CHAPTER 12

GLADSTONE – FITZROY

PIPELINE PROJECT

Environmental Impact Statement

Noise and Vibration

Gladstone Area Water Board

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12.1 Introduction

Noise and vibration from the proposed Gladstone-Fitzroy Pipeline project (the project) has the potential to adversely impact on the amenity and health of nearby noise sensitive receivers.

This chapter identifies and assesses potential noise and vibration impacts for the construction and operation of the project and mitigation options are provided where relevant. The following information is provided in this chapter:

- Identification of potential noise and vibration sources associated with the project
- Details of relevant noise and vibration criteria, including regulatory or recommended and best practice with respect to:
  - Industrial noise
  - Occupational health and safety (noise)
  - Construction noise
  - Vibration
- Results of acoustic measurements conducted along the length of the proposed pipeline, including long-term noise monitoring, attended measurements and measurement of specific noise sources
- Prediction of noise levels due to the construction and operation of the pipeline, and recommended methods for mitigation.

The proposed route of the project is shown in Figure 1.3.

Acoustic terminology is provided in Section 12.12

12.2 Methodology

12.2.1 Baseline

The basic methodology for the baseline process is:

1. Identify relevant acoustic criteria/regulations with respect to:
   - Industrial noise
   - Occupational health and safety (noise)
   - Construction noise
   - Blasting noise and vibration.
2. Identify potential noise and vibration sources
3. Conduct baseline noise measurements at noise sensitive locations and at other strategic locations.

12.2.2 Impact Assessment

The basic methodology for the impact assessment process is:

1. Determine noise limits based on baseline noise measurements
2. Predict noise levels associated with construction and operational activities
3. Recommend noise mitigation methods if required
4. Assess the residual significance of the potential noise impact, using the significance criteria described in Table 12.1.

Table 12.1 Impact Significance Criteria for Noise

Significance	Noise
Major adverse	These noise effects are likely to be important considerations at a regional or local scale. Mitigation measures and detailed design for construction are unlikely to remove all of the effects upon the affected communities or interests. Long-term detrimental effect on the local noise environment, with significant exceedance of relevant short-term and long-term noise standards. Noise impacts result in amenity and health effects in the local community and many complaints received from stakeholders.
Moderate adverse	These noise effects, while important at a local scale, are not likely to be key decision-making issues. They represent issues where effects will be experienced, but mitigation measures and detailed design for construction may ameliorate/enhance some of the consequences upon affected communities or interests. Some residual effects will occur and possibly short-term exceedance of relevant noise standards. Noise impacts result in amenity and health effects in the local community and several complaints received from stakeholders.
Minor adverse	These effects may be raised as local issues but are unlikely to be of importance in the decision-making process. Nevertheless, they are of relevance in the detailed design for construction of the project and consideration of mitigation or compensation measures. Mitigation measures are likely to remove almost all residual effects and prevent exceedance of relevant noise standards. Some complaints may still be received from stakeholders.
Not significant/ negligible	No appreciable impact on the local noise environment with effects beneath levels of perception, within normal bounds of variation or within the margin of forecast error.
Slight beneficial	Slight beneficial effect on the local noise environment (reduction in baseline noise levels as a result of the project).

12.3 Policy and Legislation

The current legislative noise and vibration requirements and guideline documents relevant in Queensland are identified below.

12.3.1 Industrial/Environmental

Prescribed noise limits in Queensland are outlined in the *Environment Protection (Noise) Policy 1997*. This policy prescribes an acoustic quality objective of achieving an ambient level of 55 $dBL_{Aeq\ 24\ hour}$ or less for most of Queensland's population living in residential areas. However, it is not the intention that in achieving the acoustic quality objective, any part of the existing acoustic environment be allowed to significantly deteriorate.

It should be noted that this policy is a blanket policy for all types and sources of noise. A companion document has also been produced by the Queensland Environment Protection Agency (EPA), which is more specific to noise management in planning schemes. This document is the *State Interest Protection Policy for Noise Management in Planning Schemes 2000*.

There is also a guideline produced by the Queensland EPA which is more specific to planning for noise control in industrial developments. This document is Ecoaccess: Planning for Noise Control Guideline 2004 (Ecoaccess PNCG) (EPA 2004) and applies to noise producing equipment which is likely to be used for this project. This document is therefore most relevant to the planned works associated with the project. The Ecoaccess PNCG takes into account the control and prevention of background creep, the determination of planning noise levels, the containment of variable and short-term emissions, and sleep disturbance.

The Ecoaccess PNCG provides guidelines for determining:

- Ways of controlling and preventing background creep
- Planning noise levels
- Appropriate levels to avoid sleep disturbance.

The methodology given in the Ecoaccess PNCG for determining these is outlined in Sections 12.3.1.1 to 12.3.1.3.

This chapter follows the Ecoaccess PNCG definitions for day, evening and night periods:

- Day (normal) 07:00–18:00 hrs
- Day (Sunday or public holiday) 09:00–18:00 hrs
- Evening 18:00–22:00 hrs
- Night 22:00–07:00 hrs.

12.3.1.1 Background Creep

To prevent background noise levels from progressively creeping higher and higher over time with the establishment of new developments in an area, the Ecoaccess PNCG recommends that the min $L_{A90,\ 1\ hour}$ outdoor background noise planning levels given in Table 12.2 not be exceeded.

Table 12.2 Recommended Outdoor Background Noise Planning Levels

Location	Receiver area dominant land use (description of neighbourhood)	Recommended background noise level, min $L_{A90, 1\ hour}$ (dB(A))		
		Time Period		
		Day	Evening	Night
Laurel Bank	Purely residential, rural residential	40	35	30
Raglan	Purely residential, rural residential	40	35	30

Noise emission levels which will control and prevent $L_{A90, 1\ hour}$ background noise creep in excess of the background noise planning levels are given in Table 12.3.

Table 12.3 Recommended Noise Emission Planning Levels ($L_{A90, 1\ hour}$) for Developments

Existing background noise level at receiver	Recommended $L_{A90, 1\ hour}$
Background noise level > recommended background noise level	10 dB below background noise level
Background noise level = recommended background noise level	10 dB below recommended background noise level
Background noise level is below recommendation background noise level by:	
1 dB	9 dB below recommended level
2 dB	5 dB below recommended level
3 dB	3 dB below recommended level
4 dB	2 dB below recommended level
5 dB	2 dB below recommended level
6 dB or more	5 dB above background level

12.3.1.2 Planning Noise Levels

Maximum hourly values of planning noise levels (PNL) for different areas containing residences are given in Table 12.4.

