.1. DAYTIME

The results from the daytime noise monitoring campaign conducted on 6 February 2023 are presented in **Table 10** and **Figure 11**. Conditions during the campaign were hot and clear with intermittent light winds (up to 0.5 m/s). Noise levels at all receptor locations were compared to the typical daytime rating level for noise in suburban areas (50 dB(A)).

Noise levels (L_{Aeq}) at two (Rec 02 and Rec 03) of the eight monitoring locations were below the respective guideline rating level. Noise levels at all other locations exceeded the guideline rating level. The main sources of noise identified at each location that exceeded the guideline included:

- Rec 01 (Zini River Estate Residential): Traffic, a truck idling (with a reverse hooter noted), birds and insects. Distant grass cutting was also noted.
- Rec 04 (Uzimgwenya Residential): Activity of nearby pedestrians, traffic along Ntshona West Road and insects.
- Rec 05 (Gobandlovu Residential): Idling vehicles near the monitor, traffic along Gobandlovu Road and insects.
- Rec 06 (Khandisa Residential): Activity of nearby pedestrians, traffic along the R102 road, and taxis hooting.
- Rec 07 (Ongoye Residential): Activity of nearby pedestrians, traffic along the R102 road and birds.
- Rec 08 (Msasandla Residential): Traffic on the N2 highway and birds.

From the daytime monitoring campaign, it is evident that the current noise climate surrounding the Port Durnford site is predominantly traffic-related, with influences from natural sources like birds and insects. Given the distance of the neighbouring Fairbreeze mine from the monitoring locations, noise from Fairbreeze was not audible.

Table 10: Daytime noise monitoring results

ID	Time	L_{Amax} (dB(A))	L_{Amin} (dB(A))	L_{Aeq} (dB(A))	L_{A50} (dB(A))	L_{A90} (dB(A))	SANS Guideline (dB(A))	Compliant
Rec 01	14:09	70.3	37.7	51.9	47.0	41.5	50	No
Rec 02	13:12	53.5	33.2	38.3	37.5	35.5	50	Yes
Rec 03	11:40	59.0	30.9	41.3	38.0	34.0	50	Yes
Rec 04	11:02	77.6	39.9	57.3	52.5	46.0	50	No
Rec 05	10:32	72.1	36.8	52.2	45.0	41.0	50	No
Rec 06	10:01	70.6	37.9	57.1	55.0	45.0	50	No
Rec 07	09:30	80.6	35.9	60.7	54.0	44.5	50	No
Rec 08	08:58	83.7	32.3	57.8	41.5	36.5	50	No

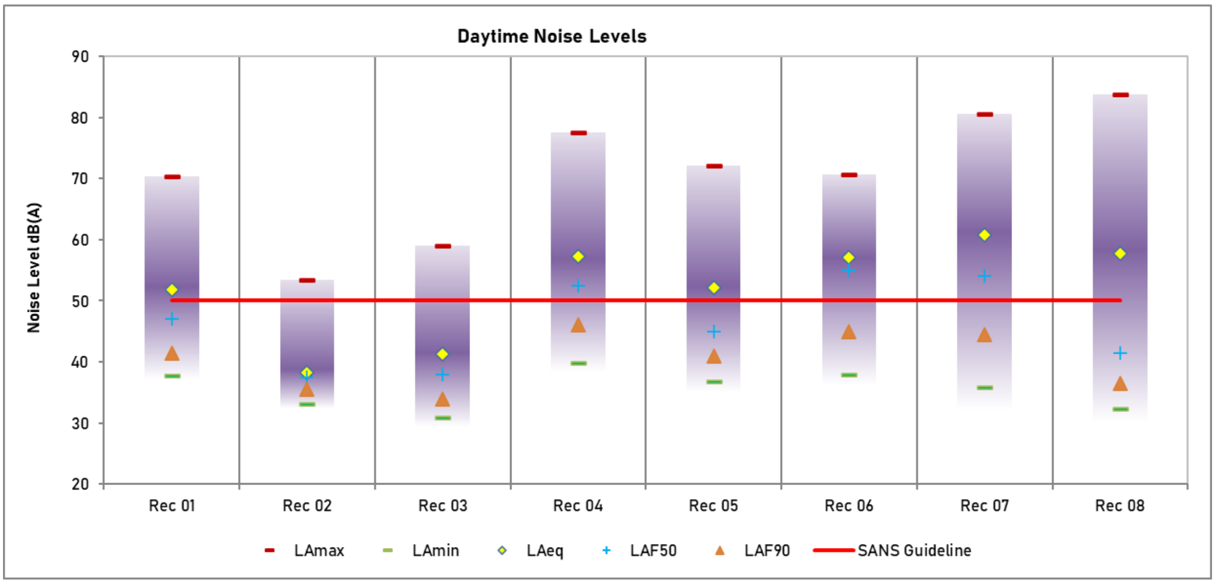

Figure 11: Daytime monitored noise levels. L_{Aeq} (yellow diamond) is compared with the SANS guideline.

7.1.2. NIGHT-TIME

The results from the night-time noise monitoring campaign conducted on 6 – 8 February 2023 are presented in **Table 11** and **Figure 12**. Conditions during the campaign were warm and clear, with generally calm conditions on both nights. Noise levels at all receptor locations were compared to the typical night-time rating level for noise in suburban areas (40 dB(A)).

Average L_{Aeq} noise levels at all eight monitoring locations exceeded the guideline level during both nights. The main sources of noise identified at each location include:

- Rec 01 (Zini River Estate Residential): Insects, birds and nearby traffic.
- Rec 02 (Port Durnford Residential): Insects, monkeys and nearby traffic.
- Rec 03 (Sikhalasenkosi Residential): Activity of nearby residents and insects.
- Rec 04 (Uzimgwenya Residential): Traffic on nearby roads and insects.
- Rec 05 (Gobandlovu Residential): Traffic on nearby roads and insects.
- Rec 06 (Khandisa Residential): Activity of nearby residents, traffic on nearby roads and insects.
- Rec 07 (Ongoye Residential): Traffic on nearby roads and insects.
- Rec 08 (Msasandla Residential): Traffic on nearby roads, insects and dogs barking.

From the night-time monitoring campaign, it is evident that the current noise climate surrounding the proposed site is predominantly traffic-related with influences from nocturnal animals and insects. Given the distance of the neighbouring Fairbreeze mine from the monitoring locations, noise from Fairbreeze was not audible.

It is noted that the logarithmic average over the two night-time monitoring campaigns was used as the baseline night-time noise levels in this impact assessment to determine changes as a result of the Port Durnford Project. Due to the limited noise sources in the area and the similar noise levels recorded on each night, the data is deemed representative of the night-time noise climate of the area.

Table 11: Night-time noise monitoring results

ID	Time	L_{Amax} (dB(A))	L_{Amin} (dB(A))	L_{Aeq} (dB(A))	L_{A50} (dB(A))	L_{A90} (dB(A))	SANS Guideline (dB(A))	Compliant
06 February 2023								
Rec 01	21:59	68.1	39.7	45.3	44.0	42.5	40	No
Rec 02	03:27	76.2	40.5	49.6	48.0	45.0	40	No
Rec 03	01:44	58.6	47.2	51.3	51.0	49.5	40	No
Rec 04	01:06	67.7	44.1	59.5	58.0	47.0	40	No
Rec 05	00:44	68.7	42.3	57.1	49.0	44.0	40	No
Rec 06	00:50	74.8	49.4	57.8	55.0	53.0	40	No
Rec 07	23:13	78.9	39.7	53.4	47.0	45.5	40	No
Rec 08	22:46	57.3	36.8	42.3	40.0	38.5	40	No

ID	Time	L_{Amax} (dB(A))	L_{Amin} (dB(A))	L_{Aeq} (dB(A))	L_{A50} (dB(A))	L_{A90} (dB(A))	SANS Guideline (dB(A))	Compliant
07 February 2023								
Rec 01	22:10	58.0	41.9	47.0	46.5	45.0	40	No
Rec 02	01:55	64.1	44.6	53.6	51.5	47.5	40	No
Rec 03	01:12	61.5	41.8	45.4	45.0	44.0	40	No
Rec 04	00:44	66.6	40.0	53.2	45.5	43.0	40	No
Rec 05	00:19	84.0	43.4	60.7	46.5	45.5	40	No
Rec 06	23:50	89.1	42.5	60.6	44.0	43.5	40	No
Rec 07	23:27	74.3	40.9	48.0	44.5	43.0	40	No
Rec 08	23:00	77.7	37.9	51.8	43.0	40.5	40	No
Logarithmic Averages								
Rec 01		65.5	40.9	46.2	45.4	43.9	40	No
Rec 02		73.4	43.0	52.0	50.1	46.4	40	No
Rec 03		60.3	45.3	49.3	49.0	47.6	40	No
Rec 04		67.2	42.5	57.4	55.2	45.4	40	No
Rec 05		81.1	42.9	59.3	47.9	44.8	40	No
Rec 06		86.2	47.2	59.4	52.3	50.5	40	No
Rec 07		77.2	40.3	51.5	45.9	44.4	40	No
Rec 08		74.7	37.4	49.3	41.8	39.6	40	No

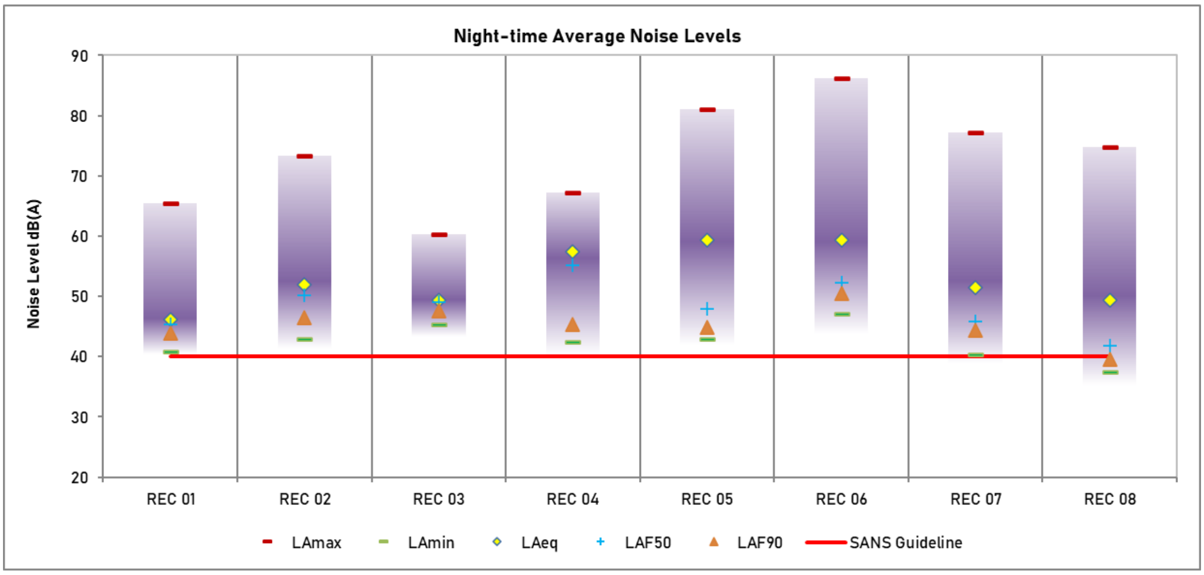

Figure 12: Night-time average (logarithmic) monitored noise levels. L_{Aeq} (yellow diamond) is compared with the SANS guideline.

7.2. PREDICTED NOISE CLIMATE

7.2.1. CONSTRUCTION PHASE

Unlike general industry, construction activities are not always stationary and in one location. Construction activities at the proposed site will include civil works (including surveying), reinforced concrete works, masonry works, façade works, floor works, carpentry works and painting including mechanical, electrical, and plumbing installation works. Due to the erratic and transient nature of such construction activities as well as the fact that detailed construction phase plans have not yet been developed for the proposed Project, noise impacts from the construction phase of the Project could not be quantified.

During the construction phase various noise sources will be present onsite including earth-moving equipment (trucks, cranes, scrapers and loaders), compressors and generators, pumps, rotary drills, concrete mixers and materials handling activities, among others. All of these sources will generate substantial amounts of noise and may impact on neighbouring sensitive receptors. As such, mitigation interventions are advised during the construction phase. These mitigation recommendations are detailed in the section that follows.

7.2.1.1. Mitigation Recommendations

To minimise the acoustic impacts from the construction phase of the proposed Project, various mitigation techniques can be employed. These options include both management and technical options (IFC, 2007):

- Planning construction activities in consultation with local communities so that activities with the greatest potential to generate noise are planned during periods of the day that will result in least disturbance. Information regarding construction activities should be provided to all local nearby communities (Port Durnford, Zini River Estate, Mtunzini, Msasandla, Ongoye, Khandisa, Gobandlovu, Uzimgwenya, Sikhalasenkosi and any other communities/receptors noted to raise concern during the public participation process). Such information includes:
    - Proposed working times.
    - Anticipated duration of activities.
    - Explanations on activities to take place and reasons for activities.
    - Contact details of a responsible person on site should complaints arise.
- When working near a potential sensitive receptor, limit the number of simultaneous activities to a minimum as far as possible.
- Using noise control devices, such as temporary noise barriers and deflectors for high impact activities, and exhaust muffling devices for combustion engines.
- Selecting equipment with the lowest possible sound power levels.
- Ensuring equipment is well-maintained to avoid additional noise generation.

7.2.2. OPERATIONAL PHASE

7.2.2.1. Phase 1

The predicted day-time noise levels at the specified receptor locations associated with the Phase 1 operations are presented in **Table 12**. It is noted that all sources for the Phase 1 operations will be operational for twelve hours a day during a five-day work week, once a month only. As such, only daytime noise predictions are presented here. The predicted noise levels were compared with the current baseline noise levels (monitored) to assess any changes (cumulative impact) and the resultant impacts on the surrounding receptors.

Day-time noise levels at all the receptor locations are predicted to remain the same, with no increases in the current baseline noise levels as a result of the Port Durnford Phase 1 operations. As per the SANS 10103:2008 guidelines, this will result in “little” community/group response.

A visual output of the modelled results for the Phase 1 operations is presented in **Figure 13**. It must be noted that the visual output is associated with the proposed Project alone and is not cumulative (i.e. taking the existing background noise levels into account). Highest noise levels are predicted around the Phase 1 operational area. Noise levels decrease as distance from the sources increase, with levels dropping below the industrial guideline level (70 dB(A)) onsite. Offsite noise levels are below the suburban guideline level of 50 dB(A).

