14

NOISE AND VIBRATION

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SUPPLEMENTARY REPORT TO THE EIS

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14 Noise and Vibration

14.1 Introduction

The supplementary noise and vibration assessment was undertaken to investigate any changes to the potential noise and vibration impacts of the Project as a result of updates to the project description or relevant State or Commonwealth legislation subsequent to the EIS. The assessment specifically addresses Project components that have been affected by these updates and also considers any noise and vibration-related submissions received during the exhibition period and supplements the assessment undertaken for the EIS.

The detailed supplementary noise and vibration assessment undertaken for the EIS is provided in the Noise and Vibration Technical Report (Appendix L) of this SREIS.

14.2 Project Description Changes Relevant to Noise and Vibration

Since preparation of the EIS, Arrow has improved its knowledge of the gas reserves and refined the field development plan and conceptual design of Project infrastructure. Further details of the changes to the project description are outlined in the Project Description chapter (Section 3) of this SREIS.

Table 14–1 provides a summary of the changes that have been made to the EIS assessment as a result of refinements to the project description, which are applicable to the noise and vibration assessment.

Table 14-1 Summary of Key Changes to the EIS

Project Aspect	EIS	SREIS	Basis for Change
Number of central gas processing facilities (CGPF)	3	Two with co-located water treatment facilities.	Project description refinement.
Number of field compression facilities (FCF)	10	33	Project description refinement - field radius has been reduced from approximately 12 km to approximately 6 km.
Integrated processing facilities (IPF)	4	Removed	Project description refinement.
Number of vertical production wells	6,625	Approximately 4,000 (up to 12 wells per pad, six vertical production and six lateral wells).	Project description refinement.

Project Aspect	EIS	SREIS	Basis for Change
Power supply	Base Case In field power generation using 10% of the maximum Coal Seam Gas (CSG) produced to power 100% of Project needs.	Base Case Grid power supply based on connection to existing electricity infrastructure with partial gas-fired power generation at remote wellheads (up to 10% of total number of wells) if required. Temporary Power Supply In field power generation at the facilities using CSG for approximately the first two years.	Project description refinement. An assessment was made between the preferred 'Base Case' power option and a temporary power supply option. It was determined that the temporary power supply option was the most conservative (highest) option and this is impact assessed.
CGPF power requirement	60 MW maximum power requirement.	44 MW maximum power requirement, including power supplied to water treatment facilities.	Project description refinement.
FCF power requirement (largest)	19 MW	35 MW	Project description refinement.
Production wellhead power requirement	75 kW	20 kW	Project description refinement.
Ramp up flaring	Assessed	Not required	Project description refinement.
Upset condition/operational flaring rates	Based on maximum worst-case rate.	Based on updated maximum worst-case rate.	Project description refinement.

14.3 Legislative Context

There have been no significant changes to the relevant noise and vibration related legislation since publication of the EIS. However, two of the Queensland Government's Guidelines in relation to environmental noise and vibration have been recently updated.

Noise

Queensland government publications that have been updated since the EIS include:

- The EHP *Noise Measurement Manual* (EHP, 2013b); and
- The EHP Noise Assessment Guideline *Prescribing noise conditions for environmental authorities for petroleum activities* (PGA Noise Guideline) (EHP, 2013a).

The noise monitoring procedures set out in the Noise Measurement Manual (EHP, 2013b) are consistent with the noise measurement methodology followed for the baseline noise measurements undertaken for the EIS. Hence the background noise measurements undertaken for the EIS are still valid for use in the Project assessment, and the results can still be considered current.

The PGA Noise Guideline (EHP, 2013a) nominates noise conditions which are consistent with the Coal *Seam Gas Industry Procedural Guide Control of Noise from Gasfield Activities* (Rumble, 2011) upon which the noise conditions previously nominated in the EIS were based. Therefore the noise conditions nominated in the EIS are still valid and are compliant with the PGA Noise Guideline published since the EIS.

Vibration

There have been no updates to the project description regarding vibration, so vibration impacts have not been considered further in this assessment and the impact assessment undertaken in the EIS remains valid.

Blasting

There have been no updates to the project description regarding blasting, so blasting impacts have not been considered further in this assessment and the impact assessment undertaken in the EIS remains valid.

Road Traffic Noise

Changes to the project description have resulted in minor revisions to the estimated traffic volumes related to construction of the facilities. The relevant noise criteria are provided in the Queensland Department of Transport and Main Roads, Road Traffic Noise Management: Code of Practice, 2008 which has not changed since the EIS was developed.

14.4 Existing Environmental Values

The environmental values in regards to noise and vibration were established in the EIS and these have remained valid since no changes to legislation would alter the values as they have been previously defined.

To further define the acoustic properties of the environment that are to be protected under the EP Act, Section 3 of the *Environmental Protection (Noise) Policy 2008* (EPP (Noise)) defines the quality objectives (environmental values) that are to be enhanced or protected under the policy.

Quality objectives are set to protect these environmental values, as well as relative limits to control 'background creep' which can occur with multiple developments in an area. The quality objectives from Schedule 1 of the EPP (Noise) and the environmental values they seek to protect are detailed in Table 14-2 below.