Table 12.4 Estimated Maximum Values of Planning Noise Levels (PNL) for Proposed Noise Sources for Different Areas Containing Residences

Noise area category	Description of neighbourhood	Maximum hourly sound pressure level, $L_{Aeq, 1\ hour}$ (PNL)		
		Monday to Saturday Sunday/public holidays		
		Day	Evening	Night
Z1	Rural residential. Less than 40 vehicles an hour	40	35	30
Z2	Negligible transportation. Less than 80 vehicles an hour	50	45	40
Z3	Low-density transportation. Less than 200 vehicles an hour	55	50	45
Z4	Medium-density transportation (less than 600 vehicles an hour) or some commerce or industry	60	55	50

Noise area category	Description of neighbourhood	Maximum hourly sound pressure level, $L_{Aeq, 1 hour}$ (PNL)		
		Monday to Saturday Sunday/public holidays		
		Day	Evening	Night
Z5	Dense transportation (less than 1,400 vehicles an hour) or some commerce or industry	65	60	55
Z6	Very dense transportation (less than 3,000 vehicles an hour) or in commercial or bordering industrial districts	70	65	60
Z7	Extremely dense transportation (3,000 or greater vehicles an hour) or within predominately industrial districts	75	70	65

Where existing noise levels from specific noise sources are close to the maximum planning levels, the noise level from any new sources must be controlled to preserve the amenity of an area. To achieve this, modifications to the recommended maximum PNL are provided, as shown in Table 12.5.

Table 12.5 Modification to Recommended Maximum Planning Noise Level (PNL) to Account for Existing Level of Specific Noise

Total existing noise level from specific sources (dB(A))	Maximum planning noise level for noise from new sources alone (dB(A))
≥ (PNL + 2)	If existing noise level is likely to decrease in the future: (PNL – 10) If existing noise level is unlikely to decrease in the future: (Existing level – 10)
(PNL + 1)	(PNL – 9)
PNL	(PNL – 8)
(PNL – 1)	(PNL – 6)
(PNL – 2)	(PNL – 4)
(PNL – 3)	(PNL – 3)
(PNL – 4)	(PNL – 2)
(PNL – 5)	(PNL – 2)
(PNL – 6)	(PNL – 1)
< (PNL – 6)	PNL

12.3.1.3 Appropriate Levels to Avoid Sleep Disturbance

The Ecoaccess PNCG recommends that the indoor sound pressure level measured as a maximum instantaneous value should not exceed approximately 45 dBL_{Amax} more than 10 to 15 times per night, in order to achieve a good sleep over eight hours.

Assuming a 5 dB attenuation through a partially closed window, the corresponding external noise level is 50 dBL_{Amax}.

12.3.2 Occupational Health and Safety

The relevant regulation is the Queensland *Workplace Health and Safety Regulation 1997*. Part 10 of the regulation states that the employer must prevent risks to the health and safety of workers from exposure to excessive noise at work. Under the regulations, "excessive noise" is a level of noise above:

- An eight hour equivalent continuous A-weighted sound pressure level of 85 dB(A), referenced to 20 micropascals
- A C-weighted sound pressure level of 140 dB(C), referenced to 20 micropascals.

12.3.3 Construction Noise

The *Environment Protection (Noise) Policy 1997* (Qld) has no specific noise limits for general construction noise, other than blasting. Noise nuisance and specifically "building noise" is addressed generally in Section 6W of the Queensland Environmental Protection Regulation 1998 (QEPR) as follows:

A builder or building contractor must not carry out building work on a building site in a way that makes or causes audible noise to be made from the building work

a) On a Sunday or public holiday, at any time; or

b) On a Saturday or business day before 06:30 hrs or after 18:30 hrs

No specific noise criteria apply to building works that occur outside the hours detailed in the QEPR (i.e. standard daytime hours). Within these hours, no audible noise emission is to occur.

It should be noted that it is a noise offence exemption if:

- The noise is caused by an Environmentally Relevant Activity (ERA)
- The general environmental duty is complied with by the person and everyone else who is in control of the cause of the noise when it happens.*

The relevant code of practice is *Code of Environmental Practice – Onshore Pipeline Industry Pipelines 2005*, published by the Australian Pipeline Industry Association (APIA). This code of practice states that:

- Where construction is adjacent to residences, noisy construction activities shall be undertaken within standard construction hours, except when unavoidable for practical reasons or agreement is obtained from affected residents. Affected residents shall be advised when unavoidable out-of-hours work, resulting in noise nuisance, will occur.

Therefore, project specific criteria may be applicable where unavoidable construction noise is expected to occur outside standard daytime hours (as assumed from the QEPR above). These criteria are discussed Section 12.6.1.

12.3.4 Blasting Noise and Vibration

The Ecoaccess PNCG specifies recommended human comfort criteria for:

- Airblast overpressure level
- Ground vibration peak particle velocity
- Times of blasting.

The guideline also specifies that blasting activity should be limited to the hours of:

- Monday to Friday 09:00–15:00 hrs
- Saturday 09:00–13:00 hrs.

Blasting activities should not occur on Sundays or public holidays.

12.3.4.1 Noise Criteria for Blasting

Blasting activities must be carried out in such a manner that if blasting noise should propagate to a noise sensitive place, then:

- The airblast overpressure must be not more than 115 dB (linear) peak for nine out of any 10 consecutive blasts initiated, regardless of the interval between blasts
- The airblast overpressure must not exceed 120 dB (linear) peak for any blast.

12.3.4.2 Vibration Criteria for Blasting

Blasting operations must be carried out in such a manner that if ground vibration should propagate to a noise-sensitive place:

- The ground-borne vibration must not exceed a peak particle velocity of 5 mm/s for nine out of any 10 consecutive blasts initiated, regardless of the interval between blasts
- The ground-borne vibration must not exceed a peak particle velocity of 10 mm/s for any blast.

12.4 Assumptions and Limitations

12.4.1 Construction

As the equipment to be used during construction is not yet finalised, a set of noise levels for generic equipment that is likely to be used during construction of the project has been used for predicting construction noise. The noise levels used to predict construction noise have been sourced from the document *Update of noise database for prediction of noise on construction and open sites* (DEFRA 2005), which contains octave-band noise levels for various types of construction machinery.

The noise levels used are provided in Appendix E5.

12.4.2 Operation

Noise levels for the equipment and plant to be used for the operation of the Alton Downs Water Treatment Plant (WTP) have been provided. Specific equipment and plant associated with the pump station and intake locations are not yet known and therefore, noise levels of equipment used at comparable facilities have been measured and used for the predictions made in this chapter. Noise levels were measured at the following locations:

- Parkhurst booster station operated by Fitzroy River Water
- Stanwell intake operated by SunWater.

* The duty may be complied with by complying with any relevant code of practice.

It should be noted that although these facilities have broadly similar characteristics to those proposed for the project, there are likely to be some differences in noise generation arising from the project as a result of the following:

- All facilities for the project will be new build and therefore likely to generate lower noise levels than older facilities
- The detailed design for construction of elements of this project will include noise attenuation measures where possible
- The operation of GAWB noise sources have been assessed against day, evening and night-time criteria and therefore have been assumed to operate 24 hours.

