7.10 Noise and Vibration

7.10.1 Introduction

The following section provides a summary of the noise and vibration assessment findings, including a description of the existing environmental values, assessment of potential noise impacts and recommended mitigation measures in accordance with the ToR requirements for the EIS. Further details are provided in Appendix U1.

7.10.2 Methodology

The noise and vibration assessment considered the potential noise and vibration impacts associated with the construction and operational phases of the gas transmission pipeline and included:

- A description of the existing acoustic and vibration environment surrounding the proposed gas transmission pipeline corridor;
- An overview of applicable construction and operational noise and vibration goals based on relevant legislation and EPA guidelines;
- Noise and vibration modelling to predict the potential impacts at representative assessment locations during the construction and operational phases of the gas transmission pipeline. Modelling methodology used for potential noise and vibration of the pipeline are as follows:
  - Noise modelling was carried out using the SoundPLAN (Version 6.4) utilising the CONCAWE prediction methodology. The computer model calculated noise emission levels and considered source sound power level (SWL), location, distance attenuation, ground absorption, air absorption, shielding attenuation, and meteorological conditions including wind effects. Predictions were carried out for various off-set distances from construction and operational activities of the pipeline to determine the distances at which the appropriate noise criteria would be achieved. Noise predictions were based on the assumption that there is flat, soft ground between the noise source and the receiver.

    Modelled off-set distances included:

    - 50 m;
    - 100 m;
    - 250 m;
    - 500 m;
    - 1,000 m;
    - 2,000 m; and
    - 5,000m.

    Further details on the methodology and equipment SWL used in the model are provided in Appendix U1; and
  - Assessment of vibration impacts was determined based on measured vibration associated with blasting (refer Appendix U1) and compared to impact guidelines (refer Section 7.10.3). The applicable off-set distance was then derived on the basis of predicted vibration.

    Traffic vibration impacts were assessed on the basis that heavy trucks passing over normal (smooth) road surfaces generate relatively low vibration levels, typically ranging from 0.01 mm/s to 0.2 mm/s at the footings of buildings located 10 m to 20 m from a roadway. Depending on the roadway surface, very large surface irregularities can cause vibrations up to 5 to 10 times higher than that of smooth road surfaces.

- Road traffic noise predictions associated with gas transmission pipeline roads were modelled using the Calculation of Road Traffic Noise (CoRTN) prediction technique recommended by the Main Roads Code of Practice. The model accounts for traffic volumes, composition, vehicle speed and road surface.
- Rail traffic noise predictions associated with gas transmission pipeline were modelled using the Nordic Rail Traffic Noise Prediction Method (Kilde 130) recommended by the Queensland Rail (QR) Code of Practice. The model accounts for traffic volumes, speed and length of train/consist.

  Cumulative road noise was assessed based on anticipated traffic movements associated with construction and operations workers as a percentage of existing road traffic. Further assessment of cumulative noise impacts associated with project related transport is considered in Section 4.

- An overview of possible mitigation measures to minimise the potential for impacts associated with the gas transmission pipeline.

A full description of the gas transmission pipeline used as the basis for the assessment is provided in Section 3.7.

7.10.3 Regulatory Framework

7.10.3.1 Noise

Refer section 6.10.3 for relevant legislation and guidelines.

Construction Criteria

The EPP (Noise) does not include construction noise limits, with noise impacts minimised by limiting the hours of operation to:

- Monday- Saturday: 6:30am to 6:30pm.

The adopted project noise and vibration criteria for the construction phase are described in Table 7.10.1.

Table 7.10.1 Summary of Construction Criteria

Construction Noise		Vibration			Blasting	
Monday to Saturday (6:30am to 6:30pm)	Monday to Saturday (6:30pm to 6:30am); Sundays and Public Holidays	Structural Damage (mm/s)	Human Comfort (mm/s)		Airblast (dB Linear Peak)	Vibration (mm/s PPV)
			Day	Night		
No limit	50 dBA LAmax	12.5	0.3 – 0.6	0.2	115	> 35 Hz - 25 < 35 Hz - 10

Operational Noise Criteria

All operational noise emissions were assessed in accordance with *EcoAccess* which considers:

- Background noise creep criteria;
- Planning noise levels criteria;
- Short term intrusive noise criteria;
- Sleep disturbance noise criteria; and
- Low frequency noise criteria.

Background Noise Creep Criteria

The background noise creep criteria aim to prevent an incremental increase in background noise from all noise sources. Where existing noise levels approach the recommended Rating Background Level (RBL), criteria must be adjusted to prevent background creep. The RBL's for each sensitive receiver were determined from ambient noise monitoring (refer Table 7.10.5) conducted at each sensitive receiver. The background creep criteria were then developed from the RBL in accordance with EcoAccess and are presented in Table 7.10.2.

A full description of the methodology used to derive the adopted criteria for the gas transmission pipeline is provided in Appendix U1.

The most significant continuous noise sources associated with the gas transmission pipeline development were assessed against the applicable background noise creep criteria with the exception of noise from the mainline valves and blowdown vents which was assessed against the short term intrusive noise criteria (transient noise sources). Refer Appendix U1 for further details.

Planning Noise Level Criteria

Maximum Planning Noise Levels (PNLs) for various noise area categories are also recommended within EPA, 2004. Where existing noise levels in an area approach the maximum PNL, the noise level from any new source must be controlled to preserve the amenity of the area. To achieve this, the EPA 2004 recommends modifications be made to the maximum PNL depending on the existing noise levels (based on measured maximum LAeq(1hour) noise levels as see in Table 7.10.6.

Short Term Intrusive Noise Criteria

The short term intrusive noise criteria (SNL) are based on the existing measured RBL with the addition of 3 dBA (refer Table 7.10.2) as per EcoAccess. The SNL noise criteria are in terms of the LAeq(1 hr) noise level.

