13 NOISE AND VIBRATION

13.1 INTRODUCTION

This chapter of the supplementary environmental impact statement for the proposed Queensland Curtis LNG (QCLNG) Project provides responses to noise and vibration related submissions received on the draft EIS of August 2009, where it pertains to the LNG Component of the Project. This chapter also presents, where relevant, additional information gathered on noise and vibration and provides an assessment and discussion of new or altered impacts as a result of amendments to the Project description since the publishing of the draft EIS.

Amendments to the Project description as pertaining to the LNG Component of the Project are outlined in *Volume 2, Chapter 9* and *Chapter 13* of this sEIS. Key amendments applicable to noise and vibration include:

- a relocation of the footprint of the LNG Plant within the LNG Facility boundary, approximately 150 m further inland and to the east (see *Volume 2, Chapter 9* of this sEIS for the revised site layout)
- relocation of the product loading jetty further south
- building a Construction Dock south of the jetty
- removal of the Mainland Road/Bridge Approach and Curtis Island Road from the Project scope.

13.2 RESPONSES TO SUBMISSIONS

Table 5.13.1 provides a summary of the comments received on noise and vibration issues pertaining to the LNG Component. The table also indicates the relevant section of the draft EIS to which the submission pertains, a response or indication of where in this chapter or elsewhere in the sEIS the comment is addressed and the final column is the unique identifier allocated to each submitter.

A full list of submissions (summary) is provided in sEIS *Appendix 2.1.*

Table 5.13.1 Summary of LNG Component noise and vibration submissions on the draft EIS

Summary of Submission	QCLNG Response	Submitter Number
Neighbouring LNG plants on Curtis Island should be considered the nearest noise-sensitive receptor. Potential noise impacts from QCLNG operations should be assessed and mitigation proposed.	See *Section 13.4.3*	32

Summary of Submission	QCLNG Response	Submitter Number
Noise impacts of pipe unloading, stockpiling and transportation on residents near Auckland Point (including at Auckland Hill) need to be considered.	See *Section 13.3* for pipe handling and stockpiling noise impacts. Transportation noise impacts are addressed in *Section 13.6.2*	29
Cumulative impacts need to consider traffic noise from heavy vehicle transport of bulk materials and pipes.	See *Section 13.6.2*	29

13.3 ADDITIONAL INPUT TO THE NOISE AND VIBRATION BASELINE

The amendments to the LNG Component project description, as outlined in *Section 13.1,* have not required additional noise and vibration baseline information to be gathered, as the study area remains the same as that presented in the draft EIS. However, as further Project definition became available on potential transport routes for aggregate materials to the mainland areas of the Project (Auckland Point and RG Tanna) and on personnel movements at Auckland Point, an evaluation of potential traffic noise on sensitive receptors near these routes could be undertaken. Detail of traffic volumes and routes is provided in *Volume 5, Chapter 14* of this sEIS.

Although not expected to result in any major changes to noise and vibration impacts (which were found to be of minor significance when assessed in the draft EIS), a noise study has been undertaken to evaluate potential changes to impacts as a result of the Project changes described above. A full description of the methodology and results from the sEIS Noise and Vibration Study can be found in the technical report attached as *Appendix 5.7.*

13.3.1 Changes at the LNG Facility

Components of the proposed LNG Facility have moved approximately 100 to 150 m further away from the shoreline. This move, along with a redesigned bench plan, has resulted in portions of the LNG Plant being located at higher levels than those previously assessed.

The base height of the LNG trains has been increased to RL13.5 m Australian height datum (AHD). There are no changes to the Plant capacity or noise sources that were modelled for the draft EIS.

In the draft EIS, two operational scenarios were assessed. Scenario one represented initial plant operations, with a single LNG process train operating, while Scenario two represented full production capacity, i.e. three trains. Owing to further Project refinement, it was decided to also model a two-train scenario (i.e., combined Trains One and Two) as the base case, with the future case being a three-train scenario.