12.5 Baseline Assessment

12.5.1 Identification of Potential Noise and Vibration Sources

12.5.1.1 Potential Noise Sources during the Construction of the Pipeline

As outlined in the previous section, details of the equipment to be used during construction are not precisely known, therefore the equipment assumed to be used during construction is:

- Bored piling rig
- Diesel generator
- Dump truck
- Excavator
- Rock breaker

As it is possible that blasting will take place as part of the construction of the pipeline and associated operational facilities such as the Aldoga Reservoir, noise levels associated with blasting must comply with the guidelines given in *Ecoaccess: Noise and vibration from blasting* (QEPA 2006).

12.5.1.2 Potential Noise Sources for the Operation of the Pipeline

It is expected that the significant sources of noise associated with the operation of the pipeline will be due to plant such as the Fitzroy River intake, the water treatment facility and pumping stations. Details of the location of these items are provided in Figure 1.3, Chapter 1, Introduction.

Fitzroy River Intake

It is expected that the pumping station will comprise of:

- Water intake area
- Low-lift pump house:
  - Water pumps
  - Ventilation air supply (only operational when operator in well).

Water Treatment Plant

It is expected that the Alton Downs WTP will comprise of:

- Polymer Batching Unit
- Drum Screens (including conveyor)
- Flash Mixers
- Coagulation Mixers
- Recirculation Sludge Pumps
- Sludge Drawoff Pumps
- Scraper Drives
- Balance Tank Scraper Drives
- Centrifuges
- Sludge Screw Conveyors
- Hopper Discharge Motors
- Electrical Transformers
- Service Water Pumps
- Fire Pump Stations
- Poly Dosing Units
- Poly Storage Blower
- Pumping Station.

Raglan Pump Station and Reservoir

It is expected that the Raglan Pump Station and Reservoir will comprise of:

- Water pumps.

12.5.1.3 Potential Sources of Vibration during Construction and Operation

During the construction phase of the pipeline, it is not expected that any standard activities will be a significant source of vibration. As it is possible that blasting will take place as part of the construction of the pipeline and associated operational facilities, vibration levels associated with blasting must comply with the guidelines given in *Ecoaccess: Noise and vibration from blasting (EPA 2006).*

It is not expected that any of the equipment associated with the operation of the project will be a significant source of vibration.

12.5.2 Noise Monitoring for Existing Environment

Acoustic measurements have been conducted at potentially noise sensitive locations along the proposed project route. Unattended noise monitoring was conducted at four locations, and attended noise monitoring was conducted at seven locations.

Unattended noise measurements were conducted by positioning noise loggers at the nominated locations to record the ambient noise levels averaged over every 15 minute period. Data was collected for a minimum of 48 hours at each location.

Attended noise measurements were carried out by acoustics personnel using a hand held Sound Level Meter (SLM). These attended measurements were at least 15 minutes in duration, recorded during the day, evening and night-time periods and were used to check and confirm the unattended noise measurements. Noise sources contributing to the recorded noise levels are also noted during these measurements.

12.5.2.1 Equipment

The equipment used for the acoustic measurements is detailed in Table 12.6.

Table 12.6 Equipment Used for Attended and Unattended Noise Monitoring

Equipment manufacturer and type	Description of equipment	Serial no.
Brüel & Kjær 2260	Type 1 sound level meter	2124638
Brüel & Kjær 4231	Sound level calibrator	1790603
RTA Technology 02	Sound logging meter	RTA-02 #031
RTA Technology 02	Sound logging meter	RTA-02 #034
RTA Technology 02	Sound logging meter	RTA-02 #035
RTA Technology 02	Sound logging meter	RTA-02 #050

Results of the unattended and attended noise monitoring can be found in Appendix E5.

12.5.2.2 Monitoring Locations

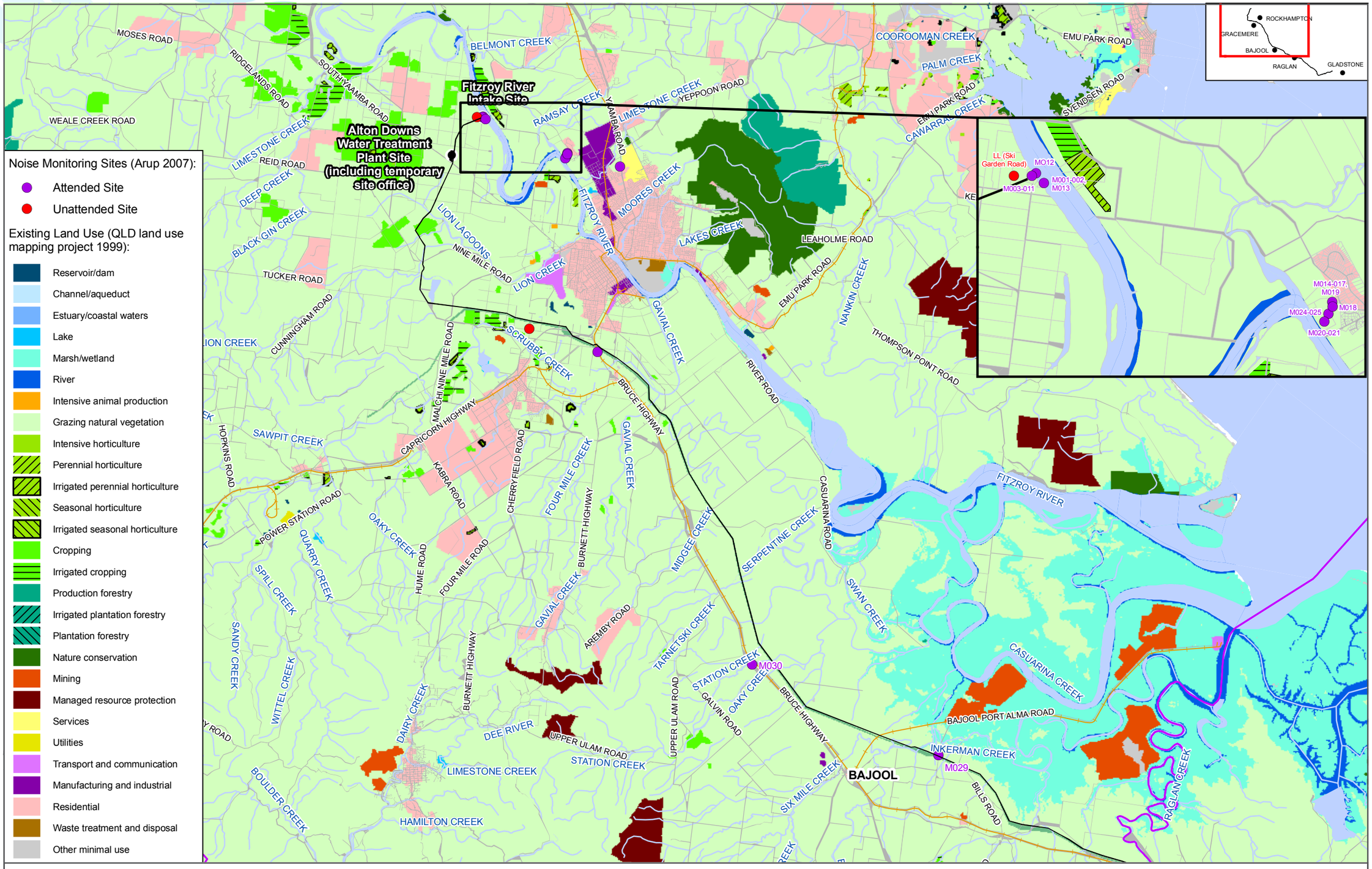
The locations of the noise measurements conducted are shown in Figure 12.1.