In very rural areas (where minimum LA90 is lower than 25 dBA) it may be possible for the (LAeq) SNL to be calculated to a lower noise level than the recommended background creep level (LA90) due to the 25 dBA threshold nominated for background creep in the Guideline. It is considered to be appropriate to set the SNL (LAeq level) higher than the background creep level (min LA90), therefore background creep + 3 dBA has been adopted for the SNL in these instances.

Sleep Disturbance Noise Criteria

The guideline recommends that in order to achieve good night of sleep, internal noise levels should not exceed:

- L_{Amax} of 45 dBA > 10 - 15 times per night.

The project adopted the sleep disturbance noise criteria of 50dBA assumes a conservative 5 dBA attenuation from building facade (refer Appendix U1 for further detail). The sleep disturbance noise criteria are shown in Table 7.10.1 (construction noise) and Table 7.10.2 (operational noise).

Low Frequency Noise Criteria

The potential for low frequency noise in the range of 20 Hz to 200 Hz was assessed in accordance with *EcoAccess Guideline: Assessment of Low Frequency Noise*. The adopted project criteria for low frequency noise are provided in Table 7.10.2 and are based on the guideline limit of 20 $L_{pA,LF}$ (dBA) and a conservative estimate of 3 dBA attenuation from building façades (for low frequency noise).

Table 7.10.2 Project Operational Noise Criteria

Noise Assessment Location	Background Noise Creep Criteria LA90(1hour) (dBA)			Design Criteria[1] LAeq(1hour) (dBA)			Sleep disturbance[2] LAmax (dBA)			Low Frequency Criteria[2] LpA,LF (dBA)		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
Gas & Pipeline 3	29	25	25	28	28	28	N/A	N/A	50	28	23	23
Gas & Pipeline 4	32	25	25	30	28	28	N/A	N/A	50	28	23	23
Gas & Pipeline 5	26	25	25	28	28	28	N/A	N/A	50	28	23	23
Gas & Pipeline 6	26	25	25	28	28	28	N/A	N/A	50	28	23	23
Gas & Pipeline 7	34	27	25	32	30	30	N/A	N/A	50	28	23	23
Gas & Pipeline 8	34	26	25	32	28	28	N/A	N/A	50	28	23	23
Gas & Pipeline 9	33	25	25	33	32	32	N/A	N/A	50	28	23	23

Note 1: Design criterion is the most stringent of the Planning Noise Level (PNL) and Specific Noise Level (SNL) (as defined in EcoAccess).

2: Sleep disturbance and low frequency criteria have been adjusted to represent outdoor levels.

7.10.3.2 Vibration

Refer to section 6.10.3.2 for guidelines on human comfort and structural damage.

Blasting

The *EPP (Noise) Environment Protection Amendment Regulation 1999 (No. 2)* contains the following blast emissions (air blast and vibration) criteria:

"Noise from blasting is not unlawful environmental nuisance for an affected building if:

- The air blast overpressure is no more than 115 dB Linear Peak for 4 out of 5 consecutive blasts: and
- *The ground vibration is:*
  - For vibrations of more than 35 Hz – no more than 25 mm/s ground vibration, peak particle velocity; or
  - For vibrations of no more than 35 Hz – no more than 10 mm/s ground vibration, peak particle velocity."

The EPP (Noise) 1999 does not nominate times of blasting, however the Queensland EPA's *Ecoaccess Guideline: Noise and Vibration from Blasting* contains both blast emissions criteria and times of blasting.

Ecoaccess Guideline: Noise and Vibration from Blasting contains the following blasting noise criteria:

> Blasting activities must be carried out in such a manner that if blasting noise should propagate to a noise-sensitive place, then-
>
> 1) *The air blast overpressure must not be more than 115 dB(linear) peak for nine out of any 10 consecutive blast initiated, regardless of interval between blasts, and*
> 2) *The air blast overpressure must not exceed 120 dB(linear) peak for any blast.*

Ecoaccess Guideline: Noise and Vibration from Blasting contains the following blasting vibration criteria:

> Blasting operations must be carried out in such a manner that if ground vibration should propagate to a noise-sensitive place, then:
>
> 1) *The ground borne vibration must not exceed a peak particle velocity of 5 mm per second for 9 out of any 10 consecutive blast initiated, regardless of interval between blasts, and*

2) *The ground borne vibration must not exceed a peak particle velocity of 10 mm per second for any blast.*

Ecoaccess Guideline: Noise and Vibration from Blasting contains the following times for blasting events:

> Blasting is only permitted during the hours of 9 am to 3 pm, Monday to Friday, and from 9 am to 1 pm on Saturdays. Blasting should not generally take place on Sundays or public holidays.
>
> Blasting outside these recommended times should be approved only where:
>
> 1) *blasting during the preferred times is clearly impracticable (in such situations blasts should be limited in number and stricter air blast overpressure and ground vibration limits should apply); or*
> 2) *There is no likelihood of persons in a noise-sensitive place being affected because of the remote location of the blast site."*

Further details on the noise and vibration criteria for blasting are contained in Appendix U.

7.10.3.3 Road Traffic Noise Criteria

Refer to section 6.10.3.3 for road traffic noise criteria.

7.10.3.4 Rail Traffic Noise Criteria

Rail traffic noise criteria applicable to the project are:

- 87 dBA $L_{Amax;}$ and
- 65 dBA L_{Aeq} (24 hours).

These are in accordance with the noise planning levels stipulated in both QR's Code of Practice for Railway Noise Management ("the Code") and EPP (Noise) 1997. The Code was first endorsed for use by the Minister for the Environment in 1999. Following the required review, the Minister for Sustainability, Climate Change and Innovation re-endorsed the use of Version 2 of the Code in December 2007.