Furthermore, the LNG Plant construction was initially proposed to be a predominantly daytime operation, with some activities, such as tank slipforming, occurring at night. However, the current Project description includes a site preparation phase of some three months at the start of the construction program during which vegetation clearing and bulk earthworks activities will occur on a 24-hour basis. As noted in *Volume 2, Chapter 13*, there will also be other periods throughout Project construction where 24-hour works will be required, for uninterrupted activities and for scheduling.

13.3.2 Results of the Baseline Traffic Noise Monitoring

The proposed aggregate haulage route follows approved B-double roads (heavy haul routes) from the Dawson Highway, turning north onto Don Young Drive, continuing via Red Rover Road to Hanson Drive, then taking one of two routes: via Alf O'Rourke Drive to a barge terminal near the RG Tanna coal facility, or following Hanson Drive to Glenlyon Road, turning onto the Port Access Road to reach laydown areas/barge terminals at Auckland Point.

Personnel vehicle access to the Auckland Point industrial area will be via Port Access Road and may also occur via the Young Street railway overpass to the south. Potential traffic and transport impacts are discussed further in *Volume 5, Chapter 14* of this sEIS.

Four residential locations were identified as potentially being affected by traffic noise associated with haulage and as such they were designated as noise assessment locations (NALs), namely, NAL 8 to NAL 11 (NAL 1 – 7 having been described in the draft EIS). Noise measurements were carried out at these locations between 9-23 November 2009, using unattended noise loggers. Attended noise monitoring was also undertaken at each location at different times of the day to better characterise the existing noise sources.

The noise monitoring locations are situated at:

- 148 Col Brown Avenue, at the corner of Don Young Drive.
- Apartments on the corner of Glenlyon Street and Port Access Road.
- 107 Auckland Street, adjacent to Port Access Road as it crosses over Auckland Street.
- 43 Toolooa Street, opposite the Young Street bridge.

Figure 5.13.1 illustrates the indicative haulage routes (subject to variation depending on source of materials) as well as the location of the four additional Project NALs.

QUEENSLAND CURTIS LNG
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Project	Queensland Curtis LNG Project	Title	Location of the Proposed Haul Route and Noise Assessment Locations
Client	QGC - A BG Group business		
Drawn	JB	sEIS Volume 5	Figure S5.13.1
Approved	BW	File No:	0086165b_SUP_GIS001_S5.13.1
Date	19.01.10	Revision	0

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13.4 UPDATE OF NOISE IMPACTS

An evaluation of impacts resulting from the Project changes and additional monitoring information is presented in the following sections.

13.4.1 Impacts Associated with Changes to the LNG Plant

Noise criteria for NALs assessed during the draft EIS remain unchanged.

13.4.1.1 Noise Impacts during Operations

Predicted noise levels from operations at the revised LNG Plant location are set out in *Table 5.13.2* and the differences between the draft EIS and current predicted values are summarised in *Table 5.13.3*. Criteria listed are for day, evening and night-time and values are represented in dBA.

Table 5.13.2 Predicted Operational Noise Levels for revised LNG Plant

Receptor	Criteria (dBA)	Operational Noise, 3-train (dBA)			Operational Noise, 2-train (dBA)		
Location	**D / E / N**	**Neutral**	**Adverse**	**Typical**	**Neutral**	**Adverse**	**Typical**
NAL1 Gladstone Marina	48/47/40	24	32	21	22	30	19
NAL2 Fisherman's Road, Yarwun	39/39/40	30	38	34	28	36	32
NAL3[4] South End, Curtis Island	35/25/27	9	17	7	4	11	1
NAL4 Flinders Parade, Gladstone	43/39/39	23	31	20	22	30	19
NAL5 Tide Island	33/34/32	30	**37**	27	29	**36**	25
NAL6 Lord Street, Gladstone	45/35/38	23	31	20	22	30	19
NAL7 Smith Street, Targinie	33/35/33	24	32	30	22	30	28

1 All levels are L_{Aeq} in dB(A)
2 Levels in bold exceed the lowest criterion for that location
3 Neutral is calm weather, Adverse is a moderate temp. inversion, Typical is ESE breeze
4 The three-train levels are significantly higher than the two-train levels at NAL3, as the third train experiences less attenuation from natural terrain than the first and second process trains.
5 D= Day, E= Evening, N=Night