Table 14-2 Acoustic Quality Objectives

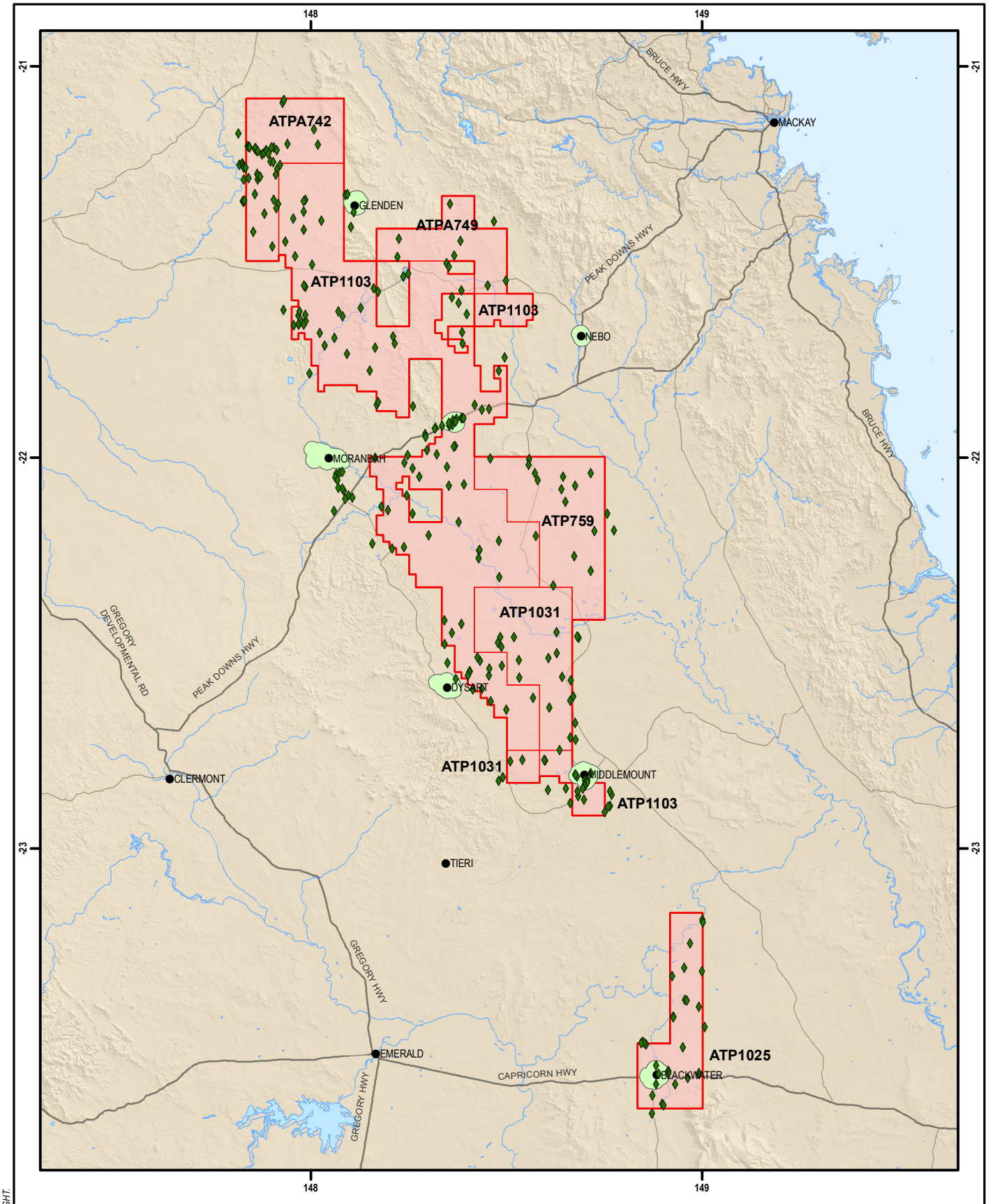
Sensitive Receptor	Time of Day	Acoustic Quality Objectives (measured at the receptor) dB(A)			Environmental Value
		$LA_{eq, adj, 1h}$	$LA_{10, adj, 1h}$	$LA_{1, adj, 1h}$	
Dwelling (for outdoors)	Daytime (0700-1800) Evening (1800-2200)	50 dB(A)	55 dB(A)	65 dB(A)	Health and wellbeing
Dwelling (for indoors)	Daytime (0700-1800) Evening (1800-2200)	35 dB(A)	40 dB(A)	45 dB(A)	Health and wellbeing
	Night-time (2200-0700)	30 dB(A)	35 dB(A)	40 dB(A)	Health and wellbeing, in relation to the ability to sleep

The above quality objectives are based on the World Health Organisation (WHO) guidelines (Berglund *et al*., 1999). The WHO guidelines are referenced by *The Health Effects of Environmental Noise – Other Than Hearing Loss* (enHealth Council, 2004) as appropriate environmental noise levels, below which no health effects will be expected.

The specific noise level criteria outlined in the EIS for this Project were developed to comply with the acoustic quality objectives outlined in Table 14-2 above.

14.4.1 Sensitive Receptors

The locations of potentially affected receptors in the Project area have been identified in a desktop study. Approximately 286 potentially affected receptors have been identified in the Project area, shown in Figure 14-1. Since these locations were identified in a desktop study, the estimated number of receptors may be conservative. During detailed design, ground-truthing for confirmation of receptors in specific areas will be established.



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BOWEN GAS PROJECT SREIS

IDENTIFIED POTENTIAL SENSITIVE RECEPTOR LOCATIONS

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Figure: 14-1

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14.4.2 Existing Noise Levels

The existing noise levels in the study area are not expected to have changed since the EIS, therefore the background noise levels monitoring undertaken for the EIS is considered to still be valid.

Baseline noise monitoring was undertaken for the EIS and reported in the Noise and Vibration chapter (Section 22) of the EIS and detailed in the Noise and Vibration Technical Report (Appendix S) of the EIS. The locations where baseline noise monitoring was undertaken are shown in Figure 14-2.

Ten monitoring locations were used to describe different conditions of sensitive receptors in the Project area where the great majority are located within rural settings with very low background noise levels. The monitoring locations are listed in Table 14-3.