Based on the results presented here, acoustic impacts of the Port Durnford Phase 1 operations are not predicted and noise-related complaints from receptors are not anticipated.

Table 12: Predicted day-time noise levels at specified receptor locations during Phase 1 operations

Receptor	Current Noise Level (dB(A))	Predicted Noise Level (dB(A))	Cumulative Noise Level (dB(A))*	Change (dB(A))	Estimated Community Response**
Rec 01	51.9	13.5	51.9	0.0	Little
Rec 02	38.3	11.3	38.3	0.0	Little
Rec 03	41.3	0.0	41.3	0.0	Little
Rec 04	57.3	0.0	57.3	0.0	Little
Rec 05	52.2	0.0	52.2	0.0	Little
Rec 06	57.1	0.0	57.1	0.0	Little
Rec 07	60.7	0.0	60.7	0.0	Little
Rec 08	57.8	25.1	57.8	0.0	Little

* It is noted that noise levels are logarithmically added due to their logarithmic nature
As per SANS 10103:2008 (see **Table 4)

Figure 13: Predicted noise levels during the Port Durnford Phase 1 operations

7.2.2.2. Phase 2: Scenario 1 (2036 – 2047)

The predicted day-time and night-time noise levels at the specified receptor locations associated with the Phase 2 (Scenario 1) operations are presented in **Table 13** and **Table 14**, respectively. The predicted noise levels were compared with the current baseline noise levels (monitored) to assess any changes (cumulative impact) and the resultant impacts on the surrounding receptors.

Day-time noise levels are predicted to increase slightly from the current baseline noise levels at three of the eight receptor locations. Noise levels are predicted to increase by between 0.1 and 0.9 dB(A) at Rec 02, Rec 03 and Rec 07, resulting in "little" community/group response. It is noted that such increases at these three locations are well below the 7 dB(A) threshold for annoyance as per the Noise Control Regulations. Such increases are also well below the IFC's threshold for annoyance of 3 dB(A).

Night-time noise levels at two of the receptor locations are predicted to increase with the Phase 2 (Scenario 1) operations. Noise levels will increase by 0.8 dB(A) at Rec 07 and by 0.1 dB(A) at Rec 08, resulting in "little" community/group response. It is noted that such increases at these locations are well below the 7 dB(A) threshold for annoyance as per the Noise Control Regulations. Such increases are also well below the IFC's threshold for annoyance of 3 dB(A).

Based on both the day and night-time results presented here, acoustic impacts of the Phase 2 (Scenario 1) operations are not predicted and noise-related complaints from receptors are not anticipated.

Table 13: Predicted day-time noise levels at specified receptor locations during Phase 2 (Scenario 1) operations

Receptor	Current Noise Level (dB(A))	Predicted Noise Level (dB(A))	Cumulative Noise Level (dB(A))*	Change (dB(A))	Estimated Community Response**
Rec 01	51.9	0.0	51.9	0.0	Little
Rec 02	38.3	32.0	39.2	+0.9	Little
Rec 03	41.3	28.3	41.5	+0.2	Little
Rec 04	57.3	26.2	57.3	0.0	Little
Rec 05	52.2	27.4	52.2	0.0	Little
Rec 06	57.1	22.2	57.1	0.0	Little
Rec 07	60.7	44.3	60.8	+0.1	Little
Rec 08	57.8	32.6	57.8	0.0	Little

* It is noted that noise levels are logarithmically added due to their logarithmic nature
As per SANS 10103:2008 (see **Table 4)

Table 14: Predicted night-time noise levels at specified receptor locations during Phase 2 (Scenario 1) operations

Receptor	Current Noise Level (dB(A))	Predicted Noise Level (dB(A))	Cumulative Noise Level (dB(A))*	Change (dB(A))	Estimated Community Response**
Rec 01	46.2	0.0	46.2	0.0	Little
Rec 02	52.0	32.0	52.0	0.0	Little
Rec 03	49.3	28.3	49.3	0.0	Little
Rec 04	57.4	26.2	57.4	0.0	Little
Rec 05	59.3	27.4	59.3	0.0	Little
Rec 06	59.4	22.2	59.4	0.0	Little
Rec 07	51.5	44.3	52.3	+0.8	Little
Rec 08	49.3	32.6	49.4	+0.1	Little

* It is noted that noise levels are logarithmically added due to their logarithmic nature
As per SANS 10103:2008 (see **Table 4)

A visual output of the modelled results for the Phase 2 (Scenario 1) operations is presented in **Figure 14**. It must be noted that the visual output is associated with the proposed Project alone and is not cumulative (i.e. taking the existing background noise levels into account). It is also noted that all sources for the Phase 2 operations will be operational for 24 hours a day, hence the predicted day and night-time noise levels are identical and only one output plot (representing day and night) is presented here.

Highest noise levels are predicted at the PWP and at the active pit where the DTMUs are located. Noise levels decrease as distance from the sources increase, with levels dropping below the industrial guideline level (70 dB(A) (day) and 60 dB(A) (night)) onsite. Offsite noise levels are below the suburban guideline levels of 40 dB(A) (day) and 50 dB(A) (night).

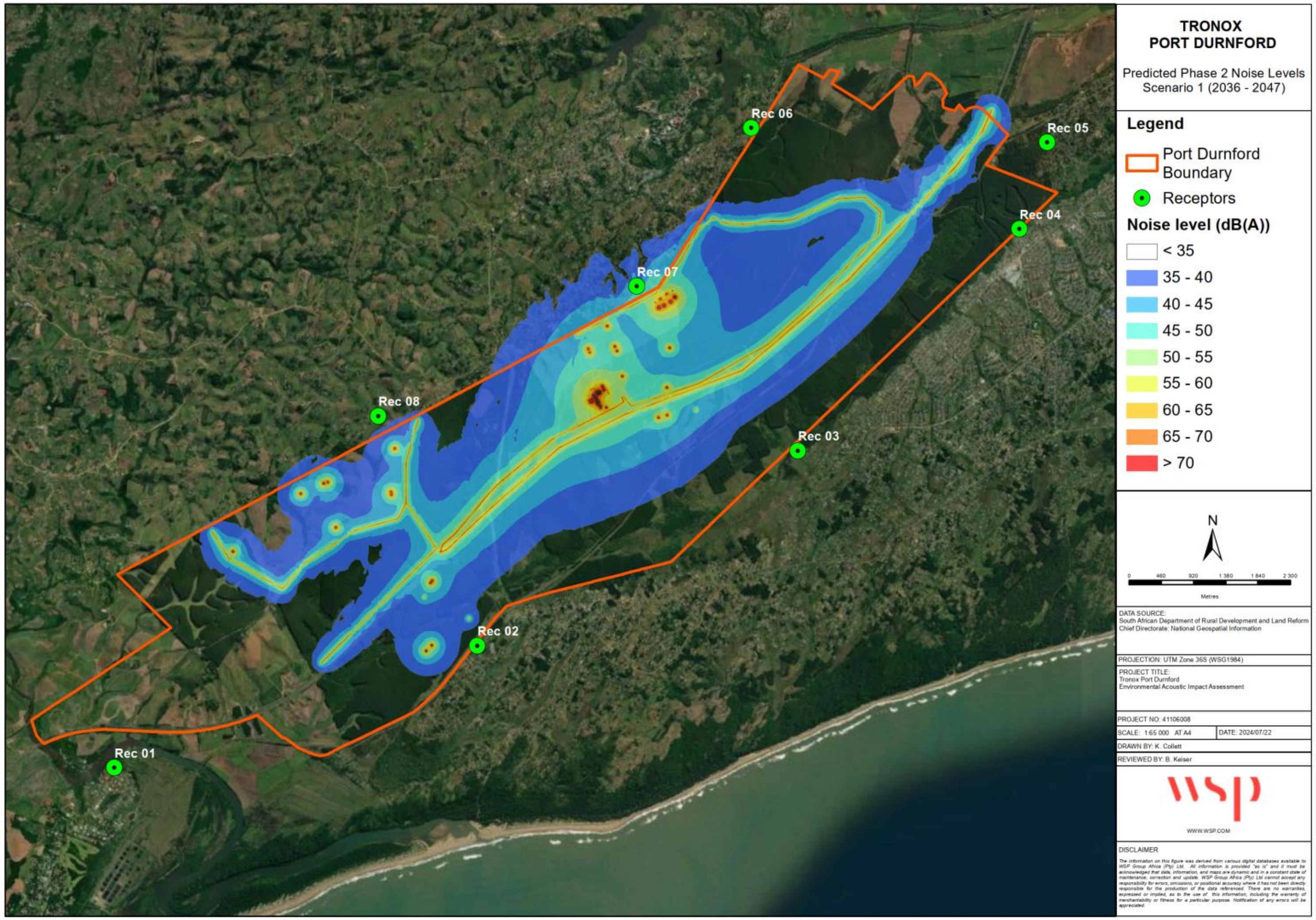

Figure 14: Predicted noise levels during the Port Durnford Phase 2 (Scenario 1) operations

7.2.2.3. Phase 2: Scenario 2 (2048 – 2053)

The predicted day-time and night-time noise levels at the specified receptor locations associated with the Phase 2 (Scenario 2) operations are presented in **Table 15** and **Table 16**, respectively. The predicted noise levels were compared with the current baseline noise levels (monitored) to assess any changes (cumulative impact) and the resultant impacts on the surrounding receptors.

Day-time noise levels are predicted to increase slightly from the current baseline noise levels at two of the eight receptor locations. Noise levels are predicted to increase by 0.3 dB(A) at Rec 02 and 0.2 dB(A) at Rec 03, resulting in “little” community/group response. It is noted that such increases at these two locations are well below the 7 dB(A) threshold for annoyance as per the Noise Control Regulations. Such increases are also well below the IFC’s threshold for annoyance of 3 dB(A).

Night-time noise levels at one of the receptor locations are predicted to increase with the Phase 2 (Scenario 2) operations. Noise levels will increase by 0.2 dB(A) at Rec 07, resulting in “little” community/group response. It is noted that such increases at these locations are well below the 7 dB(A) threshold for annoyance as per the Noise Control Regulations. Such increases are also well below the IFC’s threshold for annoyance of 3 dB(A).

Based on both the day and night-time results presented here, acoustic impacts of the Phase 2 (Scenario 2) operations are not predicted and noise-related complaints from receptors are not anticipated.

Table 15: Predicted day-time noise levels at specified receptor locations during Phase 2 (Scenario 2) operations

Receptor	Current Noise Level (dB(A))	Predicted Noise Level (dB(A))	Cumulative Noise Level (dB(A))*	Change (dB(A))	Estimated Community Response**
Rec 01	51.9	0.0	51.9	0.0	Little
Rec 02	38.3	27.3	38.6	+0.3	Little
Rec 03	41.3	28.3	41.5	+0.2	Little
Rec 04	57.3	26.2	57.3	0.0	Little
Rec 05	52.2	27.4	52.2	0.0	Little
Rec 06	57.1	30.8	57.1	0.0	Little
Rec 07	60.7	37.8	60.7	0.0	Little
Rec 08	57.8	28.5	57.8	0.0	Little

* It is noted that noise levels are logarithmically added due to their logarithmic nature
As per SANS 10103:2008 (see **Table 4)

Table 16: Predicted night-time noise levels at specified receptor locations during Phase 2 (Scenario 2) operations

Receptor	Current Noise Level (dB(A))	Predicted Noise Level (dB(A))	Cumulative Noise Level (dB(A))*	Change (dB(A))	Estimated Community Response**
Rec 01	46.2	0.0	46.2	0.0	Little
Rec 02	52.0	27.3	52.0	0.0	Little
Rec 03	49.3	28.3	49.3	0.0	Little
Rec 04	57.4	26.2	57.4	0.0	Little
Rec 05	59.3	27.4	59.3	0.0	Little
Rec 06	59.4	30.8	59.4	0.0	Little
Rec 07	51.5	37.8	51.7	+0.2	Little
Rec 08	49.3	28.5	49.3	0.0	Little

* It is noted that noise levels are logarithmically added due to their logarithmic nature
As per SANS 10103:2008 (see **Table 4)

A visual output of the modelled results for the Phase 2 (Scenario 2) operations is presented in **Figure 15**. It must be noted that the visual output is associated with the proposed Project alone and is not cumulative (i.e. taking the existing background noise levels into account). It is also noted that all sources for the Phase 2 operations will be operational for 24 hours a day, hence the predicted day and night-time noise levels are identical and only one output plot (representing day and night) is presented here.

Highest noise levels are predicted at the PWP and at the active pit where the DTMUs are located. Noise levels decrease as distance from the sources increase, with levels dropping below the industrial guideline level (70 dB(A) (day) and 60 dB(A) (night)) onsite. Offsite noise levels are below the suburban guideline levels of 40 dB(A) (day) and 50 dB(A) (night).