Unless it is specifically stated, it may be assumed that all rail traffic noise levels quoted in this assessment apply to a position one metre in front of the most exposed facade of a noise sensitive building and therefore include the appropriate facade correction (+3 dBA) for rail noise.

7.10.4 Existing Environmental Values

7.10.4.1 Sensitive Noise Receptors

The gas transmission pipeline corridor extends approximately 435 km from the CSG fields to the proposed LNG facility on Curtis Island. For the majority of its route, the gas transmission pipeline traverses rural farming land and forested areas and is expected to be at a distance from populated centres and rural residences. Existing noise sources are typical of rural areas and include traffic, insects/birds and local noises associated with rural based human occupation. Existing noise sources in the surrounding communities of Yarwun and Gladstone include industry, rail and road traffic noise and insect/bird noise.

Sensitive receptors as defined in the *Environmental Protection (Noise) Policy 2008 (EPP Noise)* and EPA (2006) were not identified due to the vast spatial coverage of the gas transmission pipeline corridor. Instead, existing ambient noise and vibration levels were recorded at various distances from the proposed locations of construction and operational works associated with the gas transmission pipeline.

7.10.4.2 Existing Ambient Noise

To determine the existing ambient noise environment in the vicinity of the gas transmission pipeline corridor, attended and long term unattended ambient noise monitoring was conducted at seven sites designated as Gas & Pipeline 3 to Gas & Pipeline 9. The sites were selected to provide spatial coverage of the communities surrounding the pipeline and are considered representative of the surrounding residential area in order to assess the pre-existing noise environment. A full description of the monitoring sites is provided in Table 7.10.3 and their location in relation to the pipeline is illustrated in Figure 7.10.1.

Unattended monitoring

Unattended monitoring was conducted continuously at each of the seven monitoring sites using ARL EL-215 and EL-316 Noise Loggers (NATA certified). Unattended monitoring was used to determine the RBL which is the 90th percentile background (L_{A90}) noise level during an assessment period (day evening and night) for the duration of monitoring in accordance with the *Queensland Environmental Protection Agency's EcoAccess Guideline Planning for Noise Control*. Unattended monitoring was undertaken during 16 June 2008 to 30 June 2008 (Gas & Pipeline 3-8).

Attended monitoring

Attended monitoring was conducted at each of the seven monitoring sites using a Rion NA-27 Precision Sound Level Meter. Attended monitoring was undertaken to confirm noise levels with an operator present. It also enabled the identification of nearby noise sources during the recording period to enable interpretation of results.

Attended monitoring was conducted for one 15 minute period during the day (7 am - 6 pm), evening (6 pm - 10 pm) and night (10 pm - 7 am) recording periods. Attended monitoring was conducted between the following dates:

- 16 to 19 June 2008 (Gas & Pipeline 3 - 8);
- 25 and 26 June 2008 (Gas & Pipeline 8 - night only); and
- 15 July 2008 (Gas and Pipeline 9).

Table 7.10.3 Ambient Noise Monitoring Locations

Monitoring Site	Description of Monitoring Site	
	Location	Logger Position
Gas & Pipeline 3	Fairview Road: 400 m west of intersection with Beilba Rd.	Positioned on fence approximately 15 m from house.
Gas & Pipeline 4	Carnarvon Development Road : 55 km north of Injune.	Positioned on fence approximately 100 m from house.
Gas & Pipeline 5	Arcadia Valley: Arcadia Valley Road	Positioned in paddock ~300 m from house*.
Gas & Pipeline 6	North of Banana: Baralaba-Banana Road, ~15 km north of Banana.	Positioned in paddock ~300 m from house*.
Gas & Pipeline 7	North of Biloela: Jambin Dakenba Road, ~15 km north of Biloela.	Positioned near house along fence on driveway.
Gas & Pipeline 8	West of Gladstone (corner of Mount Alma Road & Kaluda Road).	Positioned near house along fence.
Gas & Pipeline 9	Springwater Overseer's Cottage (corner of Mount Alma Road & Kaluda Road).	Positioned 50 m away from house*.

* Unable to be positioned closer to house due to machinery noise in immediate vicinity.

