Gloucester Gas Project
Environmental Assessment

November 2009

VOLUME 3

APPENDIX H – K

Appendix H	Noise and Vibration Assessment
Appendix I	Preliminary Hazard Analysis
Appendix J	Soil Landscapes
Appendix K	Heritage Assessment

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Appendix H Noise and Vibration Assessment

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OPERATION AND CONSTRUCTION NOISE & VIBRATION ASSESSMENT GLOUCESTER GAS PROJECT

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REFERENCES

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Environmental Noise Control Manual (ENCM)

Reference 2: Department of Environment and Climate Change,
Assessing Vibration: a technical guideline

Reference 3: Australian and New Zealand Environment and Conservation Council (ANZECC),
Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration

Reference 4: German Standard DIN4150 -1986 - Part 3

Reference 5: British Standard BS7385 -1993 - Part 2

Reference 6: Department of Environment, Climate Change and Water,
Interim Construction Noise Guideline,

EXECUTIVE SUMMARY

The Gloucester gas project is a venture of AGL Gloucester Pty Ltd *(AGL)*. The project consists of four (4) key components to produce, compress and transport coal seam gas from the Gloucester region to a delivery station in Hexham, Newcastle.

Atkins Acoustics was commissioned by *AECOM* on behalf of *AGL* to conduct an operation and construction noise and vibration impact assessment of the proposal.

The main study area is centered around the township of Stratford. The Petroleum Exploration Licence 285 *(PEL 285)* area extends approximately sixty (60) kilometres north to south and approximately twenty (20) kilometres east to west. The preferred pipeline corridor is approximately one hundred (100) metres wide and ninety-five (95) kilometres long. The corridor would extend from the selected central processing facility to the proposed gas delivery station at Hexham.

The main components of the project include the:

- Gas Field Development Area *(GFDA);* the gas production development within the *PEL285*;
- Central Processing Facility *(CPF);* the facility compresses and dehydrates the gas;
- Gas Transmission Pipeline*;* the high-pressure gas transmission pipeline from Stratford to Hexham; and
- Hexham Delivery Station *(HDS)* - Hexham pressure reduction and distribution station.

As part of the study the envisaged operation and construction activities have been assessed in accordance with the following guidelines:

- Department of Environment, Climate Change and Water's *(DECCW)* Industrial Noise Policy *(INP),*
- *DECCW* Interim Construction Noise Guideline *(ICNG),*
- *DECCW* guideline, Assessing Vibration: a technical guideline, and

- Australian and New Zealand Environment and Conservation Council (ANZECC), *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration.*

The main operational noise sources associated with the *CPF* would include gas generators, compressors, compressor cooler fans, pumps, fans and valves. The generators and compressors would be housed in individual acoustic enclosures and the compressor fin cooling fans selected on acoustic performance. The results of noise modelling show that with additional secondary engineering controls the project noise goals are predicted to be satisfied.

From investigations undertaken, it is not envisaged that there would be any significant operational noise sources or noise impacts arising from the gas transfer pipeline.

Noise modelling for the *HDS* has shown that the project noise goals are predicted to be exceeded without the inclusion of secondary noise controls at the closest residential property on Old Maitland Road and the shared industrial and commercial boundaries. As part of the detailed design (when final details of the plant and equipment will be determined) a more detailed assessment of the noise would be undertaken to confirm the extent of noise mitigation required to satisfy the project noise goals.

It is not expected that operational $L_{A1,\ 1\ mim}$ noise levels emitted from the *GFDA, CPF, gas transmission pipeline* and *HDS* would be greater than 5-10dBA above the operational L_{Aeq} levels or the *DECCW* sleep disturbance assessment goals.

No operational vibration sources have been identified that are likely to generate ground vibration at exposed receptors.

The main construction activities envisaged for the project include access track construction, vegetation clearing, drilling, fraccing, trenching, concreting, structure erection, pipe preparation, pipe installation and plant installation. It is proposed that construction activities would generally be restricted to daytime hours. Some well

construction works in the *GFDA* including drilling and preparation for fraccing would occur twenty-four (24) hours a day where noise impacts on residential dwellings can be managed.

The assessment findings have shown there would be situations where construction noise levels exceed the target assessment goals during construction. When assessing noise from construction activities it is recognised that the procedures and recommendations published by the *DECCW* are regarded as planning tools. The recommendations are not mandatory, and their application for assessing construction noise is not determined purely on the basis of compliance or otherwise with numerical noise levels.

The assessment has shown that ground vibration from construction activities can be controlled to levels that would satisfy the recommended project goals and expected to be acceptable from both human disturbance and structural damage points of view. With respect to potential blasting activities and airblast/ground vibration impacts, the assessment has shown that maximum instantaneous charges *(MIC's)* can be controlled to ensure that blasting activities (if required) can be controlled to comply with goals recommended by the Australian and New Zealand Environmental Control Committee (A*NZECC)* and accepted by the *DECCW.*

Overall the traffic volumes generated during the operational and construction phases of the project are considered as minimal when compared to the reported Annual Average Daily Traffic *(AADT)* road traffic volumes for The Bucketts Way of between 1555 and 4095 vehicles per day, and 9343 vehicles per day for the Pacific Highway, Hexham and predicted to satisfy the daytime target noise assessment goals for local and collector roads, respectively.

To manage environmental noise impacts during construction, it is recommended that a Noise Management Plan *(NMP)* be prepared. As part of the *NMP*, it is recommended that a public relations program be developed and implemented to inform residents and the community of the progress of the activities, and potential noise and vibration impacts during each phase of the construction.

1.0 INTRODUCTION

The Gloucester Gas Project is a venture of AGL Gloucester L E Pty Ltd *(AGL)*. The project consists of four (4) key components to produce, compress and transport coal seam gas from the Gloucester region to Hexham, Newcastle.

- Gas Field Development Area (GFDA); the gas production development within the PEL285;
- Central Processing Facility (CPF); the facility compresses and dehydrates the gas;
- Gas Transmission Pipeline; the high-pressure gas transmission pipeline from Stratford to Hexham; and
- Hexham Delivery Station (HDS) - Hexham pressure reduction and distribution station.

Atkins Acoustics was commissioned by *AECOM* on behalf of *AGL* to conduct an operation and construction noise and vibration impact assessment of the proposal. Due to the relatively short construction period for the gas transmission pipeline, the physical area of the pipeline corridor and the temporary transient nature of the pipeline construction works a *'Qualitative'* assessment was undertaken for this part of the assessment.

The main aims of the investigations and assessment were to:

- identify potential noise and vibration impacts from the proposal;
- measure, review and comment on the ambient background noise levels in the vicinity of the Gloucester and Hexham infrastructure works ;
- establish project noise goals in accordance with procedures documented in the Department of Environment, Climate Change *and Water (DECCW),* Industrial Noise Policy *(INP),* the *DECCW* Interim Construction Noise Guideline *(ICNG),* and the *DECCW* Assessing Vibration: a technical guideline;

- predict and evaluate operational noise from the proposal;
- predict and evaluate noise and vibration impacts from the envisaged construction activities; and
- where noise and vibration assessment goals are predicted to be exceeded, recommend ameliorative control options.

The information presented in the report has been prepared for the investigation described herein, and should not be used in any other context or for any other purpose without written approval from *Atkins Acoustics*, *AECOM* and *AGL*.

2.0 PROJECT DESCRIPTION

2.1 Overview

The main study area is centered around the township of Stratford. The Stratford Petroleum Exploration Licence 285 *(PEL 285)* area extends approximately sixty (60) kilometres north to south and approximately twenty (20) kilometres east to west.

The preferred pipeline corridor is approximately one hundred (100) metres wide and ninety-five (95) kilometres long. The corridor would extend from the selected central processing facility to the proposed gas delivery station at Hexham.

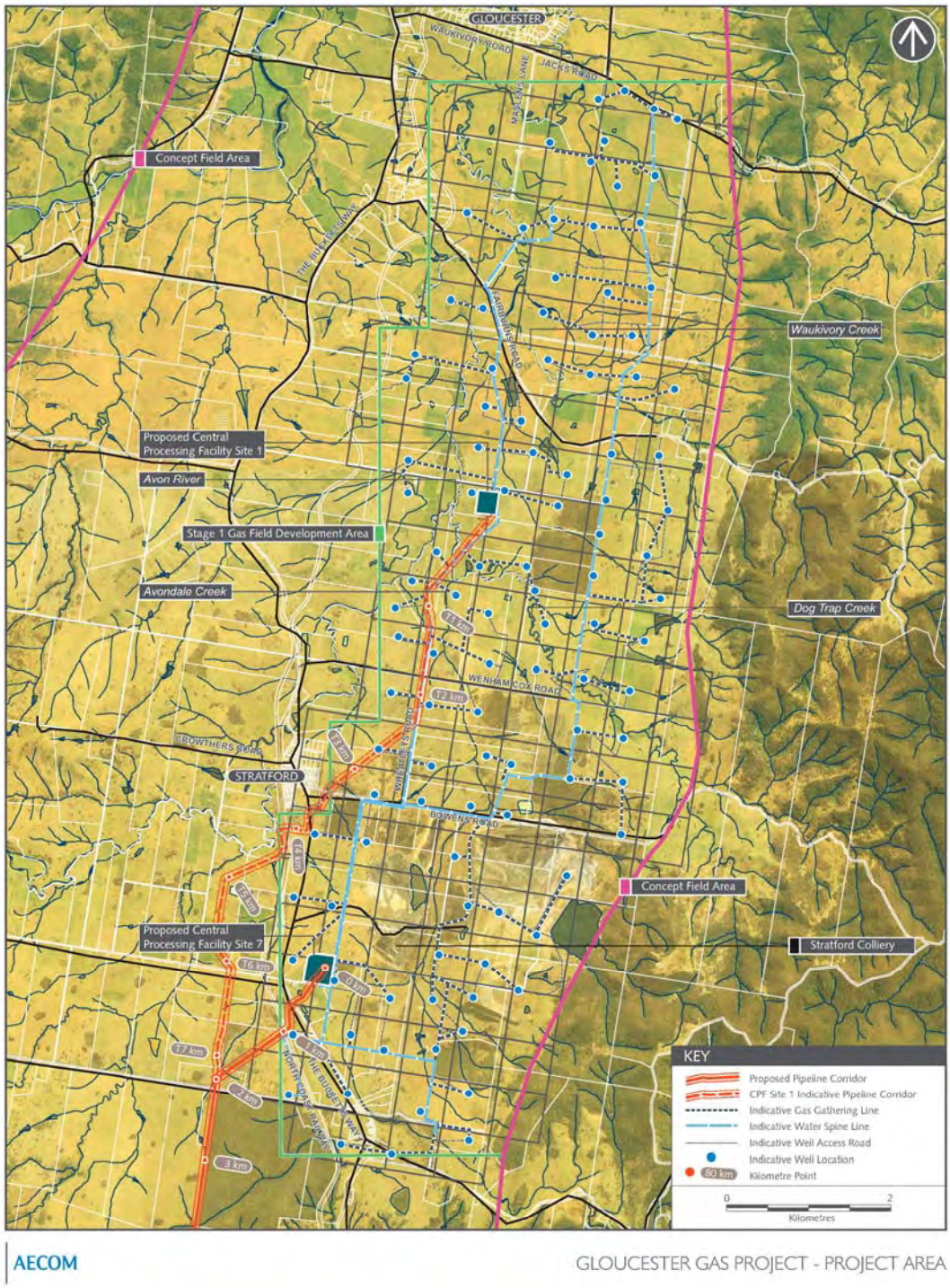
The main components of the project include the:

- Gas Field Development Area *(GFDA)* – the gas production development area within *PEL 285*;
- Central Processing Facility *(CPF)* – the facility compresses and dehydrates the gas;
- Gas Transmission Pipeline –the high-pressure gas transmission pipeline from Stratford to Hexham; and
- the Hexham Delivery Station *(HDS)* - the pressure reduction and distribution station.

2.2 Gas Field Development Area

The principal activities that would be undertaken to develop the gas field include the drilling, completion and connection of production wells. Within the *GFDA* there would be up to one hundred and ten (110) vertical wells spaced at approximately six hundred (600) metres apart. The wells would be interconnected by polyurethane pipe for the purpose of gas and water gathering. Water produced as a by-product would be captured separately for on-site treatment and disposal. *Figure 1* illustrates the layout of the *GFDA*.

Figure 1. Gas Field Area



2.2.1 Production Well Construction

At each well head a single vertical well is anticipated, although in some circumstances, as part of the development of future stages there may be more than one well. Wells would be drilled using conventional drilling rigs and completed with required down hole and surface equipment after being "fracced" to stimulate gas and water flow. The process would comprise the following activities:

- site preparation,
- production well drilling,
- production well geophysical logging,
- production casing running and cementing,
- completion which may include perforating and fracture stimulation, or an alternative completion,
- installation of pumps and surface facilities, and
- cleanup and rehabilitation.

2.2.2 Production Well Construction Program

The envisaged construction program for the *GFDA* would be scheduled over a period of twelve (12) to eighteen (18) months. This represents the shortest (i.e., most intensive) construction schedule as a worse case scenario. This may be extended, however this would reduce the intensity of activities (and potentially reduce the intensity of noise generation). The shortest timeframe therefore has been assumed for this assessment. Initial site establishment, access road, pad preparation, decommissioning and rehabilitation would be conducted during daytime hours (nominally 7.00am to 6.00pm). The development of each well and its infrastructure would occur over a period of about six to eight (6-8) weeks. This would include site preparation, drilling, well completion and installation of surface infrastructure at the well head. Should drilling take place during normal daytime hours, a period of two (2) weeks of drilling is anticipated per well. If twenty-four (24) hour drilling occurred the period would be reduced to approximately one (1) week. It is the intention of *AGL,* where feasible, to conduct drilling operations twenty-four (24) hours a day to reduce the duration of the activities and limit noise exposure for residential properties. Albeit it is acknowledged that a

number of residential dwellings are located in relative close proximity and could be exposed to construction noise. Drilling hours would be considered on a site by site basis subject to meeting relevant project noise goals or as otherwise agreed with affected landowners.

Access to well site locations within the *GFDA* would be provided via existing roads and tracks, where possible. Where access tracks are required to be constructed alignments would be determined in consultation with landowners to determine the most beneficial location.

Traffic associated with each well site could generate up to sixty-two (62) vehicle trips for the mobilisation of equipment in addition to vehicle movements required for the transport of gravel. The movement of site personnel may generate six (6) to eight (8) vehicle trips per day.