Note: Red stars denote attended measurements, blue stars denote unattended measurements.

A description of the locations for both attended and unattended noise monitoring is given in Table 12.7 and Table 12.8 respectively.

Table 12.7 Description of Attended Noise Monitoring Locations

Location Number	Location	Description
A1	Laurel Bank	Attended noise measurements were conducted at the Rockhampton Waterskiing and Powerboat Club located at the end of Ski Gardens Road, on the banks of the Fitzroy River. This location is on the flight path of aircraft entering/exiting Rockhampton airport – planes fly over approximately every 15 minutes during the day.
A2	Gracemere	Attended noise measurements were conducted on the shoulder of the Bruce Highway, approximately 1 km south of the roundabout at the entrance to Rockhampton. The main noise source was road traffic, approximately 10% heavy vehicles. Trains passed approximately once every 20 minutes.
A3	Archer	Attended noise measurements were conducted on the shoulder of the Bruce Highway near Station Creek, 1.5 km south of Archer Station. The main noise source was road traffic, approximately 10% heavy vehicles.
A4	Mt Larcom	Attended noise measurements were conducted on the corner of the Bruce Highway and Mt Larcom Gladstone Road, approximately 50 m east of the intersection. The main source of noise was traffic noise, with approximately 20% heavy vehicles.
A5	Aldoga	An attended noise measurement was conducted at property Lot 1 RP861430 in Aldoga. The main source of noise at this residence was mainly highway noise, however there was also birdlife and leaves rustling audible. An attended measurement was also conducted at this site.
A6	Yarwun	Attended noise measurements were conducted on the corner of Mt Larcom Gladstone Road, approximately 10 m from roadside. Road noise was the dominating source, with approximately 30% heavy vehicles.



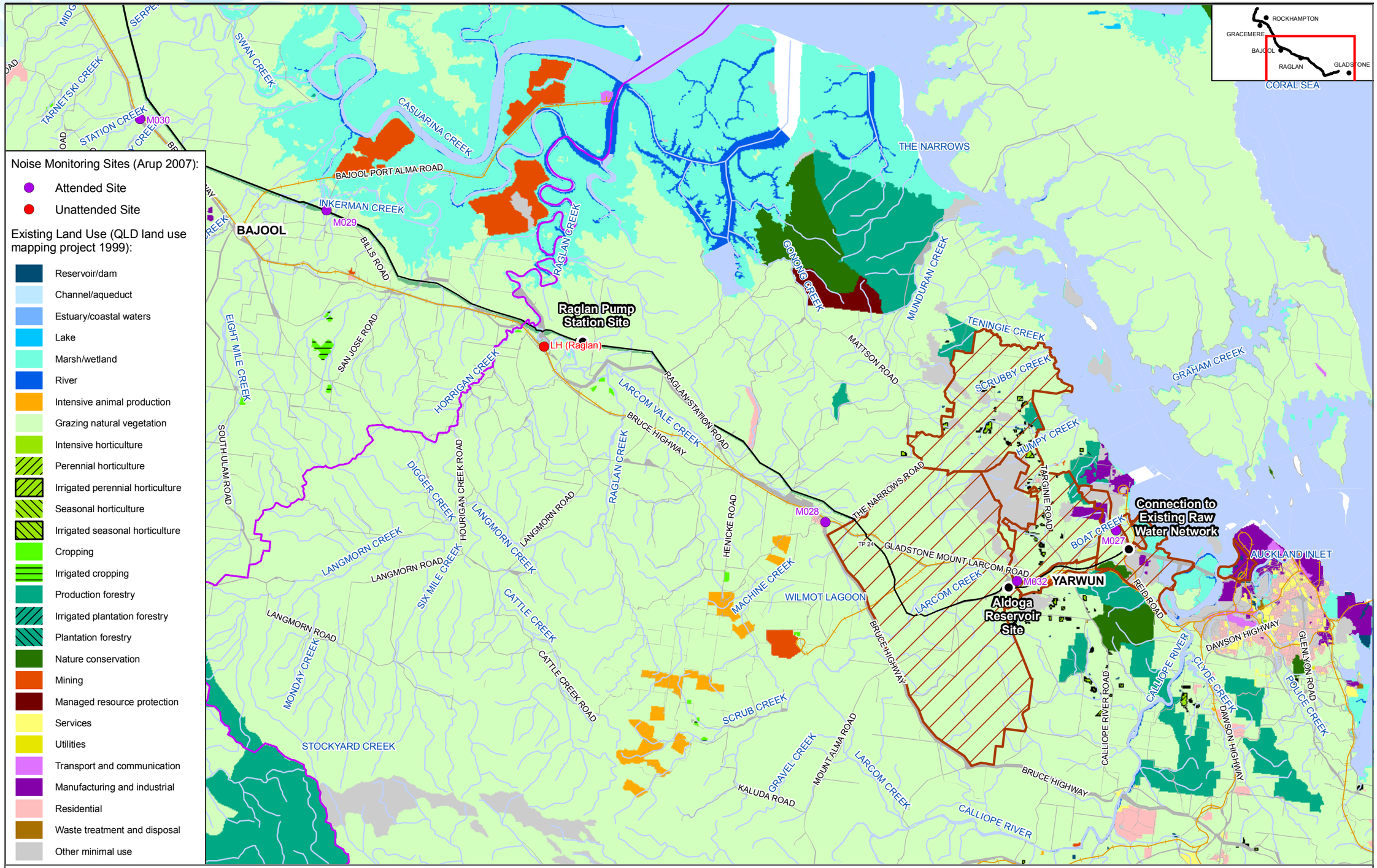


Table 12.8 Description of Unattended Noise Monitoring Locations

Location Number	Location	Description
U1	Laurel Bank	A noise logger was placed at 45 Ski Gardens Road, Laurel Bank. This residence is located near the SunWater operated water intake site, which only operates during night-time hours. This location is on the flight path of aeroplanes entering/exiting Rockhampton airport – planes fly over approximately every 15 minutes during the day.
U2	Fairy Bower	A noise logger was placed at a property in Nelson Street, Fairy Bower. The pipeline route runs through part of this property. The main noise sources audible at this site was a low drone from the highway, some livestock noise, and noise of vegetation rustling in the breeze.
U3	Raglan	A noise logger was placed on the corner of Norton Street and Langmorn Street, Raglan. This location is close to the planned booster station for the project. The main noise audible at this location was road noise; however there was some noise from birdlife and grasses and trees in the breeze. A local resident indicated that train passes were a main source of noise. Trains run day and night.
U4	Aldoga	A noise logger was placed at property Lot 1 RP861430 in Aldoga. The main source of noise at this residence was mainly highway noise, however there was also birdlife and leaves rustling audible. The resident can sometimes hear the trains pass, but rarely. An attended measurement was also conducted at this site.

