13 NOISE AND VIBRATION

Chapter 13 describes the existing noise environment in the area of the Gas Field Component, the potential impacts of Gas Field construction and operation on the noise environment and measures to mitigate those impacts. A preliminary noise impact assessment of the Gas Field infrastructure has been prepared and is provided in *Appendix 3.6.*

As part of front-end engineering design (FEED), QGC is considering options for infrastructure type, configuration and location for coal seam gas (CSG) extraction, transport and processing. The noise impact assessment described in this chapter is based on the Environmental Statement (EIS) Reference Case described in *Volume 2, Chapter 2.*

However, further noise impact assessments will be conducted as part of a Supplementary EIS should the final infrastructure type, configuration and location selected for FEED significantly alter the expected environmental and social impacts described below.

13.1 PROJECT ENVIRONMENTAL OBJECTIVE

The Project environmental objective for noise and vibration is to ensure that impacts arising from noise and vibration on ecological health, public amenity or safety are minimised.

13.2 OBJECTIVES

Along with the International Finance Corporation World Bank Group (IFC) guidelines and BG Group standards, noise level measurements were conducted in accordance with the following:

- general requirements of Queensland's environmental protection legislation
- Environmental Protection (Noise) Policy 2008
- *Noise Measurement Manual*, Queensland Government – Environmental Protection Agency (now Department of Environment and Resource Management – DERM), 3rd Edition, March 2000
- Australian Standard (AS) 1055.1-1997, Acoustics – Description and Measurement of Environmental Noise, Part 1, General Procedures
- IFC Environmental Noise Management Guideline[1]
- BG Environmental Expectation Standard BGS-HSSE-ENV-ST-1509[2].

---

1 International Finance Corporation, 2007. Environmental, Health and Safety (EHS) Guidelines: General EHS Guidelines. Environmental (Section 1.7: Noise)

2 BG Group document, July 1, 2007. Sets out minimum environmental requirements.

13.2.1 Noise Criteria

13.2.1.1 Construction

The DERM does not prescribe criteria for construction noise, although its E1 environmental guideline[3] recommends hours of operation and sets noise level limits for out-of-hours works. *Table 3.13.1* outlines the E1 construction noise criteria.

Table 3.13.1 E1 Construction Noise Criteria

Period		Construction Noise Criteria
Monday – Friday	7am-6pm	No criteria, although all equipment must be properly attenuated
	6pm-10pm	Rated Background Level (RBL) + 10 dB(A) $L_{Amax(adj,15min)}$
	10pm-7am	Inaudible within any habitable room of a residence
Saturday	7am-12pm	No criteria, although all equipment must be properly attenuated
	12pm-10pm	RBL + 10 dB(A) $L_{Amax(adj,15min)}$
	10pm-7am	Inaudible within any habitable room of a residence
Sunday/ Public Holidays	7am-6pm	RBL + 10 dB(A) $L_{Amax(adj,15min)}$
	6pm-10pm	Inaudible within any habitable room of a residence
	10pm-7am	Inaudible within any habitable room of a residence

1. The E1 guideline uses an $L_{max\ (adj,\ 15min)}$ parameter to compare against the background + 10 (taken as the RBL+10 dB(A)) criterion. The L_{A10} parameter is commonly used in place of the $L_{max(adj,\ 15min)}$ parameter. The L_{A10} and $L_{max(adj,\ 15min)}$ represent the average maximum noise level measured over a 15-minute time period. The L_{A10} is the noise level exceeded for 10% of the time period.

Construction noise could register as inaudible when the level is equal to or less than the rating background level (RBL) at the receiver location.

13.2.1.2 Operations

In accordance with the DERM E1 environmental guideline, the relevant noise limits for steady-state noise are:

- daytime: background + 5 dB(A)
- evening: background + 5 dB(A)
- night-time: background + 3 dB(A).

The noise limit is expressed as the $L_{Amax,adj,T}$, which is approximated by the $L_{A10,adj,T}$ – the A-weighted sound pressure level, adjusted for tonality and/or impulsiveness, and exceeded for 10 per cent of the sample period T.

---

3 Department of Environment and Resource Management E1 environmental guideline Noise from Construction, Renovation, Maintenance and Demolition Sites

In accordance with the DERM E1 environmental guideline for ‘‘remote’’ rural areas, the minimum background noise level applied at night-time is 25 dB(A), with an associated noise limit of 25 + 3 = 28 dB(A). The associated daytime and evening background noise levels and noise limits are:

- daytime: 35 (background) + 5 = 40 dB(A) noise limit from 7am to 6pm
- evening: 30 (background) + 5 = 35 dB(A) noise limit from 6pm to 10pm.