2.2.3 GFDA Operational Noise Sources

Field audits undertaken at existing pilot well sites identified that the main operational noise sources would be associated with valves and the vacuum pump-motor. Electricity supply to each well head could be via a network of under ground cables or from individual gas powered generators. The results of field noise measurements confirmed that the equivalent sound power level for the well head plant was 70dBA 10^{-12} Watts. The sound power level for the generator if installed would be in the order of 75-80dBA 10^{-12} Watts. At fifty (50) metres from the well head the predicted equivalent sound pressure level is in the order of 35-38dBA.

At some well heads where up to four (4) wells could be co-located, the equivalent operational noise level at one hundred (100) metres is predicted to be in the order of 29-32dBA. With a nominal six hundred (600) metres spacing between well heads, it is not anticipated that there would be any measurable cumulative noise effects from the well network. Considering the distance separation to existing residential dwellings, noise from the *GFDA* well network would be described as minimal and low risk in terms of potential impacts. Noise modelling would be undertaken during the detailed design

phase to ensure that project noise goals are satisfied. On this understanding operational noise from the well network has not been considered any further in the report.

2.3 Central Processing Facility

Two (2) preferred sites *(Figure 1)* have been selected and assessed for potential noise impacts from the *CPF*. The sites are identified as *CPF Site 7* and *CPF Site 1*. The gas and water collected at each well head would be transported via a network of pipes to the *CPF*. Gas produced by the wells would be treated at the *CPF* and pressurised for transport to Hexham via the gas transmission pipeline. Water collected from the wells would be transported for treatment at the *CPF*.

The *CPF* would consist primarily of gas-powered generators and reciprocating compressors, which would, in stages, compress the gas. Conceptual layouts of both *CPF* sites are provided in *Figures 2 and 3*

Figure 2. Conceptual Layout - CPF Site 7

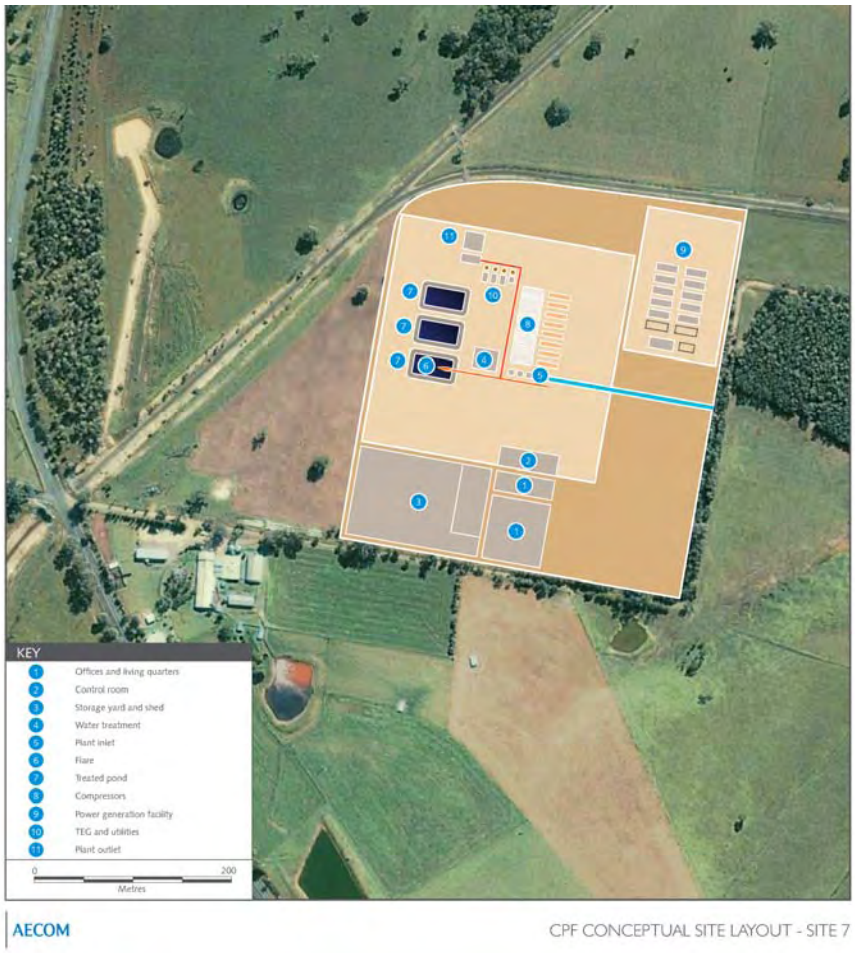


Figure 3. Conceptual Layout - CPF Site 1

2.3.1 Central Processing Facility Construction

The *CPF* site works would include clearing, civil, construction and plant installation. The components for the *CPF* would be transported to the site by road. Road transportation would include articulated vehicles with extended trailers where required. Vehicle movements associated with the delivery of plant and equipment are expected to comprise initially up to forty-six (46) heavy vehicle trips and some thirty-six (36) light vehicle trips per day.

2.3.2 Central Processing Facility Construction Program

Construction of the *CPF* would be undertaken over a period of approximately twelve (12) months, and typically between 7.00am to 6.00pm Monday to Friday, and 8.00am to 1.00pm Saturday. Where it is demonstrated that construction noise can be controlled and/or managed, construction works would be undertaken outside the above daytime hours.

2.3.3 Central Processing Facility Operational Noise Sources

The main operation noise sources associated with the *CPF* include generators, compressors, compressor cooler fans, pumps, fans and valves. To ameliorate operational noise, the following strategies have been considered and incorporated into the concept design.

- generator and compressor acoustic enclosures;
- low noise rated valves; and
- low noise rated compressors, fans and pumps.

2.3.4 Potentially Affected Receivers

The *CPF* sites are located in rural areas and generally separated from residential dwellings. *CPF Site 7* is located in the vicinity of the Gloucester Coal open cut coal mine and coal processing facilities. *CPF Site 1* is in an area described as predominantly rural. *Table 1* presents a summary of nearby residential dwellings and typical offset distances to the *CPF's.* Receptor assessment locations are shown in Attachment 4 and 5.

Table 1. Residential Assessment Locations

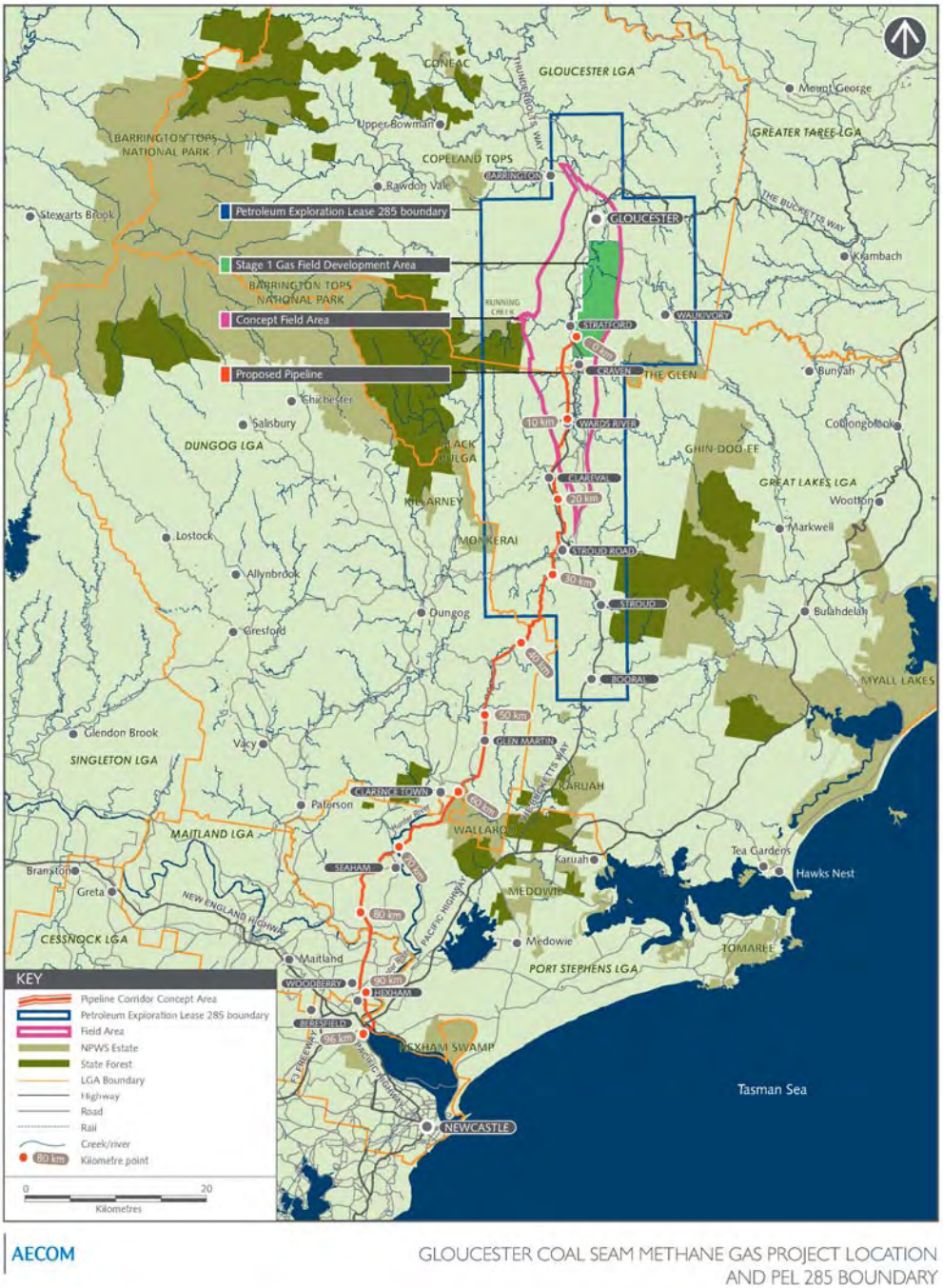
Reference Assessment Locations	Reference Measurement Location *	Distance from CPF (metres)
CPF Site 7		
P1	R2	1100
P2	R1	520
P3	R8	460
P4	-	1700
P5	-	1600
P6	-	1300
CPF Site 1		
P7	-	1900
P8	R5	1500
P9	-	1800
P10	R4	1400
P11	-	480
P12	-	1600
P13	R7	1300
P14	-	1500

***R** - Reference Measurement Locations where background noise monitoring has been undertaken to establish RBL's (refer Table 4)*

2.4 Gas Transmission Pipeline.

The gas transmission pipeline would commence at the selected *CPF* and connect to *HDS* at Hexham *(Figure 4)*. Preliminary investigations determined the preferred pipeline corridor and likely constraints relating to existing land use, environmentally sensitive areas and constructability.

Figure 4. Gas Transmission Pipeline Corridor



2.4.1 Gas Transmission Pipeline Construction

The envisaged pipeline construction activities include:

- clearing – removal of vegetation,
- civil – site leveling using graders, excavators and bulldozers,
- trenching – either a specialist trencher or an excavator to dig the trench for pipe-laying,
- pipe stringing – delivery of pipes adjacent to the trench,
- welding – welding of continuous strings of pipe up to 1 km in length,
- lowering-in and backfill – the pipe would be lowered into the trench and backfill with screened trench spoil,
- hydrostatic testing –testing with water and pressurised above the maximum allowable operation pressure to ensure the integrity,
- temporary work areas – during construction a number of temporary work areas would be required for the storage of pipe and facilities, and
- rehabilitation of the pipeline construction area.

Vehicle movements associated with the delivery of pipe, plant and equipment for this phase of the project is expected to comprise five-ten (5-10) trucks and in the order of fifteen -thirty (15-30) light vehicles per day.

2.4.2 Gas Transmission Pipeline Construction Program

Construction would be undertaken in teams on a scrolling basis along the pipeline route. It is anticipated that the total duration of the works would be approximately twelve (12) months. The envisaged duration at any one (1) specific location is expected to be in the order of three (3) weeks.

2.4.3 Potentially Affected Receivers

Built up areas along the pipeline corridor include Nelson, Duckenfield, Woodberry and Tarro. Some residences are in the order of 30-100m (estimated from aerial photography) from the corridor centre-line. Typically residences are located in excess of 200m from the corridor. Accordingly, the assessment has considered anticipated construction activities and predicted noise and vibration levels at various offset distances to represent

potential receiver locations. A detailed noise and vibration management plan would be prepared to address potential impacts in more detail when the actual pipeline location is confirmed and approved.

2.5 Hexham Delivery Station

The gas transmission pipeline would terminate at the proposed *HDS* on the southern side of the Hunter River *(Figure 5)*. The *HDS* would principally involve above ground pipe work including dry gas filtration, water bath heaters, metering, flow control valves and a noise attenuated pipeline blowdown stack.

2.5.1 Delivery Station Construction

The envisaged construction activities would include:

- civil – site leveling using graders and excavators,
- welding – welding of pipes, and
- hydrostatic testing –testing with water and pressurised above the maximum allowable operation pressure to ensure the integrity.

Vehicle movements associated with the construction of the *HDS* is expected to generate five (5) to ten (10) truck movements and eighteen (18) light vehicles per day.

2.5.2 Delivery Station Construction Program

Construction of the *HDS* would be undertaken over a period of up to six (6) months and typically between 7.00am to 6.00pm Monday to Friday, and 8.00am to 1.00pm Saturday. Where it is demonstrated that construction noise can be controlled and/or managed, construction works would be undertaken outside the above daytime hours.

Figure 5. Hexham Delivery Station

2.5.3 Delivery Station Operational Noise Sources

The main operation noise sources associated with the *HDS* includes valves/fittings and pipe radiated noise. To ameliorate operational noise, the following strategies have been incorporated into the concept design.

- pipe sizing to reduce passage velocities;
- low noise rated valves; and
- pipework design to minimise turbulent flow conditions.

2.5.4 Potentially Affected Receivers

The *HDS* is located in an area zoned and developed with a mixture of industrial and residential uses. The closest residential dwellings *(Table 2)* are located 150m to the north-west on the corner of Old Punt Road and Old Maitland Road, and 330m to the north-east on Old Maitland Road. The area is subjected to noise from road traffic and local industrial activities.

Table 2. Residential Assessment Locations - HDS

Reference Assessment Locations	Reference Measurement Locations	Distance from HDS (metres)
P15	R9*	1300
P16	-	150
P17	R10*	330

**R - Reference Measurement Locations to establish RBL's (Table 4)*

2.6 Operational Traffic

Reported *AADT* road traffic volumes for The Bucketts Way range between 1555 vehicles per day and 4095 vehicles per day. For the Pacific Highway at Hexham the reported *AADT* is in the order of 9343 vehicles per day. Likely traffic volumes generated during the operational phase of the project are summarised in *Table 3* and considered as insignificant in terms of increased traffic noise.