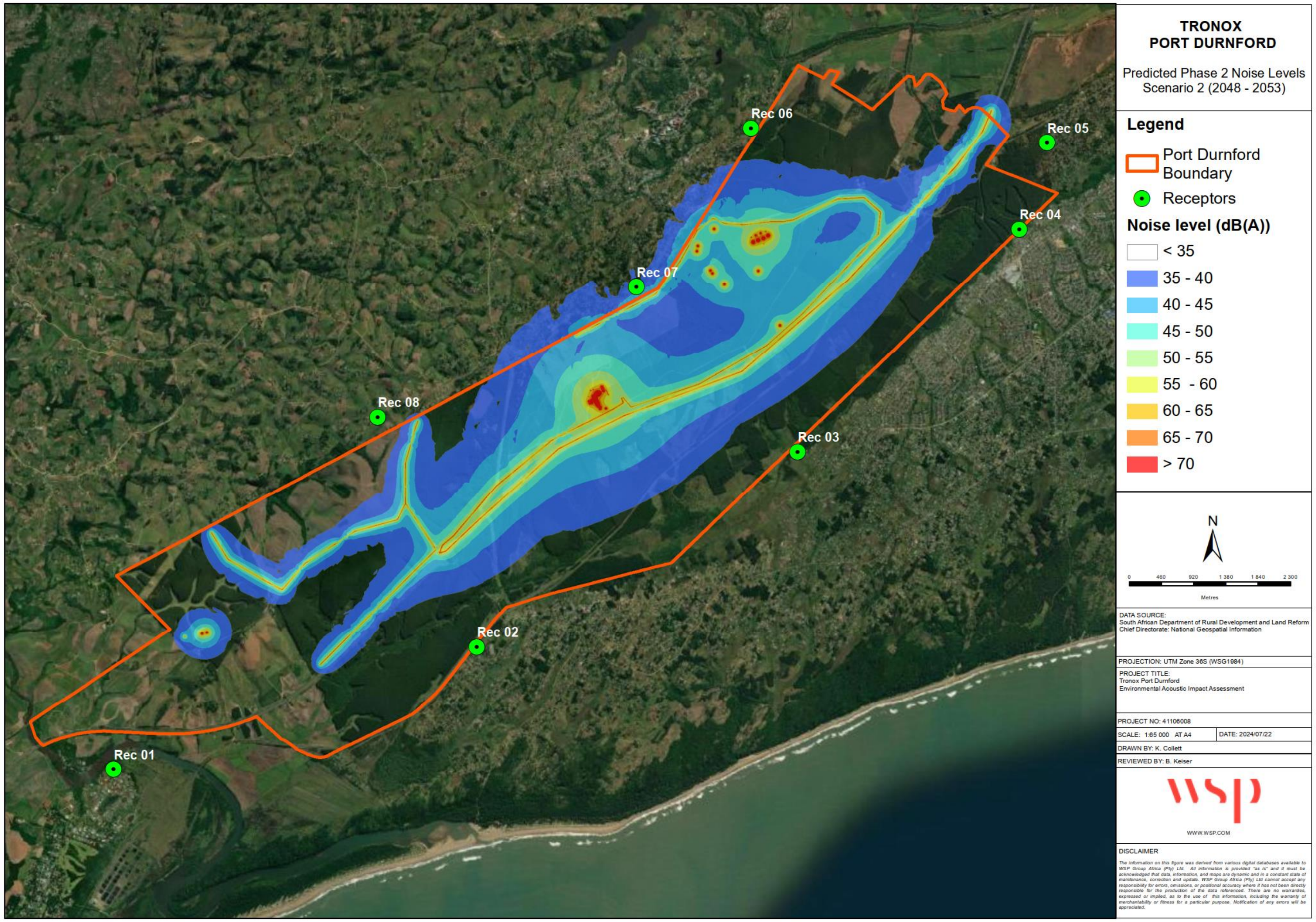

Figure 15: Predicted noise levels during the Port Durnford Phase 2 (Scenario 2) operations

7.2.2.4. Phase 2: Scenario 3 (2054 – 2057)

The predicted day-time and night-time noise levels at the specified receptor locations associated with the Phase 2 (Scenario 3) operations are presented in **Table 17** and **Table 18**, respectively. The predicted noise levels were compared with the current baseline noise levels (monitored) to assess any changes (cumulative impact) and the resultant impacts on the surrounding receptors.

Day-time noise levels are predicted to increase slightly from the current baseline noise levels at two of the eight receptor locations. Noise levels are predicted to increase by 0.8 dB(A) at Rec 02 and by 0.2 dB(A) at Rec 03, resulting in "little" community/group response. It is noted that such increases at these two locations are well below the 7 dB(A) threshold for annoyance as per the Noise Control Regulations. Such increases are also well below the IFC's threshold for annoyance of 3 dB(A).

Night-time noise levels at one of the receptor locations are predicted to increase with the Phase 2 (Scenario 3) operations. Noise levels will increase by 0.1 dB(A) at Rec 07, resulting in "little" community/group response. It is noted that such increases at these locations are well below the 7 dB(A) threshold for annoyance as per the Noise Control Regulations. Such increases are also well below the IFC's threshold for annoyance of 3 dB(A).

Based on both the day and night-time results presented here, acoustic impacts of the Phase 2 (Scenario 3) operations are not predicted and noise-related complaints from receptors are not anticipated.

Table 17: Predicted day-time noise levels at specified receptor locations during Phase 2 (Scenario 3) operations

Receptor	Current Noise Level (dB(A))	Predicted Noise Level (dB(A))	Cumulative Noise Level (dB(A))*	Change (dB(A))	Estimated Community Response**
Rec 01	51.9	0.0	51.9	0.0	Little
Rec 02	38.3	31.4	39.1	+0.8	Little
Rec 03	41.3	28.1	41.5	+0.2	Little
Rec 04	57.3	26.2	57.3	0.0	Little
Rec 05	52.2	27.4	52.2	0.0	Little
Rec 06	57.1	24.7	57.1	0.0	Little
Rec 07	60.7	36.9	60.7	0.0	Little
Rec 08	57.8	28.5	57.8	0.0	Little

* It is noted that noise levels are logarithmically added due to their logarithmic nature
As per SANS 10103:2008 (see **Table 4)

Table 18: Predicted night-time noise levels at specified receptor locations during Phase 2 (Scenario 3) operations

Receptor	Current Noise Level (dB(A))	Predicted Noise Level (dB(A))	Cumulative Noise Level (dB(A))*	Change (dB(A))	Estimated Community Response**
Rec 01	46.2	0.0	46.2	0.0	Little
Rec 02	52.0	31.4	52.0	0.0	Little
Rec 03	49.3	28.1	49.3	0.0	Little
Rec 04	57.4	26.2	57.4	0.0	Little
Rec 05	59.3	27.4	59.3	0.0	Little
Rec 06	59.4	24.7	59.4	0.0	Little
Rec 07	51.5	36.9	51.6	+0.1	Little
Rec 08	49.3	28.5	49.3	0.0	Little

* It is noted that noise levels are logarithmically added due to their logarithmic nature
As per SANS 10103:2008 (see **Table 4)

A visual output of the modelled results for the Phase 2 (Scenario 3) operations is presented in **Figure 16**. It must be noted that the visual output is associated with the proposed Project alone and is not cumulative (i.e. taking the existing background noise levels into account). It is also noted that all sources for the Phase 2 operations will be operational for 24 hours a day, hence the predicted day and night-time noise levels are identical and only one output plot (representing day and night) is presented here.

Highest noise levels are predicted at the PWP and at the active pit where the DTMUs are located. Noise levels decrease as distance from the sources increase, with levels dropping below the industrial guideline level (70 dB(A) (day) and 60 dB(A) (night)) onsite. Offsite noise levels are below the suburban guideline levels of 40 dB(A) (day) and 50 dB(A) (night).

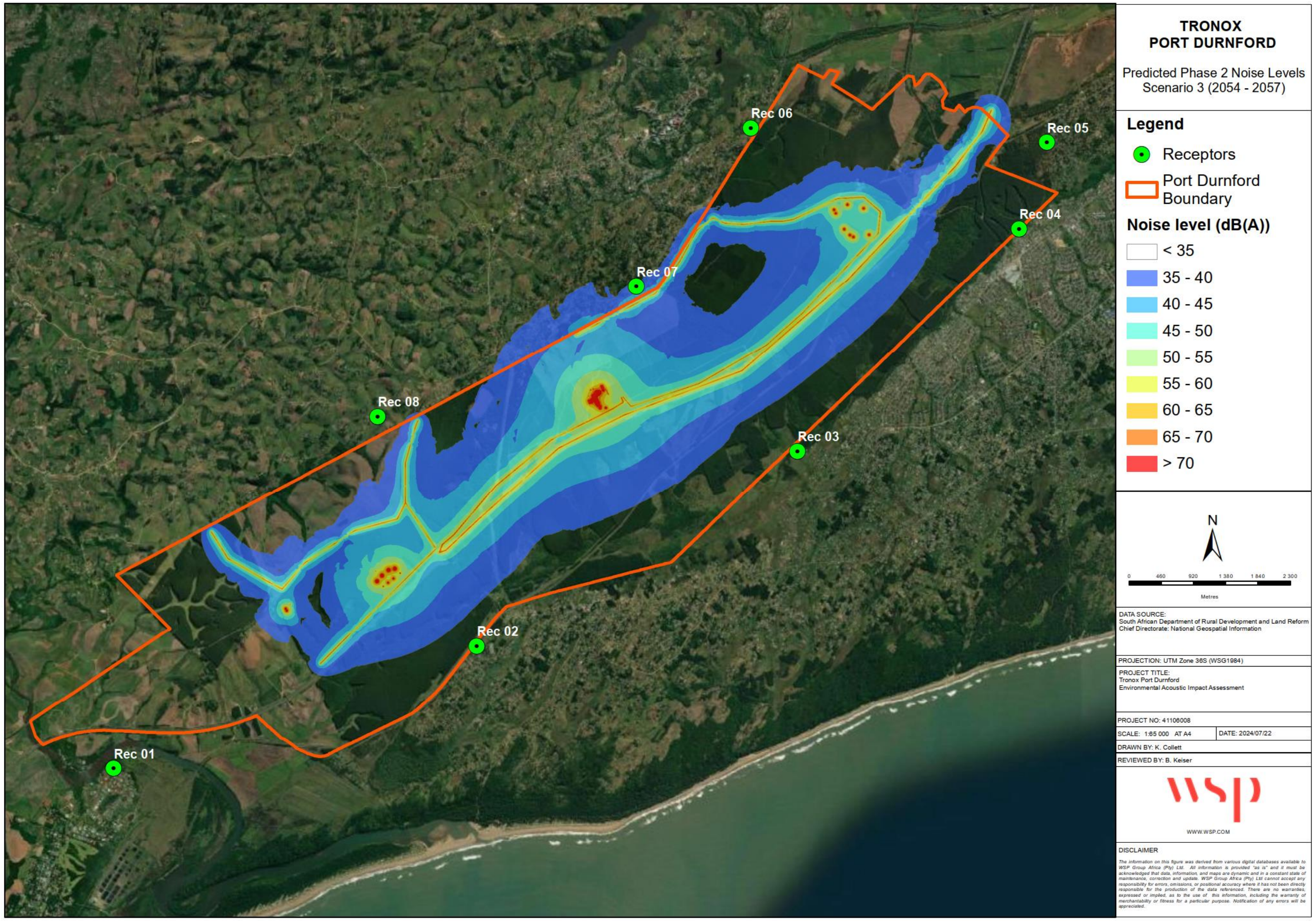

Figure 16: Predicted noise levels during the Port Durnford Phase 2 (Scenario 3) operations

7.2.2.5. Phase 2: Scenario 4 (2058 – 2061)

The predicted day-time and night-time noise levels at the specified receptor locations associated with the Phase 2 (Scenario 4) operations are presented in **Table 19** and **Table 20**, respectively. The predicted noise levels were compared with the current baseline noise levels (monitored) to assess any changes (cumulative impact) and the resultant impacts on the surrounding receptors.

Day-time noise levels are predicted to increase slightly from the current baseline noise levels at three of the eight receptor locations. Noise levels are predicted to increase by between 0.2 and 0.5 dB(A) at Rec 02, Rec 03 and Rec 06, resulting in “little” community/group response. It is noted that such increases at these three locations are well below the 7 dB(A) threshold for annoyance as per the Noise Control Regulations. Such increases are also well below the IFC’s threshold for annoyance of 3 dB(A).

Night-time noise levels at two of the receptor locations are predicted to increase with the Phase 2 (Scenario 4) operations. Noise levels will increase by 0.3 dB(A) at Rec 06 and by 0.1 dB(A) at Rec 07, resulting in “little” community/group response. It is noted that such increases at these locations are well below the 7 dB(A) threshold for annoyance as per the Noise Control Regulations. Such increases are also well below the IFC’s threshold for annoyance of 3 dB(A).

Based on both the day and night-time results presented here, acoustic impacts of the Phase 2 (Scenario 4) operations are not predicted and noise-related complaints from receptors are not anticipated.

Table 19: Predicted day-time noise levels at specified receptor locations during Phase 2 (Scenario 4) operations

Receptor	Current Noise Level (dB(A))	Predicted Noise Level (dB(A))	Cumulative Noise Level (dB(A))*	Change (dB(A))	Estimated Community Response**
Rec 01	51.9	0.0	51.9	0.0	Little
Rec 02	38.3	27.3	38.6	+0.3	Little
Rec 03	41.3	28.1	41.5	+0.2	Little
Rec 04	57.3	26.3	57.3	0.0	Little
Rec 05	52.2	27.4	52.2	0.0	Little
Rec 06	57.1	47.6	57.6	+0.5	Little
Rec 07	60.7	36.9	60.7	0.0	Little
Rec 08	57.8	28.5	57.8	0.0	Little

* It is noted that noise levels are logarithmically added due to their logarithmic nature
As per SANS 10103:2008 (see **Table 4)

Table 20: Predicted night-time noise levels at specified receptor locations during Phase 2 (Scenario 4) operations

Receptor	Current Noise Level (dB(A))	Predicted Noise Level (dB(A))	Cumulative Noise Level (dB(A))*	Change (dB(A))	Estimated Community Response**
Rec 01	46.2	0.00	46.2	0.0	Little
Rec 02	52.0	27.3	52.0	0.0	Little
Rec 03	49.3	28.1	49.3	0.0	Little
Rec 04	57.4	26.3	57.4	0.0	Little
Rec 05	59.3	27.4	59.3	0.0	Little
Rec 06	59.4	47.6	59.7	+0.3	Little
Rec 07	51.5	36.9	51.6	+0.1	Little
Rec 08	49.3	28.5	49.3	0.0	Little

* It is noted that noise levels are logarithmically added due to their logarithmic nature
As per SANS 10103:2008 (see **Table 4)

A visual output of the modelled results for the Phase 2 (Scenario 4) operations is presented in **Figure 17**. It must be noted that the visual output is associated with the proposed Project alone and is not cumulative (i.e. taking the existing background noise levels into account). It is also noted that all sources for the Phase 2 operations will be operational for 24 hours a day, hence the predicted day and night-time noise levels are identical and only one output plot (representing day and night) is presented here.

Highest noise levels are predicted at the PWP and at the active pit where the DTMUs are located. Noise levels decrease as distance from the sources increase, with levels dropping below the industrial guideline level (70 dB(A) (day) and 60 dB(A) (night)) onsite. Offsite noise levels are below the suburban guideline levels of 40 dB(A) (day) and 50 dB(A) (night).

