CHAPTER 16

Noise Generated by Shale Gas-related Activities

CHAPTER 16: NOISE GENERATED BY SHALE GAS-RELATED ACTIVITIES

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Executive Summary

Noise produced or caused by humans and generally referred to as environmental noise has a marked impact on the physical health of people, and on their psychological wellbeing.

The Karoo is a quiet area. Residual day- and night-time noise levels are approximately L_{Aeq} 33 dBA and 25 dBA, respectively. This is 10 dB below the typical levels published in local and international standards for rural areas. Subjectively a change of 10 dB is perceived as a doubling or halving of "loudness". A 10 dB difference is therefore a significant difference.

The noise impact of the exploration phase is likely to be localised and of short duration (a day). Noise would be generated predominantly by trucks, and would only be noticeable in the immediate vicinity of exploration activities, for the duration of the activities. Any core drilling exploration is likely to have a longer-term (six to eight weeks), more widespread (up to 5 kilometres (km)) noise impact, especially if any activity is done at night.

The construction, operation and decommissioning phases will likely cause noise impacts for humans and animals on sites within at least 5 km of the sites. Operational phases are expected to run constantly (day and night) for six to eight weeks. Night time noise impacts are therefore most likely, when residual noise levels are at a minimum.

Proposed sites will need individual noise impact assessments in accordance with South African National Standards (SANS) 10328 to determine the likelihood and severity of noise impacts.

There is additionally a risk of road noise impacts emanating from the surrounding roads due to increased heavy goods vehicle road traffic, especially during a Big Gas scenario, and if the roads used are otherwise quiet and seldom used.

Noise control, attenuation and monitoring will likely be required for all sites. The extent of the required measures will be determined by the noise impact assessment.

CHAPTER 16: NOISE GENERATED BY SHALE GAS DEVELOPMENT ACTIVITIES

16.1 Introduction and scope

Environmental noise has a marked impact on the physical health of people (Fritschi, 2011; Department of Environmental Affairs, 1989), and on their psychological wellbeing (Berglund, 1999). The noise climate of an environment is inextricably linked to its sense of place. As noise levels in urban areas increase, areas with low residual noise levels are becoming sought after (Visit Finland, 2016).

This chapter investigates the existing information on noise created by shale gas development (SGD) activities, and the impact that this could have on the study area in the Karoo.

This scientific assessment relies on existing, published data and recommends where more information is required to make a better assessment of the impacts. The main current shortfall in data is for reliable noise spectrum measurements (preferably in Sound Power levels, L_w) of the construction, operation and decommissioning of wells. Existing measured data is reported in A-weighted single-figure dBA levels. This must be investigated further.

Environmental noise: noise produced or caused by humans.

Residual noise: the prevailing noise level without the assessed noise present.

Ambient noise: the noise level with the assessed noise present.

Disturbing noise: a noise that raises the ambient noise level by 3 or 7 dBA above the residual level depending on applicable Noise Control Regulations.

Noise nuisance: a noise that disturbs the peace of a person.

16.1.1 Overview of international experience

The New York State Department of Environmental Conservation (NYSDEC) released in 2015 a regulatory programme for shale gas exploration (NYSDEC, 2015). This document quantified, in single-figure dBA values only, the potential impact of noise from the activities on the surrounding people and animals. It found that noise from truck traffic and during fracturing operations would cause adverse noise impacts on nearby people and animals. The report predicted an increase in noise levels of 37–42 dBA at 2000 feet (600 metres (m)) from wellpads in “quiet rural areas” with an existing noise level of 30 dBA. Areas in the Karoo are up to 10 dBA quieter than this at night.

There are currently few specific legal conditions attached to the noise associated with shale gas exploration (Chamberlain, 2012); rather the activities are assessed within the existing legal frameworks of each country.

16.1.2 Special features of the Karoo acoustic environment

The Karoo is a quiet area. Noise measurements over many years show that noise levels in the Karoo are generally L_{Aeq} 33 dBA during the day and L_{Aeq} 20–30 dBA at night (Jongens, 2011). These levels are far below the typical rating levels in Table 2 of the South African National Standards (SANS) 10103 for rural areas, which are set at L_{Aeq} 45 dBA in the day and L_{Aeq} 35 dBA at night. It is also far below the 30 dBA noise level used in the NYSDEC report for “quiet rural areas”. Karoo noise levels are also notably unaffected by wind noise (Jongens, 2011) and there is little rainfall in the area.