Table 3: Operational Traffic Projections

Personnel	Anticipated vehicle numbers	Usage information
Stage 1 GFDA		
6 field operators for field monitoring	Up to six light vehicles	Daily usage to check the wells. Movements internal to Stage 1 GFDA.
6 workover crew operating the workover rig and support vehicles	One workover rig, one truck and two light vehicles	Monthly usage for work-over operations internal to the Stage 1 GFDA.
CPF		
Field Operations management and administration	Ten light vehicles	20 external movements per day.
2 x Plant Operators (one per day and night shift)	Two light vehicles	4 external movements per day.
1 x Plant Supervisor		
1 x Electrical & Instrumentation technician	One light vehicle	2 external movements per day.
4 Workshop and maintenance staff	Four light vehicles	8 external movements per day.
6 CPF contractors (compression, E&I and environmental license compliance)	Four light vehicles	8 external movements per day. Anticipated onsite every 3 months.
Pipeline		
1 x Pipeline technicians	One light vehicle.	Routine inspections of the pipeline route requiring movements on the external road network along the pipeline route. Additional support from plant operators where required

2.7 Intermittent Operational Noise (Sleep Disturbance)

It is understood that noise from the operational plant would be continuous and intermittent sources would not be greater than 5-10dBA above the L_{Aeq} levels. Hence intermittent noise has not been assessed in terms of sleep disturbance.

2.8 Operational Ground Vibration

No operational ground vibration sources have been identified that would be likely to generate ground vibration at exposed residential receptors.

3.0 EXISTING AMBIENT NOISE ENVIRONMENT

An assessment of the existing ambient noise was undertaken to establish project noise assessment goals for the project. The measurements included both attended audits to identify sources contributing to the ambient noise and unattended monitoring.

3.1 Monitoring Equipment and Procedures

The measurement instrumentation comprised a Bruel & Kjaer Precision Sound Level Meter Type 2215, a Svantek SVAN 949 Sound Level Analyser and RTA Environmental Noise Loggers. The reference calibration level for each instrument was checked prior to and after the measurements with a Bruel & Kjaer Sound Level Calibrator Type 4230 and remained within ± 1.

3.2 Acoustic Parameters

The ambient noise levels were measured and recorded as percentile and energy averaged A-weighted levels. The percentile A-weighted sound levels are the levels exceeded for the relevant percentage of the measurement period *(Attachment 1)*. The parameters regarded as being the most common to describe ambient noise levels are the "L_{A90}" or the A-weight sound pressure level exceeded for 90% of the sampling period and is referred to as the background noise level; and, the "L_{Aeq}" or the A-weighted equivalent continuous sound pressure level for the sampling period which if maintained for the duration of the measurement period would be equal to the same energy as the actual time varying levels.

3.3 Unattended Noise Monitoring

Unattended noise monitoring was undertaken between October 2008 and June 2009. The reference measurement locations *(Tables 4 and 5)* were selected to provide information on the existing noise levels for areas considered to be potentially exposed to operational noise from the *GFDA, CPF* and *HDS*. The measurements locations selected include rural areas with limited traffic flows, areas exposed to road traffic noise and areas exposed to mining and industrial activities.

The measurement results were evaluated in accordance with *INP* procedures to confirm the *RBL's* and ambient levels *(Tables 4 and 5)*.

3.4 Meteorological Conditions during Monitoring

In accordance with Section 3.4 of the *INP*, noise data was excluded from the monitoring results when average wind speeds were greater than 5m/s and/or rain occurred.

3.5 Measurement Results

Attachment 1 presents a graphic presentation of the noise measurement results. *Tables 4 and 5* presents a summary of the measurement data collected. The measurement results show that the evening *RBL's* are marginally higher than the daytime levels. This finding is not uncommon for rural areas where the ambient noise can be influenced by wind direction changes and distant noise sources.

Table 4. Rating Background Levels and Ambient Noise Levels (CPF Sites 1 and 7)

dBA re: 20 $\times 10^{-6}$ Pa

Date	Assessment Background Noise Levels					
	RBL (dB)			Ambient $L_{Aeq, period}$		
	Day	Evening	Night	Day	Evening	Night
Ambient Noise Measurement Results (September 2008)						
Reference Measurement Location R1/P2.						
RBL	37.6	40.0	37.2			
Logarithmic Average L_{Aeq}				63.4	56.8	61.6
Reference Measurement Location R2/P1.						
RBL	32.1	35.3	31.4			
Logarithmic Average L_{Aeq}				49.6	48.6	46.8
Reference Measurement Location R3.						
RBL	32.5	34.1	29.9			
Logarithmic Average L_{Aeq}				58.8	45.5	46.0
Reference Measurement Location R4/P10.						
RBL	30.4	32.2	31.3			
Logarithmic Average L_{Aeq}				49.7	39.8	43.4
Reference Measurement Location R5/P5.						
RBL	30.6	31.5	31.1			
Logarithmic Average L_{Aeq}				56.1	52.7	49.9
Reference Measurement Location R6.						
RBL	29.7	33.2	32.2			
Logarithmic Average L_{Aeq}				53.3	51.3	47.4
Reference Measurement Location R7/P13.						
RBL	31.6	32.8	31.3			
Logarithmic Average L_{Aeq}				57.1	45.4	46.4

Notes: Daytime: 7.00am to 6.00pm Monday to Saturday, 8.00am to 6.00pm Sunday and Public Holidays.
Evening: 6.00pm to 10.00pm.
Night: 10.00pm to 7.00am Monday to Saturday, 10.00pm to 8.00am Sunday and Public Holidays.

Table 4. Rating Background Levels and Ambient Noise Levels. Cont'd (CPF Sites 1 and 7)
dBA re: 20 $\times 10^{-6}$ Pa

Date	Assessment Background Noise Levels					
	RBL (dB)			Ambient $L_{Aeq, period}$		
	Day	Evening	Night	Day	Evening	Night
Ambient Noise Measurement Results (April 2009)						
Reference Measurement Location R2A.						
RBL	35.0	34.0	31.2			
Logarithmic Average L_{Aeq}				47.4	46.2	44.8
Reference Measurement Location R8/P3.						
RBL	34.5	35.2	34.5			
Logarithmic Average L_{Aeq}				57.1	52.2	47.4

Notes: Daytime: 7.00am to 6.00pm Monday to Saturday, 8.00am to 6.00pm Sunday and Public Holidays.
Evening: 6.00pm to 10.00pm.
Night: 10.00pm to 7.00am Monday to Saturday, 10.00pm to 8.00am Sunday and Public Holidays.

Table 5. Rating Background Levels and Ambient Noise Levels (HDS)
dBA re: 20 $\times 10^{-6}$ Pa

Ambient Noise Measurement Results (June 2009*)						
Reference Measurement Location R9/P15.						
RBL	49.9	47.5	45.7			
Logarithmic Average L_{Aeq}				55.4	55.2	55.1
Reference Measurement Location R10/P17.						
RBL	43.7	45.3	39.7			
Logarithmic Average L_{Aeq}				56.0	51.8	52.9

Notes: Daytime: 7.00am to 6.00pm Monday to Saturday, 8.00am to 6.00pm Sunday and Public Holidays.
Evening: 6.00pm to 10.00pm.
Night: 10.00pm to 7.00am Monday to Saturday, 10.00pm to 8.00am Sunday and Public Holidays.

Residential properties identified as being exposed to existing industrial/mining noise sources include (R1), (R2), (R8) and (R10). The noise monitoring results for (R3) and (R6) were considered as part of the assessment of the ambient background noise. As the locations were outside the *CPF* 30dBA predicted operational noise contour plot they were not considered as the most exposed and not identified in *Tables 17* and *18.*

3.6 Industrial Noise Policy Assessment Procedures

For preservation of acoustic amenity, the *INP* requires industrial noise in residential areas be within the acceptable levels for the locality and land-use. The *INP* would define the subject receivers as *Rural* or *Suburban* and *Urban*. *Table 6* presents a summary of the *INP* acceptable and recommended maximum amenity noise goals for residential development in different noise catchments.

Table 6: INP Noise Policy Amenity Goals

Receiver Description	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban (1)	Day	55	60
		Evening	45	50
		Night	40	45
	Urban (2)	Day	60	65
		Evening	50	55
		Night	45	50
Passive recreation areas	All	When in use	50	55
Active recreation areas	All	When in use	55	60
Commercial	All	When in use	65	70
Industrial	All	When in use	70	75

NOTES: Daytime: (7.00am to 6.00pm)
Evening: (6.00pm to 10.00pm)
Nighttime: (10.00pm to 7.00am)

(1) Suburban
– an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristics:
- decreasing noise levels in the evening period (1800-2200); and/or
- evening ambient noise levels defined by the natural environment and infrequent human activity.

This area may be located in either a rural, rural-residential or residential zone, as defined or other planning instrument.

(2) Urban
- an area with an acoustical environment that:
- is dominated by 'urban hum' or industrial source noise
- has through traffic with characteristically heavy and continuous traffic flows during peak periods
- is near commercial districts or industrial districts
- has any combination of the above
- where 'urban hum' means the aggregate sound of many unidentifiable, mostly traffic related sound sources.

This area may be located in either a rural, rural-residential or residential zone, as defined or other planning instrument, and also includes mixed land-use zones such as mixed commercial and residential uses.

3.7 Ambient Noise Assessment for Pipeline Corridor

Given the short-term nature of the pipeline construction works at any particular receptor location, background noise measurements were not measured along the corridor. With respect to this component of the project, a 'qualitative assessment' has been undertaken *(Section 9)* to identify the cause of potential noise impacts and methods to manage noise.

4.0 TARGET NOISE ASSESSMENT GOALS

4.1 Operational Target Noise Goals

With respect to what is considered to represent the current best practice for assessing environmental noise, the main aims are to control intrusive noise and manage increases in ambient noise *(noise creep)* from industrial sources.

The intrusiveness of a noise is considered to be acceptable if the $L_{Aeq,\ 15\ min}$ level does not exceed the *RBL* by more than 5dBA. In order to preserve noise amenity, the *INP* recommends that L_{Aeq} level from industrial sources should not normally exceed the recommended acceptable noise level (*Table 7*) assessed over the relevant assessment period, i.e. day, evening and night. Where existing L_{Aeq} levels are controlled by industrial noise, and the level approaches or exceeds the recommended acceptable level, noise assessment goals for new sources are normally set below the existing L_{Aeq} level in order to limit any further increase or noise "creep". Meeting the *INP* acceptable levels *(Table 6)* would normally *(DECCW, INP)* protect the community from annoyance.

For the purpose of controlling and assessing environmental noise impacts, the *INP* recommends that the acceptable levels *(INP. Tables 2.1 and 2.2)* shown in *Table 6* represent the ideal total level of noise from industrial sources that should be met by any further development of the area.

The *DECCW* recognise (*INP. Section 1.4.1)* that in setting assessment goals, the levels established in accordance with the *INP* procedures are best regarded as planning tools. The levels determined in accordance with the recommended procedures are not mandatory, and an application for a noise producing development is not determined purely on the basis of compliance or otherwise of noise goals. Other factors that need to be taken into account in the determination include economic consequences, other environmental effects and the social worth of the proposal. In determining project-specific noise levels from *RBL's*, the *DECCW* recommend that the intrusive noise level for evening be set no greater than the daytime intrusive noise level and the nighttime intrusive level should be no greater than the day or evening levels.
For the purpose of establishing project noise goals, the existing *RBL's* and the

"Rural/Suburban/Urban" INP amenity goals form the basis of the evaluation and determining the noise goals summarised in *Tables 7 and 8.*

For assessment purposes the noise goals are assessed at residential boundaries or thirty (30) metres from a residential dwelling on the property, if the boundary is more than thirty (30) metres from the dwelling.

Table 7: Operational Project Noise Goals - CPF Sites 1 and 7
dBA re: 20 x 10^{-6} Pa

Period	Sound Pressure Levels				
	Existing RBL	**Existing Amenity Level L_{Aeq}**	**Recommended Amenity Goal L_{Aeq}**	**Intrusive Goal L_{Aeq}**	**Project Noise Goals L_{Aeq}**
Reference Measurement Location R1/P2.					
Day	37.6	63.4	55	43	43
Evening	40.0	56.8	45	43	43
Night	37.2	61.6	40	42	42
Reference Measurement Location R2/P1.					
Day	32.1	49.6	55	37	37
Evening	35.3	48.6	45	37	37
Night	31.4	46.8	40	36	36
Reference Measurement Location R3.					
Day	32.5	58.8	55	37	37
Evening	34.1	45.5	45	37	37
Night	29.9	46.0	40	35	35
Reference Measurement Location R4/P10.					
Day	30.4	49.7	50	35	35
Evening	32.2	39.8	45	35	35
Night	31.3	43.4	40	35	35
Reference Measurement Location R5.					
Day	30.6	56.1	50	36	36
Evening	31.5	52.7	45	36	36
Night	31.1	49.8	40	36	36
Reference Measurement Location R6.					
Day	29.7	53.3	50	35	35
Evening	33.2	51.3	45	35	35
Night	32.2	47.4	40	35	35
Reference Measurement Location R7/P13.					
Day	31.6	57.1	50	37	37
Evening	32.8	45.4	45	37	37
Night	31.3	46.4	40	36	36
Reference Measurement Location R8/P3.					
Day	34.5	57.1	55	40	40
Evening	35.2	52.2	45	40	40
Night	34.5	47.4	40	40	37

Notes: Daytime: 7.00am to 6.00pm Monday to Saturday, 8.00am to 6.00pm Sunday and Public Holidays.
Evening: 6.00pm to 10.00pm.
Night: 10.00pm to 7.00am Monday to Saturday, 10.00pm to 8.00am Sunday and Public Holidays

Table 8: Operational Project Noise Goals - HDS
dBA re: 20 x 10^{-6} Pa

Period	Sound Pressure Levels				
	Existing RBL	**Existing Amenity Level L_{Aeq}**	**Recommended Amenity Goal L_{Aeq}**	**Intrusive Goal L_{Aeq}**	**Project Noise Goals L_{Aeq}**
Reference Measurement Location R9/P15. Tomago Village Caravan Park					
Day	49.9	55.4	60	55	55
Evening	47.5	55.2	50	53	45
Night	45.7	55.1	45	51	45
Reference Measurement Location R10/P17. Old Maitland Road					
Day	43.7	56.0	60	49	49
Evening	45.3	51.8	50	50	42
Night	39.7	52.9	45	45	43

Notes: Daytime: 7.00am to 6.00pm Monday to Saturday, 8.00am to 6.00pm Sunday and Public Holidays.
Evening: 6.00pm to 10.00pm.
Night: 10.00pm to 7.00am Monday to Saturday, 10.00pm to 8.00am Sunday and Public Holidays

4.2 Sleep Disturbance Assessment Goals

The *DECCW*, Environmental Noise Control Manual *(ENCM)* provides guidelines for assessing sleep disturbance from short-term noise events. Referenced to the *ENCM (Section 19.3)* the $L_{A1,\ 1min}$ noise level measured or assessed over a one (1) minute period outside a residential bedroom window should not exceed the L_{A90} background level by more than 15dBA. The *DECCW* accept that the $L_{A1,\ 1min}$ above the *RBL* is appropriate for assessing sleep disturbance during nighttime hours (2200-0700). *Table 9* presents the sleep disturbance assessment goals developed from *RBL* levels in *Table 4*.