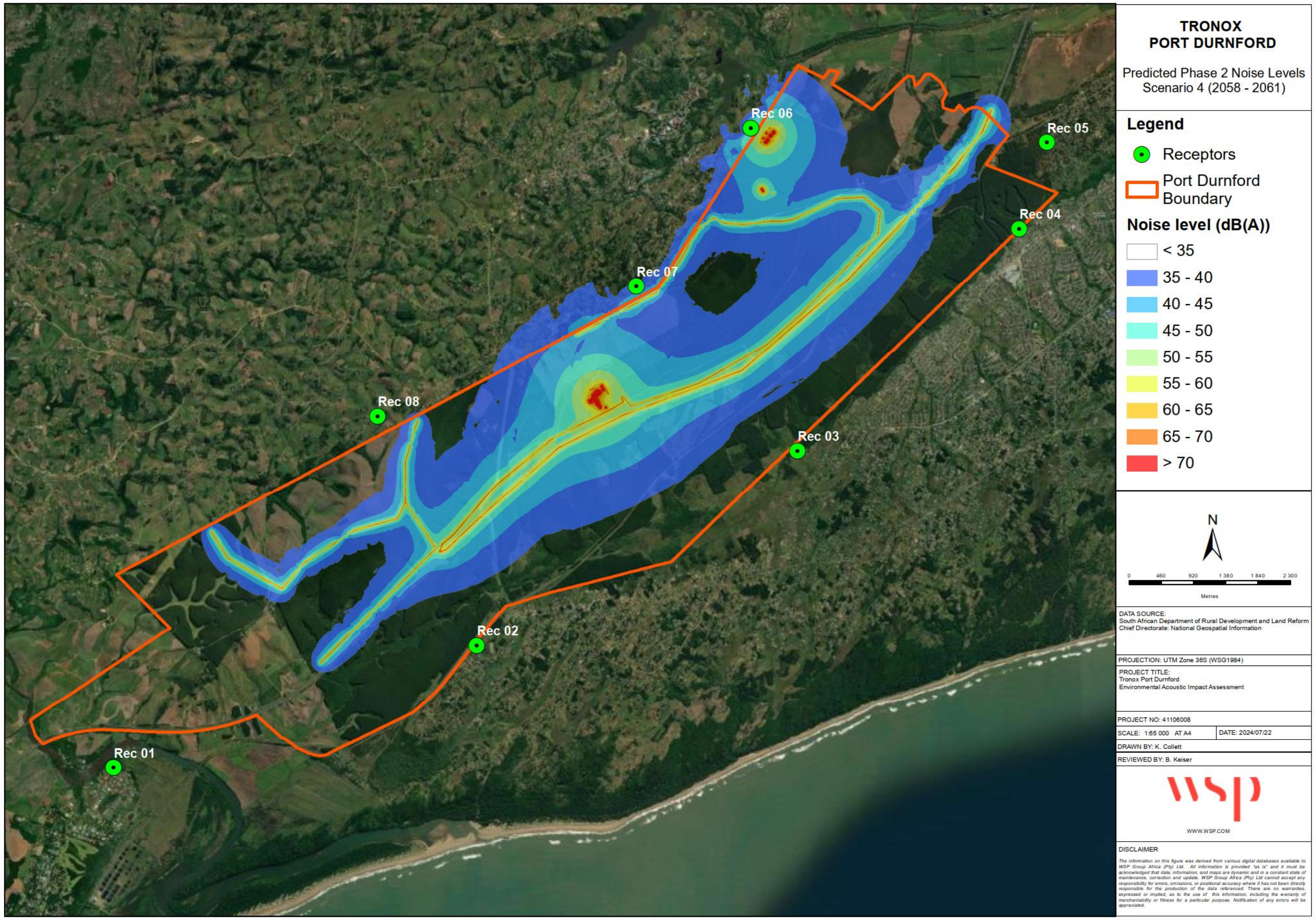

Figure 17: Predicted noise levels during the Port Durnford Phase 2 (Scenario 4) operations

7.2.2.6. Phase 2: Scenario 5 (2062 – 2069)

The predicted day-time and night-time noise levels at the specified receptor locations associated with the Phase 2 (Scenario 5) operations are presented in **Table 21** and **Table 22**, respectively. The predicted noise levels were compared with the current baseline noise levels (monitored) to assess any changes (cumulative impact) and the resultant impacts on the surrounding receptors.

Day-time noise levels are predicted to increase slightly from the current baseline noise levels at three of the eight receptor locations. Noise levels are predicted to increase by between 0.1 and 0.3 dB(A) at Rec 02, Rec 03 and Rec 08, resulting in “little” community/group response. It is noted that such increases at these three locations are well below the 7 dB(A) threshold for annoyance as per the Noise Control Regulations. Such increases are also well below the IFC’s threshold for annoyance of 3 dB(A).

Night-time noise levels at two of the receptor locations are predicted to increase with the Phase 2 (Scenario 5) operations. Noise levels will increase by 0.1 dB(A) at Rec 07 and by 0.4 dB(A) at Rec 08, resulting in “little” community/group response. It is noted that such increases at these locations are well below the 7 dB(A) threshold for annoyance as per the Noise Control Regulations. Such increases are also well below the IFC’s threshold for annoyance of 3 dB(A).

Based on both the day and night-time results presented here, acoustic impacts of the Phase 2 (Scenario 5) operations are not predicted and noise-related complaints from receptors are not anticipated.

Table 21: Predicted day-time noise levels at specified receptor locations during Phase 2 (Scenario 5) operations

Receptor	Current Noise Level (dB(A))	Predicted Noise Level (dB(A))	Cumulative Noise Level (dB(A))*	Change (dB(A))	Estimated Community Response**
Rec 01	51.9	0.0	51.9	0.0	Little
Rec 02	38.3	27.3	38.6	+0.3	Little
Rec 03	41.3	28.1	41.5	+0.2	Little
Rec 04	57.3	26.3	57.3	0.0	Little
Rec 05	52.2	27.4	52.2	0.0	Little
Rec 06	57.1	22.2	57.1	0.0	Little
Rec 07	60.7	36.9	60.7	0.0	Little
Rec 08	57.8	39.0	57.9	+0.1	Little

* It is noted that noise levels are logarithmically added due to their logarithmic nature
As per SANS 10103:2008 (see **Table 4)

Table 22: Predicted night-time noise levels at specified receptor locations during Phase 2 (Scenario 5) operations

Receptor	Current Noise Level (dB(A))	Predicted Noise Level (dB(A))	Cumulative Noise Level (dB(A))*	Change (dB(A))	Estimated Community Response**
Rec 01	46.2	0.0	46.2	0.0	Little
Rec 02	52.0	27.3	52.0	0.0	Little
Rec 03	49.3	28.1	49.3	0.0	Little
Rec 04	57.4	26.3	57.4	0.0	Little
Rec 05	59.3	27.4	59.3	0.0	Little
Rec 06	59.4	22.2	59.4	0.0	Little
Rec 07	51.5	36.9	51.6	+0.1	Little
Rec 08	49.3	39.0	49.7	+0.4	Little

* It is noted that noise levels are logarithmically added due to their logarithmic nature
As per SANS 10103:2008 (see **Table 4)

A visual output of the modelled results for the Phase 2 (Scenario 5) operations is presented in **Figure 18**. It must be noted that the visual output is associated with the proposed Project alone and is not cumulative (i.e. taking the existing background noise levels into account). It is also noted that all sources for the Phase 2 operations will be operational for 24 hours a day, hence the predicted day and night-time noise levels are identical and only one output plot (representing day and night) is presented here.

Highest noise levels are predicted at the PWP and at the active pit where the DTMUs are located. Noise levels decrease as distance from the sources increase, with levels dropping below the industrial guideline level (70 dB(A) (day) and 60 dB(A) (night)) onsite. Offsite noise levels are below the suburban guideline levels of 40 dB(A) (day) and 50 dB(A) (night).

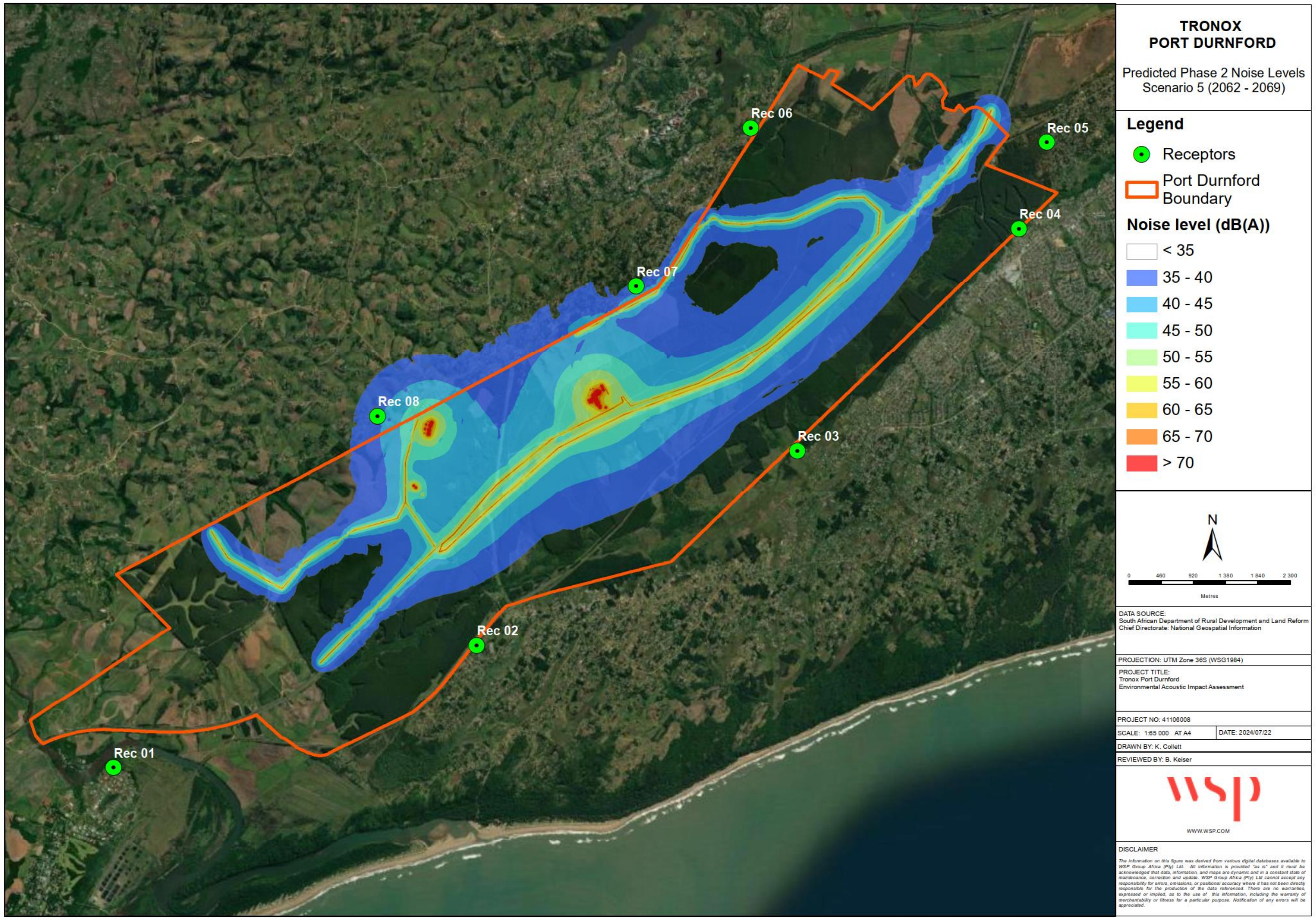

Figure 18: Predicted noise levels during the Port Durnford Phase 2 (Scenario 5) operations

7.2.2.7. Mitigation recommendations

Given the minimal impact of the operation of the proposed Port Durnford Mine on the surrounding noise climate, mitigation interventions are not required. However, should Tronox want to improve the overall noise climate onsite or further ensure that noise does not become an issue offsite, the following mitigation options can be employed (IFC, 2007):

- Ensuring equipment with the lowest sound power level specifications are selected for the Project.
- Installing suitable mufflers on engine exhausts and compressor components.
- Installing acoustic enclosures for equipment causing radiating noise.
- Locating noise sources in less sensitive areas to take advantage of distance and shielding. Such is the case with the locations of the DTMUs, which will change as the LOM progresses. The DTMUs are considered the most impactful noise sources due to their high sound power level specifications as well as their transient locations in closest proximity to sensitive receptors.
- Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective.
- Developing a mechanism to record and respond to complaints.

It is understood that Tronox plan to implement 100 m wide eucalyptus tree buffers on the outer area of the mining operations. This will ultimately attenuate noise from the site and further decrease the impact on nearby receptors.

It is also recommended that one round of environmental noise monitoring is conducted after commissioning of Phase 2 operations to confirm noise levels in the surrounding communities and identify the need for additional mitigation or additional monitoring campaigns. If elevated noise levels are detected then further monitoring campaigns will need to be considered.

7.2.3. DECOMMISSIONING PHASE

Since similar equipment used during the construction phase will be utilised during the decommissioning phase, the same impacts and mitigation recommendations provided for the construction phase are applicable to the decommissioning phase.

8. ASSESSMENT OF IMPACTS

The purpose of this Environmental Acoustic Impact Assessment is to identify the potential impacts and associated risks posed by the operation of the proposed Port Durnford Project on the noise climate of the area. The outcomes of the impact assessment will provide a basis to identify the key risk drivers and make informed decisions on the way forward in order to ensure that these risks do not result in unacceptable social or environmental risk.

All impacts of the operation of the proposed Project were evaluated using a risk matrix, which is a semi-quantitative risk assessment methodology. This system derives an environmental impact level on the basis of the nature, significance, consequence, extent, reversibility, duration and probability of occurrence. The overall risk level is determined using professional judgement based on a clear understanding of the nature of the impact, potential mitigatory measures that can be implemented and changes in risk profile as a result of implementation of these mitigatory measures. A full description of the risk rating methodology is presented in **Appendix B**. Key localised acoustic impacts associated with the project include:

- Construction phase impacts of noise on sensitive receptors.
- Phase 1 operational impacts of noise on sensitive receptors.
- Phase 2 operational impacts of noise on sensitive receptors.
- Decommissioning phase impacts of noise on sensitive receptors.

Outcomes of the Environmental Acoustic Impact Assessment are contained within **Table 23** outlining the impact of each parameter and the resulting risk level.

Table 23: Impact assessment of risks associated with the Port Durnford Project

Activity	Potential Impact	Aspects Affected	Phase in which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Physical Extent	Probability	Reversibility	Significance	Significance without Mitigation	Magnitude	Duration	Physical Extent	Probability	Reversibility	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Standards to be Achieved
Construction activities	Noise impact on surrounding sensitive receptors	Ambient noise climate	Construction Phase	Onsite	1	1	1	2	1	**8**	Low	1	1	1	1	1	**4**	Low	- Planning construction activities in consultation with local communities. - When working near a potential sensitive receptor, limit the number of simultaneous activities to a minimum as far as possible. - Using noise control devices, such as temporary noise barriers and deflectors for high impact activities, and exhaust muffling devices for combustion engines. - Selecting equipment with the lowest possible sound power levels. - Ensuring equipment is well-maintained to avoid additional noise generation.	Minimise and control through impact management.	Compliance with SANS guidelines at receptors, however, monitoring is not required due to the distance of receptors from the site.