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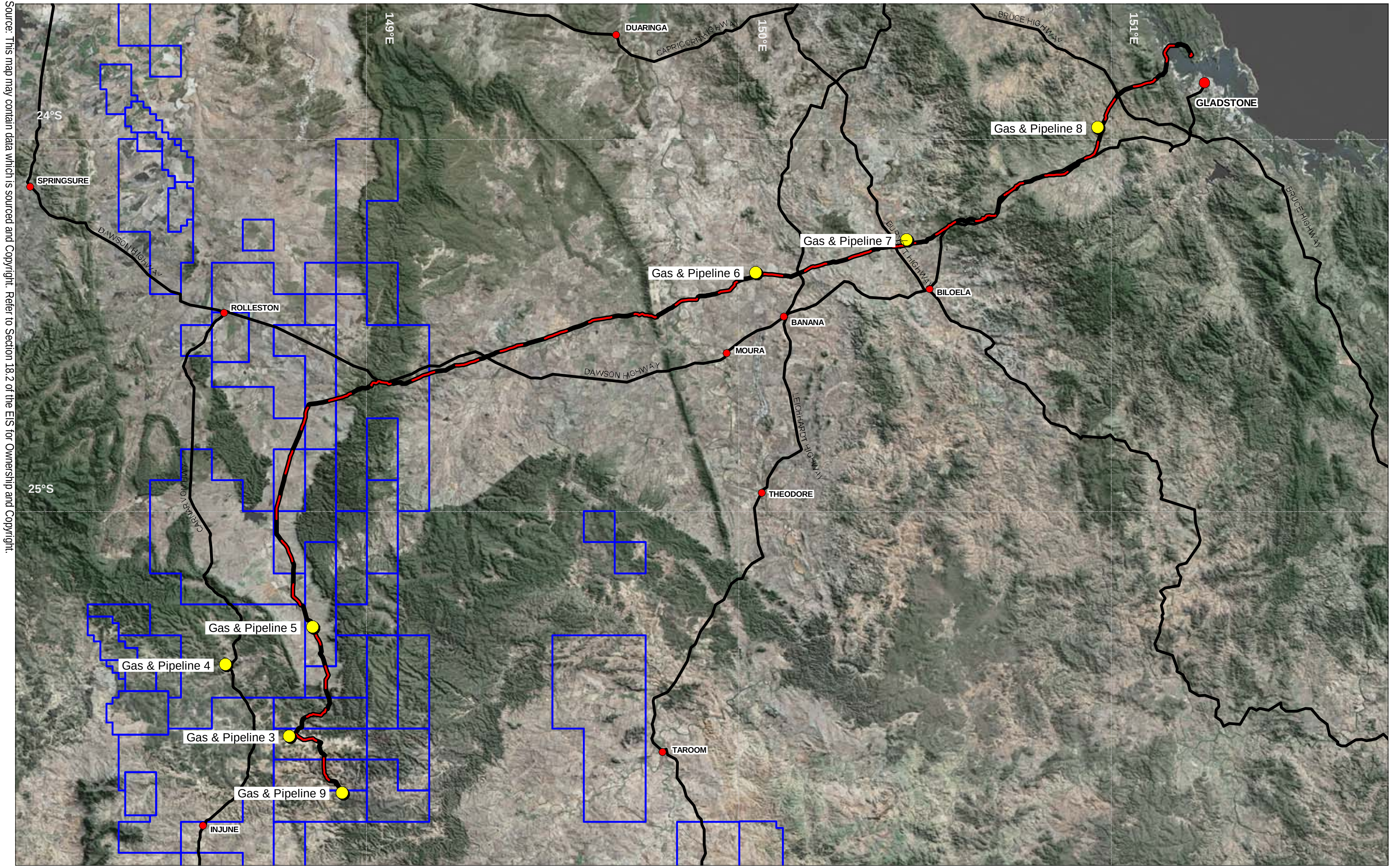

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Scale: 1:1,500,000 (A4)
Datum: GDA94

Ambient Noise Monitoring Locations
Gas Transmission Pipeline
Major Highway
CSG Fields

URS

Client: LNG

Project: GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Title: **AMBIENT NOISE MONITORING LOCATIONS FOR THE GAS TRANSMISSION PIPELINE**

Drawn: CA | Approved: JB | Date: 27-02-2009

Job No: **4262 6220** | File No: 42626220-g-865.wor

Figure: **7.10.1** | Rev: B | A4

7.10.4.3 Ambient Noise Sources

Ambient noise sources include general industrial noise for Gas & Pipeline 7 and intermittent noise sources associated with birdlife. Seasonal noise such as insects (typically during the summer months) and prevailing weather conditions have been corrected for in the measurement results. Gas & Pipeline 3 – 6 and 8 were noted as being extremely quiet (below 25 dBA) during the evening and night-time periods as shown in Table 7.10.5.

A summary of noise sources identified during attended monitoring and results is provided in Table 7.10.4.

Table 7.10.4 Attended Monitoring Results and Noise Sources

Monitoring Location	Date	Time (end of 15 min period)	Measured Noise Level (dBA)			Comments
			LA90	LAeq	LA10	
Gas & Pipeline 3	17/06/08	12:45 pm	27	42	37	Birds active and dominant; minor insect noise; truck pass-by on Fairview Road (55 - 65 dBA); light tree movement with breeze.
	-	-	-	-	-	No evening attended measurement due to safety of site access at night.
	-	-	-	-	-	No night attended measurement due to safety of site access at night.
Gas & Pipeline 4	17/06/08	5:45 pm	26	40	41	Birds, insects and cow noise dominant noise sources. Distance traffic just audible (trucks ~ 35 dBA).
	17/06/08	6:15 pm	19	34	34	Insect, bird and cow noise all dominant though not loud; distant traffic on Carnarvon Development Road audible (truck ~ 35 - 40 dBA, car ~25-32 dBA).
	-	-	-	-	-	No night attended measurement due to safety of site access at night.
Gas & Pipeline 5	17/06/08	3:15 pm	21	30	32	Insects and birds dominant; light tree movement in breeze; 4WD drove by on dirt road (45 - 47 dBA over 15 seconds).
	-	-	-	-	-	No evening attended measurement due to safety of site access at night.
	-	-	-	-	-	No night attended measurement due to safety of site access at night.
Gas & Pipeline 6	18/06/08	12:45 pm	19	32	34	Bird and cow noise dominant; light tree movement in breeze; traffic pass-by on local road (40 - 45 dBA over ~20 seconds).
	18/06/08	9:30 pm	25	28	30	Insects dominant (3.15 kHz dominant); distant cow and frog noise.
	-	-	-	-	-	No night attended measurement due to safety of site access at night.
Gas & Pipeline 7	18/06/08	3:45 pm	28	35	36	Insect and bird noise dominant; occasional car pass-by on local road (32 - 35 dBA); distant construction noise (road works ~500m) – just audible.