Therefore, the noise limits adopted in this impact assessment are:

- daytime: 40 dB(A) $L_{A10,adj,T}$
- evening: 35 dB(A) $L_{A10,adj,T}$
- night-time: 28 dB(A) $L_{A10,adj,T}$.

The selected noise limits are considered by the DERM to be reasonable, with regard to both QGC and the surrounding residences, and have been applied in numerous situations in rural Queensland.

13.2.1.3 Low-frequency Noise

The DERM Draft Guideline Assessment of Low Frequency Noise suggests methods to evaluate low-frequency noise below 200 Hz. It discusses Infrasound in the frequency range below 20 Hz, where the sound is often felt (e.g. as a pulsating sensation or pressure on the ears or chest) rather than heard, as well as low-frequency noise between 20 – 200Hz.

The DERM Draft Guideline suggests initial screening criteria as follows:

- The overall sound pressure level inside residences should not exceed 50 dB(Linear) – this would equate to 55 dB(A) outside the premises.

If the level exceeds 50 dB(Linear) and the dB(Linear) level exceeds the dB(A) level by more than 15 dB, then a 1/3rd octave band analysis should be undertaken for the measured data.

The DERM Draft Guideline centres on measurement of low-frequency noise, where accurate noise levels in 1/3rd octave bands can be recorded for analysis. For predicted noise levels (e.g. using noise-modelling software), the accuracy of the overall dB(A) level can be quite good, however, there is significantly less accuracy in octave or 1/3rd octave bands.

Predicted noise levels should also be compared to the measured ambient noise levels at the noise-sensitive receptor. If the predicted noise level is below the existing background (L_{A90}) level then the low-frequency industrial noise will be more difficult to hear.

13.2.1.4 *IFC Criteria*

IFC General Environmental Health and Safety (EHS) Guidelines[4] for noise specify a daytime (7 am to 10 pm), outdoors volume of 55 dB(A) and a night-time (10 pm to 7 am) volume of 45 dB(A). These levels apply for residential, institutional and educational facilities and are to be measured as a one-hour L_{eq}. IFC guidelines state that noise impacts should not exceed these levels or "*result in a maximum increase in background levels of* 3 dB(A) *at the nearest receptor location off site*".

This means that the noise from industry should not exceed the background noise level so that the total noise level does not increase by more than 3 dB(A). The IFC guidelines state that, "*In general, the noise level limit is represented by the background or ambient noise levels that would be present in the absence of the facility or noise source(s) under investigation.*"

Reading the IFC guidelines in conjunction with the referenced World Health Organisation (WHO) Guidelines for Community Noise[5], it is clear that the IFC guidelines are based on ambient L_{eq} noise levels and not L_{90} noise levels, as "background" is normally measured in Australia.

13.2.1.5 *BG Group Criteria*

BG Group specifies minimum environmental criteria for BG Group projects[6] in relation to noise, as outlined below. The noise criteria (based on hourly measurements) are for the nearest residential, institutional or educational building located outside the BG Group property boundary.

- Day (7am to 10pm): 55 dB(A)
- Night (10pm to 7am): 45 dB(A)

13.2.1.6 *Selection of Noise Criteria*

The noise criteria adopted for this assessment are those in *Section 13.2.1.2* above. These noise criteria are the most conservative (i.e. lowest dB(A)) of the above standard and guidelines.

13.2.2 *Baseline Noise Levels*

Due to the rural nature of the Gas Field, there may be times when existing ambient daytime noise levels could be at least 10 dB(A) less than the above background noise limits. Therefore, compliance with the noise limits for the different time periods does not necessarily create inaudibility.

---

4 International Finance Corporation. Environmental, Health and Safety Guidelines. http://www.ifc.org/ifcext/sustainability.nsf/Content/EnvironmentalGuidelines. accessed April 2009

5 World Health Organisation. Guidelines for Community Noise, http://www.ruidos.org/Noise/WHO_Noise_guidelines_contents.html. accessed April 2009.

6 BG Group: *Environmental Expectation Standard.* Unpublished document, BG Reference BGS-HSSE-ENV-ST-1509

Within the region of the Surat Basin, ambient noise assessments were previously conducted, by David Moore and Associates Pty Ltd, at three different locations (refer to *Figure 3.13.1*), namely:

- adjacent to the Warrego Highway (set back about 260 m from the highway) approximately 8 km east of Miles
- Kenya Field, adjacent to a residence to the west of the Kenya field compression station (FCS), approximately 2700 m distance
- Berwyndale South Field, adjacent to a residence approximately 3,400 m from the FCS.
- Table 3.13.2 provides the average ambient noise levels measured adjacent to the Warrego Highway for various averaging periods at different times.