Table 14-3 Noise Monitoring Locations

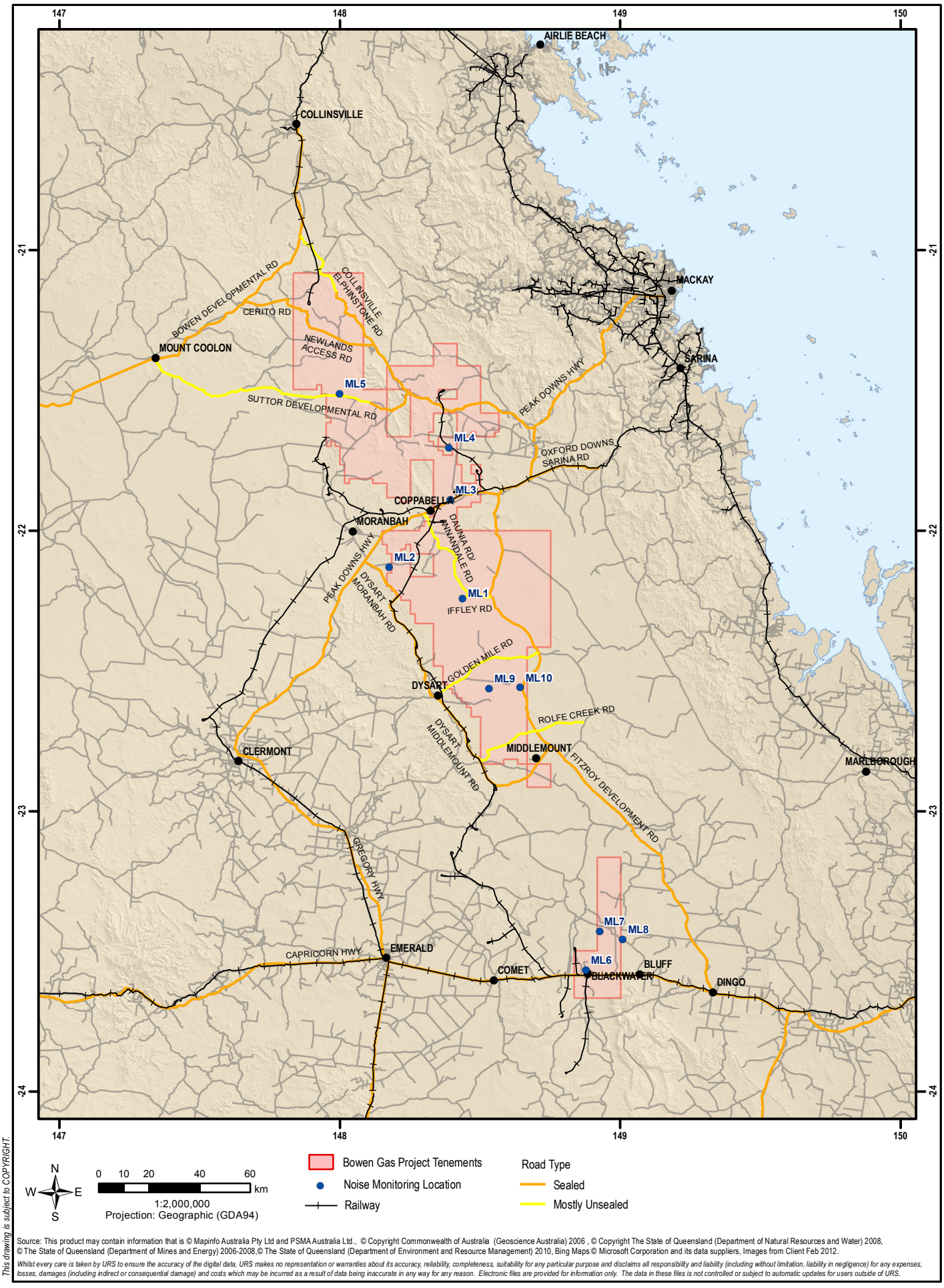
Monitoring Location	Locality	Coordinates (GDA94, Zone 55K)		Notes
		Easting	Northing	
ML1	Vermont Park Road, Valkyrie	648134	7539696	640 m east of receptor. 10 km west of Fitzroy Developmental Road; 24 km east of Peak Down coal mine; 22 km north of lake Vermont coal mine.
ML2	Winchester	621221	7552340	400 m south-west of receptor. 3.4 km north-east of Dysart Road, 8.75 km east of Peak Downs Highway; 6 km North of Peak Downs coal mine.
ML3	Coppabella	643982	7578821	No nearby receptors. 1.6 km east of airport. 440 m north-west of Peak Downs Highway; 2.8 km north-east of Coppabella town; 3.5 km south-west of Coppabella mine.
ML4	Kemmis	643708	7599368	600 m north of receptor. 2.2 km north of South Walker Creek coal mine; 14 km south of Suttor Developmental Road; 15 km north of Coppabella coal mine.
ML5	Lenton Downs, Burton	603421	7620804	750 m south-west of receptor. 750 m north of Suttor Developmental Road, 13 km south-east of Suttor Creek coal mine; 17 km north of North Goonyella coal mine.

Monitoring Location	Locality	Coordinates (GDA94, Zone 55K)		Notes
ML6	6 Hunter Street, Blackwater	691571	7392580	At receptor. Northern extent of Blackwater township. 2.2 km north of Capricorn Highway and freight railway line. 3.5 km east of coal haulage railway line. 6.2 km south of Curragh coal mine.
ML7	New Caledonia Homestead, Bluff-Jellinbah Road, Bluff	696878	7407608	At receptor. 3.3 km south-west of Jellinbah East coal mine; 3.8 km east of Curragh coal mine; 17 km north of Capricorn Highway and freight railway line.
ML8	Dunluce Homestead, Bluff-Jellinbah Road, Bluff	705214	7404337	90 m from receptor. 14 km north of Capricorn Highway and freight railway line; 8 km south-east of Jellinbah East coal mine; 17 km north-east of Blackwater township.
ML9	Picardy Homestead, Golden Mile Road, Dysart	657516	7504016	70 m from receptor. 11.3 km East of former Norwich Park coal mine (now closed); 14 km south-east of Lake Vermont coal mine; 12.4 km west of Fitzroy Developmental Road.
ML10	Cosmos Homestead, Fitzroy Developmental Road, Dysart	668935	7504249	At receptor. 940 m west of Fitzroy Developmental Road; 20 km east of former Norwich Park coal mine (now closed).