Activity	Potential Impact	Aspects Affected	Phase in which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Physical Extent	Probability	Reversibility	Significance	Significance without Mitigation	Magnitude	Duration	Physical Extent	Probability	Reversibility	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Standards to be Achieved
Phase 1 Operational Activities	Noise impact on surrounding sensitive receptors	Ambient noise climate	Operational Phase	Onsite	1	1	1	2	1	**8**	**Low**	1	1	1	1	1	**4**	**Low**	- Ensuring equipment with the lowest sound power level specifications are selected for the Project. - Installing suitable mufflers on engine exhausts and compressor components. - Installing acoustic enclosures for equipment causing radiating noise. - Locating noise sources in less sensitive areas to take advantage of distance and shielding. - Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective. - Developing a mechanism to record and respond to complaints.	Minimise and control through impact management.	Compliance with SANS guidelines at receptors, however, monitoring is not required due to the distance of receptors from the site and the fact that the predicted impacts will be negligible.

Activity	Potential Impact	Aspects Affected	Phase in which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Physical Extent	Probability	Reversibility	Significance	Significance without Mitigation	Magnitude	Duration	Physical Extent	Probability	Reversibility	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Standards to be Achieved
Phase 2 Operational Activities	Noise impact on surrounding sensitive receptors	Ambient noise climate	Operational Phase	Onsite	2	4	2	2	1	**18**	**Low**	1	4	2	1	1	**8**	**Low**	- Ensuring equipment with the lowest sound power level specifications are selected for the Project. - Installing suitable mufflers on engine exhausts and compressor components. - Installing acoustic enclosures for equipment causing radiating noise. - Locating noise sources in less sensitive areas to take advantage of distance and shielding. - Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective. - Developing a mechanism to record and respond to complaints.	Minimise and control through impact management.	Compliance with SANS guidelines at receptors. Monitoring should be undertaken during the commissioning of Phase 2 operations.

Activity	Potential Impact	Aspects Affected	Phase in which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Physical Extent	Probability	Reversibility	Significance	Significance without Mitigation	Magnitude	Duration	Physical Extent	Probability	Reversibility	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Standards to be Achieved
Decommissioning Activities	Noise impact on surrounding sensitive receptors	Ambient noise climate	Decommissioning Phase	Onsite	1	1	1	2	1	**8**	**Low**	1	1	1	1	1	**4**	**Low**	- Planning decommissioning activities in consultation with local communities. - When working near a potential sensitive receptor, limit the number of simultaneous activities to a minimum as far as possible. - Using noise control devices, such as temporary noise barriers and deflectors for high impact activities, and exhaust muffling devices for combustion engines. - Selecting equipment with the lowest possible sound power levels. - Ensuring equipment is well-maintained to avoid additional noise generation.	Minimise and control through impact management.	Compliance with SANS guidelines at receptors, however, monitoring is not required due to the distance of receptors from the site.

9. CONCLUSIONS

This Environmental Acoustic Impact Assessment investigated noise associated with the proposed Port Durnford Mining Project. To assess the existing noise climate in the area surrounding the proposed Project, ambient noise monitoring was conducted at eight receptor locations surrounding the site. An acoustic inventory was developed to identify all potential sources of noise associated with the proposed Project. The acoustic impacts of the operation of the proposed Project during both Phase 1 (100 tph operations) and Phase 2 (3,000 tph operations) were then assessed using the CadnaA acoustic model. It is noted due to the erratic and transient nature of the construction and decommissioning phases, a quantitative assessment of acoustic impacts was not undertaken, but rather a qualitative discussion thereof.

Baseline monitoring indicated current day-time noise levels were below the suburban guideline rating level of 50 dB(A) at two of the eight receptor monitoring locations. At night, average noise levels at all of the eight monitoring locations exceeded the suburban guideline rating level of 40 dB(A). From the day-time and night-time monitoring campaigns it is evident that the current noise climate surrounding the site is predominantly traffic-related, with influences from natural sources like birds and insects.

For the operational phase acoustic modelling, six scenarios were considered (operational years indicated in brackets):

- Phase 1 (100 tph) Operations (2025 – 2036)
- Phase 2 (3,000 tph) Operations (2036 – 2047)
- Phase 2 (3,000 tph) Operations (2048 – 2053)
- Phase 2 (3,000 tph) Operations (2054 – 2057)
- Phase 2 (3,000 tph) Operations (2058 – 2061)
- Phase 2 (3,000 tph) Operations (2062 – 2069)

It is noted that all sources for the Phase 1 operations will be operational for twelve hours a day during a five-day work week, once a month only. As such, only daytime noise predictions were assessed. For Phase 2, operations will be 24 hours a day, hence the predicted day and night-time noise levels were identical.

For Phase 1, day-time noise levels at all the receptor locations are predicted to remain the same, with no increases in the current baseline noise levels as a result of the Port Durnford Phase 1 operations. As per the SANS 10103:2008 guidelines, this will result in “little” community/group response. Highest noise levels are predicted around the Phase 1 operational area. Noise levels decrease as distance from the sources increase, with levels dropping below the industrial guideline level (70 dB(A)) onsite. Offsite noise levels are below the suburban guideline level of 50 dB(A). Based on these results, acoustic impacts of the

Port Durnford Phase 1 operations are not predicted and noise-related complaints from receptors are not anticipated.

For Phase 2 (all scenarios), current day-time noise levels (monitored) at three receptor locations are predicted to increase by between 0.1 and 0.9 dB(A) with the introduction of the Phase 2 mining operations. Noise levels at all other receptors are predicted to remain the same. It is noted that such increases at these three locations are well below the 7 dB(A) threshold for annoyance as per the Noise Control Regulations. Such increases are also well below the IFC threshold for annoyance of 3 dB(A).

For Phase 2 (all scenarios), current night-time noise levels (monitored) at two receptor locations are predicted to increase by between 0.1 and 0.8 dB(A) with the introduction of the Phase 2 mining operations. Noise levels at all other receptors are predicted to remain the same. It is noted that such increases at these locations are well below the 7 dB(A) threshold for annoyance as per the Noise Control Regulations. Such increases are also well below the IFC's threshold for annoyance of 3 dB(A).

The highest noise levels are predicted at the PWP and at the active pit where the DTMUs will be located. Noise levels decrease as distance from the sources increase, with levels dropping below the industrial guideline level (70 dB(A) (day) and 60 dB(A) (night)) onsite.

Based on both the day and night-time results, acoustic impacts of the Phase 2 operations are not predicted and noise-related complaints from receptors are not anticipated. As such, mitigation options are not deemed compulsory, but various mitigation recommendations are provided in this report, should the need arise. It is, however, recommended that one round of environmental noise monitoring is conducted after commissioning of Phase 2 operations to confirm noise levels in the surrounding communities and identify the need for additional mitigation or additional monitoring campaigns. If elevated noise levels are detected then further monitoring campaigns will need to be considered.

All impacts of the proposed Project were evaluated using a risk matrix, which is a semi-quantitative risk assessment methodology. This system derives an environmental impact level on the basis of the nature, significance, consequence, extent, reversibility, duration and probability of occurrence. Based on the results of this Environmental Acoustic Impact Assessment, the significance of noise-related impacts are rated as "low" for the construction, operational and decommissioning phases of the Project. *From an environmental noise perspective, it is therefore advised that the Port Durnford Project be authorised.*

10. REFERENCES

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Appendix A

CURRICULUM VITAE

Kirsten Collett

Earth & Environment, Air Quality & Acoustics – Environment & Energy, Associate

CAREER SUMMARY

Kirsten is an Associate Air Quality and Acoustic Consultant with a Master of Science (Atmospheric Sciences) degree obtained from the University of the Witwatersrand. She is currently employed at the Johannesburg branch of WSP and has worked on various air quality and acoustic impact assessments; air quality management plans; air quality and acoustic monitoring projects; and air quality and acoustic modelling projects for a variety of clients over the past twelve years. She has provided consulting support to various client industries including petrochemical, mining, metallurgical, manufacturing and local government bodies, among others. She is also a registered Professional Natural Scientist (Pr.Nat.Sci.) with the South African Council for Natural Scientific Professions (SACNASP).

Countries of work experience gained include South Africa, Botswana, Mozambique, Madagascar, Somalia, Ethiopia, Serbia, Qatar and Kuwait.

12 years with WSP

14 years of experience

Area of Expertise

Air Quality Impact Assessments

Environmental Acoustic Impact Assessments

Air Quality Management

Ambient Air Quality and Acoustic Monitoring

Language

English – Fluent

EDUCATION

Master of Science, Atmospheric Sciences, University of Witwatersrand, Johannesburg, South Africa	2009
Bachelor of Science (Honours) Geography and Environmental Studies, University of the Witwatersrand, Johannesburg, South Africa	2006
Bachelor of Science, Geography and Environmental Studies, University of Witwatersrand, Johannesburg, South Africa	2005

ADDITIONAL TRAINING

CadnaA - Acoustics Training	2022
Snake Awareness Training	2016
Business-focussed Project Management	2013

PROFESSIONAL REGISTRATIONS

SACNASP – South African Council for Natural Scientific Professions – Registration No. 115870	2016

ORGANIZATION MEMBERSHIPS

SASAS – South African Society for Atmospheric Sciences	2022
NACA – National Association for Clean Air	2016

Kirsten Collett

Earth & Environment, Air Quality & Acoustics – Environment & Energy, Associate

PROFESSIONAL HISTORY

WSP Group Africa (Pty) Ltd	September 2011 – present
Climatology Research Group (University of the Witwatersrand)	January 2009 – April 2011

PROFESSIONAL EXPERIENCE

Acoustics

National Petroleum Refiners of South Africa (Pty) Ltd, Environmental Acoustic Impact Assessment for the Hybrid Clean Fuels II Project, Sasolburg, Free State, South Africa
2023
Project Manager and Lead Consultant
WSP was appointed to undertake an environmental acoustic impact assessment for the proposed Hybrid CFII upgrade project at the refinery. Kirsten was responsible for conducting the assessment which included a baseline assessment; development of a comprehensive acoustic inventory; and determination of the impact of the proposed project on the surrounding sensitive receptors using the Computer Aided Noise Abatement (CadnaA) acoustic modelling software.

Tronox Mineral Sands (Pty) Ltd, Environmental Acoustic Compliance Statement for a Mining Expansion, Mtunzini, KwaZulu-Natal, South Africa
2023
Project Manager and Lead Consultant
WSP was appointed to undertake a desktop review of a proposed expansion to an existing mineral sands mining operation and provide a noise compliance statement in order to confirm that noise from the proposed expansion was a non-issue. Kirsten was responsible for conducting the assessment and compiling the noise compliance statement.

Red Rocket South Africa, Environmental Acoustic Compliance Statement for two Solar PV Facilities, Thuthukani, Mpumalanga, South Africa
2023
Project Manager and Lead Consultant
WSP was appointed to undertake a desktop review of two proposed solar PV facilities and provide a noise compliance statement in order to confirm that noise from the facilities was a non-issue. Kirsten was responsible for conducting the assessments and compiling the noise compliance statements.

ENERTRAG South Africa, Environmental Acoustic Screening Assessment for two Proposed Wind Energy Facilities, Belfast, Mpumalanga, South Africa
2022 – 2023
Project Manager and Lead Consultant
WSP was appointed to undertake an environmental acoustic screening assessment for two proposed wind energy facilities near Belfast in Mpumalanga. Kirsten was responsible for conducting the assessments which determined the potential acoustic impacts of the proposed projects based on the methodology prescribed by the International Finance Corporation Environmental Health and Safety (IFC EHS) Guidelines.

ENERTRAG South Africa, Environmental Acoustic Screening Assessment for two Proposed Wind Energy Facilities, Camden, Mpumalanga, South Africa
2021 – 2022
Project Manager and Lead Consultant
WSP was appointed to undertake an environmental acoustic screening assessment for two proposed wind energy facilities near Camden in Mpumalanga. Kirsten was responsible for conducting the assessments which

determined the potential acoustic impacts of the proposed projects based on the methodology prescribed by the International Finance Corporation Environmental Health and Safety (IFC EHS) Guidelines.

ENERTRAG South Africa, Environmental Acoustic Impact Assessment for a Proposed Green Hydrogen and Ammonia Facility, Camden, Mpumalanga, South Africa
2021 – 2022
Project Manager and Lead Consultant
WSP was appointed to undertake an environmental acoustic Impact assessment for the proposed Camden I Green Hydrogen and Ammonia Facility. Kirsten was responsible for conducting the assessment which included a baseline assessment; development of a comprehensive acoustic inventory; and determination of the impact of the proposed project on the surrounding sensitive receptors using attenuation-over-distance acoustic calculations.

Crossboundary Energy, Environmental Acoustic Screening Assessment for a Proposed Wind Energy Facility, Port Dauphine, Madagascar
2021 – 2022
Project Manager and Lead Consultant
WSP was appointed to undertake an environmental acoustic screening assessment for a proposed wind energy facility in Madagascar. Kirsten was responsible for conducting the assessment which determined the potential acoustic impacts of the proposed project based on the methodology prescribed by the International Finance Corporation Environmental Health and Safety (IFC EHS) Guidelines.

DP World, Environmental Acoustic Impact Assessment for the Port of Berbera Phase 2 Expansion, Somaliland, Somalia
2021 – 2022
Project Manager and Lead Consultant
WSP was appointed to undertake an environmental acoustic impact assessment for the proposed Phase 2 expansion to the Port of Berbera. An acoustic inventory was developed to identify all potential sources of noise associated with the construction and operational phases of the Phase 2 expansion project. The construction phase impacts were assessed through attenuation-over-distance acoustic calculations, whilst acoustic impacts of the proposed port operations were assessed using the Computer Aided Noise Abatement (CadnaA) acoustic model.

Loci Environmental, Environmental Acoustic Impact Assessment for a Proposed Manganese Mine, Kanye, Botswana
2021 – 2022
Project Manager and Lead Consultant
WSP was appointed to undertake an environmental acoustic impact assessment for a proposed manganese mine in Botswana. Kirsten was responsible for conducting the assessment which included a baseline assessment; development of a comprehensive acoustic inventory; and determination of the impact of the proposed project on the surrounding sensitive receptors using the Computer Aided Noise Abatement (CadnaA) acoustic modelling software.