Table 3.13.2 Average Ambient Noise Levels – Warrego Highway

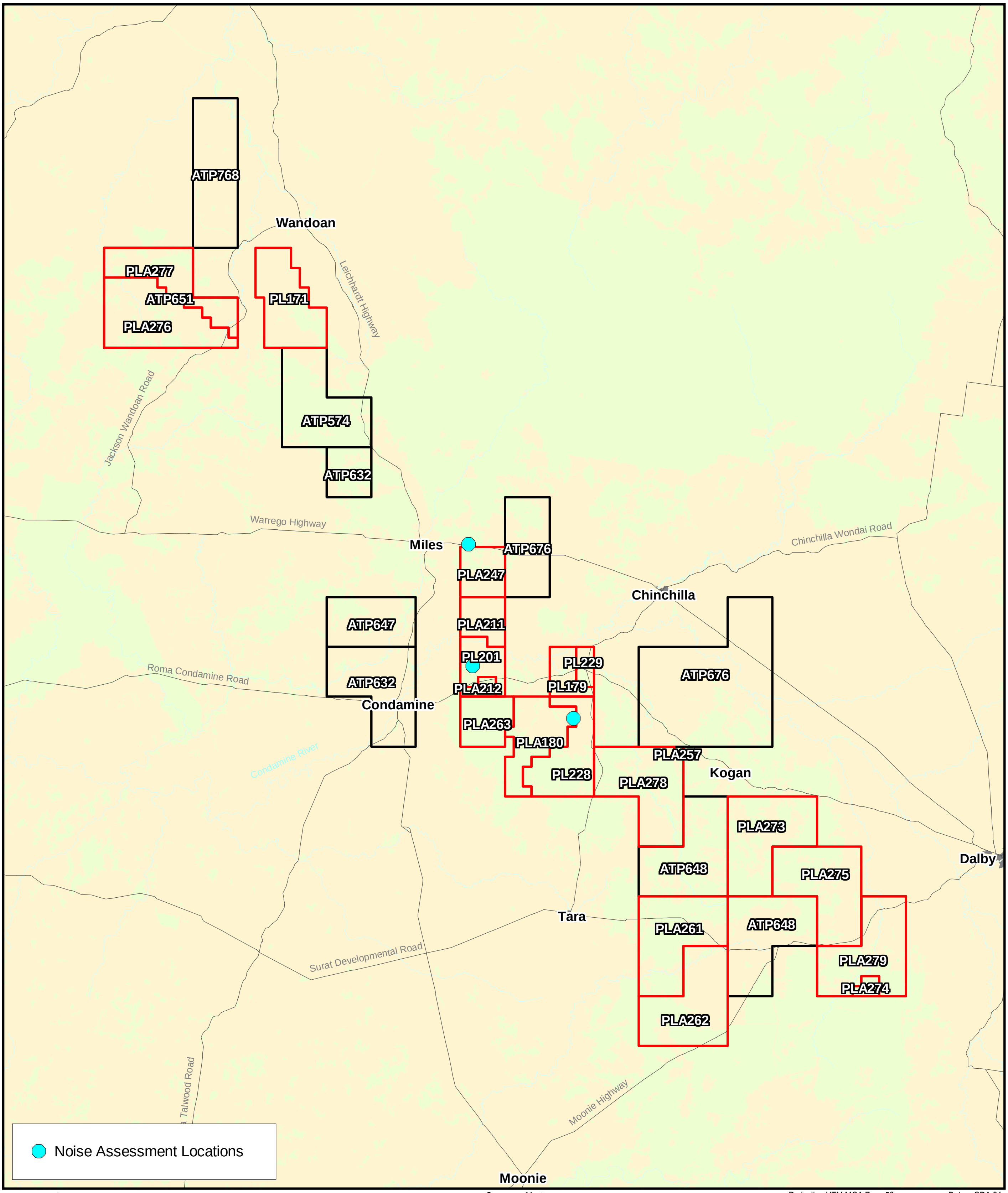
Timing Averaging Period	**Daytime (dB(A))**	**Evening (dB(A))**	**Night-time (dB(A))**
L_{Aeq}	48.6	50.1	47.3
L_{A10}	52.4	54.7	50.9
L_{A90}	36.5	27.6	25.5
L_{A90} (10^{th} percentile)	29.9	19.0	17.9

Table 3.13.3 provides the average ambient noise levels measured 2700 m from the Kenya FCS, with only one or two compressors operating, for various averaging periods at different times.

Table 3.13.3 Average Ambient Noise Levels – Kenya FCS

Timing Averaging Period	**Daytime (dB(A))**	**Evening (dB(A))**	**Night-time (dB(A))**
L_{Aeq}	46.0	28.7	37.3
L_{A10}	48.1	29.0	40.4
L_{A90}	32.2	22.6	26.1
L_{A90} (10^{th} percentile)	24.1	20.4	22.9

Note: One to two compressors operating for a seven-day period, used for the above measurements.