12.5.2.3 Summary of Monitoring Results

The results of the unattended noise measurements are expressed as day, evening and night-time noise levels to correspond with the industrial/environmental noise criteria as detailed in Section 12.3.1.

A summary of the results from unattended monitoring for each of these periods is provided in Table 12.9 for the equivalent continuous noise level (L_{Aeq}) and in Table 12.10 for the background noise level (L_{A90}). The complete unattended noise monitoring results are provided in Appendix E5

Table 12.9 Unattended Noise Monitoring Results for the Day, Evening and Night Periods (Equivalent Continuous Noise Level)

	Measured day, evening and night noise levels dBL_{Aeq}											
	Tuesday 21/08/2007			Wednesday 22/08/2007			Thursday 23/08/2007			Friday 24/08/2007		
Logger location	D	E	N	D	E	N	D	E	N	D	E	N
Laurel Bank	62*	38	33	53	53	58	69	51	63	-	-	-
Fairy Bower	-	-	-	63	58	44	62	58	43	52*	-	-
Raglan	55*	54	56	54	54	55	56	54	56	56*	-	-
Aldoga	-	-	-	51*	44	39	44	42	39	43*	-	-

**Indicates an incomplete day of measurement*

Table 12.10 Unattended Noise Monitoring Results for the Day, Evening and Night Periods (Background Noise Level)

	Measured day, evening and night noise levels dBL_{A90}											
	Tuesday 21/08/2007			Wednesday 22/08/2007			Thursday 23/08/2007			Friday 24/08/2007		
Logger location	D	E	N	D	E	N	D	E	N	D	E	N
Laurel Bank	45*	31	31	37	36	44	36	36	36	-	-	-
Fairy Bower	-	-	-	47	47	38	44	46	38	46*	-	-
Raglan	45*	40	38	44	39	37	44	41	38	43*	-	-
Aldoga	-	-	-	41*	36	36	37	35	34	37*	-	-

**Indicates an incomplete day of measurement*

The results of the attended measurements are summarised in Table 12.11. The complete attended noise monitoring results are provided in Appendix E5. The 'A' weighted background (L_{90}), average (L_{eq}) and average maximum (L_{10}) noise levels at each location are provided.

Table 12.11 Summary of Attended Measurements

Location	Time and date	Measured noise level dB(A)			Description of aural environment during measurement
		L_{10}	L_{eq}	L_{90}	
Laurel Bank	Tuesday 21 August, 16:02 hrs	41	40	35	Some distant farm activity related noise, personal water pump noise audible.
Laurel Bank	Wednesday 22 August, 23:32 hrs	36	38	31	Night measurement, some wildlife audible.
Yarwun	Thursday 23 August, 16:02 hrs	71	69	44	Dominated by road traffic noise, approx. 30% heavy vehicles.
Mt Larcom	Thursday 23 August, 16:21 hrs	66	63	46	Dominated by road traffic noise, approx. 20% heavy vehicles.
Port Alma	Thursday 23 August, 16:59 hrs	45	37	32	Distant traffic noise from the Bruce Highway, some wildlife noise.
Archer	Thursday 23 August, 17:18 hrs	76	73	45	Dominated by road traffic noise, train noise audible, some wildlife noise.
Gracemere	Thursday 23 August, 17:39 hrs	80	76	55	Dominated by road traffic noise.
Aldoga	Friday 24 August, 10:48 hrs	49	46	35	Distant industrial noise from aluminium quarry, some road noise.

12.5.3 Noise Measurements to Benchmark Typical Operational Noise

Noise measurements were made at the existing Stanwell intake at Laurel Bank and the Parkhurst booster station. The purpose of these measurements was to develop a benchmark noise level from similar operations to the operations which will form part of this project.

12.5.3.1 Stanwell Intake at Laurel Bank

The noise levels measured at the Stanwell intake at Laurel Bank, which were used for the predictions in this chapter, are presented in Table 12.12.

Table 12.12 Noise Levels Measured at Stanwell Water Intake

Equipment	Sound pressure level L_{Aeq} (dB)
Intake noise @ 1m	47

12.5.3.2 Parkhurst Booster Station

The noise levels measured at the Parkhurst booster station, which were used for the predictions in this chapter, are presented in Table 12.13.

Table 12.13 Noise Levels Measured at Parkhurst Booster Station

Equipment	Sound pressure level L_{Aeq} (dB)
Booster pumps @ 1m	63

12.5.4 Provided Equipment Noise Level

12.5.4.1 Alton Downs Water Treatment Plant

Noise levels were initially measured at the Glenmore water treatment plant for use in predicting the potential noise impacts from the GAWB project. The Glenmore water treatment plant was opened in 1971, and the equipment associated with the plant was louder than modern day equipment and therefore not representative of the planned Alton Downs WTP. In place of measured noise levels from Glenmore WTP, noise levels provided by GAWB have been used for the predictions in this chapter. These noise levels are presented in Table 12.14.

Table 12.14 Noise Levels Provided for Water Treatment Plant

Equipment	Sound pressure level L_{Aeq} @ 1m (dB)
2 x Drum Screen	83
2 xFlash Mixer	73
2 x Coagulation Mixer	78
2 x Sludge Drawoff Pump	78
2 x Scraper Drive	78
2 x Balance Tank Scraper Drive	80
4 x Centrifuge	94
6 x Sludge Screw Conveyor	83
2 x Electrical Transformer	87
2 x Service Water Pump	79
5 x Poly Dosing Units	73
2 x Recirculation Sludge Pump *	78
2 x Polymer Batching Unit *	88
3 x Sludge Screw Conveyor *	83
2 x Hopper Discharge Motors *	83
2 x Fire Pump Station *	79

** Not constant noise sources. Frequency of occurrence of this event varies depending on the quality and quantity of water being processed.*

12.6 Impact Assessment

12.6.1 Construction Noise

12.6.1.1 Determination of Noise Limits

As described in Section 12.3.3, construction should aim to take place during the standard construction hours of:

- Monday to Saturday 06:30 hrs to 18:30 hrs (excluding public holidays).

Construction noise during these hours does not have noise limits.

It is recommended that any unavoidable construction outside of these hours complies with the general noise limits provided in Table 12.15.