Table 5.13.3 Change from the Draft EIS Predictions – 3-Train Scenario

Receptor	Operational Noise, 3-train (dBA)		
Location	**Neutral**	**Adverse**	**Typical**
NAL1	-1	-1	-1
NAL2			
NAL3	-2	-1	-1
NAL4	-1	-1	-1
NAL5			
NAL6	-1	-1	-1
NAL7			

1 All levels are L_{Aeq} in dB(A)
2 Numbers represent the change in predicted noise level for each location
3 Blanks represent no change from the previous predictions
4 Neutral is calm weather, Adverse is a moderate temp. inversion & Typical is an ESE breeze
5 Refer to *Table 5.13.16* of the draft EIS *Volume 5, Chapter 13* for the predicted noise levels from the three-train scenario

From *Table 5.13.2* and *Table 5.13.3*, it is evident that the revised LNG Plant location results in slightly lower or unchanged predicted noise impacts at all receptors for the three-train scenario. This change in predicted noise impacts can be attributed to the additional shielding effect of the terrain as a result of the relocation of the plant further eastwards.

As noted in the draft EIS, the predicted operational noise levels are below the relevant criteria for all locations under neutral and typical weather conditions. Under adverse conditions, predicted operational noise levels are below the relevant criteria for all locations except NAL5 (Tide Island).

Predicted noise levels at NAL5 (the residence at Tide Island) exceed the criteria under adverse conditions (temperature inversion and calm wind conditions) due to its proximity (approximately 5 km) to the proposed LNG Plant – see the noise contours in *Figure 5.13.2*. While the predicted noise levels are 5 dB(A) above the criteria, inversions are likely to be infrequent in the Gladstone Harbour area, as they are less likely to form over water, and winds are calm for only 14 per cent of the time, based on Bureau of Meteorology windroses. As this is less than the 30 per cent referred to in the Department of Environment and Resources Management (DERM) EcoAccess Guideline *Planning for Noise Control*, this exceedance is not considered significant.

In the future, it is likely that noise from the proposed QCLNG LNG Plant will be masked by noise from other industry, including the proposed Wiggins Island coal terminal, south of Hamilton Point.

QUEENSLAND CURTIS LNG
A BG Group business

Project	Queensland Curtis LNG Project
Client	QGC - A BG Group business

Title: **LNG Facility Operational Noise Contours, 3 - Train Scenario, Adverse Conditions**

ERM
Environmental Resources Management Australia Pty Ltd

Drawn	JB	sEIS Volume 5	Figure S5.13.2
Approved	BW	File No:	0086165b_SUP_GIS002_S5.13.2
Date	11.01.10	Revision	0

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13.4.1.2 Noise Impacts during Construction

The revised LNG Plant layout does not significantly affect the assessment of construction noise described in the draft EIS. This is because the initial noise modelling placed the equipment on top of the natural terrain levels, i.e. prior to excavation of material to form bench platforms. This resulted in noise sources being higher relative to nearby terrain (that might in reality provide shielding of noise) and therefore represented a highest (worst case) scenario. The revised Plant layout provides additional screening from terrain.

Plant construction noise meets the construction noise criteria for the 6am-6pm period. However, site preparation works (including vegetation clearing and bulk earthworks) conducted at night would result in an exceedance by 2 dB(A) of the night-time construction noise criteria at NAL5 (Tide Island), under neutral wind conditions. Under adverse weather conditions (i.e. temperature inversion), full plant construction at night may exceed the construction criteria by 3 dB(A) at NAL2 (Fisherman's Road), 11 dB(A) at NAL5 (Tide Island), and 1 dB(A) at NAL7 (Targinie).

The level of exceedance at NAL5 (Tide Island) indicates that the construction noise would be clearly audible under these adverse conditions, albeit infrequently. However, these noise levels would only occur for a small percentage of the year on occasions with full plant construction occurring on a calm night and with a temperature inversion, which is unlikely.