Monitoring Location	Date	Time (end of 15 min period)	Measured Noise Level (dBA)			Comments
			LA90	LAeq	LA10	
	18/06/08	6:15 pm	64	66	67	Insects loud and dominant (3.15 kHz dominant); occasional car pass-by on local road (didn't raise levels above insects).
	18/06/08	11:00 pm	32	39	32	Insects dominant noise source; distant rail/industry noise to NE (coal mine) – low frequency noise.
Gas & Pipeline 8	19/06/08	12:45 pm	26	32	35	Insects and birds dominant noise source; light tree movement in breeze; distant creaking of tin roof on house and shed in sun.
	19/06/08	9:30 pm	31	36	35	Insects dominant noise source; distant mechanical noise (pump); truck passing by on Mt Alma Rd (up to 45 dBA for ~30 - 45 sec).
	26/06/08	2:15 am	17	21	23	Very quiet at this location; occasional frog noise; distant train movement just audible.
Gas & Pipeline 9	15/07/08	10:45 am	28	36	39	Birds dominant, light tree movement. Passing 4WDs audible (~38 - 42 dBA), 5 pass-bys in 15 min block. Distant construction noise from booster site.
	-	-	-	-	-	No evening attended measurement due to safety of site access at night.
	-	-	-	-	-	No night attended measurement due to safety of site access at night.

Note: Daytime (7.00 am to 6.00 pm), evening (6.00 pm to 10.00 pm) and night-time (10.00 pm to 7.00 am).

Noise Monitoring Results

Rating Background Level

The RBL levels were derived from the monitoring program following adjustment to take into consideration the noise floor of the logger as well as extraneous noise such as insects and wind. The adjusted ambient noise monitoring results are presented in Table 7.10.5.

Table 7.10.5 Ambient Noise Monitoring Results

Monitoring Location	Rating Background Level (dBA)		
	Day	Evening	Night
Gas & Pipeline 3	24	18 [1]	18 [1]
Gas & Pipeline 4	27	19[1]	18[1]
Gas & Pipeline 5	21 [1]	18 [1]	17[1]
Gas & Pipeline 6	21 [1]	18 [1, 2]	18 [1]
Gas & Pipeline 7	29	27	27
Gas & Pipeline 8	29	21 [1, 2]	18 [1]
Gas & Pipeline 9	30	29	29

Note 1: Adjusted to account for the noise floor of logger (noise floor referring to the lower limit that the noise logger can record noise). The adjustments to account for the noise floor are based on analysis of logger results, attended noise measurements and field observations.

2: Adjusted to correct for enhanced noise levels as a result of insect noise

The maximum $L_{Aeq(1hour)}$ noise level representative of the ambient noise environment was noted for the daytime, evening and night-time periods. The representative maximum $L_{Aeq(1hour)}$ noise levels at each location are shown in Table 7.10.6.

Table 7.10.6 Maximum LAeq(1 hour) Noise Levels

Monitoring Location	Rating Background Level (dBA)		
	Day	Evening	Night
Gas & Pipeline 3	54	37	41
Gas & Pipeline 4	52	38	43
Gas & Pipeline 5	46	29	40
Gas & Pipeline 6	55	32	43
Gas & Pipeline 7	51	58	46
Gas & Pipeline 8	54	52	50
Gas & Pipeline 9	49	40	47

7.10.5 Potential Impacts and Mitigation Measures

7.10.5.1 Noise Impact Assessment

The assessment included the identification of potential noise sources associated with the gas transmission pipeline and development of a noise model which includes the sound power level (SPL) of the identified noise sources to calculate the predicted noise level associated with the construction and operation of the gas transmission pipeline.

Due to the size of the gas transmission pipeline corridor, predictions have been carried out at various off-set distances from construction and operational activities conducted in these areas to determine the distances at which the appropriate noise criteria (see Section 7.10.3) would be achieved.

A low frequency noise assessment has not been carried out for noise sources associated with the operation of the gas transmission pipeline as low frequency noise is not a characteristic of pipeline construction or operational phases.

Potential Noise Sources

Noise emissions from the normal operation of a gas transmission pipeline are considered to be insignificant. Once the gas transmission pipeline has been constructed and commissioned, there should not be any requirement for movement of large plant or equipment along the gas transmission pipeline corridor (except for planned maintenance and upset situations) and noise levels along the easement will return to pre-existing levels.

In an upset situation and during planned maintenance, high pressure gas venting may occur at the mainline valves and scraper stations. The typical sound power level from this gas venting will be approximately 120 dBA.

Construction

Specific construction activities associated with the gas transmission pipeline development include:

- Survey and fencing;
- Clear and grade;
- Blasting (preparation);
- Trenching, stringing and lowering step (chain/wheel trencher or an excavator);
- Welding and joint coating;
- X-ray and pressure test;
- Padding and backfilling;
- Tie-ins, push sections and road crossings; and
- Restoration and rehabilitation.

The safe working level (SWL) of construction equipment is provided in Appendix U1.

Rail Laydown Areas

Rail laydown areas are proposed to store pipe joints used to construct the gas transmission pipeline. Laydown areas are planned to only operate during daytime hours although there is a risk that operations will be carried out on Sundays or public holidays. Therefore the construction noise criteria outside "normal" working hours may be applicable. Typical noise sources for rail yards and laydown areas are provided in Table 7.10.7.

Table 7.10.7 Summary of Typical Maximum Sound Power Levels for Laydown Areas

Equipment	Typical L_{Amax} Sound Power Level (dBA)
Crane truck	105
Forklift	100
Loco Idling	99

Blasting

Blasting may be required to form the trench in areas of igneous rock unable to be separated by mechanical methods. Typical blast parameters used to assess blast noise and vibration from blasting are provided in Table 7.10.8.

Table 7.10.8 Typical Blast Design Parameters

Parameter	Free-Face
Bench height.	4.2 m
Stemming (using 20 mm aggregate).	2.7 m
Blast hole diameter.	102 mm
Blast hole spacing.	3.0 m
Burden.	3.0 m
Maximum Instantaneous Charge (MIC).	10, 25 and 50 kg

Operation

Potential noise sources during the operational phase primarily relate to the intermittent and short term operation of vents at mainline valves. Mainline valves will be located approximately every 75 km along the gas transmission pipeline. Venting at mainline valves during planned maintenance and upset situations has a typical SPL of 120 dBA.