Table 9: Sleep Disturbance Assessment Goals CPF and HDS
dBA re: 20 x 10^{-6} Pa

Referenced Assessment Location	Existing RBL	Sleep Disturbance Assessment Goals $L_{A1,\ 1\ min}$
CPF Sites 1 and 7 and GFDA		
Rural (R2-R7)	30-32	45-47
Rural exposed to Gloucester Colliery (R1, R8)	34-37	49-52
HDS		
Hexham	40-46	55-61

4.3 Road Traffic Noise

Procedures for assessing road traffic noise from new land use developments are documented in the *DECCW (*EPA), *Environmental Criteria for Road Traffic Noise (ECRTN)* and summarised in *Table 10*

Table 10. Road Traffic Noise Goals

dBA re: 20 x 10^{-6} Pa

Land Use Development	Traffic Noise Assessment Goals		Where Goals are already Exceeded
	Daytime (7.00am to 10.00pm)	**Nighttime (10.00pm to 7.00am)**	
Land use developments with potential to create additional traffic on local roads	$L_{Aeq,\ 1\ hour}$ 55	$L_{Aeq,\ 1\ hour}$ 50	In all cases, the redevelopment should not increase existing noise levels by more than 2dBA. Where feasible and reasonable noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies.
Land use developments with potential to create additional traffic on collector roads	$L_{Aeq,\ 1\ hour}$ 60	$L_{Aeq,\ 1\ hour}$ 55	
Land use developments with potential to create additional road traffic on existing freeways/arterial roads	$L_{Aeq,\ 15\ hour}$ 60	$L_{Aeq,\ 9\ hour}$ 55	

For the purpose of assessing likely future road traffic noise from the proposal the $L_{Aeq,\ 1\ hour}$ 55/60dBA (daytime) and $L_{Aeq,\ 1\ hour}$ 50/55dBA (nighttime) assessment goals have been considered.

5.0 METEOROLOGICAL CONDITIONS

Site investigations confirmed that the study areas are subject to seasonal prevailing winds and temperature inversions. It is recognised that the effects of meteorological conditions enhance or reduce noise propagation and noise at distant receptors. In the near field wind has minor influence on measured down wind sound levels. Wind effects become more important as distances increase. Depending on wind speed and distance from a noise source, up wind noise measurement levels compared to down wind conditions can vary by over ±10dBA. Temperature gradients create similar enhancement effects to wind, however the effects are generally less than wind effects and uniform in all directions.

In accordance with *INP* procedures meteorological conditions have been assessed from data provided by *AECOM*.

5.1 Gloucester Area

The meteorological data reported for Gloucester included seasonal day, evening and night data for wind and stability classes *(Attachments 2 and 3)*.

5.1.1 Wind

Table 11 presents a summary of the dominant wind data and the frequency of occurrences.

Table 11: Summary of Wind Direction and Percentage Occurrence

Season	Winds ± ≤ 3m/s with Frequency of Occurrence's ≥ 30%	
	Direction	<3m/sec
Day		
Summer	ENE (± 45º)	27%
Autumn	SSW (± 45º)	24%
Winter	SW (± 45º)	10%
Spring	SE (± 45º)	20%
Evening		
Summer	NE (± 45º)	49%
Autumn	NNW (± 45º)	26%
Winter	WNW (± 45º)	13%
Spring	NW (± 45º)	21%
Night		
Summer	N (± 45º)	41%
Autumn	NW (± 45º)	38%
Winter	WNW (± 45º)	12%
Spring	NW (± 45º)	29%

Referenced to *INP* assessment procedures for seasonal frequency of wind velocities up to 3m/sec. north-east, north and north-west winds require assessment in the noise modelling.

5.1.2 Atmospheric Stability

Table 12 presents summaries of the atmospheric stability class data and frequency of occurrences.

Table 12: Atmospheric Stability Frequency and ELR - Winter Nights

Stability Class	Occurrence Percentage	Estimate ELR °C/100m	Qualitative Description
A	0	<-1.9	Lapse
B	0	-1.9 to -1.7	Lapse
C	0	-1.7 to -1.5	Lapse
D	48.1%	-1.5 to -0.5	Neutral
E	45.7%	-0.5 to 1.5	Weak Inversion
F	6.3%	1.5 to 4.0	Moderate Inversion
G	-	> 4.0	Strong Inversion

From the *INP* assessment procedures referenced to the frequency of occurrence of moderate to strong (1.5 °C/100m to >4.0 °C/100m) inversions is less than 30%. With respect to Class E (weak inversions) the frequency of occurrence is greater than 30% and requires assessment in the noise modelling.

5.2 Hexham/Kooragang Island

Site investigations revealed that the Hexham/Kooragang Island areas are subject to seasonal prevailing winds and temperature inversions. In accordance with *INP* procedures meteorological conditions have been assessed from data collected at the Port Waratah Coal Services *(PWCS)* Kooragang Coal Loader (Kooragang Island).

5.2.1 Wind

The meteorological data reported includes annual and seasonal data for wind and stability classes *(Attachments 3 and 4). Tables 13 and 14* present summaries of the wind data and percentage occurrences of stability classes.

Table 13: Summary of Wind Direction and Percentage Occurrence

Season	Winds ± ≤ 3m/s with Frequency of Occurrence's ≥ 30%		
	Day	Evening	Night-time
Summer	Nil	NE	Nil
Autumn	Nil	Nil	Nil
Winter	Nil	Nil	WNW
Spring	Nil	NNE	Nil

Referenced to *INP* north-east, north-north-east and west-north-west wind effects would be considered as dominant conditions and require assessment.

5.2.2 Atmospheric Stability

Table 14 present summaries of the atmospheric stability class data and frequency of occurrences.

Table 14: Atmospheric Stability Frequency of Occurrence - Winter/Night

Stability Class	Occurrence Percentage	Estimate ELR[1] °C/100m	Qualitative Description
A	0%	<-1.9	Lapse
B	0%	-1.9 to -1.7	Lapse
C	0%	-1.7 to -1.5	Lapse
D	31.4%	-1.5 to -0.5	Neutral
E	17.9%	-0.5 to 1.5	Weak Inversion
F	50.8%	1.5 to 4.0	Moderate Inversion
G	-	> 4.0	Strong Inversion

The *INP* assessment procedures and data assessed moderate (1.5 to 4.0 °C/100m) inversions occur more than 30% and require assessment.

6.0 OPERATIONAL NOISE AND VIBRATION

6.1 Noise and Vibration Sources

The main operational noise sources associated with the project include the *CPF* and *HDS.* The noise from both facilities is expected to be continuous and free from significant tonal and impulsive sources.

It is not expected that operational $L_{A1,\ 1\ mim}$ noise levels emitted from the *GFDA, CPF, GTP* and *HDS* would be greater than 5-10dBA above the operational L_{Aeq} levels or exceed the *DECCW* sleep disturbance assessment goals.

No operational vibration sources have been identified that are likely to generate ground vibration at exposed receptors.

6.1.1 CPF Plant

The *CPF* plant would include five (5) three (3) MW gas powered generators, eight (8) compressors, eight (8) compressor cooling fan systems, pumps and valves. *Table 15* presents a summary of plant and measured sound power data provided by the manufacturer, which have been adopted for noise modelling and assessing compliance with the project noise goals. The data summarised in *Table 15* assumes that the generators and compressors are installed in individual acoustic enclosures and the fin cooling fans selected on noise performance and that there would be no significant tonal or low frequency noise characteristics. No allowance for low frequency noise has been assumed in the noise modelling. When the final operational specifications for the *CPF* are determined, the acoustic parameters would be reviewed and noise control requirements determined.

Table 15. Plant Sound Power Levels (CPF)
dB 10^{-12} Watts

Plant Description	Sound Power Levels 10^{-12} Watts									Lw
	31	62	125	250	500	1K	2K	4K	8K	dBA
Central Processing Facility										
Compressor	116	104	98	92	85	77	72	64	53	89
Compressor Fin Fan Cooler	-	100	99	96	91	89	82	77	71	94
Compressor Exhaust	-	88	72	65	69	72	68	63	61	75
Power Generator	117	111	115	109	95	92	92	94	94	105
Power Generator Exhaust	105	99	103	97	83	80	80	82	82	93

6.1.2 HDS Equipment

Operational noise from the *HDS* would be dependent on design factors including the number of process trains, gas flow pressure and velocities, valve types, pipe sizes and the location of bends and valves. *Table 16* presents a summary of manufactures and measured sound power data adopted for noise modelling and assessing compliance with the project noise goals. As the distribution station design would be site specific and dependent on final operational specifications the design and noise control requirements would be determined during the detail design phase.

Table 16. Plant Sound Power Levels (HDS)
dB 10^{-12} Watts

Plant Description	Sound Power Levels 10^{-12} Watts									Lw
	31	62	125	250	500	1K	2K	4K	8K	dBA
Hexham Delivery Station										
High Flow Rate										
Water bath heater 1	92	102	108	111	114	114	113	113	111	120
Water bath heater 2	92	102	108	111	114	114	113	113	111	120
Dry Gas Filters	94	104	110	113	116	116	115	115	113	122
Meters	92	102	108	111	114	114	113	113	111	120
Flow Control Stage 1	74	84	90	93	96	96	95	95	93	102
Flow Control Stage 2	82	92	98	101	104	104	103	103	101	110
Low Flow Rate										
Water bath heater 1	65	75	81	84	87	87	86	86	84	93
Water bath heater 2	65	75	81	84	87	87	86	86	84	93
Dry Gas Filters	44	54	60	63	66	66	65	65	63	72
Meters	65	75	81	84	87	87	86	86	84	93
Flow Control Stage 1	69	79	85	88	91	91	90	90	88	97
Flow Control Stage 2	77	87	93	96	99	99	98	98	86	105

6.2 Noise Modelling Procedure

Noise from the two *CPF* sites was modelled with the *DECCW* approved Environmental Noise Model *(ENM)* computer model. The model considers attenuation factors including distance, ground absorption, atmospheric absorption, topographical features of the area and normal operating conditions.

Section 5.3.1 of the *INP* guidelines recommends that atmospheric stability and wind effects be assessed when they occur for 30% of the time or more in any assessment period or season. Considering the meteorological and seasonal wind data *(Section 5),* calm conditions and north, northeast and northwest winds have been assessed together with temperature gradients of 2°C/100m. The meteorological scenarios modelled are outlined below:

- Condition 1: Calm (day/evening): RH 60%, and 20°C;
- Condition 2: Northeast wind (summer/evening): 2m/sec, RH 60%, and 20°C;
- Condition 3: North wind (summer/night): 2m/sec, RH of 60%, and 15°C;
- Condition 4: Northwest wind (autumn/night): 2m/sec, RH 60%, and 15°C;
- Condition 5: Northwest wind (spring/night): 2m/sec, RH 60%, and 15°C;
- Condition 6: Temperature gradient 2°C/100m, RH 60%, and 15°C, and
- Condition 7: Temperature gradient of 2°C/100m, 2m/sec northwest wind, RH 60%, and 15°C.

6.3 CPF Noise Predictions

Noise contours plots produced from the ENM modelling are presented in *Attachment 4 CPF Site 7 and CPF Site 1* for calm wind conditions. The contours are presented for descriptive and visual purpose only. For assessment purposes the closest residential dwellings were evaluated and reference locations *(Attachments 4)* selected to model and assess operational noise contributions *(Tables 17 and 18).*

Table 17: Predicted Sound Pressure Level Contributions CPF Site 7
L_{Aeq} re: 20 x 10^{-6} Pa

Reference Location	Predicted Sound Pressure Level Contributions							Project Noise Goal
	Meteorological Conditions							
	1	**2**	**3**	**4**	**5**	**6**	**7**	
R2/P1	28	25	23	24	24	29	25	**36**
R1/P2	38	42	41	36	36	41	37	**42**
R8/P3	**40**	**46**	**44**	**39**	**39**	**43**	**42**	**37**
P4	26	32	32	30	30	30	31	**35**
P5	26	32	33	32	32	30	32	**35**
P6	31	35	**36**	35	35	34	**36**	**35**

1. Calm: relative humidity of 60%, and air temperature of 20°C;
2. Northeast wind (summer/evening): 2m/sec, relative humidity of 60%, and air temperature of 20°C;
3. North wind (summer/night): 2m/sec, relative humidity of 60%, and air temperature of 15°C;
4. Northwest wind (autumn/night): 2m/sec, relative humidity of 60%, and air temperature of 15°C;
5. Northwest wind (spring/night): 2m/sec, relative humidity of 60%, and air temperature of 15°C;
6. Temperature gradient 2°C/100m elevation, relative humidity of 60%, and air temperature of 15°C, and
7. Temperature gradient of 2°C/100m elevation, 2m/sec northwest wind, relative humidity of 60%, and air temperature of 15°C.

Table 18: Predicted Sound Pressure Level Contributions CPF Site 1
L_{Aeq} re: 20 x 10^{-6} Pa

Reference Location	Predicted Sound Pressure Level Contributions							Project Noise Goal
	Meteorological Conditions							
	1	**2**	**3**	**4**	**5**	**6**	**7**	
P7	29	31	30	27	27	30	29	**36**
R5/P8	34	34	32	30	30	34	32	**36**
P9	30	32	32	31	31	31	31	**35**
R4/P10	**44**	**45**	**46**	**45**	**45**	**45**	**46**	**36**
P11	24	21	24	27	27	26	29	**36**
P12	31	27	29	34	34	35	**37**	**36**
R7/P13	28	24	26	30	30	30	31	**36**

1. Calm : relative humidity of 60%, and air temperature of 20°C;
2. Northeast wind (summer/evening): 2m/sec, relative humidity of 60%, and air temperature of 20°C;
3. North wind (summer/night): 2m/sec, relative humidity of 60%, and air temperature of 15°C;
4. Northwest wind (autumn/night): 2m/sec, relative humidity of 60%, and air temperature of 15°C;
5. Northwest wind (spring/night): 2m/sec, relative humidity of 60%, and air temperature of 15°C;
6. Temperature gradient 2°C/100m, relative humidity of 60%, and air temperature of 15°C, and
7. Temperature gradient of 2°C/100m, 2m/sec northwest wind, relative humidity of 60%, and air temperature of 15°C.