The Karoo is therefore notably quiet, and these noise levels are notably constant and reliable.

16.1.3 Relevant legislation, regulation and practice

Environmental noise in South Africa is generally governed by the Noise Control Regulations (NCRs) in terms of Section 25 of the Environmental Conservation Act, 1989 (Department of Environmental Affairs, 1992). For those parts of the study area that fall in the Western Cape, the provincial Western Cape (2013) NCRs supersede the national regulations. These regulations set the concepts of a disturbing noise and a noise nuisance. While these two terms are defined differently by different provincial regulations, essentially a disturbing noise can be objectively measured, while a noise nuisance is a subjective “annoyance” that cannot be reliably measured, such as a dog barking or other discrete events.

Two standards, SANS 10328 and SANS 10103 further expand on these regulations. SANS 10328 specifies the standard procedure for conducting a noise impact assessment. SANS 10103 specifies procedures for assessing the noise under investigation.

16.2 Key potential impacts and their mitigation

16.2.1 The effect of noise on humans

Humans are demonstrably impacted by acoustic noise (Berglund, 1999). The World Health Organisation (WHO) recommends a noise limit of $L_{night,outside}$ 40 dB and $L_{Amax,inside}$ 35 dB (Fritschi, 2011). These limits are set to help prevent health issues related to impaired sleep. The WHO estimated that in western European countries, at least one million healthy life years are lost every year from traffic-related noise, predominantly due to sleep disturbance. These two papers showed the relationship between environmental noise and specific health effects, including cardiovascular disease, cognitive impairment, sleep disturbance and tinnitus. It further showed that living in a loud environment leads to chronically raised levels of stress hormones.

The noise levels associated with health effects, where sufficient evidence is available, is shown in Table 16.1. For open windows, the difference between indoor and outdoor noise levels is approximately 10 dBA (Berglund, 1999). This means that the noise thresholds in Table 16.1 are exceeded when external night time noise levels exceed 42–45 dBA.

Table 16.1: Summary of effects and threshold levels for effects where sufficient evidence is available (from Table 1 of World Health Organisation [WHO], 2012).

Effect		Indicator	Threshold, dB
Biological effects	Change in cardiovascular activity	*	*
	EEG awakening	$L_{Amax,inside}$	35
	Motility, onset of motility	$L_{Amax,inside}$	32
	Changes in duration of various stages of sleep, in sleep structure and fragmentation of sleep	$L_{Amax,inside}$	35
Sleep quality	Waking up in the night and/or too early in the morning	$L_{Amax,inside}$	42
	Prolongation of the sleep inception period, difficulty getting to sleep	*	*
	Sleep fragmentation, reduced sleeping time	*	*
	Increased average motility when sleeping	$L_{night,\ outside}$	42
Well-being	Self-reported sleep disturbance	$L_{night,\ outside}$	42
	Use of somnifacient drugs and sedatives	$L_{night,\ outside}$	40
Medical conditions	Environmental insomnia**	$L_{night,\ outside}$	42

* Although the effect has been shown to occur or a plausible biological pathway could be constructed, indicators or threshold levels could not be determined.

** Note that "environmental insomnia" is the result of diagnosis by a medical professional whilst "self-reported sleep disturbance" is essentially the same, but reported in the context of a social survey. Number of questions and exact wording may differ.

16.2.2 The effect of noise on animals

There is a growing body of evidence that increased environmental noise levels has a wide range of impacts on animals (Barber, 2009; Francis, 2013) notably four behavioural changes:

1. Temporal patterns, i.e. changes in the times that animals do a certain activity.
    - Boat traffic noise changes the times that West Indian manatees forage (Miksis-Olds, 2007).

    - In noisy environments, European robins sing at night when it is otherwise quieter (Fuller, 2007).
2. Spatial distributions and movements.
    - Usually the abandonment of a noisy area (Francis, 2013).
3. Decreases in foraging or provisioning efficiency and increased vigilance and anti-predator behaviour.
    - Increased ambient noise reduces the distance that prey can hear approaching predators. This increases the amount of time animals spend looking around for predators, reducing foraging time (Gavin and Komers, 2006).
    - Predators that rely on sound take longer to find prey, reducing their hunting efficiency and increasing energy usage (Siemers and Schaub, 2011).
4. Changes in mate attraction and territorial defence.
    - Higher noise levels mask mating calls. Some birds and frogs have been seen to change their calls to higher frequencies to avoid the masking frequencies of the ambient noise. It seems though that this is correlated with lower clutches and fewer fledglings (Halfwerk et al., 2011).