Full details of the noise measurements at each location, including daily plots, are presented in the Noise and Vibration Technical Report (Appendix S) of the EIS.

The general observed trends in the monitoring data show that background (L_{A90}) noise levels stay fairly consistent around 25 dB(A) within $^{+}$/- 5 dB(A) during the night. Background noise levels are generally about 10 or 15 dB(A) higher during the day and stay fairly steady around 35-40 dB(A). Shoulder periods of generally higher noise levels are often evident in the morning and evening, typically resulting from birds and insects, wind in the trees and grass from morning and evening breezes, and daily peak vehicle traffic flows.

Background (L_{A90}) noise levels were found to be consistently low and typical of rural areas. The highest ambient (L_{Aeq}) noise levels were measured at ML6 in the township of Blackwater which is adjacent the Capricorn highway and a coal haulage freight railway line.



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BOWEN GAS PROJECT SREIS

NOISE MONITORING LOCATIONS

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NOISE AND VIBRATION

Figure: 14-2

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Within the Project area, background (L_{A90}) and ambient (L_{Aeq}) noise levels can typically be expected to be higher near the major roads, railway lines and in towns such as Blackwater, Moranbah, Middlemount, Dysart, Coppabella and Glenden.

14.4.3 Existing Vibration Sources

An outline of the existing baseline vibration sources within the locality of the Project is provided below. These sources are discussed here to provide a basic context of the background existing vibration environment.

It should be noted that this discussion does not alter the EIS impact assessment, as there have been no updates to the project description regarding vibration. The impact assessment undertaken in the EIS remains valid in determining that no adverse impacts are expected from operation or construction vibration (see Noise and Vibration chapter (Section 22.7.2 and 22.7.3) of the EIS), with the proposed implementation of management measures such as buffers distances from sensitive receptors (refer to the Draft Environmental Management Plan (Appendix Z) of the EIS).

Existing sources of vibration in the Project area include several active coal mines as well as several coal haulage railway lines.

Many of these mines typically carry out blasting on a daily basis, which would be a regular source of vibration for sensitive receptors in the proximity.

The coal haulage railway lines that run through the Project area service many of these mines including Saraji and Peak Downs mines near Dysart, Blair Athol mine south-west of Moranbah, and the Goonyella mines north of Moranbah, as well as others. These railway lines would be regular sources of vibration for any receivers within close proximity such as some of the receptors in the town of Coppabella.

Other minor sources of vibration in the area include several highways including the Peak Downs highway which carries a relatively high volume of heavy vehicle traffic. Other roads that run through the Project area in proximity to sensitive receptors include Fitzroy Developmental Road, Middlemount Road and Suttor Developmental Road.

14.5 Noise and Vibration Criteria

As there have been no significant changes to the relevant noise and vibration related legislation or guidelines since publication of the EIS, the noise and vibration criteria derived and presented in the EIS remain valid. The pertinent criterion from the noise level limits given in the Noise and Vibration Technical Report (Appendix S, Table 6-2) of the EIS applies to all construction and operational short-term, medium-term and long-term noise sources occurring at night-time between 10pm and 6am is 28 dB(A) $L_{Aeq,adj,15\ mins}$.

14.6 Potential Impacts

14.6.1 Construction Noise

The only significant change between the EIS and the SREIS as a result of the change in the project description is the addition of noise emissions from the possible introduction of a concrete batching plant, required for the Project, in the vicinity of the two CGPF sites.

A concrete batching plant may be required near the CGPF sites during the surface equipment installation phase of construction activities. Concrete would then be trucked to other sites as required.

The revised noise emissions from the CGPF sites during the construction phase are shown in Table 14-4.

Table 14-4 Predicted Construction Noise Levels - Construction of CGPFs

Construction Stage	Noise Sources	Predicted Noise Level, dB(A)							
		50 m	**100 m**	**150 m**	**200 m**	**250 m**	**500 m**	**750 m**	**1,000 m**
Surface equipment installation – construction of CGPF	EIS noise sources	77	72	69	67	65	58	53	50
	Concrete batching plant	73	67	62	58	55	48	44	40
	Total including concrete batching plant	78	73	70	67	65	58	53	50
Increase compared to EIS		1	1	1	0	0	0	0	1

The predicted noise levels shown in Table 14-4 show that a minor increase of up to 1 dB(A) in the noise emissions during construction of a CGPF is expected due to the inclusion of a concrete batching plant.

As there have been no changes to the legislation or guidelines regarding noise from construction activities since production of the EIS, the recommendations for construction noise management given in the EIS remain valid.

14.6.2 Operational Noise

The exact locations of wells and facilities have not been finalised since the EIS, consequently it is not possible to undertake noise level predictions at individual receptors. Therefore, in order to investigate the noise levels associated with the Project, noise level predictions have been undertaken by modelling the noise levels received at several offset distances from the noise sources.

14.6.2.1 Prediction Methodology

Noise level predictions were undertaken using the same methodology and assumptions in the EIS, including atmospheric and meteorological effects chosen to be conservatively favourable to noise propagation (i.e. worst-case), and assumed flat ground topography with no natural acoustical shielding.