Legend:

Gas Fields - Petroleum Lease/Petroleum Lease Application

Gas Fields - Authority to Prospect

Source Note:
1:250,000 Topographic vector copyright Geoscience Australia

Projection UTM MGA Zone 56 Datum GDA 94

0 10 20 30 40
Kilometres

N

QUEENSLAND CURTIS LNG
A BG Group business

ERM
Environmental Resources Management Australia Pty Ltd

Project	**Queensland Curtis LNG Project**	Title	**Background Ambient Noise Assessment Locations**
Client	**QGC - A BG Group business**		

Drawn DB	**Volume** 3 **Figure** 3.13.1		
Approved CDiP	File No: QC02-T-MA-00088		
Date 10.06.09	Revision A		

Disclaimer:
Maps and Figures contained in this Report may be based on Third Party Data,
may not be to scale and are intended as Guides only.
ERM does not warrant the accuracy of any such Maps and Figures.

Table 3.13.4 provides the average ambient noise levels measured 3400 m from the Berwyndale South FCS for various averaging periods at different times.

Table 3.13.4 Average Ambient Noise Levels – Berwyndale South FCS

Timing / Averaging Period	Daytime (dB(A))	Evening (dB(A))	Night-time (dB(A))
L_{Aeq}	49.0	43.8	48.5
L_{A10}	50.4	45.5	44.1
L_{A90}	39.1	38.3	36.1

Note: Six compressors operating for a seven-day period used for the above measurements.

Despite the presence of compressors near the above noise-monitoring locations, the levels measured are likely to be a reasonable estimate of the ambient noise levels in the region. This is because there were only one or two compressors operating at the time noise measurements were made at Kenya FCS, and the distances between the compressors and the monitoring locations were great enough to make the additional impact of the compressors negligible.

13.2.3 Background Noise Sources

Within the Gas Field the current acoustic environment comprises primarily natural noises such as birds, insects and wind in the vegetation, as well as some noise associated with agricultural pursuits.

In rural areas there would generally be negligible traffic noise, except during the daytime for those residences near state highways and other main roads.

For residences within townships there would also be community noise, which in addition to the natural noises could include local traffic, air-conditioning units, people and general property maintenance.

13.2.4 Sensitive Receptors

With regard to the location of the closest residences, the information was extracted from Google Earth Imagery. All potential sensitive receptors within a 4km buffer zone of the Gas Field tenements were included. However, the data was not ground-truthed and is subject to the following inaccuracies:

- captured residences include all buildings and constructions and may not necessarily be occupied dwellings
- in high-density areas such as Chinchilla and Miles townships, residences were automatically placed within each property boundary
- where buildings were grouped in the same area, one point was used for the group.

13.3 MODELLING METHODOLOGY

13.3.1 Climate

All computer noise modelling was conducted for flat ground (no ground contours), with a ground absorption factor of -0.5 and the following atmospheric conditions:

- temperature 20ºC
- humidity 60 per cent
- a light breeze from the noise source to the receiver.

The above atmospheric conditions, in particular wind speed and direction, provide noise levels at the receptors that represent the worst-case scenario. Wind direction is always modelled from noise source to receptor. If there was no wind then the actual noise levels would be less than those predicted by the model, by approximately 5 dB(A). For a wind in the opposite direction (from the receptor to the noise source) the noise levels predicted by the model could be up to 8 to 10 dB(A) lower.

Changes in temperature and humidity levels will not change the noise levels at the closest residences by the same magnitude as wind direction and speed and, for this reason, only average temperature and humidity values have been used.

Daily and seasonal variations are not modelled. Changing these parameters to allow for daily and seasonal variations would not significantly alter the predicted resultant noise levels at the closest residences, as the worst-case scenario has been modelled.

13.3.2 Gas Field Infrastructure

The Gas Field noise sources comprise:

- well drilling
- well pump equipment
- installation of gathering lines
- engines and compressors at each FCS
- engines, compressors and flare at each Central Processing Plant (CPP)
- construction of infrastructure
- water treatment facilities and water pumps
- transport.

Well drilling will typically occur for less than two weeks at each location. Hence this noise source will be temporary and modelling has not been conducted.

Well pump equipment will typically be used for less than nine to twelve months at each well site. Hence this noise source has a limited duration. Nevertheless, noise modelling was conducted.

Installation of gathering lines will result in temporary (less than one month) noises at a particular location. Noise sources are primarily from heavy vehicles, including delivery trucks, bulldozers, excavators and cranes. Due to the temporary nature of noise from this source, modelling was not conducted.