Based on the above, plant construction at the amended location is not expected to cause a significant noise impact.

13.4.2 Potential Construction Traffic Related Impacts

Aggregate haulage is expected to occur on an 18-hour basis, with schedule slippage or peak construction activity necessitating 24-hour haulage when required.

Traffic noise criteria have been drawn from the Queensland Main Roads Code of Practice[1]. However, there are no specific criteria for night-time truck movements in Queensland, therefore, a comparison with existing traffic noise levels has been used to assess the potential noise impacts at night (between 10pm and 7am).

Existing traffic on Don Young Drive is 2,438 vehicles per day (24 hours), with 1,750 vehicles per day recorded on Port Access Road[2]. Traffic numbers for the QCLNG Project indicate peak truck movements of approximately 240 truck movements per day. This would not result in any significant increase in traffic

1 Qld Department of Main Roads "Road Traffic Noise Management – Code of Practice", January 2008

2 Traffic count data was provided by the QCLNG traffic and transport consultants, Halcrow MWT (November 2009)

noise during the day and evening, when considerable numbers of vehicles (including a large number of heavy vehicles) already use these roads.

Based on the latest available Project traffic numbers, the road traffic noise level at NAL8 (near Don Young Drive) is expected to increase by 1.5 dB(A), to approximately 61.5 dB(A). This remains well below the criterion of 68 dB(A) for increases in traffic on an existing road. At NAL9 (the western end of the Port Access Road), an increase of 240 truck movements per day would increase traffic noise levels by less than 1 dB(A) to 68-69 dB(A), due to the already high numbers of vehicles on Glenlyon Street and Port Access Road. NAL10 would experience a similar increase of about 1 dB(A), to a total of 72 dB(A).

The actual increase in noise level at NAL 9 and NAL 10 (Auckland Street near Port Access Road) will be less than that noted, as a percentage of the 240 trucks will travel to RG Tanna (via Alf O'Rourke Drive) and not to Auckland Point. While these levels are greater than the L_{10}(18 hour) 68 dB(A) criterion, they are less than a 3 dB(A) increase considered to be significant. Therefore, haulage of bulk materials is not expected to cause significant noise impacts during the day and evening periods.

At night, traffic numbers indicate a Project peak night-time traffic load of six truck movements per hour for Don Young Drive, and 12 truck movements per hour for the Port Access Road. At this rate, individual vehicles passing by are separated by several minutes or more, and the noise levels experienced at residences are dependent upon individual vehicle noise emissions rather than the number of vehicles. Noise monitoring on-site showed existing truck pass-by noise levels of 72-79 dB(A). Noise from proposed trucks would be at a similar level. Therefore, although the number of vehicles passing by during the night would increase with the additional QCLNG traffic, the noise level of a typical pass-by would not.

13.4.3 Potential Impacts on the Gladstone LNG Construction Camp

There are no standard noise criteria for construction camps, as they are temporary in nature and while residential in use, they are built for the convenience of having the construction workforce in proximity to the work site. Depending on construction and operational timing, it is possible that the Gladstone LNG (GLNG) construction camp may be occupied when the QCLNG Facility is under construction or operating. The land use at this time would be industrial.

The relationship between the GLNG camp and the proposed QCLNG Plant is indicated in *Figure 5.13.3*.

Australian Standard AS1055[3] provides average background noise levels for different areas containing residences in Australia, and is useful in providing

3 AS1055.2 - 1997 Acoustics – Description and measurement of environmental noise Part 2: Application to specific situations.

estimated noise levels for future residential uses. For areas within predominantly industrial districts, AS1055 provides the following background noise levels: day 65 dB(A); evening 60 dB(A); and night 55 dB(A). When industries construct buildings on their own sites (including worker accommodation), they are required to be designed to meet acceptable internal noise levels (taking into account sleep disturbance and speech interference) for the types of external noise levels generated from their industrial noise sources. Hence, if the noise from an adjacent industry meets these levels then the impact from the QCLNG Plant should be acceptable.