Table 12.15 General Construction Noise Limits

Time period	Noise limit
Monday to Saturday	
06:30 to 18:30 hrs	No limit
18:30 to 22:00 hrs	Background + 10 dBL_{Amax}
22:00 to 06:30 hrs	45 dBL_{Amax} internal*
Sunday (and public holidays)	
All day	45 dBL_{Amax} internal*

**This is the Ecoaccess sleep awakening criterion, based on the Ecoaccess: Planning for Noise Control guideline, which recommends that the indoor sound pressure level measured as a maximum instantaneous value should not exceed approximately 45 dBL_{Amax} more than 10 to 15 times per night, in order to achieve a good sleep over eight hours.*

Using the general construction noise limits provided in Table 12.15, and the background noise levels measured during the unattended noise monitoring, the specific noise limits that apply to construction of the project are provided in Table 12.16. The noise limits presented are maximum noise levels at a noise sensitive receiver. The night-time limit is based on the sleep disturbance criteria of 45 dBL_{Amax} internal and the corresponding external noise level to achieve this is 52 dBL_{Amax}.

Table 12.16 Project Specific Construction Limits

Time period	Noise limits at each unattended measurement location L_{Amax}			
	Laurel Bank	Fairy Bower	Raglan	Aldoga
Monday to Friday				
06:30 to 18:30 hrs	No Limit	No Limit	No Limit	No Limit
18:30 to 22:00 hrs	45	57	50	46
22:00 to 07:00 hrs	52	52	52	52
Sunday (and public holidays)				
All day	52	52	52	52

It is important to note that any noise and vibration associated with blasting must comply with the limits specified in the *Ecoaccess: Noise and Vibration from Blasting* guideline 2006. These limits have been given in Section 12.3.4.

12.6.1.2 Impact from Potential Sources

The noise levels associated with each of the pieces of equipment listed in Section 12.5.1.1 at varying distances are presented in Table 12.17. Detailed descriptions of the equipment and octave band noise levels used for predictions are provided in Appendix E5.

Table 12.17 Sound Pressure Levels of Machinery at Varying Distances

Equipment	Sound power level dB(A)	Sound pressure level at distance dB(A)					
		5 m	10 m	25 m	50 m	100 m	200 m
Excavator	104	82	76	68	62	56	50
Diesel generator	65	43	37	29	23	17	11
Bored piling rig	114	92	86	78	72	66	60
Rock breaker	121	99	93	85	79	73	67
Dump truck	108	86	80	72	66	60	54

Although there are no construction noise limits during the daytime periods, noise mitigation strategies should be implemented where practical to reduce the potential for adverse noise impacts and complaints.

For construction activities which must take place outside of the daytime construction period given in Section 12.6.1, the noise limits provided in Table 12.16 should be applied. Note that noise is cumulative, so if multiple pieces of equipment are being used simultaneously, the noise contribution of each piece must be taken into account.

Blasting activities will follow the criteria presented in Section 12.3.4.

12.6.2 Operational Noise

12.6.2.1 Determination of Noise Limits

As noise limits determined using the Ecoaccess PNCG method apply to operational noise, only the residences near the proposed Fitzroy River intake and the Alton Downs WTP and the pump station and reservoir in Raglan are considered in this analysis.

Using background noise levels measured at Laurel Bank and Raglan as given in, and the methodology given by the *Ecoaccess: Planning for Noise Control Guideline 2004* (Ecoaccess PNCG) guideline (Section 12.3.1.1), the criteria for the prevention of background creep and the planning noise levels are given in Table 12.19.

Table 12.18 Calculated Rating Background Level (RBL)

Location	Recommended $L_{A90,\ 1\ hour}$ (dB(A))		
	Time period		
	Day	Evening	Night
Laurel Bank	33	34	32
Raglan	42	36	33

Table 12.19 Criteria for Prevention of Background Creep

Location	Recommended $L_{A90,\ 1\ hour}$ (dB(A))		
	Time period		
	Day	Evening	Night
Laurel Bank	38	26	25
Raglan	32	26	25

Both Raglan and Laurel Bank are considered to be noise category Z1 (refer to Table 12.4). It is unlikely that the existing noise level will decrease in the future.

The criteria for background creep will be considered as the noise limit for noise associated with the constant operation of the project. Noise associated with the project which may be constant for periods of time include:

- Noise associated with the Fitzroy River intake pumps
- High-lift pumps in the water treatment plant at Alton Downs
- Booster pump operation at Raglan.

The planning noise levels determined in Table 12.20 will be considered to be the noise limits for noise which will occur as part of the operation of the pipeline, but is not always present. These activities may include, but are not limited to:

- Ventilation systems for pump wells
- Backwash of sedimentation tanks
- Vibrators
- Routine maintenance.

Table 12.20 Planning Noise Levels

Location	Planning noise level $L_{eq,\ 1\ hour}$ (dB(A))		
	Time period		
	Day	Evening	Night
Laurel Bank	51	37	41
Raglan	45	44	46

Any noise associated with works during the night period should comply with the sleep awakening criteria of 52 dBL_{Amax} at noise sensitive receivers.

12.6.2.2 Impact from Potential Sources

The Fitzroy River Intake, the Alton Downs WTP and the Raglan Pump Station and Reservoir are potential sources of noise from operation.

Fitzroy River Intake

The Fitzroy River Water Intake is located at a distance of over 100 m from the nearest residence. Using the measured noise levels at the existing Stanwell intake at Laurel Bank, and the noise limits for Laurel Bank, as developed in Section 12.6, it is possible to assess if there may be exceedances. These are presented in Table 12.21.

Table 12.21 Impact of Fitzroy River Water Intake on Nearby Residences

	Noise Levels at Residence dBA		
	Day	Evening	Night
Constant Noise Sources			
Water Intake at 100 m distance	7	7	7
Noise Limit (prevention of background creep)	38	26	25
Exceedence	-	-	-

The noise levels associated with the Fitzroy River Intake are predicted to be well below the noise limits at 100 m.

Alton Downs Water Treatment Plant

The Alton Downs WTP is located at a distance of approximately 175 m from the nearest residence. Using the provided water treatment plant noise levels, and the noise limits for Laurel Bank, as developed in Section 12.6.2, it is possible to assess whether there may be exceedences. These are presented in Table 12.22.

Table 12.22 Alton Downs Water Treatment Plant Impact on Nearby Residences

	Noise levels at residence (dB(A))		
	Day	Evening	Night
Constant noise sources			
From Noise data supplied			
2 x Drum Screen	83	83	83
2 xFlash Mixer	73	73	73
2 x Coagulation Mixer	78	78	78
2 x Sludge Drawoff Pump	78	78	78
2 x Scraper Drive	78	78	78
2 x Balance Tank Scraper Drive	80	80	80
4 x Centrifuge	94	94	94
6 x Sludge Screw Conveyor	83	83	83
2 x Electrical Transformer	87	87	87
2 x Service Water Pump	79	79	79
5 x Poly Dosing Units	73	73	73
Total noise at residence	50	50	50
Noise limit (prevention of background creep)	38	26	25
Potential exceedence	12	24	25
Occasional noise sources			
From noise data supplied			
2 x Polymer Batching Units	88	88	88
2 x Recirculation Sludge Pump	78	78	78
2 x Polymer Batching Unit	88	88	88
3 x Sludge Screw Conveyor	83	83	83
2 x Hopper Discharge Motors	83	83	-
2 x Fire Pump Station	79	79	79
1 x Poly Storage Blower	90	90	90
Total noise at residence*	50	50	50
Noise limit (planning noise level)	51	37	41
Potential exceedence	-	14	10

**Assumes worst case scenario of all occasional noise source events occurring simultaneously – also accounts for presence of constant noise.*

The noise levels associated with the WTP are predicted to exceed the noise limits and mitigation is expected to be required (i.e. acoustic enclosure/s).