The requirement for water treatment facilities and water pumps, as well as their location, number and type, had not been decided at the time of preparation of this EIS. Should these facilities be required (and infrastructure specifications become known), noise impact modelling and assessments will be conducted. If this occurs within an appropriate timeframe, further information will be provided in the Supplementary EIS.

Compressors are expected to operate 24 hours a day at the same location for approximately 20 years. Thus the most pertinent noise limit requiring compliance is the night-time limit of 28 dB(A).

Measured noise data for QGC's existing Torromont screw and reciprocating compressors and well pump equipment have been used for noise modelling. This noise data is considered to be a conservative representation of the noise of the screw and reciprocating compressors that may be selected during FEED.

The option of alternative compression configuration using electric drive compressors is being evaluated. Sound power levels from electric drive compressors are less than gas drive compressors. The sound power levels will be compared against the EIS reference case during FEED.

No noise data is available for the gas flares, but it has been assumed that the noise level of this activity will be 110 dB(A) at 10 m, with the top of the flare at 30 m high and being the primary noise source.

Computer noise modelling was conducted for the following scenarios:

- one FCS containing eight screw compressors
- one CPP containing 10 reciprocating compressors
- one CPP and three FCSs (a ''production unit'')
- nine CPP and 27 FCSs
- a variety of wellhead pumps
- one gas flare at a CPP.

Refer to *Appendix 3.6* for further technical details about modelling parameters and assumptions.

13.3.3 Location of Gas Field Infrastructure

The location of Gas Field infrastructure has not been determined. However, nominal compressor locations were identified based on an even distribution of compressors across the Gas Field.

These locations were used as a proxy to estimate the quantum of noise impacts on sensitive receptors. As such, impacts on sensitive receptors are only presented in general terms. It would be misleading to present noise impacts on individual sensitive receptors.

Once the final locations and types of compressors are known, further detailed modelling will be conducted to determine the impacts on sensitive receptors. This information will be presented as part of the Supplementary EIS.

13.4 IMPACTS

Noise impacts can be associated with the wellbeing of an individual as well as their lifestyle. For some people, simply being able to hear the additional noise of the Gas Field infrastructure could be sufficient to annoy or irritate, as well as cause sleeplessness or disturbed sleep. Some residents could become increasingly agitated as, in the case of compressors, the noise is likely to continue for 24 hours a day, seven days a week for extended periods.

13.4.1 Construction

Noise produced during construction will be caused by:

- machinery and equipment involved in the construction process
- vehicle movements
- temporary campsites.

Construction activities will be limited to 12 hours per day, 7 days per week, other than for drill rigs, which will operate 24 hours per day. Construction noises at any one site are expected to be limited to approximately one month for well pads and gathering lines. Drill rigs will operate at any one well site for approximately one week. Construction of individual compressor sites and water management infrastructure will occur over approximately 12 months. Due to the limited duration of construction noise at any one site, these noise sources have not been modelled. Mitigation measures to reduce the impact of construction noise are described in *Section 13.5.1*.

13.4.2 Transport

Transportation noise needs to be considered relative to state and local controlled roads as well as on private property.

With regard to private property, most vehicle movements would be during the daytime when all other ambient noise sources are at their maximum, thereby minimising potential noise impacts from transportation. Access road routes will be developed in consultation with the occupier of residences, including residences on adjoining properties. Consultation will seek to identify the routes which minimise potential noise impacts and methods to mitigate noise impacts.

For state and council-controlled roads, the greater the existing traffic volume and percentage of heavy vehicles the less likely the impact of vehicle noise associated with the Project. As such, any noticeable increase in traffic noise from state highways is not anticipated, although there could be increases of approximately 2 to 6 dB(A) on council-controlled local roads.

Table 3.13.5 shows the increase in noise level for various percentage increases in heavy vehicle traffic.

Table 3.13.5 Noise Level Increases from Heavy Vehicles

Percentage Increase in Heavy Vehicles	Noise level Increase (dB(A))
5-10	0.8
10 -20	2.0
20-30	3.0
30-40	4.0
40-50	4.6
50-60	5.1
60-70	5.6
70-80	6

Any increase will occur predominantly during the daytime when all other ambient noise levels are at their greatest, so overall transportation noise impact is likely to be insignificant.

13.4.3 Operations

13.4.3.1 Sound Power Levels

The total sound power level for one screw compressor (engine and compressor) is 122.7 dB(A).

The total sound power level for one reciprocating compressor (engine and compressor) is 121.1 dB(A).

For the wellhead pumps, the total sound power levels are:

- one Kudu Industries GTA 5.9, 116hP @ 1800 rpm (5.9L Cummins engine, turbo charged), 106.7 dB and 104.4 dB(A)SWL
- one Weatherford Model K3VL-80, s/n 6184841, @ 1600rpm, 114.7 dB and 106.6 dB(A)SWL
- one Oil Lift G5700, 101.3 dB(A)SWL.