The overall effect of noise on the environment depends on the specific environment. Disruptions in the ecosystem (such as a predator or a prey leaving the area), and can have unknown and complex knock-on effects on the local ecosystem. This would require further study.

16.2.3 Other key noise impacts

The introduction of man-made noise that raises the residual noise level appropriate to a district has a negative impact on the human experience of the space and possibly health. Toerien et al. (2016) shows that noise will adversely affect tourism in the Karoo where visitors expect to experience naturally quiet and peaceful wilderness spaces.

16.2.4 Key noise sources associated with SGD

The four main phases of SGD each have notable noise sources:

1. Exploration
    - Vehicles associated with surveying and seismic investigations
    - Exploration core drilling
2. Construction
    - Increased vehicle movements
    - Construction vehicles (diggers, lorries, bulldozers, etc.)

    - Plant (generators, pumps, etc.)
3. Extraction
    - Extraction plant, pumps, etc.
    - Generators and air handling equipment
    - Tankers bringing water and chemicals to site
4. Decommissioning
    - Increased vehicle movements removing debris, etc.
    - Construction vehicles (concrete breakers, diggers, etc.)
    - Plant (mainly generators)

The exploration survey phase will have localised, short duration (a few days) noise impacts. The impact will therefore be low. The exploration core drilling, depending on the depth, would require up to 80 days for the drilling, excluding site preparation (SLR, 2014). Noise associated with this drilling would occur 24 hours a day.

The most significant noise sources during the construction and extraction phases are the increased traffic flow and plant noise.

Traffic noise has been noted as disturbing rural communities due to the constant traffic flow to and from site, especially at night (Weigle, 2010; Ireland, 2012). Table 1.4 in Burns et al. (2016) estimates each drilled well requires 500, 10–20 tonne truck trips for the transport of construction materials, hydraulic fracturing ("fracking') chemicals, water, oil, etc. The traffic flows directly relating to SGD are estimated in Van Huyssteen et al. (2016) as:

- Scenario 0 (Reference Case): Negligible
- Scenario 1 (Exploration Only) & 2 (Small Gas): 25 vehicles per day
- Scenario 3 (Big Gas): 166 vehicles per day

Note that these traffic flows do not include traffic due to supporting activities such as employee traffic, or support services.

Construction, drilling and fracking noise levels have been estimated in Table 16.2, based on current research (NYSDEC, 2015) and standards (BSI British Standards, 2009). These noise levels for the construction activities use a "Usage Factor" (*UF*) to account for the approximate amount of time the equipment is used during a 16 hour daytime period. Note that these calculations are simple approximations, making no allowance for factors such as topography, atmospheric conditions, frequency content of the noise levels, and the condition of the equipment. In reality, dBA values cannot be simply added together; noise spectrum data is required in octave bands to be able to accurately combine noise levels.

The noise level $L_{p,2}$ at a distance r_2 is calculated using the simplified formula:

$$L_{p,2} = L_{p,1} + 10\log\left(\frac{UF}{100}\right) - 20\log\left(\frac{r_2}{r_1}\right) + 10\log(n)$$

here n is the number of pieces of equipment.

Table 16.2: Estimated composite noise levels at 4 km

Activity	**Noise level L_p, dBA at 4 km from the activity**	
	Daytime	**Night time**
None (residual)	33	25
Exploration core drilling	28	28
Access road construction	37	37
Wellpad construction	32	32
Rotary air well drilling	29	29
Horizontal drilling	28	28
Fracking	56	56

The following activities as listed by NYSDEC (2015) were used to calculate the noise levels in Table 16.2:

Access road construction:

- Excavators
- Graders
- Bulldozers
- Compactors
- Water trucks
- Dump trucks
- Loaders

Wellpad construction:

- Excavators
- Bulldozers
- Water trucks
- Dump trucks
- Pickup trucks

For drilling, the drill rig drive engine is based on a CAT 32 ACERT 1000–1200 bhp industrial diesel engine housed in a CAT ISO Energy 30ft Container, rated at 85 dBA at 3 m (Caterpillar, 2011). An option is available for an 85 dBA at 1 m Container, which will reduce engine noise levels by approximately 10 dBA. Note though that the compressors would also require attenuation for this 10 dBA reduction to be realised.