Raglan Pump Station and Reservoir

The Raglan Pump Station and Reservoir is located at a distance of well over 150 m (e.g. approximately 1096 m) from the nearest residence. Using the measured noise levels at the Parkhurst booster station, and the noise limits for Raglan, as developed in Section 12.6.2, it is possible to determine if there are exceedences at a conservative distance of 150 m. These are presented in Table 12.23.

Table 12.23 Raglan Pump Station & Reservoir Impact on Nearby Residences

	Noise levels at residence (dB(A))		
	Day	Evening	Night
Constant noise sources			
Booster station at 150 m* distance	20	20	20
Noise limit (prevention of background creep)	32	26	25
Potential exceedence	-	-	-

The noise levels associated with the Raglan Pump Station and Reservoir are predicted to be well below the noise limits at 150 m. It is understood that the nearest residence is currently located at approximately 1 km from the pump station.

12.7 Mitigation

12.7.1 Construction Noise

Although there are no construction noise limits during the daytime periods, noise mitigation strategies should be implemented where practical to reduce the potential for adverse noise impacts and complaints. Mitigation methods for construction noise can be separated into strategies for:

- Source noise control
- Work practice control
- Community liaison.

12.7.1.1 Source Noise Control Strategies

Examples of mitigation options to control noise at the source are:

- Selection of the quietest plant and equipment made wherever possible
- Keeping all equipment and plant regularly maintained
- Timing of noisy equipment (i.e. construction activities must be managed to avoid audible noise nearest to the noise sensitive receiver during certain hours of the day)
- Loading/unloading as far from sensitive receivers as possible
- Placing heavy materials into dump trucks (i.e. not dropping) where paractiable
- Keeping horns and reversing alarms to the minimum volume level possible, without compromising safety requirements
- Using non-tonal / broadband type reversing alarms
- Using stockpiled materials as "noise barriers" to shield sensitive receivers.

12.7.1.2 Work Practice Control Strategies

Options to assist in the control of noise through work practices are:

- Fitting diesel powered equipment (including, but not limited to excavators, front end loaders, dump trucks) with "residential class" mufflers
- Minimising exhaust brake on site
- Educating operators of equipment in potential noise issues, and in work techniques to minimise potential impacts
- Set and regularly check target noise levels for equipment.

12.7.1.3 Community Liaison Strategies

In order to assist in controlling the expectations and the understanding of the communities, community liaison will occur during construction and a complaints procedure will be in place. This will include the following:

- Keeping residents informed about when they will be affected by works, and the duration of the works
- Informing residents about the mitigation strategies in place to control noise and protect their interests as far as practicable
- Establish a free call line so that residents always have an immediate point of contact when they have questions or concerns.

It is also important that feedback resulting from this liaison is duly processed and that:

- Where complaints are received, or noise limits exceeded, it is followed up with an investigation
- If there are particularly critical construction stages (e.g. blasting, night-time works), monitoring must be conducted.

These and other mitigation measures are included in Chapter 20, Planning Environmental Management Plan.

12.7.2 Operational Noise

As shown in Table 12.22, noise levels attributed to the operation of the WTP may exceed noise limits. The potential exceedence is up to 25 dB(A) during the evening and night periods. This exceedence will be avoided through the use of modern equipment, and mitigated witrh measures identified in detailed design for construction such as housing the pump and equipment in an acoustically rated building. Examples of appropriate noise mitigation structures could include:

- Reinforced concrete walls and block work
- Internal lining of enclosure with acoustical absorption material
- Solid-core access doors with compression seals
- Acoustically-rated machinery access doors.

It is noted that this is a basic construction guideline, and that acoustic advice will be sought during the detailed design for construction phase to ensure the structure is providing the appropriate noise attenuation to the outside environment. Therefore, it is expected that, in cases where the above construction is not practical, an acoustic equivalent will be used.

Neither the water intake in Laurel Banks nor the booster pump in Raglan require an acoustically rated housing in order to meet local noise limits (see Table 12.22 and Table 12.23).

These recommendations are based on the assumption that equipment used in the Gladstone-Fitzroy Pipeline operations where noise data is unavailable will have noise levels equivalent to or less than the equipment used at the Stanwell intake and Parkhurst pump station.

These and other mitigation measures are included in Chapter 20, Planning Environmental Management Plan.

12.8 Residual Impact

12.8.1 Construction Noise

Due to the sectional nature of pipeline construction, the construction activities will progress along the pipeline route so that very few receivers will be exposed to construction noise for longer than a few weeks. There are also limited locations where receptors are in close proximity to pipeline construction. Therefore the impact of construction noise for the majority of receivers is expected to be **minor adverse.**

Receivers near locations of operations facilities may have longer exposure to noise from construction, however, implementing the mitigation methods outlined in Section 12.7, it is expected that the impact of construction noise be **minor adverse.**

12.8.2 Operational Noise

It is expected that all noise associated with the construction and operation of the project will have some low-frequency component (i.e. frequency content below 200Hz), however noise which has a frequency spectra dominated by frequency content below 200Hz is considered low-frequency noise for the purpose of this EIS. In order to determine whether noise is dominated by low-frequency content (i.e. dominated by frequencies below 200Hz) the A-Weighted noise level (L_{eq} dB(A)) is compared against the C-Weighted noise level (L_{eq} dB(C)), which is more responsive to low-frequency content. Should the C-weighted noise level vary by 15dB or greater from the A-weighted noise level, then the noise is considered to be low-frequency noise. Where it has been determined that low-frequency noise is present, a 5dB penalty is to be applied in completing calculations.

Using this methodology, it has been determined that only the noise from the water intake is considered to be low-frequency noise.

Provided that the above mitigation strategies are implemented, it is expected that residual noise impacts to residents near the operational facilities will be **minor adverse** and will not exceed the noise limits.

12.9 Cumulative and Interactive Effects

There is the potential for cumulative noise effects to arise when other noise producing activities occur at the same time and in the vicinity of the noise generating activities associated with this project. The Stanwell-Gladstone Infrastructure Corridor (SGIC) within which this project is located for the majority of the pipeline length is planned to accommodate several pipelines. The purpose of the SGIC is to reduce the potential cumulative effects of multiple projects in the region by lessening the disruption caused by investigation and construction on individual landowners, surrounding communities and the environment that would otherwise occur if access to multiple pipeline routes was sought on a project-by-project basis. However in the event that construction of one or more of these other pipelines occurs at the same time as this project, there will be an increase in the amount of machinery and equipment present on site for certain periods and therefore likely greater noise levels. There are few sensitive receptors in close proximity to the SGIC so potential cumulative noise effects are not expected to have a significant impact.