Further details of modelling of sound power levels are provided in *Appendix 3.6.*

13.4.3.2 One CPP

Noise modelling for one CPP, comprising 10 reciprocating compressors, was conducted for an average source height of 2 m. *Table 3.13.6* details the distance from the CPP at which the daytime, evening and night-time noise limits are exceeded.

Table 3.13.6 Distances at which Noise Limits Exceeded - CPP

Noise Limit	Distance (m)
Night-time – 28 dB(A)	4000
Evening – 35 dB(A)	2700
Daytime – 40 dB(A)	1900

13.4.3.3 One FCS

Noise modelling for one FCS, comprising eight screw compressors, was conducted for an average source height of 2 m. *Table 3.13.7* details the distance from the FCS at which the daytime, evening and night-time noise limits are exceeded.

Table 3.13.7 Distances at which Noise Limits Exceeded - FCS

Noise Limit	Distance (m)
Night-time – 28 dB(A)	4300
Evening – 35 dB(A)	2800
Daytime – 40 dB(A)	2100

13.4.3.4 One Production Unit

Noise modelling for a production unit, comprising one CPP and three FCSs, was conducted for an average source height of 2 m. For the purpose of generic modelling, each CPP was located in the centre of the three FCSs, with each FCS 5 km from the CPP and 120 degrees apart (that is, equidistant at a distance of 5 km from the CPP). *Table 3.13.8* details the distance from the production unit at which the daytime, evening and night-time noise limits are exceeded.

Table 3.13.8 Distances at which Noise Limits Exceeded – Production Unit

Noise Limit	Distance (m)
Night-time – 28 dB(A)	4900
Evening – 35 dB(A)	3200
Daytime – 40 dB(A)	2400

13.4.3.5 *Entire Gas Field*

As per *Section 13.3.3*, *Location of Gas Field Infrastructure*, the compressor locations selected for impact modelling do not necessarily reflect the final compressor location.

A total of 1219 residences were included in the noise modelling for the entire Gas Field. Based on nominal compressor locations evenly distributed across the Gas Field, *Table 3.13.9* sets out the number of residences and percentage of total residences at which noise limits are likely to be exceeded.

Table 3.13.9 Residences in Excess of Noise Limits

Noise Limit	Number of residences	Percentage of total residences
Night-time – 28 dB(A)	357	29.3%
Evening – 35 dB(A)	142	11.6%
Daytime – 40 dB(A)	72	5.9%

13.4.3.6 *Well Pump Equipment*

Noise modelling for the various types of well pump equipment was conducted for an average source height of 1 m. Of the three types of well equipment modelled, the Weatherford model produced the most noise. *Table 3.13.10* details the distance from the Weatherford model at which the daytime, evening and night-time noise limits are exceeded.

Table 3.13.10 Distances at which Noise Limits Exceeded – Well Pump

Noise Limit	Distance (m)
Night-time – 28 dB(A)	800
Evening – 35 dB(A)	400
Daytime – 40 dB(A)	300

13.4.3.7 *Flares*

One flare will be located at each CPP. It is possible that detailed engineering design will identify the need for flares at each FCS. These flares are likely to have a similar impact to the flares described below. Noise data for the flare was only available as overall dB(A) sound pressure levels, namely:

- 860 kg/hr, equal to 80 dB(A) at 30 m
- 8600 kg/hr, equal to 90 dB(A) at 30 m
- 76,000 kg/hr, equal to 109 dB(A) at 30 m.

By adopting 90 dB(A) at 30 m as the source noise level for the flare, the sound power level would be approximately 131 dB(A).

Noise modelling for a flare was conducted for an average source height of 30 m. *Table 3.13.11* details the distance from the flare at which the daytime, evening and night-time noise limits are exceeded.

Table 3.13.11 Distances at which Noise Limits Exceeded - Flare

Noise Limit	Distance (m)
Night-time – 28 dB(A)	5500
Evening – 35 dB(A)	3300
Daytime – 40 dB(A)	2200

Flaring will occur only in emergencies or during maintenance. There may be approximately 20 maintenance activities a year per CPP. During maintenance activities, flaring is not expected to occur for longer than 15 minutes. There may be approximately three emergency events per year. During emergencies, flaring may continue for one hour to one day. Thus noise from flaring will be short and infrequent.

13.4.4 Low-Frequency Noise

There is the potential for low-frequency noise to be associated with drill rigs and the gas compression facilities.

Low-frequency noise will be present in most noise sources, and is assessed in 1/3rd octaves from 10 to 200 Hz. Source noise data in this frequency range was not available from either manufacturers or field data at the time of this document's preparation. Low-frequency noise assessments will be conducted at the closest sensitive receptors, based on the existing infrastructure that best replicates that proposed for the Gas Field.