As described in the GLNG EIS[4], the GLNG camp (located at approximately RL20-24 m) will be located to the south-east of the plant. This is a favourable location from a noise perspective as the ridgeline (varying from RL32 m to RL56 m) situated immediately to the north-west shields the camp from the QCLNG site. Noise modelling predictions indicate that noise levels of 40-45 dB(A) would be experienced at the GLNG construction camp site during construction and operation of the QCLNG facility. These levels are below the background noise levels of 55 dB(A) expected for an industrial area at night, hence no significant noise impacts are expected at the GLNG camp.

4 Santos, 2009. Gladstone LNG Environmental Impact Statement

QUEENSLAND CURTIS LNG A BG Group business	Project	Queensland Curtis LNG Project	Title: Proposed Location of the GLNG Plant and Camp
	Client	QGC - A BG Group business	
ERM Environmental Resources Management Australia Pty Ltd	Drawn: JB	sEIS Volume 5 Figure S5.13.3	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
	Approved: BW	File No: 0086165b_SUP_GIS003_S5.13.3	
	Date: 19.01.10	Revision: 0	

13.4.4 Pipe unloading and stockpiling at Auckland Point

Approximately 260 km of pipeline will be brought into Gladstone via ship and offloaded at Auckland Point. Area 4 at Auckland Point (see *Volume 2, Chapter 13*) has been designated as the pipe laydown area, i.e. for pipe stockpiling prior to distribution to the right-of-way. The closest noise sensitive receptors to Area 4 are residences located approximately 500 m south-west, across the railway line.

Pipe handling activities, which includes pipe loading/offloading from trucks and stockpiling, are not expected to generate characteristic sounds of steel on steel contact for the following reasons:

- The pipes are coated in a Fusion Bonded Epoxy layer to protect them from damage. As there is no direct contact of steel, this coating also limits noise generation.
- The pipes will be vacuum lifted by crane during loading/unloading, hence there is no rough handling of the pipes that would generate noise.
- For stockpiling, an engineering pipe support system will be used, to prevent the pipes from collapsing onto each other.

There will be some noise from operation of cranes, forklifts and vehicles at Area 4, although noise from these sources is not expected to be a major noise contributor.

Pipe will not be distributed by rail, hence there will be no noise associated with rail loading.

For further description of noise impacts associated with the Pipeline Component of the Project, please see draft EIS *Volume 4, Chapter 12*.

13.4.5 Impact Summary

While the changes to the Project result in reduced operational impacts, the overall noise impact associated with the LNG Facility remains unchanged from that described in the draft EIS, with impact significance remaining as minor as construction and operations phase noise and vibration are not predicted to impact on sensitive receptors under most conditions. Predicted exceedances of noise criteria will be experienced infrequently by residents of Tide Island.

13.5 MITIGATION

This section outlines mitigation measures that are additional to those outlined in *Volume 5, Chapter 13* and *Volume 11* of the draft EIS, hence they should be read together for a complete suite of mitigation and management measures for noise and vibration impacts, ignoring mitigation measures described in the

EIS for the bridge and roads, as this infrastructure is no longer within the scope of the Project.

A consolidated list of all supplementary mitigation measures associated with the LNG Component of the Project is included in *sEIS Volume 11*.

Additional mitigation measures for noise and vibration impacts of the LNG Component of the Project include:

- Aggregate haulage will be limited to the hours of 4am to 10pm (18 hours), wherever practicable, to reduce impacts of night-time noise on residential receptors in proximity to the haul route.
- Truck drivers will be educated to reduce pass-by noise in residential areas at night by limiting use of air brakes, horn, and avoiding rapid acceleration.
- All vehicles will be well maintained (including mufflers and equipment covers) to limit noise emissions, especially at night.
- Construction camp buildings, both on the QCLNG site and other adjacent LNG facility sites, will be constructed to achieve acceptable internal noise levels, given the industrial noise levels that would be experienced at these locations.

13.6 CUMULATIVE IMPACTS

13.6.1 Noise impacts from multiple industries

For the consideration of cumulative noise effects of other LNG operators on Curtis Island, the GLNG Facility, located immediately to the south of the proposed QCLNG Facility, was considered.