7.10.5.2 Predicted Noise Impacts and Mitigation

Construction Phase

Construction Equipment

The predicted noise levels for all stages of the gas transmission pipeline construction works are shown in Table 7.10.9. The most significant noise is generated from earthmoving activities such as clearing, grading, restoration and rehabilitation.

There is no day time criterion applicable for day time construction work. Construction noise is predicted to meet the 50 dBA LAmax sleep disturbance noise criterion at assessment locations with an off-set greater than 500 m from the construction activities. A summary of minimum off-set distances for work performed during night-time or public holidays for each work activity is described in Table 7.10.9.

Table 7.10.9 Predicted Noise by offset distance

Activity	Noise Criteria[1] (dBA)	Predicted Noise Level at Buffer Distance (dBA)							Minimum Required Buffer (m)
		Buffer Distance (m)							
		50	100	250	500	1,000	2,000	5,000	
Survey and fencing	50	68	60	47	38	30	21	6	225
Clear and grade	50	76	68	57	49	40	31	16	475
Blasting (preparation)	50	71	63	52	42	33	23	7	300
Trenching, stringing and lowering step	50	77	69	56	47	39	31	15	425
Welding and joint coating	50	71	62	50	42	34	26	10	250
X-ray and pressure test	50	69	62	50	41	32	23	8	250
Padding and Backfilling	50	73	65	54	46	38	29	13	375
Tie-ins, push sections and road crossings	50	71	64	54	45	37	28	13	375
Restoration and rehabilitation	50	76	68	57	50	42	33	18	500

Note 1: Night-time (6.30 pm to 6.30 am) and public holiday noise criteria only applicable for construction work that can not be limited to daytime on Monday to Saturday.

Rail Laydown Areas

Based on the noise sources associated with rail laydown areas stated in Table 7.10.10, an off-set buffer distance was predicted at which compliance with the 50 dBA LAmax sleep disturbance noise criteria is achieved (see Table 7.10.11).

Table 7.10.10 Offset Distances from Laydown Areas to Achieve Noise Criteria

Process	Relevant Sleep Disturbance Criterion (dBA)	Offset Buffer Distance (m)
Unloading pipe joints at laydown/ storage areas	50	400

If rail laydown areas are required to be located closer than 400 m to sensitive receptors, mitigation measures may be required and should be determined in consultation with the affected residents.

Blasting

Blasting activities will meet the air blast criterion of 115 dBL (maximum of 120 dBL) based at the minimum offset distances as summarised in Table 7.10.11. In general, residences were predicted to be impacted within 420 m of blast locations (dependant upon the blast configuration).

Table 7.10.11 Offset Distances to Comply with Noise (Airblast) Criteria

Maximum Instantaneous Charge	Offset Distances (m)	
	Airblast	
	115 dBL	120 dBL
10 kg	250	160
25 kg	330	210
50 kg	420	260

Construction Mitigation

The adoption of off-set buffer distances is expected to limit the likelihood of construction noise and vibration impacts on residents surrounding the gas transmission pipeline corridor. Where applicable, construction work during evening and night-time periods (6.30 pm to 6.30 am) and on Sundays/public holidays will be undertaken in accordance with "best practice" noise management where sensitive noise receptors are present. AS 2436-1981 "*Guide to Noise Control on Construction, Maintenance and Demolition Sites"* sets out numerous practical recommendations to assist in mitigating construction noise emissions. Noise control strategies that will be considered for construction activities carried out on the gas transmission pipeline are listed below.

- Source Noise Control Strategies:
  - Quietest plant and equipment that can economically undertake the work will be selected, wherever possible; and
  - Regular maintenance of equipment in order to keep it in good working order.
- Work Practice Control Strategies:
  - Construction work to occur, wherever possible, within the daytime period;
  - Where practicable, avoid the coincidence of plant and equipment working simultaneously close together;
  - Operators of construction equipment to be made aware of the potential noise problems and of techniques to minimise noise emission through a continuous process of operator education; and
  - For transportation of materials for the gas transmission pipeline in railway wagons special care should be taken to avoid metal against metal impact noises during rail operations. This can be avoided by lining the railway wagons with a rubber mat and in a similar way isolate between the pipes and other materials being transported.

- Community Liaison Strategies:
  - Utilise existing community consultation framework to provide access to information for the community and maintain positive relations with residents; and
  - For short term gas transmission pipeline construction noise alternative arrangements may be considered.

Transport

Due to the low potential for traffic related noise impacts, no mitigation measures are proposed.

Operational Phase

The predicted noise levels associated with intermittent mainline valve operation during emergency situations indicates that the short term intrusive noise criteria (28 dBA) would be met at an off-set buffer distance of 1,500 m.

Operation Mitigation

Mainline Valve

Due to the low number of mainline valves required, adoption of the off-set buffer distance (1,500 m) when positioning the mainline valve will eliminate the need for mitigation measures associated with their intermittent use. If the off-set buffer from a sensitive receptor is not obtainable mitigation measures will be implemented to minimise the impact.

7.10.6 Vibration Impact Assessment

7.10.6.1 Potential Vibration sources

Construction Phase

Potential sources of ground vibration associated with the construction of the gas transmission pipeline include:

- Truck traffic;
- Blasting;
- Mobile equipment; and
- Ground treatments (i.e. compaction, piling).

7.10.7 Predicted Vibration Impacts and Mitigation

7.10.7.1 Construction Phase

Transport

Vibration levels from truck traffic are expected to be significantly below both “building damage” and “human comfort” criteria.

Blasting

Vibration from blasting will meet the peak vector sum (PVS) ground vibration criterion of 5 mm/s (maximum of 10 mm/s) following the adoption of off-set distances summarised in Table 7.10.12 (depending upon the blast configuration and methodology). The PVS is the summarised peak particle

velocity (PPV) in both horizontal and vertical directions. The vibration criteria were predicted to be exceeded within 220 m of blast locations.