Distances between noise sources and receptors that do not result in noise limits being exceeded are also expected to be sufficient to result in low-frequency noise limits not being exceeded at these receptors. For receptors that exceed one or more of the noise limits, there is an increased likelihood that the low-frequency noise limits could also be exceeded.

13.4.5 Vibration

No sources of vibration could cause blast overpressure in the Gas Field. There is potential for vibration to be associated with the drill rigs and the gas compression facilities. Drill rigs will operate for limited duration (less than two weeks in any one location). It is unlikely that there would be sufficient levels of vibration to exceed the criteria at any of the closest sensitive receptors to the vibration sources.

13.4.6 Cumulative Impacts

The cumulative impacts of all compressors to be operated by the Proponent are described in *Section 13.4.3.5*.

For noise impacts to be cumulative in conjunction with a compressor, noise sources of the same magnitude as the compressor would need to be approximately 10 to 15 km from the compressor. Other than power stations, there are no known noise sources of the magnitude of a compressor station that exist within or adjacent to the Gas Field, or within 10 to 15 km of a compressor location, that may contribute to cumulative noise impacts.

13.5 MITIGATION MEASURES

13.5.1 Construction

Limiting construction hours and scheduling the noisiest activities to occur at times of least disruption usually minimises noise impacts. Construction activities will be limited to 12 hours per day, 7 days per week, other than for drill rigs, which will operate 24 hours per day. Where construction noise has the potential to impact during those periods, affected sensitive receptors will be consulted to determine the best mitigation measures.

It is expected that the majority of construction noise will be of limited duration (less than one month) in any one area. It is expected that construction occurring in any one area for longer than one month will be for infrastructure that will be appropriately sited to minimise operational noise impacts. This will result in the construction noise being located at a distance from sensitive receptors to meet operational noise limit objectives (see below).

Other mitigation measures to reduce noise impacts during construction include:

- ensuring machinery and equipment are well maintained
- locating campsites to ensure noise impacts at nearest residences are at an acceptable level
- managing vehicle movements and transport routes.

13.5.2 Operation

Noise mitigation measures for operations include:

- selecting the optimal location for infrastructure
- purchasing equipment, where practicable, with the lowest sound power level for a particular infrastructure requirement
- constructing a complete or partial acoustic enclosure around the noise source

- constructing acoustic barriers (i.e. walls)
- noise-reduction techniques at the affected receptor.

As the final location, type and configuration of compressors is unknown, it is not possible to provide specific site and equipment noise mitigation measures. However, an overview of potential noise mitigation measures is provided below.

13.5.2.1 Location

In consultation with potentially affected sensitive receptors, each of the potential noise sources, such as well pump equipment, FCSs, CPPs and flares, will be located as remotely as possible from sensitive receptors. This mitigation measure should consider both the noise from the closest source to a particular receptor as well as the combined effect of multiple noise sources.

Generally, for every doubling of separation distance from source to receiver a further 6 dB(A) noise-level reduction is achieved. Ground absorption could provide further attenuation, but this is likely to be only an additional 1 or 2 dB(A).

13.5.2.2 Low Noise Purchases

The purchase of equipment with the lowest sound power levels will be considered as part of a Best Available Techniques (BAT) assessment, particularly for compressors in close proximity to sensitive receptors. Options include electric rather than gas-powered engines to drive compressors.

This strategy requires noise reduction of all compressor components, including the compressor unit, the engine used to power the compressor, the cooling fans and the muffler. There are too many variables to accurately calculate the magnitude of noise-level reduction achieved by purchasing a quieter noise source, but a 10 dB(A) reduction should be possible.

13.5.2.3 Acoustic Enclosures

Acoustic enclosures are to be constructed in close proximity to, and completely or partially surrounding, the noise sources. For instance, the engine and compressor could be totally enclosed in a room. However, there must be adequate ventilation and the enclosure should not restrict efficiency of the operation or present a safety risk.

Acoustic enclosures would generally be provided by the equipment manufacturer and meet safety guidelines. The equipment manufacturer should provide the data for anticipated noise-level reduction, expected to be at least 10 dB(A) and possibly as much as 20 dB(A).

13.5.2.4 *Acoustic Barriers*

Acoustic barriers made from various materials with different noise reflection or absorption properties can be constructed between a noise source and a sensitive receptor. However, they are only effective for receptors in a given direction. For receptors in the opposite direction, care must be taken to not increase their noise exposure due to reflected noise off the inside surface of the barrier.