14.6.2.2 Well Pads

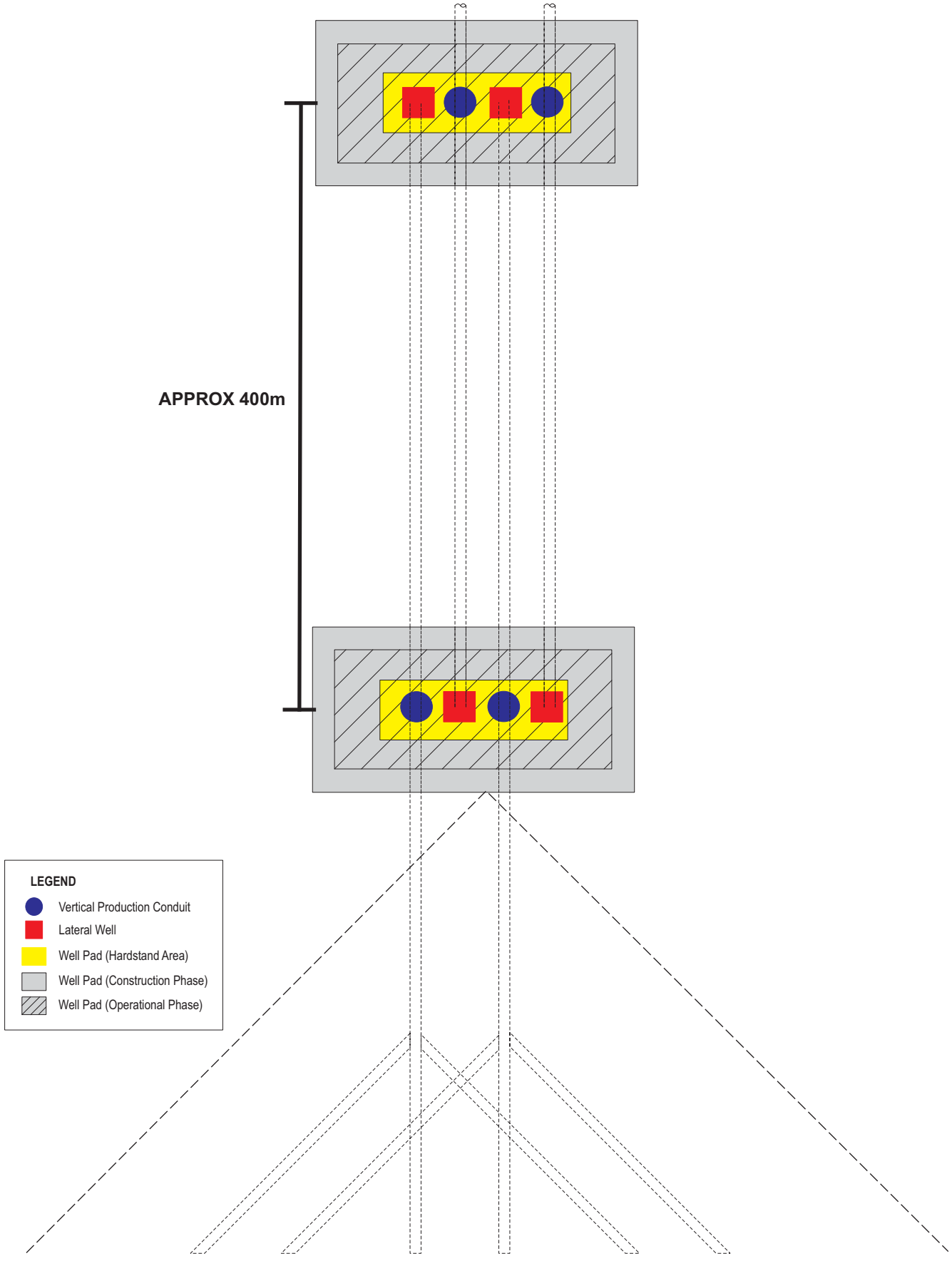
The updated well pad design described in the revised project description incorporates two different types of wells on each well pad, and each well pad exists with its corresponding pair of wells located approximately 400 m away. Each production well intersects the corresponding lateral well which facilitates gas and water drainage to the production well. Only the production wells generate noise during operation. Therefore for a 4-well pad, only the two production wells generate noise, but for each pair of 4-well pads there will be a total of four production wells that generate noise. Similarly for each pair of 8-well pads there will be a total of eight production wells, and also for each pair of 12-well pads there will be 12 production wells. The pairs of well pads are nominally 400 m apart for each configuration. A general arrangement drawing of a pair of 4-well pads is shown in Figure 14–3. The alternative 8- or 12-well pads are similar designs but with more wells on each pad.

The noise source associated with each of the production wells is a 22 kW electric motor.

Noise from the changed design configuration of well pads since publication of the EIS has been predicted for each of the three pairs of well pad sizes, rather than each well being located in isolation as per the EIS:

- 2 × 4 well pads;
- 2 × 8 well pads, and
- 2 × 12 well pads.

The Arrow nominated minimum distance of a well pad from a sensitive receptor is 300 m. However, since the well pad pairs are located approximately 400 m apart, depending on the orientation of the well pad pair the receptor may be as close as 300 m from both well pads, or as far as 700 m from one and 300 m from the other. For the purposes of this assessment, it has been conservatively assumed that the noise receptor is located at 300 m from both well pads.



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BOWEN GAS PROJECT SREIS

TYPICAL CONFIGURATION OF A PAIR OF 4-WELL PADS

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Figure: 14-3

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The revised project description indicates that most of the production wells will be electrically driven, with power supplied from the electrical distribution network to be constructed along with other Project infrastructure. It is estimated that between 90 to 98% of all wells will not require local power generation. Hence, for the purposes of this impact assessment a conservative assumption of a maximum of 10% of wells not being electrically powered will be taken, and this 10% will require local power generation by small gas engines up to 60 kW in size. The predicted noise emissions from both the electrically driven wells and the well pads powered by on-site gas engines are given in Table 14-5.