Rotary air well drilling:

- Drill rig drive engine
- Compressors
- Hurricane boosters
- Compressor exhaust

Horizontal drilling:

- Drill rig drive engine
- Generators
- Top drive
- Draw works
- Triple shaker

The fracking process is usually done once during the life of the well, for a period of two to five days. The required water volume and pressure requirements mean that up to 20 pumper trucks are likely required (NYSDEC, 2015). Depending on the load on the engines, noise levels can be between 110 and 115 dBA at 1 m, with the main noise in the frequency range 50–250 Hz.

Fracking:

- Pumper trucks

It is reasonable to assume that construction will be done during the day, while the drilling and extraction processes run continuously (day and night) for approximately one to two months (Xiphu et al., 2012; Weigle, 2010; Broderick, 2011). Construction noise impact would therefore need to be assessed during the day, while drilling and extraction would be assessed at night time, when residual noise levels are lowest.

The decommissioning phase will likely have similar noise sources to the construction phase with the addition of potential demolition equipment, such as concrete breakers. This equipment is noisy, and often with impulsive sound, which makes the noise much more noticeable over long distances (SANS 10103).

16.2.5 Likelihood and areas of noise impact

The likelihood of noise impacting on noise sensitive receivers depends on three main factors:

1. Residual noise level (the prevailing noise level without any activities);
2. Noise level of the activities at the receiver; and
3. The character of the noise, i.e. whether the noise draws attention to itself (a tone, intermittency, impulsive noise, etc.). SANS 10103 requires that these noise levels are adjusted by adding (usually) 5 dB depending on the respective noise characteristic.

16.2.5.1 Drilling activities

Since the drilling activities will run continuously, the associated noise levels are likely to be assessed against the night time residual noise level of L_{Aeq} 20–30 dBA.

Single- figure dBA noise levels have been documented in a recent study by the NYSDEC (2015).

Most of the noisy activities at a wellpad will have a noticeable low frequency character, especially engines/generators and compressors. Demolition plant such as concrete breakers emit noise with an impulsive character, which attracts an extra correction of +5 dB.

Assuming a point source for noise sources on the wellpads, noise levels generally reduces by 6 dB for every doubling of distance (SANS 10357; Fry, 1988). This means that if an object has a noise level of 95 dB(A) at 1 m to equal the residual night time noise levels, one must travel:

- 1.75 km to reduce by 65 dB to 30 dB(A), and
- 5.6 km to reduce by 75 dB to 20 dB(A)

This ignores the “near field effect” of large equipment such as generators, where the noise level at 1 m and at 5 m can be very similar. This also excludes screening, topography or any meteorological effect such as temperature inversions, which will affect these distances. An assessment radius of at least 5 km around a site is therefore recommended. Large sites with more, noisy plant might require a substantially larger study area. This might exceed the guaranteed limits of some noise modelling software.

16.2.5.2 Vehicle noise

Exploration work is done using light and heavy vehicles. Drilling activities are supported by vehicles, which bring equipment, water, chemicals and other supplies to the wellpads.

Vehicles are expected to visit the wellpads at regular intervals. The anticipated number of large support vehicles (10 and 20 tonne vehicles) for each scenario is as follows:

- Reference Case: Negligible
- Exploration Only and Small Gas: 25 per day (i.e., 1 per hour)
- Big Gas: 166 per day (i.e. 7 per hour or one every 9 minutes)

Note that this does not include light vehicles, or vehicles for ancillary activities such as staff vehicles.

There is clearly no noise impact from vehicle noise for the Reference Case.

The impact of vehicle noise for Exploration Only to the Big Gas scenario will depend on:

- The existing traffic flow on the roads being used.
    - The noise impact on a remote, seldom used road will be higher than on a regularly used road.
- The condition of the roads being used.
    - Traffic noise is higher on rough, poorly maintained roads than on smooth roads in good condition.
- The proximity of noise sensitive receivers to the roads.
    - Receivers next to roads are more affected by increased traffic flow than receivers far from the roads.

These aspects will need to be considered for each wellpad site.

In general, the Exploration Only and Small Gas scenarios road traffic noise is unlikely to cause significant noise impacts. One vehicle per hour for one to two months is a small noise impact, even for receivers close to the road.