Other projects in the SGIC may include operational equipment such as pump stations that, if located in close proximity to the pump stations or water treatment plant for this project, could result in a cumulative noise impact to residential properties. However the location or nature of future infrastructure is currently unknown and would be subject to future planning and assessment to determine the level of impact.

12.10 Summary and Conclusions

This chapter describes the noise assessment that has been undertaken for the Gladstone-Fitzroy Pipeline project. Noise measurements were taken at various locations in the project area to establish the baseline noise environment and enable the appropriate planning noise levels to be determined. Noise measurements were also undertaken at Parkhurst booster station and Stanwell intake at Laurel Bank for use in predicting the potential noise generation that may arise during the operation of the project. Noise data for the equipment proposed to be used at the Alton Downs WTP was provided for use in the prediction of potential noise impacts.

Assumptions were made regarding the type of equipment and machinery that will be used during construction so that the noise levels associated with the different pieces of equipment could be determined. Construction during the hours of 06:30 hrs and 18:30 hrs on weekdays and Saturdays does not have applicable noise limits however mitigation measures will still be implemented, where practical, to reduce noise impacts. Outside of these hours construction limits should apply to the project and mitigation measures will be implemented where practical so that limits are not exceeded.

During operation, the Fitzroy River intake, the Alton Downs WTP and the Raglan Pump Station and Reservoir are potential sources of noise. The intake is located further than 100 m from the nearest residence. Based on noise measurements taken at the existing Laurel Bank intake and on the determined noise criteria for Laurel Bank there are not expected to be exceedance of noise criteria at the nearest residence (See Table 12.21).

The Alton Downs WTP is located at a distance of approximately 175 m from the nearest residence. Using the baseline noise measurements undertaken at Laurel Bank it was possible to determine the noise criteria relevant to the operation of the WTP for comparison with predicted operational noise levels. It was found that there is the potential for exceedance of noise criteria at residences in proximity to the WTP (See Table 12.22). This is a worst case scenario and is not considered likely as the WTP will be new build using current technology and will incorporate mitigation measures so that noise criteria are not exceeded.

Raglan Pump Station and Reservoir is approximately 1km from the nearest identified residence and is not likely to result in exceedances of noise criteria, and as such no mitigation measures are proposed for its operation (See Table 12.23).

Residual noise impact during construction and operation of the project has been assessed as **minor adverse** as shown in Table 12.24.

Table 12.24 Assessment Summary Matrix

EIS Area: **Noise** **Feature/ Activity**	**Current Value** **+ Substitutable** **Y:N**	**Description of Impact**		
		Description in Words	Mitigation Inherent in Design/ Standard Practice Mitigation	Residual Impact Using Significance Criteria
Construction related noise	Local noise amenity Not substitutable	Construction machinery noise	Restricted working hours Selection of quiet machinery where possible Maintenance of machinery Complaints procedure in place	Minor adverse
Operational noise	Local noise amenity Not substitutable	Noise from the WTP and pump stations during operation	Design of WTP housing to attenuate noise levels.	Minor adverse

12.11 References

Australian Pipeline Industry Association (APIA) 2005. *Code of Environmental Practice – Onshore Pipelines*

Department for Environment Food and Rural Affairs (DEFRA), 2005. *Update of noise database for prediction of noise on construction and open sites,* HMSO

Environment Protection (Noise) Policy 1997

Queensland Environmental Protection Agency (EPA), 2004. *Guideline: Planning for noise control,* Ecoaccess.

Queensland Environmental Protection Agency (EPA), 2006. Guideline: *Ecoaccess Noise and vibration from blasting,* Ecoaccess.

State Interest Protection Policy for Noise Management in Planning Schemes 2000

12.12 Glossary of Acoustic Terminology

Decibel

The ratio of sound pressures which we can hear is a ratio of 10^6 (one million to one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the *sound pressure level* (L_p) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

'A' Weighted Sound Level dB(A)

The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dB(A). An A-weighting network can be built into a sound level measuring instrument such that sound levels in dB(A) can be read directly from a meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to

various sounds. It is worth noting that an increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3 dB is subjectively barely perceptible.

dB(C)

The unit used for measuring maximum industrial noise levels in Australia is the C-weighted sound pressure level in decibels, denoted dB(C). C-weighting has a relatively flat response when compared to an A-weighting network and is generally more affected by low frequencies.

L_{Aeq}, Equivalent A-Weighted Continuous Sound Level

Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

Frequency

The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted kHz, e.g. 2 kHz = 2000 Hz. Human hearing ranges approximately from 20 Hz to 20 kHz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.

Ground-Borne Noise

The transmission of noise energy as vibration of the ground. The energy may then encounter building elements and become structure-borne noise.

Sound Power

The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source. The sound pressure level varies as a function of distance from a source. However, the sound power level is an intrinsic characteristic of a source (analogous to its volume or mass), which is not affected by the environment within which the source is located.

Statistical Noise Levels (dBL_{Ax})

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for ten percent of the time period under consideration, has been adopted in this country for the assessment of road traffic noise. The $L_{90,}$ the level exceeded for ninety percent of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for one percent of the time, is representative of the maximum levels recorded during the sample period. A-weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference time period (T) is normally included, e.g. $dBL_{A10, 5min}$ or $dBL_{A90, 8hr}$.

Structure-Borne Noise

The transmission of noise energy as vibration of building elements. The energy may then be re-radiated as airborne noise. Structure-borne noise is controlled by structural discontinuities, i.e. expansion joints and floating floors.

Vibration

Vibration may be expressed in terms of displacement, velocity and acceleration. Velocity and acceleration are most commonly used when assessing structure-borne noise or human comfort issues respectively. Vibration amplitude may be quantified as a peak value, or as a root mean squared (rms) value.

Vibration amplitude can be expressed as an engineering unit value (e.g. 1 mm/s) or as a ratio on a logarithmic scale in decibels:

vibration velocity level, $dB = 20 \log (V/V_{ref})$.

(where the preferred reference level, V_{ref}, for vibration velocity = 10^{-9} m/s.)

The decibel approach has advantages for manipulation and comparison of data.

L_{A90}, Background Noise Level

The A-weighted sound pressure level of the residual noise (dB) exceeded for 90 percent of a given time interval, measured using "fast" time weighting and quoted to the nearest whole number of decibels.

L_{A10}, Average Maximum Noise Level

Sometimes referred to as the "average maximum" noise level, the A-weighted sound pressure level of the noise (dB) exceeded for 10 percent of a given time interval, measured using "fast" time weighting and quoted to the nearest whole number of decibels.

Noise Senstive Receiver (Receiver)

For the purpose of this EIS, a noise sensitive receiver (or receiver) has been taken as a place of residence where it can be reasonably assumed that there is a regularly habitable room and/or sleeping area.