6.4 HDS Noise Predictions

Noise contour plots produced from the ENM modelling are presented in *Attachment 5* for calm wind conditions. The contours are presented for descriptive and visual purpose only. For assessment purposes the closest residential dwellings were evaluated and reference locations selected to model and assess operational noise contributions *(Table 19)*. The meteorological scenarios modelled are outlined below:

- Condition 1: Calm: RH 60%, and 20°C;
- Condition 2: Northeast wind (evening): 2m/sec, RH 60%, and 20°C;
- Condition 3: North-north-east wind (evening): 2m/sec, RH of 60%, and 20°C;
- Condition 4: West-north-west wind (night): 2m/sec, RH 60%, and 15°C;
- Condition 5: Temperature gradient 4°C/100m, RH 60%, and 15°C, and
- Condition 6: Temperature gradient of 4°C/100m, 2m/sec west-north-west wind, RH 60%, and 15°C.

Table 19: Predicted Sound Pressure Level Contributions (HDS)

L_{Aeq} re: 20 x 10^{-6} Pa

Reference Location	Description	Predicted Sound Pressure Level Contributions						Project Noise Goals
		Meteorological Conditions						
		1	2	3	4	5	6	
High Volume Flow								
R9/P15	Caravan Park	34	30	30	44	38	**49**	45
P16	Punt Road	**68**	**65**	**66**	**70**	**69**	**70**	43
R10/P17	Old Maitland Road	**59**	**59**	**60**	**63**	**60**	**65**	43
Low Pressure Flow								
R9/P15	Caravan Park	14	9	10	24	19	30	45
P16	Punt Road	**46**	41	42	**47**	**47**	**48**	43
R10/P17	Old Maitland Road	35	34	36	41	36	43	43

1. Calm : relative humidity of 60%, and air temperature of 20°C;
2. Northeast wind (evening): 2m/sec, relative humidity of 60%, and air temperature of 20°C;
3. North North East wind (evening): 2m/sec, relative humidity of 60%, and air temperature of 20°C;
4. West North West (night): 2m/sec, relative humidity of 60%, and air temperature of 15°C;
5. Temperature gradient 4°C/100m elevation, relative humidity of 60%, and air temperature of 15°C, and
6. Temperature gradient of 4°C/100m elevation, 2m/sec northwest wind, relative humidity of 60%, and air temperature of 15°C.

6.5 Assessment

6.5.1 CPF Sites

The noise modelling summarised in *Table 17* for *CPF Site 7* show that the recommended project noise goals are exceeded at P3. A marginal (1dBA) noise exceedance is predicted at P6 when the effects of prevailing north winds and temperature inversions are considered. The noise modelling results identified that the generators, compressors and compressor cooling fin fans contribute to the predicted noise exceedances. To achieve an additional 9-10dBA cumulative noise reduction, the generator and compressor noise controls require upgrading. Management options that

could be considered to reduce the site noise emissions include upgraded acoustic treatments, and built structures around the generators and compressors.

The noise modelling summarised in *Table 18* for *CPF Site 1 show* that the project noise goals are exceeded at P11 for calm and adverse meteorological conditions. The plant contributing to the predicted noise exceedances include the generators, compressors and compressor cooling fin fans. To achieve the 10dBA site noise reduction, the generator and compressor enclosures and compressor cooling fin fan noise controls would require upgrading and/or secondary noise control structures.

6.5.2 HDS

The noise predictions summarised in *Table 19* show that the project noise goals are exceeded at the closest residential properties for calm and adverse meteorological conditions. With respect to the site boundaries that are shared with industrial and commercial properties the project noise goals *(65-75dBA)* are exceeded without the inclusion of secondary noise controls. The main sources contributing to the predicted noise exceedances include the valves, fittings and radiated noise from pipe trains. As the distribution station design would be site specific and dependent on final operational specifications the design and noise control requirements would be determined during the detail design phase. Secondary controls could include the reselection of valves and fittings, design of pipe trains to reduce velocities and turbulence, lagging pipes and acoustic rated compound walls/mounds.

6.5.3 Comments

As part of the project design, development and assessment when final details of the plant and equipment are specified and the project noise goals confirmed, a more detailed noise assessment would be undertaken to establish and confirm the extent of noise mitigation required for the *CPF* and *HDS* . During the detailed project design phase, the acoustic investigations would assess for the need to adjust the source noise to account for tonality, impulsiveness, intermittency, irregularity or low-frequency content.

7.0 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT GOALS

For major construction projects undertaken in New South Wales the *DECCW* recommend procedures for assessing noise and vibration impacts. Publications released and referred to by the *DECCW* with reference to the assessment of construction noise and vibration impacts include the *Interim Construction Noise Guideline (2009)* and *Assessing Vibration: a technical guideline.*

7.1 DECCW, Interim Construction Noise Guideline

The Interim Construction Noise Guideline *(ICNG)* was developed by the *DECCW* in response to concerns raised with respect to construction noise impacts. The primary objective of the *ICNG* is aimed at managing noise from construction works regulated by the *DECCW*. The guideline deals with procedures to:

- promote a clear understanding of ways to identify and minimise noise from construction works;
- focus on applying all 'feasible and reasonable' work practices to minimise construction noise impacts;
- encourage construction to be undertaken during recommended hours;
- streamline the assessment and approval stages
- reduce time spent dealing with complaints at the project implementation stage; and
- provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts.

The *DECCW* recognise that feasible work practices are practical to implement, while reasonable work practices take into account the balance of costs and benefits and community views. Work practices recommended by the *DECCW* can include notifying the community of expected noise impacts and when they are expected to occur.

The procedures and recommendations published in the *ICNG* for assessing noise from construction activities are best regarded as planning tools. They are not mandatory, and their application for assessing construction noise is not determined purely on the basis

of compliance or otherwise with numerical noise levels.

For the purpose of assessing and managing noise impact the *ICNG* procedures refer to the proposed construction hours and the duration of the works. For construction works extending more than three (3) weeks a 'quantitative assessment method' is recommended. For construction works that are unlikely to affect an individual or sensitive land use for more than three (3) weeks in total, the *ICNG* refers to a 'qualitative assessment method'.

7.1.1 Construction Hours

The recommended standard hours for construction are summarised in *Table 20.* Albeit the *DECCW* recognise that the recommended hours are not mandatory and that there would be situations, where construction works are undertaken outside of these hours.

Table 20. Recommended Standard Construction Hours

Work Type	Recommended Standard Hours of Work*
Normal Construction	Monday to Friday 7.00am to 6.00pm Saturday 8.00am to 1.00pm No works on Sundays or public holidays
Blasting	Monday to Friday 9.00am to 5.00pm Saturday 9.00am to 1.00pm No blasting on Sundays or public holidays

* The relevant authority (consent, determination or regulatory) may impose more or less stringent construction hours

7.1.2 Quantitative Assessment Method

The *ICNG (Chapter 4)* refers to quantitative assessment methods involving predicted noise levels and comparing them with levels developed from Chapter 4 of the Guideline. For assessment purposes the Rating Background Level *(RBL)* is used when determining the management assessment level. *Table 21* sets out noise management levels at residences and how they are applied. Restrictions to construction hours may apply to activities that generate noise at residences above the 'highly noise affected ' noise management level.

Table 21. Noise at Residences (Quantitative Assessment)

Time of Day	Management Level LAeq (15 min)	How to Apply
Recommended standard hours: Monday to Friday 7.00am to 6.00pm Saturday 8.00am to 1.00pm No works on Sundays or public holidays	Noise affected RBL+10dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured LAeq 15min is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details
	Highly noise affected 75	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. If the community is prepared to accept longer period of construction in exchange for restrictions on construction times
Outside recommended standard hours	Noise affected RBL+5	• A strong justification would typically be required for works outside the recommended standard hours • The proponent should apply all feasible and reasonable work practices to meet the noise affected level • Where feasible and reasonable practices have been applied and noise is more than 5 above the noise affected level, the proponent should negotiate with the community

* Noise levels apply at the residential property boundary that is most exposed to construction noise. If the property boundary is more than 30m from the residence the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence.

For other noise sensitive land uses, such as schools, hospitals, etc *Table 22* presents management levels based on the principle that the characteristic activity for each of these land uses should not be unduly disturbed. Internal levels referenced in *Table 22* are to be assessed at the centre of the occupied room. External levels are to be assessed at the most affected point within 50m of the area boundary. Where internal noise levels cannot be measured adjusted external levels are recommended.

Table 22. Noise at Other Sensitive Receptors (Quantitative Assessment)

Land Use	Management Level LAeq (15 min)	
	Internal	External
Classrooms at schools and other educational institutes	45	55
Hospital wards and operating theatres	45	55
Places of worship	45	55
Active recreation areas	-	65
Passive recreation areas	-	60
Industrial premises	-	75
Office, retail outlets		70
Community centres	Refer to AS2107**	

* External levels measured within 50m of property boundary.
** Refer to recommended 'maximum' internal levels in AS2107 for specific uses.

7.1.2(a) Sleep Disturbance at Residences

Where construction works are planned to extend over more than two consecutive nights, and a quantitative assessment method is used, the *ICNG* recommends that the analysis include the assessment of maximum noise levels, and the extent and number of time that the maximum noise level are likely to exceed the *RBL*.

7.1.3 Qualitative Assessment Method

The qualitative method for assessing noise is used for construction sites that are not likely to affect an individual or sensitive land use for more than three (3) weeks. Where residences may be affected by noise, work practice methods should be considered and a community notification program be implemented together with a Noise Management Plan.

7.1.4 Project Construction Noise Goals

Considering the *ICNG* and the measured *RBLs*, the target assessment goals recommended for evaluating construction noise from the *GFDA, CPF's and HDS* are summarised in *Table 23*.

For assessment purposes construction noise is assessed at a height of 1.5m above ground level at a residential property boundary or thirty (30) metres from a residential dwelling, if the boundary is more than thirty (30) metres from the dwelling.

Table 23: Construction Noise Target Goals – dBA 20 × 10^{-6} Pa

Period	Sound Pressure Levels				
	Existing RBL	Existing Amenity Level L_{Aeq}	Daytime Noise Goal L_{Aeq}	Evening Noise Goal L_{Aeq}	Night Noise Goal L_{Aeq}
STAGE 1- GAS FIELD DEVELOPMENT AREA					
GFDA					
Reference Measurement Location R1/P2.					
Day	37.6	57.1	48		
Evening	40.0	52.2		45	
Night	37.2	47.4			42
Reference Measurement Location R2/P1.					
Day	32.1	49.6	42		
Evening	35.3	48.6		40	
Night	31.4	46.8			36
Reference Measurement Location R3.					
Day	32.5	58.8	43		
Evening	34.1	45.5		37	
Night	29.9	46.0			35
Reference Measurement Location R4/P10.					
Day	30.4	49.7	40		
Evening	32.2	39.8		35	
Night	31.3	43.4			35
Reference Measurement Location R5/P8.					
Day	30.6	56.1	41		
Evening	31.5	52.7		36	
Night	31.1	49.9			36
Reference Measurement Location R6.					
Day	29.7	53.3	40		
Evening	33.2	51.3		35	
Night	32.2	47.4			35
Reference Measurement Location R7/P13.					
Day	31.6	57.1	42		
Evening	32.8	45.4		37	
Night	31.3	46.4			36
CPS Site 1					
Reference Measurement Location R4/P10.					
Day	30.4	49.7	40		
Evening	32.2	39.8		35	
Night	31.3	43.4			35
Reference Measurement Location R5/P8.					
Day	30.6	56.1	41		
Evening	31.5	52.7		36	
Night	31.1	49.9			36
Reference Measurement Location R7/P13.					
Day	31.6	57.1	42		
Evening	32.8	45.4		37	
Night	31.3	46.4			36

Notes: Daytime: 7.00am to 6.00pm Monday to Saturday, 8.00am to 6.00pm Sunday and Public Holidays.
Evening: 6.00pm to 10.00pm.
Night: 10.00pm to 7.00am Monday to Saturday, 10.00pm to 8.00am Sunday and Public Holidays

Table 23: Construction Noise Target Goals
dBA 20 × 10^{-6} Pa

Period	Sound Pressure Levels				
	Existing RBL	**Existing Amenity Level L_{Aeq}**	**Daytime Noise Goal L_{Aeq}**	**Evening Noise Goal L_{Aeq}**	**Night Noise Goal L_{Aeq}**
CPS Site 7					
Reference Measurement Location R1/P2.					
Day	37.6	57.1	48		
Evening	40.0	52.2		45	
Night	37.2	47.4			42
Reference Measurement Location R2/P1.					
Day	32.1	49.6	42		
Evening	35.3	48.6		40	
Night	31.4	46.8			36
Reference Measurement Location R8/P3.					
Day	34.5	57.1	45		
Evening	35.2	52.2		40	
Night	34.5	47.4			40
HEXHAM DELIVERY STATION					
Reference Measurement Location R9/P15.					
Day	49.9	55.4	60		
Evening	47.5	55.2		53	
Night	45.7	55.1			53
Reference Measurement Location R10/P17.					
Day	43.7	56.0	54		
Evening	45.3	51.8		50	
Night	39.7	52.9			45

Notes: Daytime: 7.00am to 6.00pm Monday to Saturday, 8.00am to 6.00pm Sunday and Public Holidays.
Evening: 6.00pm to 10.00pm.
Night: 10.00pm to 7.00am Monday to Saturday, 10.00pm to 8.00am Sunday and Public Holidays

7.2 Ground Vibration

As part of the site preparation rock may be encountered and accordingly rock hammers and or small explosive charges may be required. The effect of vibration on humans and structures is normally considered and evaluated in terms of annoyance and structural damage.