The cumulative noise assessment undertaken for the draft EIS was modified to account for more recent information, sourced from the published GLNG EIS Noise and Vibration Report[5]. *Figure 5.13.4* illustrates the location of the existing and future major projects in the Gladstone area

Table 5.13.4 lists the predicted noise levels from various existing and proposed projects, under neutral meteorological conditions, updated with predicted impacts from the GLNG EIS.

5 Heggies Report 20-2014-R1 Revision 4, "Santos Gladstone LNG - Environmental Impact Statement – Noise and Vibration (Terrestrial)", dated 22 May 2009

Table 5.13.4 Noise Levels from Proposed Projects Around Gladstone Harbour

Location	NAL1	NAL2	NAL3	NAL4	NAL5	NAL6	NAL7
QCLNG	24	30	9	23	30	23	24
GLNG (Santos)	31	33	22		39	28	
Gladstone LNG (Fisherman's Landing)		35			25		22
Wiggins Is	36				54	32	
Gladstone Nickel		41				19	
Total (no QCLNG)	37	42	22		54	34	22
Total (with QCLNG)	37	43	22	23	54	34	26
Current LAeq	50	41	38	48	41	45	41

1 All levels are L_{Aeq} in dB(A)
2 Levels are for neutral weather conditions.
3 Plant levels for QCLNG and GLNG are for three- train operation.
4 Total levels are logarithmic sums of the individual levels, with and without QCLNG levels
5 Typical minimum daily L_{Aeq} levels at the locations.

Examination of the noise levels in *Table 5.13.4* reveals that the predicted noise impact from the QCLNG Project is exceeded by that from other major industrial projects at all locations except NAL4 (Flinders Parade), where no other predictions were available, and NAL7 (Smith Sreet, Targinie), where it will be 2dB higher than predicted impacts from the proposed Gladstone LNG plant. However, the Targinie area is State Development land, which will be developed for industrial purposes in the future. Furthermore, the total level at NAL4 and NAL7 is well below the current minimum daily L_{Aeq} noise level.

The cumulative total with and without QCLNG varies by 0 – 1dB(A) for all locations except NAL4 and NAL7, indicating that QCLNG does not make a significant contribution to the cumulative noise levels at most locations. At all locations other than NAL 4 and NAL7, the cumulative total without QCLNG is significantly higher than the predicted noise level from QCLNG.

Comparison of the total noise levels with the current minimum daily L_{Aeq} noise levels indicates that the most significant change will occur at NAL5 (Tide Island) due to projects other than QCLNG. Total noise levels at NAL2 (Lot 2 Fisherman's Road, Yarwun) also slightly exceed the current minimum daily LAeq noise level due to projects other than QCLNG, although this location is on industrial land.

QUEENSLAND CURTIS LNG	Project	Queensland Curtis LNG Project	Title: Proposed Industrial Projects in the Gladstone Area
	Client	QGC - A BG Group business	
ERM Environmental Resources Management Australia Pty Ltd	Drawn: JB	sEIS Volume 5 Figure S5.13.4	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
	Approved: SO	File No: 0086165b_SUP_GIS004_S5.13.4	
	Date: 19.01.10	Revision: 0	

13.6.2 Cumulative Traffic Noise Impacts – Pipeline Import

Pipe will be brought into Gladstone via ship and offloaded at Auckland Point, from where it will be distributed by truck to the pipeline right-of-way. Pipe distribution is expected to occur over a 12-month period (from October 2010 - September 2011). Truck numbers are provided in *Volume 5, Chapter 14* of this sEIS, but are anticipated to average approximately 32 movements per day for pipeline.

Based on the information provided on aggregate haulage out of Auckland Point in *Section 13.4.2*, that being 240 truck movements per day (resulting in a 1 dB(A) increase during daytime), an additional 32 truck movements is not considered to be a substantial increase in daytime traffic, and hence additional heavy vehicle traffic noise impacts are not expected in Gladstone.