The Big Gas scenario road traffic noise could cause noticeable and significant road traffic noise impacts, especially if:

- noise sensitive receivers are close to the roads,
- the roads are currently rarely used especially at night
    - a heavy vehicle every nine minutes, day and night, on a seldom used road is a significant increase in vehicle noise, and

- the roads are poorly maintained.

16.2.6 Noise mitigation

There are several potential noise mitigation methods recommended in BSI British Standards (2009) and in use in many operating sites (NYSDEC, 2015; Perenco, 2012). The appropriate methods for each site will need to be investigated on a site by site basis. Below are common techniques that must be considered to reduce noise impact.

- Traffic noise control
    - Ensure all vehicles used are in good working condition, with no faulty silencers, squeaking brakes or screeching fan belts.
    - Ensure that roads are in good condition to minimise bangs and other impulsive noise associated with heavy vehicles driving over rough roads.
    - Plan traffic routes that use busy roads, and road far from noise sensitive receivers.
- Plant noise control
    - All generators, compressors and noisy drilling equipment installed in acoustic enclosures, with silencers fitted to the flues. These reduce noise levels by approximately 20 dB(A). This was required at three drill sites at the Wytch Farm site (Perenco, 2012).
    - See comments below on the ineffectiveness of localised screening for these sites.
    - Fit fans with attenuators.
- Noise monitoring
    - The noise impact assessment for the site will identify the noise limits for the site.
    - Set up noise monitoring stations as required to check that the noise limits are not being exceeded.
    - This is to protect:
        - the noise sensitive receivers from excessive noise, and
        - the operator from spurious noise complaints.
    - This monitoring may also show that the noise limits (which would likely have been based on calculations and predictions) need to be adjusted up or down.
- Financial compensation
    - If the drilling noise is predicted to impact on a sensitive receiver such that there will be a financial impact on the receiver (e.g. a tourism venue that sells "solitude" or "silence") then this receiver could be financially compensated for the likely loss of income for the duration of the noisy activities.

It is important to note that for this application, noise screening will not be an effective method of noise control for the following reasons:

1. Noise screens will only provide significant noise reduction if located close to the sound source or close to the receiver.
   - Distances between the receptors and the screens will necessarily be further for this application (likely kilometres away), making screening less effective.
2. Noise screens are more effective at higher frequencies of sound (Berglund, 1999).
   - The noise from the drill sites is likely to have significant low-frequency content.

16.3 Risk assessment

16.3.1 Risk measurement

The nearest noise sensitive receivers to a proposed well point must be identified. Due to the constant activity on these sites, this means that noise measurements are required (day and night) at the nearest noise sensitive receivers prior to any activity on site. Measurements must be daytime (06h00–22h00) and night time (22h00–06h00). It has been proposed that measurements are done for two to five years before drilling is done, taking into account seasonal variations of noise levels (Centre for Environmental Rights (CER) 2014). Existing noise levels show that noise levels change very little in the Karoo with weather conditions (Jongens, 2011). Residual noise measurements must nevertheless be done during calm and dry conditions, as required by SANS 10103.

The noise levels for the proposed plant and activities for a wellpad are then calculated using published or measured noise level data and predicted for the intended site. It is recommended that in addition to the L_{Aeq} requirements in SANS 10103, maximum noise levels (L_{Amax}) are measured for equipment, processes and vehicles to better compare the noise impacts to the WHO limits for sleep disturbance. Typical plots are not possible for this assessment as accurate activity noise levels are not available. Noise travel propagation is also affected by topography, so an assessment will be required for each wellpad. If equipment and layout is similar at each wellpad, then these assessments will be relatively quick and easy to repeat.

Corrections of tonality and impulsivity must be added to any relevant noise sources. The measurement and assessment of noise in accordance with South African Standards and Noise Regulations are obliged to be based on the Impulse L_{AIeq}. The impulsivity is thus included in all noise assessments.

Noise impacts due to road traffic noise, especially for the Big Gas scenario activities must be assessed.

The calculated activity noise levels are then compared to the measured noise levels at the noise sensitive receivers.

16.3.2 Limits of acceptable change

The NCRs state that a disturbing noise is created if the activity noise (with corrections added, if applicable) raises the ambient noise level by 3 or 7 dBA or more above the residual noise level depending on the NCR applicable to the province.