Die Oesterreichische Entwicklungsbank Ag And Metito Utilities Ltd, Environmental Acoustic Impact Assessment for a Proposed Wastewater Treatment Plant, Zrenjanin, Serbia
2021
Project Manager and Lead Consultant
WSP was appointed to undertake an environmental acoustic impact assessment for the development of a proposed wastewater treatment plant (WWTP). To assess the existing noise climate in the area surrounding the proposed site, ambient noise monitoring was conducted at four receptor locations. An acoustic inventory was developed to identify all potential sources of noise associated with the construction and operational phases of the WWTP. The acoustic impacts of the operation of the proposed WWTP were then assessed using the Computer Aided Noise Abatement (CadnaA) acoustic model, while construction phase impacts were assessed through attenuation-over-distance acoustic calculations.

DNG Energy Ltd, Environmental Acoustic Impact Assessment for a Proposed Gas to Power Project, Komatipoort, Mpumalanga, South Africa
2021
Project Manager and Lead Consultant
WSP was appointed to undertake an environmental acoustic impact assessment for the development of the proposed Khensani Gas to Power Project. To assess the existing noise climate in the area surrounding the proposed site, ambient noise monitoring was conducted at five receptor locations. An acoustic inventory was developed to identify all potential sources of noise associated with the operational phase of the project. The acoustic impacts of the operation of the proposed facility during both an unmitigated and mitigated scenario were then assessed using the Computer Aided Noise Abatement (CadnaA) acoustic model.

Platinum Cement Industries, Environmental Acoustic Impact Assessment for a Proposed Cement Grinding Processing Facility, Umbogintwini, KwaZulu-Natal, South Africa
2020 – 2021
Project Manager and Lead Consultant
WSP was appointed to conduct a screening-level environmental acoustic impact assessment for a proposed cement grinding processing facility. Kirsten was responsible for conducting the assessment which included a baseline assessment; development of a comprehensive acoustic inventory; and determination of the impact of the proposed project on the surrounding sensitive receptors using attenuation-over-distance acoustic calculations.

AngloGold Ashanti, Environmental Acoustic Impact Assessment for the Expansion to a Tailings Storage Facility, Northwest, South Africa
2017 – 2020
Project Manager and Lead Consultant
WSP was appointed to undertake an environmental acoustic impact assessment for the proposed extension of the Kareerand Tailings Storage Facility. Kirsten was responsible for conducting the assessment which included baseline acoustic monitoring; development of a comprehensive acoustic inventory for both the construction and operational phases of the project; and determination of the impact of the proposed project on the surrounding sensitive receptors using the Computer Aided Noise Abatement (CadnaA) acoustic modelling software.

BioTherm Energy, Environmental Acoustic Impact Assessment for three Wind Energy Facilities, Northern and Western Cape, South Africa
2016 – 2019 and 2021 – 2022
Project Manager and Lead Consultant
WSP was appointed to undertake an environmental acoustic impact assessment for three proposed wind energy facilities located between Sutherland and Matjiesfontein in the Northern and Western Cape provinces. Kirsten was responsible for conducting the assessments which included baseline acoustic monitoring; development of a comprehensive acoustic inventory for both the construction and operational phases of the project; and determination of the impact of the proposed wind energy facilities on the surrounding sensitive receptors (farmhouses) using the Computer Aided Noise Abatement (CadnaA) acoustic modelling software. Various updates and expansions to the above-mentioned projects were then further assessed during 2021/2022.

Sappi Southern Africa Limited, Environmental Acoustic Impact Assessment for the proposed Expansion to a Paper Mill, KwaZulu-Natal, South Africa
2018
Project Manager and Lead Consultant
WSP was appointed to undertake an environmental acoustic impact assessment for the proposed expansion to the Sappi Saiccor Mill, near Umkomaas. Kirsten was responsible for conducting the assessment which included baseline acoustic monitoring; development of a comprehensive acoustic inventory for the proposed expansion activities; and determination of the impact of the proposed expansion on the surrounding sensitive receptors through the use of attenuation-over-distance acoustic calculations.

Sappi Southern Africa Limited, Environmental Acoustic Impact Assessment for a Proposed Timber Handling Facility, Umkomaas, KwaZulu-Natal, South Africa
2017
Project Manager and Lead Consultant
WSP was appointed to undertake an environmental acoustic impact assessment for a proposed timber handling facility near Umkomaas. Kirsten was responsible for conducting the assessment which included

baseline acoustic monitoring; development of a comprehensive acoustic inventory; and determination of the impact of the proposed facility on the surrounding sensitive receptors (specifically, a newly proposed retirement village) using the Computer Aided Noise Abatement (CadnaA) acoustic modelling software.

Loci Environmental, Environmental Acoustic Impact Assessment for the Proposed Rehabilitation of the Sekoma-Morwamosu Road Section, Botswana
2017
Project Manager and Lead Consultant
WSP was appointed to undertake an environmental acoustic impact assessment for the proposed rehabilitation of a section of road within the southern part of Botswana. Kirsten was responsible for conducting the assessment. Current operational noise levels in the vicinity of the road section were determined using an acoustic modelling platform, with current (2017) traffic count data as input. The acoustic impacts of the proposed rehabilitation were determined using attenuation-over-distance calculations (construction phase) and acoustic modelling (operational phase). Changes in noise levels at specific receptor locations were then assessed for each phase and the resultant community responses were evaluated.

City of Cape Town, Environmental Acoustic Impact Assessment for the Redevelopment of the Athlone Power Station, Cape Town, Western Cape, South Africa
2016 – 2017
Lead Consultant
WSP was contracted to undertake an environmental acoustic impact assessment for redevelopment of the Athlone Power Station site to determine the noise impacts of a) the surrounding activities on the redevelopment site; and b) the proposed site activities on the surrounding communities. Kirsten was responsible for conducting the assessment which included baseline acoustic monitoring; development of a comprehensive noise source inventory; and determination of the impact of the current noise climate on the Athlone site as well as the impact of the proposed redevelopment activities on the surrounding communities.

Central Termica Da Ressano Garcia, Environmental Acoustic Monitoring for a Gas Engine Power Plant, Ressano Garcia, Mozambique
2016
Project Manager
WSP was commissioned to undertake acoustic monitoring at the Central Termica De Ressano Garcia gas engine power plant site in order to assess the noise associated with the operation of the plant. Kirsten was responsible for project management, technical input and reporting for this project.

Anglo American Coal SA, Community Environmental Acoustic Monitoring Survey, Vereeniging, Gauteng, South Africa
2016
Project Manager
WSP was appointed to conduct community-based noise monitoring in a region adjacent to the New Vaal Colliery in order to assess the acoustic impacts of the colliery on the surrounding communities. Kirsten was responsible for project management, data analysis and reporting for the project.

Anglo American Platinum Limited, Screening Level Environmental Acoustic Impact Assessment for a New Ventilation Shaft, Rustenburg, Northwest, South Africa
2016
Lead Consultant
WSP was appointed to investigate the acoustic impacts associated with the construction and operation of an additional ventilation shaft at the Siphumelele 1 Mine near Rustenburg. Kirsten was responsible for conducting the assessment through baseline acoustic monitoring and acoustic propagation calculations.

Industrial Development Corporation of SA (Pty) Ltd, Environmental Acoustic Impact Assessment for a Proposed Paper Mill, Frankfort, Free State, South Africa
2013 – 2015
Lead Consultant
WSP was contracted to undertake an environmental acoustic impact assessment for a proposed paper mill in Frankfort in the Free State Province. Kirsten was responsible for conducting the assessment which included baseline acoustic monitoring; development of a comprehensive noise source inventory; and determination of the impact of the proposed project on the surrounding communities using the Computer Aided Noise Abatement (CadnaA) acoustic model.

South32 Aluminium SA Limited, Environmental Acoustic Impact Assessment for the Decommissioning of a Smelter, Richards Bay, KwaZulu-Natal, South Africa
2014 – 2015
Lead Consultant
WSP was contracted to undertake a screening-level environmental acoustic impact assessment for the decommissioning of the Bayside Aluminium Smelter in Richards Bay. Kirsten was responsible for conducting the assessment which included the development of a comprehensive noise source inventory; and determination of the impact of the proposed project on the surrounding communities using noise propagation calculations.

Sasol New Energy Holding (Pty) Ltd, Environmental Acoustic Monitoring for a Gas Engine Power Plant, Ressano Garcia, Mozambique, Africa
2014 – 2015
Project Manager and Lead Consultant
WSP was commissioned by Sasol New Energy Holding (Pty) Ltd to undertake acoustic monitoring at the Central Termica De Ressano Garcia gas engine power plant site in order to assess the noise associated with the construction and operational phases of the plant. Kirsten was responsible for technical input, acoustic data analysis and reporting for this project.

Sonae Novobord (Pty) Ltd, Environmental Noise Survey for a Wood Producer, White River, Mpumalanga, South Africa
2012 – 2015
Consultant
WSP has been conducting environmental noise monitoring at the Sonae Novobord White River plant since 2009. The project includes day and night-time monitoring in accordance with the SANS 10103:2008 methodology, data analysis, compliance assessment and reporting. Kirsten was involved in the data analysis, interpretation and reporting for the project.

Atha-Africa Ventures (Pty) Ltd, Environmental Acoustic Impact Assessment for a Proposed Mine, Wakkerstroom, Mpumalanga, South Africa
2012 – 2014
Lead Consultant
WSP Environmental was commissioned to undertake an environmental acoustic impact assessment for a proposed underground coal mine near Wakkerstroom, Mpumalanga as part of a comprehensive environmental and social impact assessment for the mine. Kirsten was responsible for conducting the environmental acoustic assessment. The assessment comprised on-site environmental noise monitoring in order to obtain a baseline noise climate for the region as well as acoustic modelling to determine the predicted impacts that the proposed mine will have on the existing noise climate. An inventory of all noise sources during the construction and operational phases was compiled with associated sound power levels for each source. These sources were then input into the Computer Aided Noise Abatement (CadnaA) acoustic model. Results were compared with the monitored (existing) noise levels as well as the SANS day and night-time guidelines to assess compliance.

Sonae Novobord (Pty) Ltd, Environmental Noise Survey for a Wood Producer, Panbult, Mpumalanga, South Africa
2013
Project Manager
WSP was commissioned to do a once-off environmental acoustic compliance monitoring survey at the Sonae Novobord Panbult site in Mpumalanga. Kirsten was responsible for project management and reporting for the project.

Rustenburg Platinum Mines Limited, Environmental Noise Impact Assessment for the Amandelbult Mine, Limpopo, South Africa
2013
Lead Consultant
As part of an environmental impact assessment, WSP was commissioned to conduct an environmental noise assessment for the sinking of a new shaft at the Tumela mine in the Limpopo Province. Kirsten conducted this environmental noise impact assessment through a baseline review of the site; compilation of a detailed site-specific noise inventory; determination of the impact of the proposed project on the surrounding communities using the CadnaA acoustic model; interpretation of modelled results; compliance assessment; and reporting.

Shell and BP South Africa Petroleum Refineries (SAPREF), Environmental Noise Impact Assessment for SAPREF Cleaner Fuels Phase Two, Durban, KwaZulu-Natal, South Africa
2013
Lead Consultant
WSP was contracted to perform the environmental noise impact assessment of the Cleaner Fuels Phase Two Project for the SAPREF Refinery in South Durban. The project investigated the noise associated with undertaking the required modifications to the refinery in order to meet the pending fuel specifications published by the South African Department of Energy. Kirsten was responsible for analysis and interpretation of on-site acoustic monitoring; compilation of a detailed site-specific noise inventory; determination of the impact of the proposed project on the surrounding communities through the use of the CadnaA acoustic model; interpretation of modelled results; compliance assessment; and reporting.

Assmang Black Rock Mine Operations, Environmental Monitoring Assessment for a Manganese Mine, Hotazel, Northern Cape, South Africa
2012 – 2013
Consultant
WSP was commissioned to conduct environmental monitoring for their underground manganese mining venture at Black Rock in the Northern Cape Province. The environmental monitoring consisted of both environmental noise monitoring and particulate monitoring. Vehicle noise and emissions testing was also performed on various Assmang owned vehicles onsite. Kirsten was responsible for analysis of all monitored data, interpretation, compliance assessment and reporting.

AngloGold Ashanti (Pty) Ltd, Environmental Noise Surveys, Vaal River and West Wits Operations, Northwest, South Africa
2012
Consultant
WSP was commissioned by Anglo Gold Ashanti to perform environmental noise surveys of their Vaal River and West Wits mining operations in the Northwest Province, as part of their commitment to minimise negative impacts on the environment. The project included day and night-time monitoring in accordance with the SANS 10103:2008 methodology, data analysis, compliance assessment and reporting. Kirsten was responsible for assisting with data analysis, interpretation and reporting.

Sasol New Energy Holding (Pty) Ltd, Environmental Acoustic Impact Assessment for a proposed Power Plant, Ressano Garcia, Mozambique
2011
Field Consultant
WSP was commissioned by Sasol New Energy Holding (Pty) Ltd to undertake an integrated environmental and social impact assessment (ESIA) and bankable environmental, social and health impact assessment (ESHIA) for the proposed gas engine power plant that is to be constructed in Ressano Garcia, Mozambique. As part of this assessment, a specialist environmental acoustic study was conducted to assess what impacts the proposed plant may have on the noise climate of the region. Kirsten was responsible in assisting with on-site acoustic monitoring for the project.

Air Quality Impact Assessments (AQIAs)

Transnet Port Terminals - Saldanha, AQIA for a Proposed Expansion to an Iron Ore Loading Terminal, Saldanha, Western Cape, South Africa
2020 – 2022
Project Manager and Lead Consultant
WSP was contracted to undertake an air quality impact assessment in the form of an atmospheric impact report (AIR) to determine the impacts of a proposed increase in iron ore storage and handling capacity at the Saldanha Port. The project was part of an Atmospheric Emission Licence (AEL) variation application, with an AIR specifically requested by the authorities. The project included a baseline assessment, compilation of a comprehensive emissions inventory and dispersion modelling using the CALPUFF dispersion model to assess the impacts of emissions on the surrounding communities. The project also included the AEL component, with authority liaison, advertisement placement and submission of the AEL variation application on the South African Atmospheric Emission Licencing and Inventory Portal (SAAELIP).