7.2.1 Annoyance

The *DECCW, Assessing Vibration: a technical guideline* recommends goals for assessing human response and potential disturbance to the occupants of buildings. *Table 24* presents a summary of velocity levels (rms) referenced to specific frequency bands adjusted by multiplying factors for residential receptors referenced to human response *(BS 6472-1992. Figure B1.4).*

Table 24: Vibration Levels for Assessment of Human Comfort

Frequency (Hz)	Vibration Level (mm/s)			
	Continuous Vibration		Intermittent Vibration	
	Day (2)	Night (1.4)	Day (60)	Night (90)
1	3.2	2.2	95	31
1.25	2.3	1.6	68	22
1.6	1.6	1.1	47	15
2	1.1	0.8	33	11
2.5	0.8	0.6	24	8.0
3.15	0.6	0.4	17	5.8
4	0.4	0.3	19	4.0
5	0.3	0.2	9.5	3.2
6.3	0.3	0.2	7.6	2.5
8	0.2	0.1	6.0	2.0
10	0.2	0.1	6.0	2.0
12.5	0.2	0.1	6.0	2.0
16	0.2	0.1	6.0	2.0
20	0.2	0.1	6.0	2.0
25	0.2	0.1	6.0	2.0
31.5	0.2	0.1	5.4	1.8
40	0.2	0.1	6.0	2.0
50	0.2	0.1	6.0	2.0
63	0.2	0.1	6.0	2.0
80	0.2	0.1	6.0	2.0

7.2.2 Perception

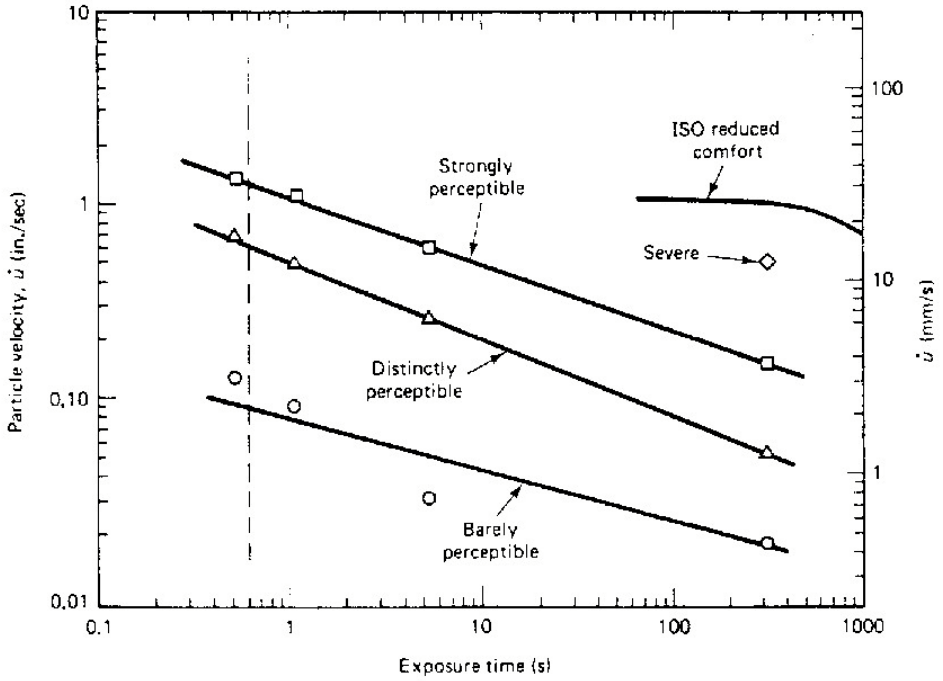
For comparison of vibration in terms of human response, *Table 25* presents a summary of levels referenced to likely perception.

Table 25: Human Perception of Vibration
Ref: German Standard DIN 4150 (1986)

Vibration Levels mm/sec	Likely Perception
0.15	Perception Threshold
0.35	Barely Noticeable
1.0	Noticeable
2.2	Easily Noticeable
6.0	Strongly Noticeable
14.0	Very Strongly Noticeable

Figure 6 compares human response to vibration levels and exposure. The data in *Figure 6* demonstrates that short duration vibration exposure levels are less perceptible than longer continuous levels.

Figure 6: Human Response to Vibration



7.2.3 Structural Damage

German Standard DIN4150 Part 3 (1986) provides guidelines for evaluating the effects of vibration on structures. The values recommended in the standard are summarised in *Table 26*. The values are the maximum levels measured in any direction at the building foundation.

Table 26: Safety Limits for Structural Damage

Type of Structure	Vibration Level (mm/s)		
	< 10Hz	**10Hz to 50Hz**	**50Hz to 100Hz**
Commercial/industrial buildings or buildings with similar design	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20
Structures of great intrinsic value (eg. buildings under preservation)	3	3 to 8	8 to 10

Ref: German Standard DIN4150

7.3 Blast Assessment Goals

Guidelines documented in the *ANZECC "Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*" and *ENCM* [Chapter 154] are normally used to establish goals for assessing blast air-blast overpressure and ground vibration.

7.3.1 Air-blast Overpressure

The *DECCW/ANZECC* recommends a level 115dBLin for the assessment of air-blast overpressure at residential dwellings and commercial premises. The *DECCW* allows this level to be exceeded by up to 5% of the total blasts over a period of 12 months, with a maximum limit of 120dBLin.

7.3.2 Ground Vibration

The *DECCW/ANZECC* ground vibration goal for residential is 5mm/sec (peak particle velocity). The *DECCW* normally allow this level to be exceeded by up to 5% of the total number of blasts over a period of 12 months with a maximum limit of 10mm/s.

7.3.3 Blast Project Assessment Goals

From the *DECCW/ANZECC* recommendations, *Table 27* provides a summary of the recommended blast assessment goals.

Table 27: Assessment Goals for Blasting

Assessment Location	Air-blast Overpressure dBLin		Ground Vibration PPV mm/s	
	Recommended	Maximum Allowable	Recommended	Maximum Allowable
Residential/Commercial Buildings	115	120	5	10

For assessment of air-blast overpressure the *DECCW/ANZECC* recommends measurement at any sensitive receiver be at least three point five (3.5) metres from a building or structure, and ground vibration measured at any point at least the longest dimension of the foundations of a building or structure away from the building or structure.

8.0 CONSTRUCTION PLANT NOISE and VIBRATION SOURCES

The main construction activities envisaged include: access track construction, vegetation clearing, drilling, fraccing, trenching, concreting, structure erection, pipe preparation, pipe installation and plant installation.

8.1 Overview of Construction Activities

The construction sequence would generally be conducted as follows, however subject to the work program some activities may be conducted concurrently at multiple locations.

8.1.1 Gas Field Development Area Construction

At wellhead locations in the *GFDA* single and multiple vertical wells are anticipated *(Figure 1)*. Wells would be drilled using conventional truck mounts drilling rigs and completed with required down hole and surface equipment after being "fracced" to stimulate gas and water flow. The process would comprise the following activities:

- site preparation;
- production well drilling;
- production casing running and cementing;
- fraccing;
- installation of pumps and surface facilities, and
- site cleanup and rehabilitation.

8.1.2 Central Processing Facility

The *CPF* site would require an access road to be constructed, site establishment, preparation for foundations, the erection of structures and the installation of the support plant and equipment. The process would comprise the following activities:

- site preparation;
- foundation preparation;
- concrete pours;
- erection of structures; and
- installation of plant and surface facilities, and site cleanup.

8.1.3 Gas Transmission Pipeline Construction

Much of the route is located on cleared rural land and would not require further clearing, however where the route deviates over timbered land, clearing would be required. Clearing would be conducted in small teams utilising hand tools such as chain saws and the like where appropriate. Where large trees are identified, graders and bulldozers may be utilised to remove entire trees including stumps. Where possible, all vegetation would be mulched.

The envisaged sequence of construction activities for the pipeline include:

- site access and clearing;
- site leveling using graders, excavators and bulldozers;
- trenching with a specialist trencher or excavator;
- pipe stringing – delivery of pipes adjacent to the trench;
- welding – welding of continuous strings up to 1 km in length;
- lowering-in and backfill.

Where required, preparation of the working areas would utilise a front-end loader and/or dozer. Should rock be encountered use of rock hammers or small explosive blast may be required.

8.1.4 Hexham Delivery Station

The *HDS* site would require minor site preparation works, foundations, the erection of structures, pipe work and valves. The process would comprise the following activities:

- site preparation;
- foundation preparation;
- erection of structures;
- welding, installation of plant and surface facilities, and
- site cleanup.

8.2 Construction Equipment Noise Emission Levels

For the assessment of noise from the envisaged construction activities, the following plant noise levels (*Table 28*) have been considered.

Table 28: Plant Schedules and Sound Power Levels
dBA re: 10^{-12} Watts

Item	Type	Number of Items	Sound Power Level L_{Aeq}
GFDA			
Access Track Construction			
Dozer	Tracked	1	109
Grader		1	103
Dump Truck		1	105
Vibrating Roller		1	106
Water Cart		1	103
		Total	**114**
Vegetation Clearing			
Timber Shredder	Truck mounted	1	118
Excavator	Tracked	1	106
Dozer	Tracked	1	109
Chainsaw		1	110
		Total	**119**
Site Preparation/Clean Up			
Excavator	Tracked	1	106
Water Cart		1	103
Grader		1	103
Dozer	Tracked	1	109
Truck		1	105
		Total	**113**
Production Well Construction			
Generator	Diesel	1	103
Forklift		1	105
Drill Rig		1	112
Crane		1	104
Concrete Vibrator		1	105
Concrete Truck/Pump		1	106
		Total	**115**
Fraccing			
Generator	Diesel	1	103
Reticulating Pumps		4	124
Mountain Mover		1	123
V12 Pump		4	117
		Total	**127**
Gas Gathering Line Installation			
Trenching machine		1	105
Excavator	Tracked	1	106
Grader		1	103
		Total	**109**

Table 28: Plant Schedules and Sound Power Levels. Cont'd.
dBA re: 10^{-12} Watts

Item	Type	Number of Items	Sound Power Level L_{Aeq}
Central Processing Facility			
Access Track Construction			
Dozer	Tracked	1	109
Water Cart		1	103
Vibrating Roller		1	106
Grader		1	103
		Total	**112**
Earthworks (Site Preparation/Clean Up)			
Excavator	Tracked	2	109
Water Cart		1	103
Truck		2	108
Vibrating Rollers		2	109
Grader		1	103
Dozer	Tracked	2	112
		Total	**116**
Civil and Construction			
Grader		1	103
Excavator		2	109
Bobcats		2	105
Forklift		1	103
Piling Rig		1	116
Water Cart		1	103
Concrete Vibrator		1	105
Concrete Truck/Pump		1	106
Crane		2	107
Generator		1	103
		Total	**119**
Gas Transmission Pipeline			
Access Track Construction			
Grader		1	103
Water Cart		1	103
		Total	**108**
Vegetation Clearing			
Timber Shredder		1	118
Grader		1	103
Dozer	Tracked	2	109
Chainsaw		1	110
		Total	**119**
Earthworks (Site Preparation/Clean Up)			
Grader		1	103
Dozer	Tracked	1	109
Water Cart		1	103
Truck		1	105
		Total	**112**

Table 28: Plant Schedules and Sound Power Levels. Cont'd.
dBA re: 10^{-12} Watts

Item	Type	Number of Items	Sound Power Level L_{Aeq}
Pipeline Installation			
Trenching Machine		1	105
Excavator		1	106
Rock Saw		1	102
Side booms		3	104
Padding Machine		1	104
Grader		1	103
Water Cart		1	103
Truck		1	105
Diesel Generator		1	103
		Total	**113**
Hexham Delivery Station			
Access Construction			
Grader		1	103
Water Cart		1	103
		Total	**106**
Earthworks (Site Preparation/Clean Up)			
Dozer	Tracked	1	109
Grader		1	103
Vibrating Roller		1	106
Water Cart		1	103
Truck		1	105
		Total	**113**
Civil and Construction			
Piling Rig		1	116
Water Cart		1	103
Bobcat		1	102
Concrete Truck/Pump		1	106
Crane		2	107
Truck		1	105
		Total	**117**

8.3 Construction Equipment Vibration Emission Levels

During the excavation and construction activities associated with access tracks and preparation of trenches, it may be necessary to use plant and equipment that would generate ground vibration. To evaluate the likely effects of the construction activities, the following vibration levels (*Table 29*) have been considered.

Table 29: Typical Plant Vibration Levels
mm/sec

Plant Description	Vibration Levels mm/sec		
	@ 5m	**@ 20m**	**@ 40m**
Rock-breaker (large)	5	0.5	0.3
Rock breaker (light)	1	0.3	0.1
Dozer	2	0.2	0.02
Truck	1	0.05	0.02

9.0 CONSTRUCTION NOISE and VIBRATION IMPACT ASSESSMENT

9.1 Construction Noise Predictions

A summary of predicted noise levels for typical construction activities at reference distances is presented in *Tables 30-31*. The modelling assumed the plant schedules referenced in *Table 28* with no account of additional attenuation from topography or ground absorption. To assist with the identification of typical residential receptors potentially exposed to noise from the well construction sites and the noise levels summarised in *Tables 30, 32-43, Figure 1* identifies the extent of the *CFDA* and well locations.

9.1.1 Gas Field Development Area

Construction stages across the *GFDA* for each well site would include site preparation, drilling, fraccing, installation of plant and site cleaning up. The construction noise target goals *(Table 23)* established for these works are 40/43dBA (day), 35/37dBA (evening) and 35/36dBA (night). *Table 30* presents the calculated noise levels from each phase.

Table 30: Predicted Construction Noise Levels (GFDA)
L_{Aeq} re: 20×10^{-6} Pa

Construction Activity	Distance from Construction Activity (m)						
	25m	100m	250m	500m	1000m	2000m	3000m
Access Track Construction	78	66	58	52	46	40	36
Vegetation Clearing	83	71	63	57	51	45	41
Site Preparation/Clean Up	77	65	57	51	45	39	35
Production Well Construction	79	67	59	53	47	41	37
Fraccing	91	79	71	65	59	53	49
Gas Gathering Line Installation	73	61	53	47	41	35	31

Noise controls and mitigation requirements during the *GFDA* construction would be considered on a site-specific basis and managed in accordance with a Noise Management Plan. As part of the NMP additional ambient background noise monitoring would be undertaken to confirm site specific target assessment goals. For the purpose of this assessment the range of ambient background noise levels presented in *Table 23* have been adopted to develop target noise assessment goals

Modelling has shown that noise levels from access track construction and vegetation clearing could exceed the daytime target assessment goal (40/43dBA) at a number of residential properties. The access track establishment activities for each site would be short term (1-3 days) and restricted to daytime hours.