Furthermore, a noise nuisance is created if a noise impairs the peace of a person. This is a subjective assessment, and is often closely related to audibility of the noise source, and whether the person approved of the activity related to the noise. A person hostile to an activity will be more likely to be annoyed by a noise associated with that activity. People also blame unrelated noises on the activity. For assessing risk, the likelihood of audibility is a good assessment method, but can be difficult to predict or prove as "discernible noise" is often not measureable.

SANS 10103 gives categories of community or group response to noise. These can be translated to a consequence table (Table 16.3).

16.3.3 Consequence table

Table 16.3: Consequence table

	None	**Slight**	**Moderate**	**Substantial**	**Extreme**
Excess $\Delta L_{Req,T}$	0	0–10	5–15	10–20	>15
Description (Human reaction)	No detectable change in noise climate	Sporadic complaints	Widespread complaints	Threats of community or group action	Vigorous community or group action

$\Delta L_{Req,T}$ is the amount, in dB, the ambient noise level exceeds the residual noise level.

Table 16.4 shows for different activities the estimated excess above residual noise levels <u>at 4 km</u>, from Table 16.2. The impact of each excess can be compared to the consequence in Table 16.3 above. The night time excesses show that more detailed assessment is required for sites within 5 km of the activity site. Fracking will likely exceed day and night time residual levels even further from the wellpad than 5 km.

Table 16.4: Predicted excess of activity noise levels over residual noise levels at 4 km.

Activity	**Noise level L_p, dBA at 4 km from the activity**	
	Daytime	Night time
None	0	0
Access road construction	4	12
Wellpad construction	-1	7
Rotary air well drilling	-4	4
Horizontal drilling	-5	3
Fracking	23	31

Animal species differ in their sensitivities to noise exposure. Some animals will be negatively impacted, for example if they require a quiet environment to hunt or to hear predators (Barber, 2009). Consequentially, prey could thrive if their natural predators can no longer find them using hearing.

16.4 Risk assessment

For the Exploration Only scenario, noise levels from the multiple wellpad example used in Burns et al. (2016) are shown in Figure 16.1 as an illustration of noise levels at a distance, and their associated risk levels from Table 16.5. The figure shows that the risk of noise impacts from well activities reduces to low once approximately 5 km from the well. This figure does not include potential disturbance due to increased road traffic noise if roads are otherwise quiet.

Figure 16.1: Risk levels at a distance from multiple wellpads for a 30 km x 30 km area.