Table 14-5 Predicted Noise Levels from Production Wells

Well Pad Configuration	Noise Level dB(A)					Approximate Distance Required to Achieve 28dB(A) (m)
Receptor Distance	**300 m**	**1 km**	**2 km**	**3 km**	**4 km**	
2x4 Well Pads (electric)	32	18	9	< 10	< 10	350
2x8 Well Pads (electric)	34	21	12	< 10	< 10	460
2x12 Well Pads (electric)	34	23	14	< 10	< 10	500
2x4 Well Pads (gas engine powered)	35	21	13	< 10	< 10	500
2x8 Well Pads (gas engine powered)	37	24	16	10	< 10	620
2x12 Well Pads (gas engine powered)	36	25	17	11	< 10	620

As shown in Table 14-5 the noise emissions from all modelled well configurations may not comply with the limit of 28 dB(A) at the minimum distance of 300 m, and may require the inclusion of additional noise mitigation in order to achieve the criterion.

As also shown in Table 14-5 the predicted noise level limit of 28 dB(A) is achieved at various distances for the different well configurations without any additional noise mitigation being required, provided no other Project-related noise sources were contributing to the received noise.

At distances less than 1 km, the noise limit can be achieved with an appropriate noise reduction strategy using a combination of distance attenuation and engineering noise control treatments.

The predicted noise levels shown in Table 14-5 are based on assumptions, including flat ground topography, omni-directional wind, etc. The noise attenuation properties of the intervening landscape such as acoustical shielding by topographical features will be considered in the selection of sites for infrastructure and the design of appropriate mitigation treatments.

14.6.2.3 Field Compression Facilities

FCFs will be comprised of a battery of screw compressor trains each producing nominally 20 TJ/d. FCFs will have up to seven compressor trains per facility, depending on the production capacity and the number of the connected wells. Their locations are not yet known so the noise assessment cannot

present noise predictions at individual noise sensitive receptors. Therefore noise level predictions are presented at indicative distances up to 5 km from the noise sources.

The expected total number of FCFs with the different number of compressor trains is given in Table 14-6.

Table 14-6 Number of FCFs with Number of Compressor Trains

Number of Compressor Trains per FCF	Number of FCFs
1	3
2	9
3	13
4	4
5	1
6	2
7	1

The FCFs shown in Table 14-6 will be progressively commissioned between 2018 and 2031 with approximately half expected to commence operation in the first three years from 2018 to 2020. Noise level predictions have been undertaken for an FCF with seven compressor trains representing the worst case for this type of facility. The noise emissions from an FCF will depend on the number of compressor trains.

All FCFs will ultimately be electrically powered from the power distribution network to be constructed with the other types of Project infrastructure. However, for up to the first two years, temporary power generation may be required for those FCFs planned to be commissioned during these initial two years. Two local temporary power generation options have been investigated. Local power generation can be undertaken with either temporary reciprocating gas engine generators (e.g. approximately 1.1 MW relocatable containerised reciprocating gas engines) or with small gas turbines (e.g. relocatable containerised open cycle gas turbines approximately 5.7 MW). These types of relocatable power generators are typically supplied with standard noise reduction treatments, although the noise control treatments can usually be upgraded if required.

The predicted noise levels from a 7-train FCF without additional noise mitigation are shown in Table 14-7 at kilometre interval distances from the facility.

The approximate distances that the different FCF configurations are predicted to comply with the 28 dB(A) noise limit without additional noise mitigation are shown in Table 14-7, provided no other Project-related noise sources are contributing to the received noise.

In order to achieve the noise limit criterion of 28 dB(A) at closer distances, noise mitigation treatments may be required for FCFs powered either electrically or by temporary power generation.

Table 14-7 Predicted Noise Levels (dB(A)) from 7-train FCFs without Additional Noise Mitigation

FCF Noise Sources	Noise Level dB(A)					Approximate Distance Required to Achieve 28 dB(A) (km)
Receptor Distance	1 km	2 km	3 km	4 km	5 km	
FCF 7-Train (electrically powered)	58.4	43.4	33.5	26.7	21.7	3.8
FCF 7-Train (powered – 1.1 MW generators)	58.9	44.7	35.9	30	25.6	4.4
FCF 7-Train (powered – 5.7 MW generators)	59	45	36.5	30.6	26.1	4.6

14.6.2.4 Central Gas Processing Facilities and Water Treatment Facilities

There are two CGPFs proposed as part of the Project. Their locations are not yet known so the noise assessment cannot undertake noise predictions at individual noise sensitive receptors, therefore noise level predictions have been presented at indicative distances up to 5 km from the noise sources.

The CGPFs will each be comprised of a battery of centrifugal compressors with each compressor train producing up to 90 TJ/d of gas. CGPF1 is expected to consist of five compressor trains producing up to 450 TJ/d and CGPF2 is expected to consist of four compressor trains producing up to 360 TJ/d.

Predicted noise levels from CGPFs and the co-located WTFs without additional noise mitigation are shown in Table 14-8.

Table 14-8 Predicted Noise Levels (dB(A)) from CGPFs and co-located WTFs without Additional Noise Mitigation

CGPF Noise Sources	Noise Level dB(A)					Approximate Distance Required to Achieve 28 dB(A) (km)
Receptor Distance	1 km	2 km	3 km	4 km	5 km	
CGPF1 (electrically powered)	50	40	33	27	23	3.9
CGPF1 (powered – 1.1 MW generators)	53	43	36	31	26	4.8
CGPF1 (powered – 5.7 MW generators)	54	44	37	32	27	4.9
CGPF2 4-Train (electrically powered)	50	40	33	27	22	3.9
CGPF2 (powered – 1.1 MW generators)	52	42	35	30	26	4.8
CGPF2 (powered – 5.7 MW generators)	53	43	36	31	27	4.9

As shown in Table 14-8, both of the CGPFs are predicted to comply with the 28 dB(A) criterion at a distance marginally closer than 4 km when electrically powered. With either of the temporary power generation options, both of the CGPFs are predicted to comply with the 28 dB(A) criterion at distances marginally closer than 5 km.