Table 7.10.12 Offset Distances to Comply with Noise (Airblast) and Vibration Criteria

Maximum Instantaneous Charge	Offset Distances (m)	
	PVS Ground Vibration	
	5 mm/s	10 mm/s
10 kg	<100	<100
25 kg	150	<100
50 kg	220	130

7.10.7.2 Operational Phase

Pipeline Operation

There are no major sources of vibration associated with the operation of the gas transmission pipeline.

Transport

Road vibration impact from the operational phase of the gas transmission pipeline is expected to be insignificant due to the low number of daily traffic movements (approximately eight vehicles per day).

7.10.8 Transport Noise Impact Assessment

7.10.8.1 Potential Road and Rail Traffic Sources

It is proposed that 20 seater 4WD buses will be utilised to transport workers flying in/out of the surrounding townships to the accommodation facilities along the gas transmission pipeline corridor. Transport noise generated by the project will be highest during the construction phase with approximately 150 daily traffic movements associated with workforce movement. During the operational phase, daily traffic flow will be minimal and is estimated at approximately eight vehicle movements per day although during short periods of maintenance or repair works, this number of daily vehicle movements could be increased. Further information on traffic numbers/movements are provided in Section 4.

Construction of the gas transmission pipeline will require transportation of pipe joints and other materials from ships at Auckland Point (Gladstone) to designated pipeline/material laydown areas at the beginning of the construction program (2010 – 2011) for a period of approximately six months. Two transportation options have been proposed for this transportation of materials including:

- Truck - approximately 67 truck loads per day between Gladstone and designated laydown areas; and
- Rail - approximately one rail load per day between Gladstone and Moura.

Noise impacts associated with truck traffic are discussed below in 7.10.5.6, while rail traffic is discussed in Section 7.10.5.7.

7.10.8.2 Predicted Road Transport Noise Impacts and Mitigation

New Roads

No new roads are expected for the gas transmission pipeline so therefore a road traffic noise assessment has not been undertaken.

Existing Road Noise

Based on anticipated traffic movements associated with workers (via 20 seater buses), an increase of greater than 2 dBA from road traffic associated with the GLNG Project may occur for roads with existing traffic volumes (assuming 15 % heavy vehicles typical of a rural highway) are less than the following:

- 950 vehicles per day when the contribution of gas transmission pipeline traffic during the construction phase is 150 vehicles per day (100 % of gas transmission pipeline vehicles are classified as heavy vehicles).

If current traffic volumes per day and/or percentage of heavy vehicles are higher than those nominated above, the incremental increase in road traffic noise levels will be lower than 2 dBA (refer Section 4).

Incremental changes in road traffic noise levels of greater than +2 dBA would only occur for roads where the existing traffic volumes are low. Therefore the overall noise emissions from road traffic will also be minimal.

The number of heavy vehicles transporting pipe joints for the gas transmission pipeline construction phase is expected to consist of approximately 134 truck movements per day (67 loaded and 67 empty). If the existing road traffic volume on these roads is greater than 850 vehicles per day with 15 % heavy vehicles, the incremental increase in road traffic noise due to the project would be less than 2 dBA. This increase will be negligible.

Transport Mitigation - Road

Due to the low potential for traffic related noise impacts, no mitigation measures are proposed.

7.10.8.3 Predicted Rail Transport Noise Impacts and Mitigation

Rail noise levels for existing rail traffic, including the proposed additional rail traffic during the construction of the gas transmission pipeline have been predicted at distances of 25 m, 50 m, 100 m and 200 m to residential receivers. The parameters used to predict the existing and future rail noise levels are summarised in Appendix U1.

Rail traffic noise emission levels were predicted by reference to the general rolling stock emissions used by QR and represented by two noise sources:

- Diesel-Electric locomotives (sources at 4 m above rail); and
- Freight consists (sources at 0.5 m above rail).

It should be noted that predicted noise levels assume propagation over flat, soft ground and don't take into account elevated noise levels due to rail curves, bridge crossings, turnouts, mechanical joints, braking or squeal noise.

As there is to be no change to the type of locomotive and rolling stock, it would be expected that there will be no change in the L_{Amax} noise level at any of the nearby receptors due to the addition of any proposed rail traffic associated with the gas transmission pipeline construction. The predicted maximum noise levels at 25 m from the rail line between Moura and Gladstone and inside Gladstone is 85 dBA L_{Amax}, which complies with the L_{Amax} noise criterion of 87 dBA.

Existing Rail Noise

Based on the existing and future rail parameters, rail noise levels were predicted for various off-set buffer distances to residences adjacent to the rail corridor. The predicted existing $L_{Aeq\ (24hour)}$ noise levels and cumulative $L_{Aeq\ (24hour)}$ noise levels due to the gas transmission pipeline construction phase are shown in Table 7.10.13 and Table 7.10.14.

Table 7.10.13 Predicted LAeq (24-hour) Noise Levels – Moura to Gladstone Rail Operations

Distance to Receiver (m)	Existing Trains $L_{Aeq(24\ hours)}$ (dBA) [1]	Incorporating GLNG Trains $L_{Aeq(24\ hours)}$ (dBA) [2]	Criteria $L_{Aeq(24\ hours)}$ (dBA)
25	60	61 (+0.2)	65
50	57	57 (+0.3)	65
100	53	54 (+0.3)	65
200	50	50 (+0.2)	65

Note 1: Existing rail traffic on Moura to Gladstone line is 26 trains per day

2: Incorporating GLNG rail traffic on Moura to Gladstone line, there are 28 trains per day (2 additional trains per day due to GLNG)

Table 7.10.14 Predicted LAeq (24-hour) Noise Levels – Gladstone to Auckland Point Rail Operations