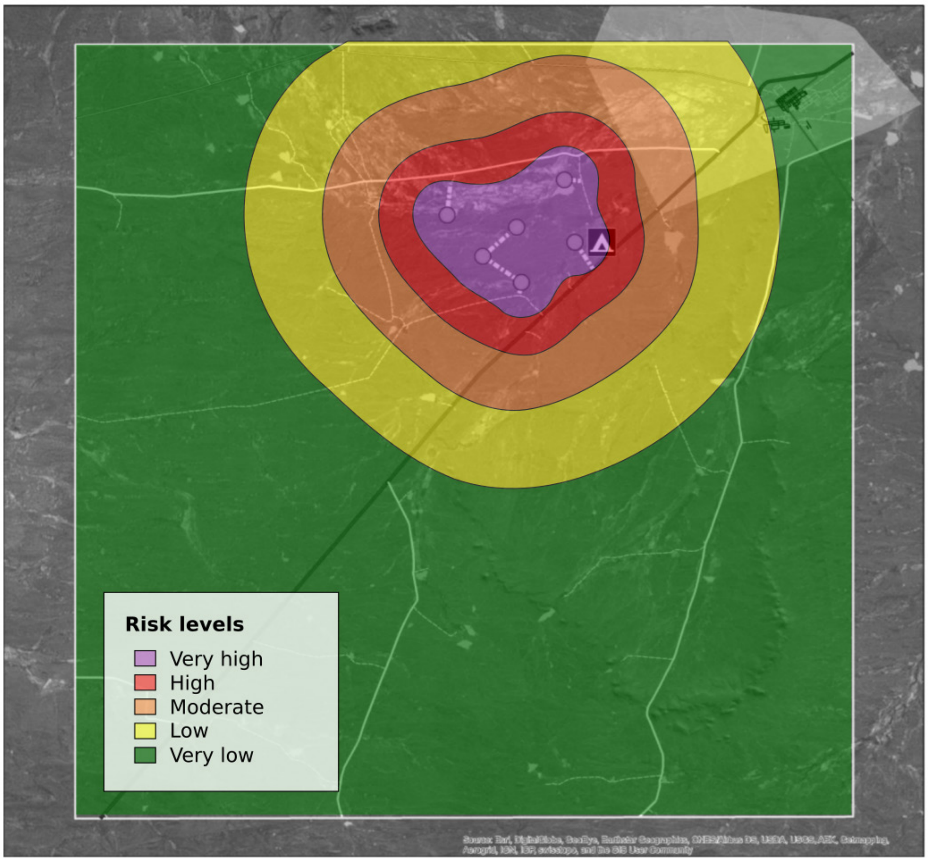

Table 16.5: Risk assessment table for noise impacts that may be caused by SGD.

Impact	Scenario	Location	*Without mitigation*			*With mitigation*		
			Consequence	**Likelihood**	**Risk**	**Consequence**	**Likelihood**	**Risk**
Disturbance to humans due to wellpad noise	Reference Case	Within 5 km of wellpads	Substantial	Extremely Unlikely	Very Low	Substantial	Extremely Unlikely	Very Low
	Exploration Only		Substantial	Extremely Unlikely	Very Low	Substantial	Extremely Unlikely	Very Low
	Small gas		Substantial	Very Likely	High	Substantial	Likely	Moderate
	Big gas		Extreme	Very Likely	Very High	Extreme	Likely	High
Disturbance to humans due to road traffic noise	Reference Case	Within 3 km of remote, quiet roads	Substantial	Extremely Unlikely	Very Low	Substantial	Extremely Unlikely	Very Low
	Exploration Only		Substantial	Unlikely	Low	Substantial	Unlikely	Low
	Small gas		Substantial	Unlikely	Low	Substantial	Unlikely	Low
	Big gas		Substantial	Very Likely	High	Substantial	Likely	Moderate
Disturbance to sensitive species	Reference Case	Within 3 km of wellpads and remote, quiet roads	Substantial	Extremely Unlikely	Very Low	Substantial	Extremely Unlikely	Very Low
	Exploration Only		Substantial	Extremely Unlikely	Very Low	Substantial	Extremely Unlikely	Very Low
	Small gas		Substantial	Likely	Moderate	Substantial	Unlikely	Low
	Big gas		Substantial	Very Likely	High	Substantial	Likely	Moderate

16.5 Best practice guidelines and monitoring requirements

At all times, the recommendations of the site's noise impact assessment must be followed. Depending on the location of the site and the plant used, the requirements may be onerous or easily complied with.

16.5.1 Planning

Avoid obviously noise sensitive areas, such as residential properties, resorts, areas where the quiet and calm nature of the place is material to its appeal. A noise impact assessment for the planned site must be done according to the methods of SANS 10328. A Noise Management Plan must be written based on this assessment, which the operator must adhere to at all times.

16.5.2 Construction

Follow the recommendations of the noise impact assessment, including noise monitoring if required. Follow the best practice guidelines in BS 5228-1 for controlling noise on open sites. Attenuate all noisy plant.

16.5.3 Operations

Follow the recommendations of the noise impact assessment, including noise monitoring if required. Follow the best practice guidelines in BS 5228-1 for controlling noise in open sites, such as the use of localised enclosures as required for noisy activities. Attenuate all noisy equipment.

16.5.4 Decommissioning

Follow the recommendations of the noise impact assessment, including noise monitoring if required. Follow the best practice guidelines in BS 5228-1 for controlling noise in open sites. Attenuate all noisy equipment. The combination of short-term, high noise level, and longer-term, constant level noise will need to be addressed in the site's Noise Management Plan.

16.5.5 Monitoring and Evaluation

It is recommended that some noise monitoring is conducted for the sites. The extent required will be determined by the noise impact assessment.

The operator must submit regular noise reports, showing that they are complying with the requirements of the noise impact assessment.

The operator should be responsible for the purchasing, installation and maintenance of any noise monitoring stations.

16.6 Gaps in knowledge

There is a lack of published and reliable measurement data in octave or third-octave bands for the noise created by SGD activities for the exploration, operation and decommissioning phases.
Such data is required by SANS for accurate propagation predictions used in the noise impact assessments and hence in the risk assessment formulation.

16.7 References

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