Cast Products South Africa, AQIA for a Section 22A AEL Renewal for a Foundry, Boksburg, Gauteng, South Africa
2022
Project Manager and Lead Consultant
WSP was contracted to undertake an air quality impact assessment in the form of an atmospheric impact report (AIR) for the Boksburg Foundry. The Client failed to renew their current AEL timeously and as such a Section 22A rectification process was triggered. As part of the Section 22A process, an AIR was specifically requested by the authorities. The project included a baseline assessment, compilation of a comprehensive emissions inventory and dispersion modelling using the AERMOD dispersion model to assess the impacts of emissions on the surrounding communities. The project also included the AEL component, with authority liaison, advertisement placement and submission of the AEL renewal application on the South African Atmospheric Emission Licencing and Inventory Portal (SAAELIP).

Orion Engineered Carbons, AQIA for a Bulk Liquid Cargo Facility, Port of Gqeberha, Eastern Cape, South Africa
2020 – 2021
Project Manager and Lead Consultant
WSP was appointed to conduct an AQIA in the form of an Atmospheric Impact Report as part of the licencing of the operational tanks at the port. This formed part of a Noxious Use Permit application, as per the Port Elizabeth Zoning Scheme. The assessment consisted of quantification of emissions from the tanks using the US EPA's Tanks 4.0.9 model as well as dispersion modelling using the AERMOD dispersion model to assess the impacts of emissions on any surrounding receptors.

Platinum Cement Industries, AQIA for a Proposed Cement Grinding Processing Facility, Umbogintwini, KwaZulu-Natal, South Africa
2020 – 2021
Project Manager and Lead Consultant
WSP was appointed to conduct an AQIA in the form of an Atmospheric Impact Report as part of an Atmospheric Emission Licence (AEL) application for a proposed cement grinding processing facility. The assessment consisted of the compilation of a comprehensive emissions inventory to account for emissions from the facility as well as dispersion modelling using the AERMOD dispersion model to assess the impacts of emissions on any surrounding receptors.

Protea Chemicals, AQIA for a Revised Production Rate for a Chemical Producer, Cape Town, Western Cape, South Africa
2020
Project Manager and Lead Consultant
WSP was appointed to conduct an AQIA in the form of an Atmospheric Impact Report as part of an Atmospheric Emission Licence (AEL) amendment application for a production rate change at the facility. The assessment consisted of the compilation of a comprehensive emissions inventory to account for emissions from the facility as well as dispersion modelling using the AERMOD dispersion model to assess the impacts of emissions on any surrounding receptors.

Kirsten Collett

Earth & Environment, Air Quality & Acoustics – Environment & Energy, Associate

WSP Middle East, AQIA for a Proposed Independent Power Project, Qatar
2020
Project Manager and Lead Consultant
WSP was contracted to undertake a screening-level air quality impact assessment to determine the suitability of the proposed stack heights in dispersing emission away from sensitive receptors. The project included a baseline assessment, emissions inventory, dispersion modelling using SCREEN3 and comparison of the predicted concentrations against the Qatar ambient air quality standards.

Transnet Port Terminals - Saldanha, AQIA for a Proposed Expansion to an Iron Ore Loading Port, Saldanha, Western Cape, South Africa
2019
Project Manager and Lead Consultant
WSP was contracted to undertake an air quality impact assessment to determine the impacts of a proposed increase in iron ore storage and handling capacity at the Saldanha Port. The project included a baseline assessment, compilation of a comprehensive emissions inventory and dispersion modelling using the CALPUFF dispersion model to assess the impacts of emissions on the surrounding communities.

Anglo American Coal SA, AQIA for a proposed coal stockpile at an underground mine, Ogies, Mpumalanga, South Africa
2018
Project Manager and Lead Consultant
WSP was appointed to conduct an Air Pollution Assessment in the form of an Atmospheric Impact Report for a proposed coal stockpile at the underground section of the Zibulo Colliery. The assessment consisted of the compilation of a comprehensive emissions inventory to account for emissions from the proposed stockpile as well as dispersion modelling using the AERMOD dispersion model to assess the impacts of emissions on any surrounding receptors.

WSP Middle East, AQIA for a Proposed Waste to Energy Facility, Kuwait
2017 – 2018
Project Manager and Lead Consultant
WSP was contracted to undertake an air quality impact assessment to determine the impacts of a proposed waste to energy facility in Kuwait. The project included assessment of baseline monitoring data (conducted by a local partner), a baseline assessment, emissions inventory, dispersion modelling using CALPUFF and comparison of the predicted concentrations against the Kuwait and International ambient air quality guidelines/standards. A preliminary screening assessment was undertaken using SCREEN3 to determine the monitoring locations for the baseline monitoring campaign.

The Dow Chemical Company (Rohm and Haas) - Advanced Materials, AQIA for a Chemical Manufacturer, New Germany, KwaZulu-Natal, South Africa
2015
Project Manager and Lead Consultant
WSP was appointed to conduct an Air Pollution Assessment in the form of an Atmospheric Impact Report for the proposed Polyol Blending Plant at the Dow Advanced Materials site in New Germany. The assessment consisted of the compilation of a comprehensive emissions inventory to account for emissions from both the existing and proposed operations as well as dispersion modelling using the AERMOD dispersion model to assess the impacts of emissions on the surrounding communities.

South32 Aluminium SA Limited, AQIA for Remediation of a Smelter, Richards Bay, KwaZulu-Natal, South Africa
2015 – 2016
Lead Consultant
WSP was contracted to undertake an air quality impact assessment to determine the impacts of remediating the legacy landfill sites at the Bayside Aluminium Smelter in Richards Bay. Kirsten was responsible for the

development of a comprehensive emissions inventory; and determination of the impact of the proposed project on the surrounding communities using the AERMOD dispersion modelling software.

South32 Aluminium SA Limited, AQIA for a Smelter Decommissioning, Richards Bay, KwaZulu-Natal, South Africa
2014 – 2015
Lead Consultant
WSP was contracted to undertake a screening-level air quality impact assessment for the decommissioning of the Bayside Aluminium Smelter in Richards Bay. Kirsten was responsible for the development of a comprehensive emissions inventory; and determination of the impact of the proposed project on the surrounding communities using the AERSCREEN Tier 1 dispersion modelling software.

First in Spec Biofuels Ltd, AQIA for a Biodiesel Plant, Coega IDZ, Eastern Cape, South Africa
2011 – 2015
Lead Consultant
As part of a larger Environmental Impact Assessment for a proposed biodiesel production plant in Coega, WSP was commissioned to conduct a specialist air quality impact assessment for the facility. Kirsten was responsible for compiling the air quality impact assessment which was initially a screening-level assessment and later upgraded to a Tier 2 full air quality impact assessment. The project involved a baseline review of the area; baseline meteorological and pollutant data analysis; emission inventory compilation; dispersion modelling; reporting; and atmospheric emission licence (AEL) compilation.

Atha-Africa Ventures (Pty) Ltd, AQIA for a Proposed Mine, Wakkerstroom, Mpumalanga, South Africa
2012 – 2014
Lead Consultant
WSP was commissioned to undertake an air quality impact assessment for a proposed underground coal mine near Wakkerstroom, Mpumalanga as part of a comprehensive environmental and social impact assessment for the mine. Kirsten was responsible for conducting the air quality assessment. The assessment comprised on-site ambient air quality monitoring in order to assess the existing air quality in the region as well as dispersion modelling (using the ADMS (v5) software) to determine the predicted impacts that the proposed mine will have on the existing air quality.

Apollo Tyres South Africa (Pty) Ltd, AQIA for a Tyre Manufacturer, Durban, KwaZulu-Natal, South Africa
2012 – 2013
Consultant
WSP was commissioned to perform an air quality impact assessment for a tyre manufacturer to determine the changes in emissions should they replace their existing heavy fuel oil fired boiler with two coal fired boiler equipped with bag filters. Kirsten was responsible for conducting this screening-level air quality assessment through a baseline review of the site; emissions inventory compilation; and determination of the impact of the boiler emissions on the surrounding communities using the SCREEN3 screening-level dispersion modelling software.

Ferrochrome Furnaces (Pty) Ltd, AQIA for Ferrochrome Production Facility, Rustenburg, North West, South Africa
2012
Lead Consultant
WSP was commissioned to perform an air quality impact assessment of a proposed ferrochrome production facility in Zinniaville, Rustenburg as part of a larger environmental impact assessment. Kirsten was responsible for conducting the air quality assessment through a baseline review of the site; compilation of a detailed site-specific emissions inventory; determination of the impact of the proposed facility on the surrounding communities using the ADMS dispersion modelling software; and compilation of the atmospheric emission licence (AEL) application.

Kirsten Collett

Earth & Environment, Air Quality & Acoustics – Environment & Energy, Associate

SIVEST SA (Pty) Ltd, AQIA for a Fuel Depot Recommissioning, Western Cape, South Africa
2012
Consultant
WSP was commissioned as part of a broader environmental impact assessment, to conduct an air quality impact assessment of the recommissioning of the Total Paarden Island fuel storage and distribution terminal near Cape Town. The air quality impact assessment investigated emissions generated as a result of both the construction phase and operational phase of the facility. Kirsten was responsible for the assessment which comprised a baseline review of the site; compilation of a detailed site-specific emissions inventory; estimation of emissions generated from each of the onsite storage tanks through the use of the TANKS 4.0.9 model; and determination of the impact of the proposed facility on the surrounding communities using the SCREEN3 dispersion modelling software.

Noble Resources Ltd, AQIA for a Proposed Oilseeds Processing Plant, Standerton, Mpumalanga, South Africa
2011-2012
Consultant
Noble Resources proposed to construct an oilseeds processing plant in Standerton and required an air quality assessment to determine what impacts the activity would have in the region. Kirsten performed this assessment through a baseline assessment of the site; development of a comprehensive emissions inventory; and determination of the proposed impacts through the use of a Tier 2 atmospheric dispersion model (ADMS)

City of Johannesburg, Ambient Air Quality Assessment during Car Free Day, Johannesburg, South Africa
2007 – 2008
Consultant
This project monitored vehicular emissions from a mobile monitoring station placed alongside the M1 highway in Johannesburg. This was done to evaluate the effectiveness of car free day and to assess whether there was a reduction in emissions on the day. Kirsten was involved in the assessment, analysis and reporting in this specific project.

Air Quality Management

Strandfoam Group (Pty) Ltd, NAEIS submission for a Polyurethane Foam Manufacturer, Strand, Western Cape
2023
Project Manager and Lead Consultant
WSP was appointed to undertake the required National Atmospheric Emissions Inventory System (NAEIS) reporting for the facility. Kirsten was responsible for compiling the emissions inventory for the facility and uploading the necessary information to the NAEIS.

Weir Minerals, Atmospheric Emission Licence (AEL) Audit, Annual Reporting and NAEIS submission for a Foundry, Isando, Gauteng
2021
Project Manager and Lead Consultant
WSP was appointed to undertake an audit of the facility's current AEL to assess the accuracy of what was represented in the AEL as well as to evaluate compliance with the conditions stipulated in the AEL. Additionally, the scope of work included compilation of their Annual Report as well as reporting of emissions onto the National Atmospheric Emissions Inventory System (NAEIS). Kirsten was responsible for conducting the audit, compiling the audit report and annual report and submitting all information onto NAEIS.

Kirsten Collett

Earth & Environment, Air Quality & Acoustics – Environment & Energy, Associate

Sasol Satellite Operations Ekandustria, Atmospheric Emission Licence (AEL) Audit for an Explosives Manufacturer, Ekandustria, Mpumalanga, South Africa
2020
Project Manager and Lead Consultant
WSP was appointed to undertake an audit of the facility's current AEL to assess the accuracy of what was represented in the AEL as well as to evaluate compliance with the conditions stipulated in the AEL. Kirsten was responsible for conducting the audit and compiling the audit report.

Anglo American Coal SA, Isibonelo Colliery Air Quality Management Plan, Mpumalanga, South Africa
2019 – 2020
Project Manager and Lead Consultant
Anglo American Coal SA requested the compilation of an Air Quality Management Plan (AQMP) for the Isibonelo Colliery in the Mpumalanga province. The AQMP was aimed at improving air quality at the colliery through the identification of main sources of emissions and recommendations to reduce emissions from these sources. Kirsten was responsible for the compilation of the AQMP which was performed through a baseline assessment of activities at the colliery; identification of key emission sources; compilation of a detailed site specific emissions inventory; determination of the impact of emissions from the colliery on surrounding communities using the AERMOD dispersion modelling software; review of current management and mitigation techniques at the colliery; and development of strategies to minimise any impacts of emissions from the colliery going forward.

Transnet Port Terminals Saldanha Bay, Atmospheric Emission Licence (AEL) Audit for a Manganese Multipurpose Terminal, Saldanha, Western Cape, South Africa
2019
Lead Consultant
WSP was contracted to undertake an audit of the current provisional AEL (PAEL) for the terminal and assist with conversion of the PAEL to a final AEL. The project included a site visit and audit, Client and Authority liaison and assistance with submission of the AEL on the South African Atmospheric Emission Licencing and Inventory Portal (SAAELIP).

Anglo American Coal SA, Mafube Colliery Integrated Air Quality Management Plan, Mpumalanga, South Africa
2015 – 2016
Project Manager and Lead Consultant
WSP was appointed for the compilation of an integrated Air Quality Management Plan (AQMP) for the Mafube Colliery in the Mpumalanga province. The AQMP was aimed at improving air quality at the colliery through the identification of main sources of emissions and recommendations to reduce emissions from these sources. Kirsten was responsible for the compilation of the AQMP which was performed through a baseline assessment of activities at the colliery; identification of key emission sources; compilation of a detailed site specific emissions inventory; determination of the impact of emissions from the colliery on surrounding communities using the AERMOD dispersion modelling software; review of current management and mitigation techniques at the colliery; and development of strategies to minimise any impacts of emissions from the colliery going forward.

Sonae Novobord (Pty) Ltd, Air Quality Management Reports, White River, Mpumalanga, South Africa
2011 – 2015
Consultant
WSP has been continuously monitoring formaldehyde, suspended particulate matter (PM_{10}) and dust deposition (fallout) concentrations in and around the Sonae Novobord White River plant since 2008. Kirsten was responsible for analysing and assessing the ambient monitoring data and drafting the air quality management reports.

Anglo American Coal SA, Combined Integrated Air Quality Management Plan for the Greenside, Kleinkoppje and Landau Collieries, Mpumalanga, South Africa
2013 – 2014
Lead Consultant
Anglo American Coal SA requested the compilation of a combined integrated Air Quality Management Plan (AQMP) for the Greenside, Kleinkoppje and Landau Collieries in the Mpumalanga province. The AQMP was aimed at becoming a management tool for the collieries going forward Kirsten was responsible for the compilation of the combined AQMP which was performed through a baseline assessment of activities at each colliery; identification of key emission sources; compilation of a detailed site specific emissions inventory for each colliery; determination of the impact of emissions from each colliery (as well as the combined impact) on surrounding communities using the CALPUFF dispersion modelling software; review of current management and mitigation techniques at each colliery; and development of strategies to minimise any impacts of emissions going forward.