During site preparation, including drilling and well construction noise levels are predicted to exceed the daytime target assessment goal (40/43dBA) at exposed properties. Noise from the drilling operations during evening and nighttime hours is predicted to exceed the target assessment goals (35/37dBA (evening) and 35/36dBA (night) at the closest exposed residential properties without additional noise controls. With respect to noise from drill rigs, investigations and audit measurements have shown that noise typically exhibits directional characteristics. Particularly noticeable is that the noise at the 'rear' or the drive side of rigs is 8-10dBA higher than at the 'front'. Noise measurements 40-50 metres back from drilling rigs have shown that the 'front' to the 'rear' directional characteristics reduce to 6-8dBA. With consideration to site establishment and rig orientation for sensitive receiver locations, effective noise reductions are readily available. General principles available to reduce noise from drilling activities involve maximising benefits from directivity characteristics of drilling rig, location of site offices, control rooms and other ancillary buildings to provide shielding, 'cut & fill' operations in the formation of the work pad to maximise shielding effects and the location of excavated fill material and/or installation of temporary noise walls. Where practical and feasible, plant selections, temporary noise controls and work practices would be considered to minimise noise exposure and impacts. With the adoption of acoustic screens, work practices and plant with acoustic enclosures significant noise reductions can be readily achieved.

Noise modelling for fraccing activities has shown that the daytime (40/43dBA) and evening (35/37dBA) target noise goals are likely to be exceeded at exposed residential properties. Noise from the fraccing process can be reduced with secondary noise controls including orientation of equipment, portable acoustic screens, work practices and barriers. With respect to the fraccing activities for each well site, the fraccing itself would be limited to three-four (3-4) hours. To further manage noise exposure during the

fraccing operation, it is recommended that consultation be undertaken with affected landowners.

The *GFDA* noise controls and mitigation requirements would be considered on a site-specific basis and managed in accordance with a Noise Management Plan. Well site construction would be undertaken with the goal of achieving compliance with relevant criteria. Where compliance cannot be achieved with all feasible and reasonable mitigation in place, consultation would be undertaken with the affected receptor to manage noise impacts during construction. Options such as restricting the use of plant/equipment and timing of activities likely to generate significant noise impacts would also be considered to minimise noise exposure.

9.1.1(a) Sleep Disturbance Noise Predictions

Noise from possible intermittent activities include metal/metal contact, hammering, etc associated with nighttime drilling was modelled with a source sound power level of 110-115dBA. The predicted levels in *Table 31* are presented and for assessment can be compared to the target noise goals 45/47dBA. Noise from these activities would be controlled and mitigation requirements considered and managed on a site-specific basis in accordance with a Noise Management Plan.

Table 31: Predicted Construction LA1 Noise Levels (GFDA)
L_{A1} re: 20×10^{-6} Pa

Construction Activity	Distance from Construction Activity (m)			
	250m	500m	1000m	2000m
Intermittent Noise	54-59	48-53	42-47	36-41

9.1.2 Central Processing Facility Construction

The envisaged *CPF* construction stages include site preparation, concrete pours, installation of plant and site cleaning up. The daytime construction noise target goals *(Table 23)* for *CPF Site 1* and *CPF Site 7* are 40/43dBA, 45/48dBA, respectively.

For assessment purposes *Table 32* presents calculated noise levels from each stage of the *CPF* site works.

Table 32: Predicted Construction Noise Levels (CPF)
L_{Aeq} re: 20 × 10 $^{-6}$ Pa

Construction Activity	Distance from Construction Activity (m)						
	25m	100m	250m	500m	1000m	2000m	3000m
Access Track Construction	76	64	56	50	44	38	34
Site Preparation/Clean Up	80	68	60	54	48	42	38
Civil and Construction	83	71	63	57	51	45	41

Noise controls and mitigation requirements would be considered on a site-specific basis and managed in accordance with a Noise Management Plan. Where compliance cannot be achieved at a receptor with all feasible and reasonable mitigation in place, consultation would be undertaken with the affected receptor to manage noise impacts during construction. Options such as restricting the use of certain plant/equipment and timing of activities likely to generate significant noise impacts would also be considered to minimise noise exposure.

9.1.3 Gas Transmission Pipeline Construction

Table 33 presents the calculated noise levels from each phase of the pipeline construction works. Construction would be undertaken in teams on a scrolling basis along the pipeline route. The envisaged duration at any one (1) specific location is expected to be less than three (3) weeks.

Table 33: Predicted Construction Noise Levels (Pipeline)
L_{Aeq} re: 20 × 10 $^{-6}$ Pa

Construction Activity	Distance from Construction Activity (m)						
	25m	100m	250m	500m	1000m	2000m	3000m
Access Track Construction	72	60	52	46	40	34	30
Vegetation Clearing	83	71	63	57	51	45	41
Site Preparation/Clearing	76	64	56	50	44	38	34
Pipe Installation	77	65	57	51	45	39	35

Where practical and feasible, plant selections, temporary noise controls and work practices would be considered to minimise noise impacts. This would typically involve orientation of equipment, staging of activities, shielding and minimisation of simultaneous operations. To ensure noise levels are controlled and impacts managed during construction a Construction Environmental Management Plan *(CEMP)* would be

prepared and implemented by the contractors engaged.

Construction of the gas transmission pipeline would also include crossing a number of watercourses and road/rail infrastructure which would require horizontal directional drilling (HDD) and thrust boring techniques. These activities would require twenty four (24) hour construction to maintain the integrity of the borehole. Construction periods of up to two (2) months may also be required. Sufficient detailed design and planning has not yet been undertaken to determine the exact locations of these locations, and would be dependent on factors including crossing depth, pipe diameter, setback distances from the crossing location as well as other design factors.

A noise impact assessment for would be undertaken for HDD and thrust boring activities prior to construction as part of a Noise Management Plan, which would be included within the Construction Environmental Management Plan (CEMP). This would include identification of sensitive receptors, background noise monitoring (if required), prediction of noise levels and design of mitigation measures to manage noise impacts from these construction activities.

9.1.4 Hexham Delivery Station Construction

The construction stages for the Hexham site would include minor site preparation, concrete pours, installation of pipework and site cleaning up. *Table 34* presents the calculated noise levels for each phase of the site works.

Table 34: Predicted Construction Noise Levels (HDS)
L_{Aeq} re: 20×10^{-6} Pa

Construction Activity	Distance from Construction Activity (m)		
	100m	250m	500m
Access Construction	58	50	44
Site Preparation/Clean Up	65	57	51
Civil and Construction	69	61	55

Noise from the envisaged civil and construction works is predicted to satisfy the target daytime noise goal (54dBA) at the closest residential dwellings on Old Maitland Road (P17) and exceed the goal at P16. With the adoption of acoustic screens, work practices

and plant with acoustic enclosures the envisaged civil and construction noise levels are expected to satisfy the target daytime noise goal (54dBA) at P16. Where practical and feasible, plant selections, temporary noise controls and work practices would be considered to minimise noise impacts.

9.2 Overview

To assist providing and understanding of noise impacts and the levels presented above, a summary of typical noise source levels is presented in *Table 35*.

Table 35: Range of Typical Noise Sources.
re: 20 $\times 10^{-6}$ Pa

Sound Pressure Level dBA	Source Description	Subjective Evaluation
130	Threshold of pain	Intolerable
120 110	Heavy rock concert Grinding on steel	Very noisy
100 90	Loud car horn at 3m Construction site with pneumatic hammering	Noisy
80 70	Kerbside of busy street Loud radio or TV	Loud
60 50	Department store General Office	Moderate to quiet
40 30	Inside private office Inside bedroom	Quiet to very quite
20	Unoccupied recording studio	Almost silent

9.3 Traffic Generation

Traffic generated during construction would be associated with construction plant and equipment deliveries and construction workers. Where possible, construction traffic would be restricted to internal road networks created for the project and the pipeline right of way, reducing potential impacts upon the surrounding road network and public roads.

9.3.1 GFDA Traffic

Vehicle movements associated with the initial delivery of plant and equipment for the drilling phase of the development are shown in *Table 36* and expected to comprise up to sixty-two (62) initial heavy vehicle movements to the site over a period of several days. Vehicle movements beyond the initial delivery of drill plant and equipment would

largely occur within the *GFDA* with drill rigs and associated plant moving between well sites. Each mobilisation of drilling plant would require some sixty-two (62) heavy vehicle movements. There may be a need for this equipment to travel off-site onto the surrounding local road network in order to access other well sites within the *GFDA*, however this is expected to occur infrequently. Mobilisation of drilling equipment would predominantly occur on the internal *GFDA* road network.

Upon completion of drilling, plant and equipment would be removed from the site involving a further sixty-two (62) movements. Removal of plant and equipment from the site is expected to take several days with vehicle movements being spread over this period. Where possible, deliveries would be made outside of peak transport times, and within the internal road network for the project to minimise potential disturbances to local traffic.

Table 36: Vehicle Movements During GFDA Construction

Item Description	Vehicle/s	Movements
Drilling rigs	Trucks	8-12
Frac equipment	Trucks	14
Frac tanks	Trucks	14
Production equipment	Trucks	4
Cementing equipment	Trucks	8
Water Tankers	8-10 tankers.	10
Total Heavy Vehicle Movements*		**62**
Personnel Transport	6 – 8 per well location	6-8

9.3.2 CPF Traffic

The *CPF* construction would require delivery of construction plant and materials to the site prior to construction and represent the main traffic volumes in respect of the *CPF* facility. The *CPF* construction would also generate some thirty-six (36) light vehicle movements per day over the anticipated construction period of twelve (12) months

Delivery of construction plant and equipment would be staggered to reflect the construction program with the earthmoving equipment delivered to the *CPF* site first. Concrete would then be delivered, followed by the generators, compressor units and other plant. Vehicle movements associated with the delivery of materials to the *CPF* are

summarised in the *Table 37*.

Table 37: Vehicle Movements - CPF Plant and Materials

Description	Delivery Vehicle	Movements to Site	Movements from Site
Compressor Skids (8 Units)	1 low loader per unit with escorts	8	8
	2 low loaders with escorts	16	16
	One Truck	8	8
	One Truck	8	8
Dehydration Skids	One Truck	2	2
	One Truck	2	2
	One Truck	2	2
Miscellaneous containers and Equipment	One Truck per delivery	3 per week	3 per week
Concrete Delivery	275 Truck deliveries	9 per day	9 per day
Equipment transport	2 trucks	2 per day	2 per day
Personnel transport	18 light vehicles	18 per day	18 per day

9.3.3 GTL Traffic

Vehicle movements on public roads associated with the construction of the pipeline would be largely generated through the initial delivery of plant, equipment and materials. In relation to the pipeline construction, there is expected to be three laydown areas along the pipeline route, spaced at roughly equal intervals. Construction materials, including the pipeline itself would be delivered to these laydown areas and stored until required for use. The laydown areas would be located on private land in consultation with relevant landowners. Materials (including sections of pipe) would be transported along the appropriate major route dependent upon the section of the pipeline under construction, with local and private roads utilised to gain access to the laydown area. The use/construction upgrade of private access roads would be subject to agreement with relevant landowners. Where possible, delivery of materials, plant and equipment for pipeline construction would be made outside of peak transport times to minimise potential disturbances to local traffic. Vehicle movements associated with the initial

delivery of materials to laydown areas are summarised in the *Table 38*.

Table 38: Pipeline Construction Material Delivery

Description	Item Information	Delivery Vehicle
Pipe Delivery	Approximately 10 movements per day	5 trucks per day over a stringing period of 70 days delivering to two of three laydown areas.
Equipment transport	Approximately 4 movements per day	2 low loaders per day transporting equipment from one work front to the next.
Water	2 trucks continuously during construction	2 water trucks per day travelling along the ROW.

9.3.4 HDS Traffic

The *HDS* construction would require delivery of construction equipment and various plant and construction materials to the site. Deliveries would be staggered to reflect the construction program with the site preparation equipment delivered first. Concrete would then be delivered, followed by the pipe work and other auxiliary fittings/valves etc. Vehicle movements associated with the delivery of materials to the *HDS* are summarised in the *Table 39*.

Table 39: Vehicle Movements - HDS

Description	Movements
Miscellaneous site preparation	4-5 per day
Concrete Delivery	4-5 per day
Equipment transport	Total 8
Personnel transport	18 per day
Pipework/valves/etc	Total 9-12

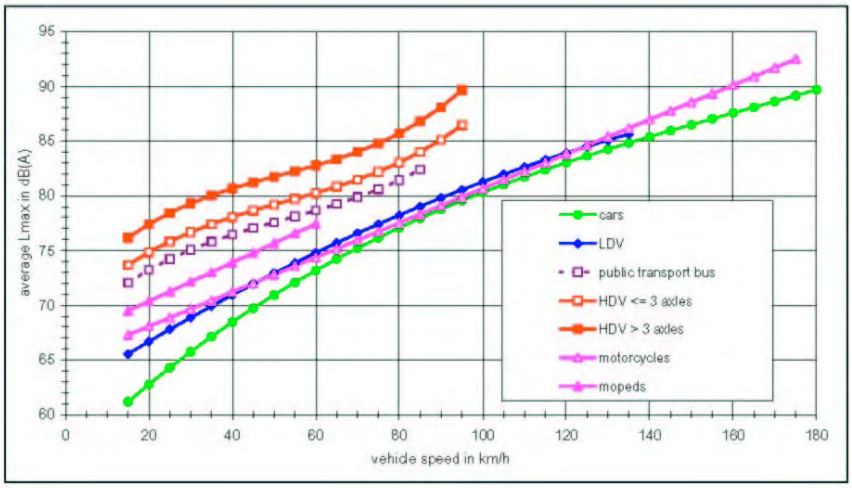
9.3.5 Traffic Noise Assessment

For the traffic noise modelling it was assumed that construction activities could generate up to 30-40 car movements per hour with 10% heavy vehicles. With an average pass-by traffic speed of 50kph, the predicted $L_{Aeq\ 1\ hour}$ at thirty (30) metres of 51dBA satisfies the daytime 55/60dBA target noise assessment goals for local and collector roads, respectively. Passby L_{Amax} noise levels *(Figure 7)* from cars and trucks

at thirty (30) metres are predicted to range between 56-72dBA.

Overall the traffic volumes generated during construction are considered as minimal when compared to the reported *AADT* road traffic volumes for The Bucketts Way, Stratford of between 1555 and 4095, and 9343 for the Pacific Highway, Hexham.

Figure 7. LAmax Passby Traffic Noise Levels @ 10 metres
(Reference: Steven, 2005)



9.4 Vibration Levels from Construction Activities

The main source of ground vibration that has been identified and assessed is associated with rock hammers. Ground vibration level predicted from rock hammers could range up to 0.5mm/sec at a distance of twenty (20) metres, and are below 0.3mm/sec at forty (40) metres. Vibration levels at these distances satisfy the structural damage assessment goals *(Table 24*), and expected to be acceptable from a human disturbance point of view.