In order to achieve the noise limit criterion of 28 dB(A) at closer distances than shown in Table 14-8, noise mitigation treatments may be required for CGPFs powered either electrically or by temporary power generation.

14.6.3 Flaring

14.6.3.1 Ramp-up Flaring

In an effort to reduce gas flaring, changes have been made to the commissioning strategy to minimise flaring associated with the upstream Project ramp-up. Under the current design concept, limited or no ramp-up flaring is expected to take place in any gas field or at any compression facility.

14.6.3.2 Upset Condition / Maintenance Flaring

Flaring at FCFs and CGPFs may occur due to upset conditions throughout the operational phase of the Project.

Unplanned and planned maintenance flaring frequency and rates at FCFs were updated as follows:

- Approximately one occurrence in 5 years at a rate of 40 TJ/d for 13 hours; and
- Approximately 10 occurrences per year at a rate of 20 TJ/d for 26 hours.

Unplanned and planned maintenance flaring frequency and rates at CGPFs were updated as follows:

- Approximately one occurrence in 2 years at a rate of 360 TJ/d for 21 hours;
- Approximately one occurrence in 5 years at a rate of 141 TJ/d for 22 hours;
- Approximately one occurrence in 3 years at a rate of 62 TJ/d for 18 hours; and
- Approximately 12 occurrences per year at a rate of 30 TJ/d for 41 hours.

As the expected durations of these flaring events are between 8 hours and 5 days, and they are not expected to occur at intervals less than 4 weeks, flaring associated with the Project would be defined as medium-term events according to the PGA Noise Guideline.

Flares at FCFs

Noise emissions have been predicted from the flares that will be located at the FCFs with estimated potential flaring rates of 20 and 40 TJ/d.

The predicted noise levels from flaring at an FCF are shown in Table 14-9 in kilometre interval distances from the facility.

Table 14-9 Predicted Component Noise Levels (dB(A)) from Flaring at FCFs

Distance	20 TJ/d (approx. 10 per year)	40 TJ/d (approx. 1 per 5 years)
1 km	33	36
2 km	20	23
3 km	13	16
4 km	< 10	11
5 km	< 10	< 10

As shown in Table 14-9 noise emissions from planned and unplanned flaring at FCFs may exceed the medium-term noise criterion of 28 dB(A) at 1 km distance, but are predicted to comply with the criterion at 2 km or more provided no other Project noise sources are contributing.

Flares at CGPFs

Noise emissions from the flares located at the CGPFs have been estimated using the potential flaring rates listed in Section 14.6.3.2 of this report.

The results of the noise modelling of flaring at the CGPFs are given in Table 14-10.

Table 14-10 Flaring at CGPFs

Receiver	360 TJ/d (80 kg/s) (approx. 1 per 2 years)	141 TJ/d (31 kg/s) (approx. 1 per 5 years)	62 TJ/d (14 kg/s) (approx. 1 per 3 years)	30 TJ/d (7 kg/s) (approx. 12 per year)
1 km	65	61	58	55
2 km	55	51	47	44
3 km	48	44	40	37
4 km	42	38	35	32
5 km	38	34	31	28
6 km	35	30	27	24
7 km	32	27	24	21
8 km	29	25	21	18
9 km	27	23	19	16
10 km	25	21	18	15

As shown in Table 14-10, noise emissions from flaring at CGPFs may exceed the medium-term noise criterion of 28 dB(A) at distances of up to 8 km from the flare, depending on the flaring rate.

The three flare events generating the highest noise levels are expected to occur only rarely (2 to 5 years). The lowest expected flaring rate of 30 TJ/d is expected to occur approximately 12 times per year for approximately 41 hours per event. On these occasions, flaring noise is expected to exceed the medium-term night-time criteria at distances up to 5 km.

14.7 Noise Impact on Protected Areas and Fauna

A discussion of potential noise impacts on any nearby protected areas, terrestrial or avifauna is provided in the Terrestrial Ecology Technical Report (Appendix P, Section 6.6.4) of the EIS.

The Terrestrial Ecology Technical Report (Appendix P, Table 19) of the EIS also lists 24-hour noise from gas facility operation and maintenance as an activity component that threatens ecological values, where the potential impact is to cause animals to leave the area.

The protected areas such as National Parks and Refuges are listed in the Terrestrial Ecology Technical Report (Appendix P, Section 5.4) of the EIS.

The predicted noise levels in the Noise and Vibration Technical Report (Appendix S) of the EIS and the Noise and Vibration Technical Report (Appendix L) of the SREIS may be used as a guide to determine the extent of noise impact in the listed protected areas, which can assist the selection of suitable sites for large gas processing facilities.

14.8 Road Traffic Noise

Changes to the project description have resulted in minor revisions to the estimated heavy vehicle traffic movements related to construction of the facilities.

Changes to the expected number of heavy vehicle trips per facility and the expected activity duration of facilities' construction results in slightly higher or lower numbers of average vehicle movements per facility, as compared with the information provided in the EIS.

Table 14-11 Heavy Vehicle Traffic Generation during Facility Construction

Activity	Number of Heavy Vehicles (per site)	Duration	Heavy Vehicles per Day (Average)
Production wells	232	67 days	3
FCF	1,516	26 weeks	8
CGPF	2,858	52 weeks	8
WTF	9,126	52 weeks	25

As shown in Table 14-11 the average heavy vehicle traffic generation during facility construction will add very few heavy vehicles to the existing public roads on a daily basis.

Since the Project will add very few extra heavy vehicles to the public road network, the increases in traffic on public roads will have a negligible increase in noise level at the nearest receivers when assessed as $L_{A10,18hr}$ noise levels.