Columbus Stainless (Pty) Ltd, Fugitive Dust Suppression Plan for a Steel Producer, Middelburg, Mpumalanga, South Africa
2013
Lead Consultant
WSP was commissioned to compile a fugitive dust suppression plan in order to assess the fugitive dust emanating from a stainless-steel plant in Middelburg. Kirsten was responsible for compiling the fugitive dust suppression plan through on-site dust fallout monitoring; analysis of all historical particulate matter, dust fallout and meteorological data for the site; identification of key emission sources; and provision of mitigation and management measures to limit the impact of fugitive dust going forward.

Anglo American Coal SA, Greenside Colliery Integrated Air Quality Management Plan, Mpumalanga, South Africa
2012 – 2013
Lead Consultant
Anglo American Coal SA requested the compilation of an integrated Air Quality Management Plan (AQMP) for the Greenside Colliery in the Mpumalanga province. The AQMP was aimed at improving air quality at the colliery through the identification of main sources of emissions and recommendations to reduce emissions from these sources. Kirsten was responsible for the compilation of the AQMP which was performed through a baseline assessment of activities at the colliery; identification of key emission sources; compilation of a detailed site specific emissions inventory; determination of the impact of emissions from the colliery on surrounding communities using the ADMS dispersion modelling software; review of current management and mitigation techniques at the colliery; and development of strategies to minimise any impacts of emissions from the colliery going forward.

Anglo American Coal SA, Landau Colliery Integrated Air Quality Management Plan, Mpumalanga, South Africa
2012
Lead Consultant
Anglo American Coal SA requested the compilation of an integrated Air Quality Management Plan (AQMP) for the Landau Colliery in the Mpumalanga province. The AQMP was aimed at improving air quality at the colliery through the identification of main sources of emissions and recommendations to reduce emissions from these sources. Kirsten was responsible for the compilation of the AQMP which was performed through a baseline assessment of activities at the colliery; identification of key emission sources; compilation of a detailed site specific emissions inventory; determination of the impact of emissions from the colliery on surrounding communities using the ADMS dispersion modelling software; review of current management and mitigation techniques at the colliery; and development of strategies to minimise any impacts of emissions from the colliery going forward.

Kirsten Collett

Earth & Environment, Air Quality & Acoustics – Environment & Energy, Associate

Sonae Novobord (Pty) Ltd, Strategic Overview of Air Quality Conditions at the Sonae Novobord Plant, White River, Mpumalanga, South Africa
2008 – 2011
Consultant
WSP has been monitoring various air quality aspects in and around the Sonae Novobord White River plant since 2008. Concentrations of formaldehyde, suspended particulate matter (PM_{10}) and dust deposition (fallout) have been continually monitored in terms of the requirements of the NEMA Section 24G Environmental Management Plan. Kirsten was involved in performing a strategic assessment of conditions at the plant, to ascertain whether the air quality has improved over time and whether the conditions set out in the Record of Decision and the Air Quality Management Plan are being met.

Ambient Monitoring

Anglo American Coal SA, Dust Fallout and Particulate Matter Monitoring for nine Collieries, Mpumalanga, South Africa
2016 – 2022
Project Manager
WSP was appointed to manage Anglo American Coal SA's air quality monitoring requirements at nine of their collieries. The contract includes dust fallout monitoring at all nine collieries, while continuous particulate matter (PM_{10} and $PM_{2.5}$) monitoring is conducted at seven collieries using mobile custom-designed solar system trailers. Kirsten was responsible for project management and quality control for the project.

Foskor (Pty) Ltd, Dust Fallout and Particulate Matter Monitoring for a Phosphate Mine, Phalaborwa, Limpopo, South Africa
2016 – 2019
Project Manager
WSP was commissioned to manage and maintain a dust monitoring network for Foskor Phalaborwa's phosphate rock operations in the Limpopo Province. The monitoring network comprises 37 dust fallout samplers, and a real-time particulate matter (PM_{10}) monitor. Kirsten was responsible for project management and quality control for the project.

Total South Africa (Pty) Ltd, Leak Detection and Repair Programs for Ten Fuel Depots, South Africa
2016 – 2017
Project Manager
WSP was appointed to conduct leak detection and repair programs at ten of Total South Africa's bulk fuel storage depots as part of their atmospheric emission licence conditions. Kirsten was responsible for project management, data analysis and reporting for the project.

Eskom Holdings SOC Limited, Dust Fallout Monitoring for Kendal Power Station, Kendal, Mpumalanga, South Africa
2016
Project Manager
WSP was commissioned to monitor dust fallout at the Kendal Power Station in Mpumalanga for a six month period. Kirsten was responsible for project management, data analysis and reporting for the project.

Evraz Highveld Steel and Vanadium Corporation Ltd, Dust Fallout Monitoring for a Steel Facility, Mpumalanga, South Africa
2012 – 2015
Project Manager
As part of Evraz Highveld Steel's on-going monitoring program for the assessment of dust generated by the steelworks and associated activities, WSP was commissioned to conduct dust fallout monitoring both on and off site. Monitoring has been performed over time at the site on a monthly basis in accordance with the ASTM D1739 reference method. Kirsten was responsible for data analysis, interpretation and reporting during the

2012 monitoring period. Most recently, Kirsten was responsible for project management during the 2014 and 2015 campaign.

Evraz Highveld Steel & Vanadium Corporation Ltd, Particulate Matter Monitoring for a Steel Facility, Mpumalanga, South Africa
2014 – 2015
Project Manager
WSP was commissioned to monitor particulate matter concentrations at three locations in and around the Evraz Highveld Steel facility using E-sampler monitoring equipment. Kirsten was responsible for project management and reporting for the project.

Eskom Holdings SOC Limited, Dust Fallout Monitoring for Majuba Power Station, Volksrust, Mpumalanga, South Africa
2013 – 2015
Project Manager
WSP was commissioned to monitor dust fallout at the Majuba Power Station in Mpumalanga for a two-year period. Kirsten was responsible for project management, data analysis and reporting for the project.

Tubular Holdings (Pty) Ltd, Dust Fallout Monitoring, Kendal, Mpumalanga, South Africa
2013 – 2014
Project Manager
WSP was commissioned to monitor dust fallout and meteorological conditions at the Tubular Holdings workers' living quarters near Kendal, Mpumalanga. The project was initiated to determine the source of dust at this location. Kirsten was responsible for project management; data analysis; and reporting for the project.

Atlantis Foundries (Pty) Ltd, Dust Monitoring Program for a Foundry, Atlantis, Western Cape, South Africa
2011
Data Analyst
WSP was commissioned to provide specialist air quality support and monitoring services to Atlantis Foundries (Pty) Ltd, situated within Atlantis near Cape Town. The project included: dust deposition monitoring, the compilation of an Atmospheric Emission Licence (AEL) for the facility and the development of site-specific dust mitigation and management strategies. Kirsten was involved in assisting with data analysis and interpretation of the results obtained from the monthly monitoring campaigns at the site.

Sasol New Energy Holding (Pty) Ltd, Air Quality Monitoring for a Proposed Power Plant, Ressano Garcia, Mozambique
2011
Field Consultant
WSP was commissioned by Sasol New Energy Holding (Pty) Ltd to undertake an integrated environmental and social impact assessment (ESIA) and bankable environmental, social and health impact assessment (ESHIA) for the proposed gas engine power plant that is to be constructed in Ressano Garcia, Mozambique. As part of this assessment, a specialist air quality study was conducted to assess what impacts the proposed plant may have on air quality in the region. Kirsten was responsible in assisting with the set-up of passive monitoring equipment, dust buckets and a meteorological station at the site.

Eskom Holdings SOC Limited, European Integrated Project on Aerosol, Cloud, Climate and Air Quality Interactions, Mpumalanga, South Africa
2007 – 2010
Technical Consultant
This was an international aerosol project focusing on four developing countries, namely South Africa, India, Brazil and China. It was initiated to provide a comparative set of aerosol emission data between the four countries. Kirsten was involved in the setup and maintenance of the monitoring instrumentation at the South

African site. For this, Kirsten was also involved in an aerosol training course in Hyytiälä, Finland as well as technical training in Leipzig, Germany for the SMPS (Scanning Mobility Particle Sizer) instrument.

Eskom Holdings SOC Limited, Ambient Air Monitoring at the Point of Highest Impact Resulting from Kriel and Matla Power Stations, Mpumalanga, South Africa
2009
Consultant
This study was conducted on the Mpumalanga Highveld in order to increase our understanding of the sources and diurnal variations of various atmospheric species as well as the effects of local meteorology on the concentration of these species. The study included ambient monitoring using a mobile monitoring station. Kirsten was involved in the data analysis, statistical manipulation and reporting.

MSC Thesis

The Atmospheric Nitrogen Budget over the South African Highveld, Mpumalanga, South Africa
2007 – 2009
This project was Kirsten's MSc thesis and was performed in collaboration with Eskom. The project aimed to assess the atmospheric nitrogen cycle in the industrialised Highveld region. The project investigated the various atmospheric nitrogen compounds on the South African Highveld and looked at the dominant sources, the transport and conversion of the species in the atmosphere and in what form they are deposited to the ground. From this it was confirmed that the majority of emitted nitrogen remains in the atmosphere, confirming the trends depicted by satellite technology. Client: Eskom Holdings SOC Limited.

Honours Project

NOx or Not: Nitrogen Oxide Levels over the South African Highveld, Mpumalanga, South Africa
2006
This was Kirsten's honours project and was performed in collaboration with Eskom. This project aimed to validate the nitrogen dioxide hotspot over the South African Highveld as identified by satellite technology. The prevalent sources of nitrogen dioxide were investigated as well as the diurnal and seasonal distributions. Client: Eskom Holdings SOC Limited.

AWARDS

2009 - MSc Distinction

2008 - Best presentation for paper entitled "The Atmospheric Nitrogen Budget over the South African Highveld".
National Association for Clean Air (NACA) conference

PUBLICATIONS AND PRESENTATIONS

Publications

Collett, K.S., Piketh, S.J. and Ross, K.E. "An assessment of the atmospheric nitrogen budget on the South African Highveld." South African Journal of Science, 2010, pp. #106, 5/6, Article# 220.

Laakso, L., Vakkari, V., Laakso, H., Virkkula, A., Kulmala, M., Beukes, J.P., van Zyl, P.G., Pienaar, J.J., Chiloane, K., Gilardoni, S., Vignati, E., Wiedensohler, A., Tuch, T., Birmili, W., Piketh, S., Collett, K., Fourie, G.D., Komppula, M., Lihavainen, H., de Leeuw, G. and Kerminen, V.-M. "South African EUCAARI – measurements: a site with high atmospheric variability, "Atmospheric Chemistry and Physics Discussion. Month 2010, 10, 30691 – 30729.

Ross, K., Broccardo, S., Heue, K-P., Collett (nee Ferguson), K. and Piketh, S. "Nitrogen oxides on the South African Highveld." Clean Air Journal, Month 2007. 16, 2, 6 – 15.

Kirsten Collett

Earth & Environment, Air Quality & Acoustics – Environment & Energy, Associate

Presentations

Collett, Kirsten. "The Atmospheric Nitrogen Budget over the South African Highveld." National Association for Clean Air Conference, Nelspruit, Mpumalanga, 2009.

Appendix B

IMPACT ASSESSMENT METHODOLOGY

Impacts are assessed in terms of the following criteria:

1) The nature; a description of what causes the effect, what will be affected and how it will be affected:

Nature or Type of Impact	Definition
Beneficial / Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Adverse / Negative	An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.
Direct	Impacts that arise directly from activities that form an integral part of the Project (e.g. new infrastructure).
Indirect	Impacts that arise indirectly from activities not explicitly forming part of the Project (e.g. noise changes due to changes in road or rail traffic resulting from the operation of Project).
Secondary	Secondary or induced impacts caused by a change in the Project environment (e.g. employment opportunities created by the supply chain requirements).
Cumulative	Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.

2) The physical extent:

Score	Description
1	the impact will be limited to the site;
2	the impact will be limited to the local area (local study area);
3	the impact will be limited to the region;
4	the impact will be national; or
5	the impact will be international;

3) The duration, wherein it is indicated whether the lifetime of the impact will be:

Score	Description
1	of a very short duration (0 to 1 years)
2	of a short duration (2 to 5 years)
3	medium term (5–15 years)
4	long term (> 15 years)
5	permanent (this is considered permanent if the impact will be experienced post mine closure)

4) Reversibility: An impact is either reversible or irreversible. How long before impacts on receptors cease to be evident:

Score	Description
1	The impact is immediately reversible.
3	The impact is reversible within 2 years after the cause or stress is removed; or
5	The activity will lead to an impact that is in all practical terms permanent.

5) The magnitude of impact on ecological processes, quantified on a scale from 0-10, where a score is assigned:

Score	Description
0	small and will have no effect on the environment.
1	minor and will not result in an impact on processes (to be defined by individual specialist fields).
2	low and will cause a slight impact on processes.
3	moderate and will result in processes continuing but in a modified way.
4	high (processes are altered to the extent that they temporarily cease).
5	very high and results in complete destruction of patterns and permanent cessation of processes.

6) The probability of occurrence, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale where:

Score	Description
1	very improbable (probably will not happen).
2	improbable (some possibility, but low likelihood).
3	probable (distinct possibility).
4	highly probable (most likely).
5	definite (impact will occur regardless of any prevention measures).

The significance, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high:

- The status, which is described as either positive, negative or neutral.
- The degree to which the impact can be reversed.
- The degree to which the impact may cause irreplaceable loss of resources.
- The degree to which the impact can be mitigated.

The significance is determined by combining the above criteria in the following formula:

Significance = (Extent + Duration + Reversibility + Magnitude) x Probability

[S= (E+D+R+M) ×P]

Where the symbols are as follows:

Symbol	Criteria
S	Significance Weighting
E	Extent
D	Duration
M	Magnitude
P	Probability

The significance weightings for each potential impact are as follows:

Overall Score	Significance Rating (Negative)	Significance Rating (Positive)	Description
< 30 points	Low	Low	where this impact would not have a direct influence on the decision to develop in the area
31 - 60 points	Medium	Medium	where the impact could influence the decision to develop in the area unless it is effectively mitigated
> 60 points	High	High	where the impact must have an influence on the decision process to develop in the area

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