For well pump equipment, the acoustic barrier could be reasonably small, consist of moveable screens and be constructed of suitable materials to minimise noise levels. These screens could be placed around the side of the noise source that faces the closest sensitive receptor and remain for the life of that noise source (6 to 12 months) at the well site.

For the compressor facility, any acoustic barrier would extend the total side of the compressors facing the closest sensitive receptor, with returns at each end. It is likely that this barrier would need to be at least 4 to 6 m high, lined externally with sheet metal or a denser material and internally with acoustic foam protected from the weather. Acoustic barriers should be located as close as possible to the noise source, but not create a safety risk or restrict access.

Noise-level reduction provided by an acoustic barrier would generally be in the vicinity of 5 to 8 dB(A) at the receptor.

13.5.2.5 *Treatment at the Receptor*

Prior to commencing construction and operations, those potentially impacted by noise sources will be consulted to determine appropriate mitigation measures. Acoustic treatments would generally provide noise-level reduction inside residences only (i.e. not for any external living area) and would need to be considered on a residence-by-residence basis and mitigated appropriately.

13.5.2.6 *Property Acquisition*

As a last resort, QGC could seek to acquire the property of a noise-affected receptor. This is not specifically a noise mitigation measure, but in some circumstances would occur as part of the Project where a property is purchased for the location of major infrastructure such as compressors.

13.5.3 *Results of Mitigation Measures*

For compressors with noise-limit exceedences of up to approximately 10 dB(A), mitigation measures would only need to relate to the engine and the compressor. For exceedences greater than approximately 10 dB(A), noise mitigation measures would need to relate to the engine, compressor, cooling fans and muffler, and include location choices, optimal equipment selection, acoustic barriers and treatment at the receptor. As these noise mitigation measures can complement each other, it is possible to achieve a cumulative noise-reduction level of between 10 and 40 dB(A) at a sensitive receptor.

Table 3.13.12, based on the results of modelling described in *Section 13.4.3.5*, shows the number of receptors and percentage of total receptors that would still exceed noise limits following mitigation measures that result in 10, 20, 30 and 40 dB(A) reductions.

This assumes that all mitigation measures can be applied equally for all receptors, such that an acoustic barrier provides maximum effectiveness for all receptors. Treatment at sensitive receptors is not considered in *Table 3.13.12*, as reductions in noise levels apply only to exterior noise.

Table 3.13.12 Noise Exceedences after Mitigation

Noise Limit dB(A) reduction – number and percentage of sensitive receptors in excess of noise limits	**Night-time – 28 dB(A)**	**Evening – 35 dB(A)**	**Daytime – 40 dB(A)**
10 dB(A) reduction – number of receptors	99	41	19
10 dB(A) reduction – percentage of total receptors	8.1%	3.4%	1.6%
20 dB(A) reduction – number of receptors	28	10	4
20 dB(A) reduction – percentage of total receptors	2.3%	0.8%	0.3%
30 dB(A) reduction – number of receptors	4	2	2
30 dB(A) reduction – percentage of total receptors	0.3%	0.2%	0.2%
40 dB(A) reduction – number of receptors	0	2	1
40 dB(A) reduction – percentage of total receptors	0%	0.2%	0.1%

The following conclusions can be made from the above table:

- mitigation measures of greater than 30 dB(A) result in virtually no exceedences of any noise limits at sensitive receptors
- mitigation measures of 10 dB(A) result in a decline in the number of sensitive receptors in excess of night-time noise limits, from 357 (refer Section 13.4.3.5) to 99, a decrease of 72 per cent
- mitigation measures of 20 dB(A) result in 28 (2.3 per cent) sensitive receptors exceeding night-time noise limits.

13.5.4 Mitigation of Temporary Noises

A number of noise sources are temporary, such as well establishment and gathering-line installation. Noise associated with temporary sources will predominantly be dealt with by community consultation and, in some circumstances, direct communication with individual landholders.

13.6 CONCLUSION

The primary noise source from the Gas Field Component of the QCLNG Project will be the operation of compressors. Other noise sources have either low noise levels or limited duration and do not present a significant impact to the environment.

There is inherent uncertainty in modelling noise impacts, as the final location, type and configuration of the compressors is not known. Nor has the location of sensitive receptors been tested.

Initial modelled results, based on worst-case scenarios, indicate that approximately 350 residences could experience noise levels in excess of limits identified for this assessment.

Mitigation measures may result in a 10 to 40 dB(A) reduction in noise levels at sensitive receptors. This could significantly decrease the number of sensitive receptors exceeding noise limits to less then five. A summary of the impacts outlined in this chapter is provided in *Table 3.13.13*.

Table 3.13.13 Summary of Impacts for Noise

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Long-term
Impact extent	Local
Impact likelihood	High

Overall assessment of impact significance: minor to negligible when appropriate site selection and mitigation measures are employed.