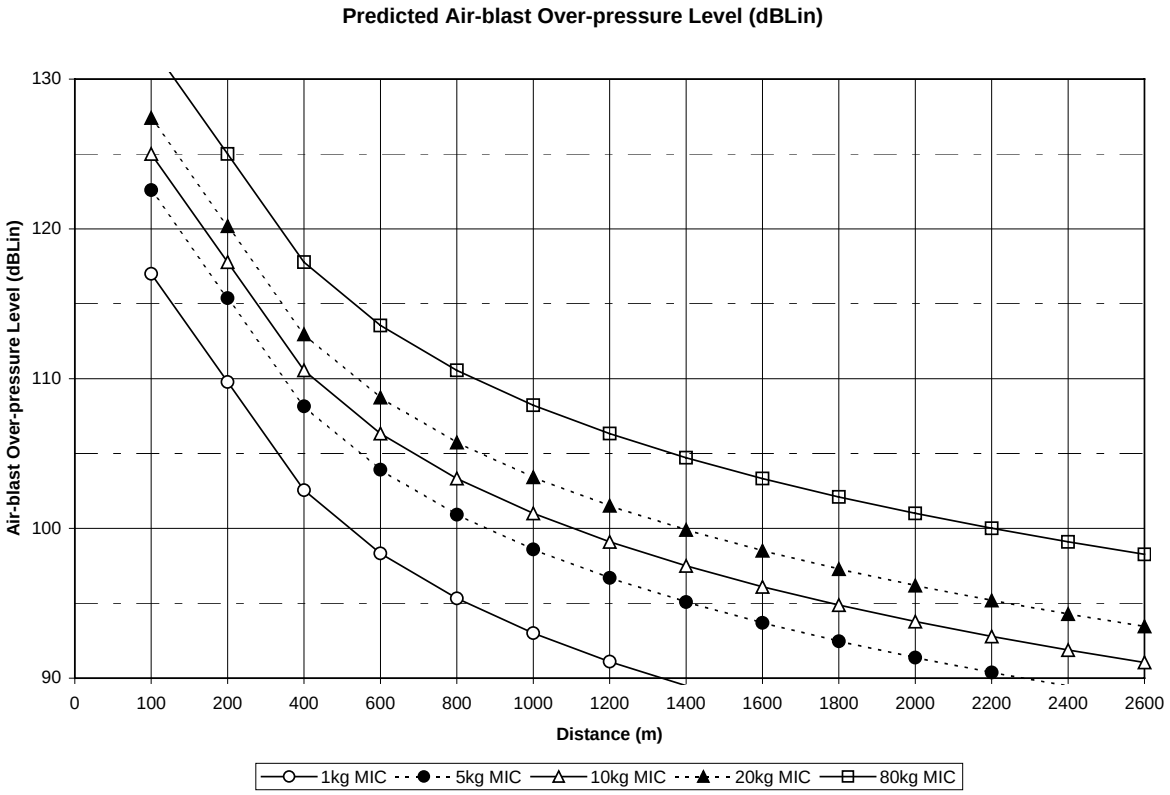
9.5 Blast Assessment

Confined blasting may be required to remove rock outcrops. Blast holes would be drilled and filled with an explosive charge and detonated with the aid of primers and detonators. Impacts associated with blasting normally relate to air blast overpressure and ground vibration.

9.5.1 Air-blast Overpressure Prediction Model

Air-blast overpressure is a function of maximum instantaneous explosive charge and the distance between the receiver and blast location. *Figure 8* presents a summary of the maximum instantaneous charge *(MIC)* blast design data used to predict air-blast overpressure.

Figure 8: Air-blast Overpressure v Distance



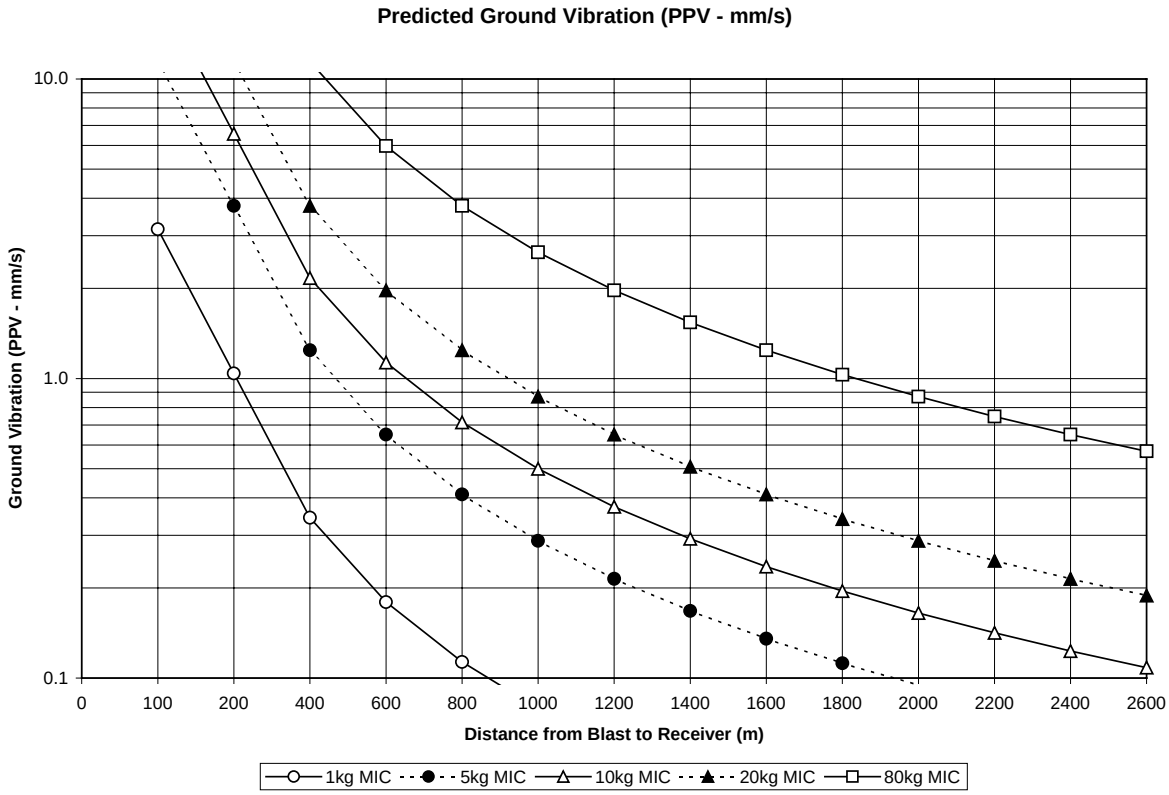
The results in *Figure 8* show that the *DECCW/ANZECC* air-blast overpressure goal (115dBLin) can be satisfied with the employment of controlled MIC's (1-3kg) at a distance of two hundred (200) metres.

9.5.2 Ground Vibration Prediction Model

Ground vibration is a function of maximum instantaneous charge, the distance between receiver and blast location and ground condition. The predictive formula adopted for peak particle velocity (PPV) assessment is based on the site law data provided in Australian Standard AS2187: Part 2 (1993). *Figure 9* provides the predicted PPV v

distance vibration levels for confined blast conditions.

Figure 9: Ground Vibration v Distance



The results summarised in *Figure 9* show that the *DECCW/ANZECC* ground vibration goal (5mm/sec) is satisfied with the employment of controlled MIC's (1-3kg) at a distance of two hundred (200) metres.

10.0 MANAGEMENT OF NOISE AND VIBRATION IMPACTS

As part of the project management it is recommended that a Noise Management Plan (*NMP)* be prepared to address and manage construction and operational noise and vibration, and identify methods to manage impacts. The *NMP* would be prepared in consultation with relevant authorities including *DECCW* and construction contractors. As part of the NMP, the following would be addressed:

- selection of plant and equipment where practical on acoustic performance;
- noise certification of all site plant and equipment prior to commencing site work and regular monitoring and maintenance to ensure equipment noise emission levels do not deteriorate due to poor maintenance or damage;
- work practices to minimise potential noise and vibration impacts;
- a monitoring program to ensure that construction noise and vibration emissions are controlled and that the best possible practices are implemented;
- noise and vibration monitoring shall be conducted in response to community complaints and at the request of the *DECCW*. Reports of investigations shall be provided to the *DECCW* upon request;
- development and implementation of a public relations program to inform residents and the community of the progress of activities and potential noise and vibration impacts of each phase of the project; and
- the establishment of procedures to address noise and vibration complaints received from the public during the construction period
- The Proponent shall implement all practicable measures to undertake the development in a way that minimises the noise generated.

Concept Area

The Proponent shall undertake further detailed noise assessment in respect of proposed works within the Concept Area once further details of well site locations and associated infrastructure are confirmed. Details of this assessment shall form part of subsequent project application/s required to be submitted in respect of the proposed works.

As a guide, the following general principles would be considered when identifying potential well site locations for the Concept Field Area:

- Well site locations would be chosen in consideration of the proximity to nearest sensitive receivers and would take account of local topography and meteorological conditions which may affect the extent of noise impacts;
- The potential for noise impact would be considered in the preliminary planning phase of the project such that noise minimisation would be built into the inherent project design;
- The full range of available mitigation measures would be considered and applied where necessary to ensure that noise impacts can be maintained at an acceptable level, and managed as part of a Noise Management Plan.

Stage 1 GFDA

- Fraccing would be undertaken during daytime hours. Finishing works associated with fraccing could extend into evening hours where project noise goals can be achieved or as otherwise agreed with affected landowners. Secondary noise controls such as portable acoustic screens would be installed.
- Drilling activities would be undertaken during daytime hours. Drilling activities are to be undertaken during evening and night time hours only where project noise goals can be achieved or as otherwise agreed with affected landowners.
- Activities associated with the construction of access tracks and the clearing of vegetation to be undertaken during daytime hours only.

CPF

- The Proponent shall undertake a detailed assessment for the acoustic design measures required for the *CPF* plant to ensure that operational noise levels are maintained within the relevant project noise goals:
- Following final plant selection and detailed design, the Proponent shall commission a further detailed operational noise assessment of the *CPF* plant to establish and confirm expected operational noise levels and inform detailed design of noise mitigation for the plant.
- The Proponent shall undertake a program of noise monitoring once the *CPF* is operational in order to validate the design and mitigation measures applied to the facility. If required, further mitigation may be recommended following the

monitoring program to ensure that operational noise is maintained at an acceptable level.

Gas Transmission Pipeline

- The Proponent shall ensure that advanced notification of commencement of construction works is provided to potentially affected landowners (generally those within two (2) kilometres of the pipeline construction works) indicating the length of time during which impacts may be experienced, the nature of potential impacts and a contact number for complaints to be recorded and responded to.
- The Proponent shall ensure that works requiring the use of rock hammers do not occur within twenty (20) metres of a residence.
- The Proponent shall ensure that works requiring blasting do not occur within two hundred (200) metres of a residence.

Hexham Delivery Station

- The Proponent shall undertake a detailed assessment for the acoustic design measures required for the *HDS* plant to ensure that operational noise levels are maintained within the relevant project noise goals:
- Following final plant selection and detailed design, the Proponent shall commission a further detailed operational noise assessment of the *HDS* plant to establish and confirm expected operational noise levels and inform detailed design of noise mitigation for the plant.
- The Proponent shall undertake a program of noise monitoring once the *HDS* is operational in order to validate the design and mitigation measures applied to the facility. If required, further mitigation may be recommended following the monitoring program to ensure that operational noise is maintained at an acceptable level.

11.0 CONCLUSION

The Gloucester gas project is a venture of AGL Gloucester Pty Ltd *(AGL)*. The project consists of four (4) key components to produce, compress and transport coal seam gas from the Gloucester region to a delivery station in Hexham, Newcastle.

The main study area is centered around the township of Stratford. The Exploration Licence 285 area extends approximately sixty (60) kilometres north to south and approximately twenty (20) kilometres east to west. The preferred pipeline corridor is approximately one hundred (100) metres wide and ninety-five (95) kilometres long. The corridor would extend from the selected central processing facility to the proposed gas delivery station at Hexham.

The main operational noise sources associated with the *CPF* would include gas generators, compressors, compressor cooler fans, pumps, fans and valves. The generators and compressors would be housed in individual acoustic enclosures and the compressor fin cooling fans selected on acoustic performance. The results of noise modelling show that with additional secondary engineering controls the project noise goals are predicted to be satisfied.

From investigations undertaken, it is not envisaged that there would be any significant operational noise sources or noise impacts arising from the gas transfer pipeline.

Modelling for the *HDS* has shown that the project noise goals are predicted to be exceeded at the closest residential properties on Punt Road, Old Maitland Road and the shared industrial and commercial boundaries without the inclusion of secondary controls. As part of the detailed design (when final details of the plant and equipment will be determined) a more detailed assessment of the noise would be undertaken to confirm the extent of noise mitigation required to satisfy the project noise goals.

It is not expected that operational $L_{A1,\ 1\ mim}$ noise levels emitted from the *GFDA, CPF, gas transmission pipeline* and *HDS* would be greater than 5-10dBA above the

operational L_{Aeq} levels or the *DECCW* sleep disturbance assessment goals.

No operational vibration sources have been identified that are likely to generate ground vibration at exposed receptors.

The main construction activities envisaged for the project include access track construction, vegetation clearing, drilling, fraccing, trenching, concreting, structure erection, pipe preparation, pipe installation and plant installation. It is proposed that construction activities would generally be restricted to daytime hours. Some well construction works in the *GFDA* including drilling and preparation for fraccing would occur twenty-four (24) hours a day where noise impacts on residential dwellings can be managed.

Noise modeling has shown there would be situations where construction noise levels exceed the target assessment goals during construction.

Ground vibration from construction activities can be controlled to levels that would satisfy the recommended project goals and expected to be acceptable from both human disturbance and structural damage points of view.

Traffic volumes generated during the operational and construction phases of the project are considered as minimal when compared to the reported Annual Average Daily Traffic *(AADT)* road traffic volumes for The Bucketts Way of between 1555 and 4095 vehicles per day, and 9343 vehicles per day for the Pacific Highway, Hexham and predicted to satisfy the daytime target noise assessment goals for local and collector roads, respectively.

To manage environmental noise and vibration impacts during construction, it is recommended that a Noise Management Plan *(NMP)* be prepared. As part of the *NMP*, it is recommended that a public relations program be developed and implemented to inform residents and the community of the progress of the activities, and potential noise and vibration impacts during each phase of the construction.