Distance to Receiver (m)	Existing Trains $L_{Aeq(24\ hours)}$ (dBA) [1]		Incorporating GLNG Trains $L_{Aeq(24\ hours)}$ (dBA) [2]		Criteria $L_{Aeq(24\ hours)}$ (dBA)
	30 km/h	50 km/h	30 km/h	50 km/h	
25	46	49	47	51	65
50	42	45	44	47	65
100	39	42	40	44	65
200	35	39	37	40	65

Note 1: Existing rail traffic on Gladstone to Auckland Point line is 4 trains per day

2: Incorporating GLNG rail traffic on Gladstone to Auckland Point line, there are 6 trains per day (2 additional trains per day due to GLNG)

Table 7.10.13 and Table 7.10.14 show the cumulative effect to the $L_{Aeq(24hour)}$ noise level from the additional rail movements associated with the pipeline construction phase is less than 0.5 dBA for the Moura rail line (outside Gladstone) and approximately 1.5 dBA increase on the rail section down to Auckland Point.

A change of up to 3 dBA in the level of a sound is difficult for most people to detect. The cumulative effects of the additional rail movements are considered to be negligible. Therefore no noise attenuation measures are proposed to attenuate noise from rail traffic.

It should also be noted that all rail traffic associated with the project would only operate during daytime hours and the additional trains associated with the project would only be required during the beginning of the construction phase (approximately the first six months) when the pipes and other associated materials for the gas transmission pipeline are being delivered.

7.10.9 Cumulative Noise Impacts

Section 1 identifies other proposed gas transmission pipelines associated with other potential CSG Projects. There is limited information available as to the planned development or timing of these projects. However, a qualitative assessment can be made of the possible cumulative impacts.

Some sections of the proposed gas transmission pipeline corridor may be located within an area where these other pipelines are proposed to be located in the future.

Cumulative noise impacts were inherently assessed through the background creep (L_{A90}) and planning noise level (L_{Aeq}) criteria contained within EcoAccess (see Section 7.10.3.1). The criteria takes into account the existing ambient noise level associated with existing industry and road/railway traffic and a comparison with recommended ambient noise levels for various land use types.

The cumulative effect of noise emission from the pipeline development and any other proposed industrial developments (including any other pipeline developments) is assessed to not exceed the recommended ambient noise levels, on the basis that any other proposed industrial developments would be required to achieve the same noise criteria which are applicable for the GLNG Project. In some circumstances the existing ambient noise level may already be above the recommended noise levels. Where this is the case, noise generated by the pipeline development will be maintained at approximately 8 or 10 dBA below the existing ambient noise level. This should ensure that the cumulative noise impacts of the project will be negligible.

In the event that the “Yarwun Neck” in the Gladstone State Development Area (GSDA) contains multiple pipelines, cooperation between the relevant pipeline development proponents and regulatory agencies will be required to minimise noise impacts.

The Queensland Government has advised that its preference is for the gas transmission pipelines for all LNG facilities proposed for Curtis Island to be located in a common pipeline corridor across the GSDA, including the Port Curtis Crossing and Curtis Island pipeline sections to minimise potential impacts in this area.

It is expected that the other gas transmission pipeline development projects will include some or all of the proposed mitigation measures in relation to noise described in this section. By utilising the mitigation methods the expectation is the minimisation of the cumulative impacts on the receiving environment.

Table 7.10.15 provides a summary of potential noise and vibration impacts and mitigation measures for the gas transmission pipeline.

Table 7.10.15 Potential Noise Impacts and Mitigation Measures

Aspect	Potential Impact	Mitigation Measures	Objective
Construction			
General construction noise	Excess noise associated with drilling, blasting and/ or general construction equipment noise (SWL).	• Select pipeline route and infrastructure locations in accordance with required offset distance guidelines. • Avoid use of routes near sensitive receptors for construction haulage where practicable. • Fit all construction equipment with noise attenuation mufflers. • Maintain equipment to reduce noise generation. • Limit construction work during evening and night-time periods (6.30 pm to 6.30 am) and on Sundays/public holidays where sensitive receptors are present.	Minimise potential for cumulative noise impacts from existing field operation and construction activities.
Operation			
Air blast	Potential air-blast impacts associated with blasting for pipeline construction.	• Undertake blasting activities in accordance with required off-set distances to meet noise guidelines. • Limit blasting during evening and night-time periods (6.30 pm to 6.30 am) and on Sundays/public holidays where sensitive receptors are present.	Minimise potential for noise impacts associated with pipeline blasting requirements.
Mainline valve (MLV) operation	Excess noise associated with MLV operation	• If possible MLVs will be located outside of the 1,500 m buffer to sensitive receptors. If MLVs are within the off-set buffer mitigation measures will need to be implemented to mitigate the impact.	Minimise potential for noise impacts associated with intermittent compressor mainline valve operation.

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7.10.10 Summary of Findings

7.10.10.1 Construction

The noise and vibration assessment identified that compliance with the applicable criteria is achievable with the adoption of appropriate off-set buffer distances between construction plant items and noise sensitive receptors.

The road traffic noise assessment carried out for project-related vehicle movements revealed that impacts from road traffic noise are predicted to be minimal.

The rail traffic noise assessment carried out for project-related rail movements revealed that impacts from rail noise are predicted to be minimal.

7.10.10.2 Operation

Noise sources associated with the operation of the gas transmission pipeline consist of only noise from the operation of the MLVs during intermittent gas venting for planned maintenance and upset situations. The MLVs are to be positioned outside of the required off-set buffer distance in order to meet project objectives for noise, if possible. There are no major vibration sources associated with the operational phase of the gas transmission pipeline which are likely to generate vibrations at the sensitive receptors.

The construction and operational phases of the pipeline are expected to have minimal impacts to the surrounding environment and will not increase background noise and vibration levels above that of the existing environment.