14.9 Noise Impact Mitigation Measures

14.9.1 Mitigation Packages for Gas Facilities and Water Treatment Facilities

Mitigation packages have been considered to reduce the setback distance required to achieve the Project noise criteria. The mitigation packages investigated were the same as previously considered in the EIS.

14.9.1.1 Electrically Powered Well Pads

Noise mitigation for well pads can be achieved using either acoustic enclosures over the electric motors and/or construction of a noise barrier in close proximity to the motors. For the electrically powered well pads, noise mitigation of 4 to 6 dB(A) may be required to achieve the noise limit criterion of 28 dB(A) at a receiver 300 m away, provided no other Project related noise sources were contributing to the received noise. This level of noise attenuation could be achieved by an acoustic enclosure or with a noise barrier. The acoustic enclosure and/or noise barrier would be designed and constructed to suit the noise reduction requirements of the specific situation, considering the topography and ground covering.

14.9.1.2 Well Pads with Local Power Generation

An additional 9 dB(A) noise attenuation may be required in order to achieve the noise criterion of 28 dB(A) at 300 m from a well pad with locally generated power. Noise mitigation for the electric motors at the well pads can be achieved using acoustic enclosures. However, the gas engines are already enclosed in a noise attenuation casing, so the noise emissions from these generators can be reduced by improving the attenuation performance of the acoustic enclosure, mufflers and/or construction of a suitable noise barrier.

14.9.1.3 FCFs

Acoustics treatment package selections have been investigated to determine if noise emissions from a 7-train FCF can comply with the noise limit criterion at various distances and what types of noise treatments might be required.

Similar noise mitigation investigations would be undertaken for each of the FCFs with various numbers of compressor trains during the detailed design phase when the final detailed plant and equipment noise emission information is available.

Mitigation of Electrically Powered FCFs

Noise mitigation treatments have been investigated for the electrically powered FCFs. It has been determined that it is possible to achieve the noise criterion at approximately 1 km from an electrically powered FCF with sufficiently high performance noise attenuation treatments applied to the noisiest plant elements.

Mitigation of Powered FCFs (1.1 MW Generators)

Noise mitigation treatments have been investigated for FCFs with local power generation by 1.1 MW generators. It has been determined that it is possible to achieve the noise criterion at approximately 2.7 km from an FCF with sufficiently high performance noise attenuation treatments applied to the noisiest plant elements.

Mitigation of Powered FCFs (5.7 MW Generators)

Noise mitigation treatments have been investigated for FCFs with local power generation by 5.7 MW generators. It has been determined that it is possible to achieve the noise criterion at approximately 2.7 km from an FCF with sufficiently high performance noise attenuation treatments applied to the noisiest plant elements.

14.9.1.4 CGPFs

Acoustics treatment package selections have been investigated to determine if noise emissions from a 5-train CGPF can comply with the noise limit criterion at various distances and what types of noise treatments might be required.

More definitive noise mitigation investigations would be undertaken for both CGPF1 and CGPF2 during the detailed design phase when the final detailed plant and equipment noise emission information is available.

Mitigation of Electrically Powered CGPFs

Noise mitigation treatments have been investigated for the electrically powered CGPFs. It has been determined that it is possible to achieve the noise criterion at approximately 1 km from an electrically powered CGPF with sufficiently high performance noise attenuation treatments applied to the noisiest plant elements.

Mitigation of Generator Powered CGPFs (1.1 MW Generators)

Noise mitigation treatments have been investigated for the CGPFs with local power generation by 1.1 MW generators. It has been determined that it is possible to achieve the noise criterion at approximately 3 km from a CGPF powered by 1.1 MW generators with sufficiently high performance noise attenuation treatments applied to the noisiest plant elements.

Mitigation of Generator Powered CGPFs (5.7 MW Generators)

Noise mitigation treatments have been investigated for CGPFs with local power generation by 5.7 MW generators. It has been determined that it is possible to achieve the noise criterion at approximately 4 km from an CGPF powered by 5.7 MW generators with sufficiently high performance noise attenuation treatments applied to the noisiest plant elements.

14.9.2 Flaring Noise

Predicted noise levels from flaring at FCFs are expected to be relatively minor at distances of more than 2 km.

Predicted noise levels from flaring at CGPFs are expected to be more substantial and may exceed the medium-term noise criterion of 28 dB(A) at distances up to about 8 km from the CGPFs during the highest flaring rates combined with worst case weather conditions. Flaring events with the highest flaring rates are not expected to occur more frequently than once every two years, for a maximum period up to 21 hours.

Options for mitigation of flare noise using engineering noise control treatments are limited, and the industry standard for modern flare stack tips typically includes best available noise control technology in the stack tip design.

Opportunities to further improve the noise reduction treatments in the CGPF flare stack tip designs will be investigated during the detailed design phase.

Strategies for management of noise impact from flaring will be incorporated into an environmental management plan associated with a site specific Environmental Authority application. These strategies would follow a management hierarchy based on the preferences given in the EPP (Noise):

1. Avoid the noise impact (e.g. locating the position of the flare(s) in area(s) away from sensitive receptors wherever possible);
2. Minimise the noise impact, in the following order of preference:
    a) Orient the activity to minimise the noise, and
    b) Utilise practical methods to mitigate noise at the source; and
3. Manage the noise impact.

14.10 Conclusions

This supplementary assessment has investigated the changes to the potential environmental noise and vibration impacts associated with the Project as a result of the updated project description.

The assessment has demonstrated that the Project noise limit criteria can be achieved using a combination of noise attenuation by distance and engineering noise control treatments to plant and equipment. In some cases significant noise control treatments may be required. In all cases the amount of noise reduction required will depend on the proximity of sensitive receptors to the noise sources.

As the locations of the facilities are not yet confirmed, the proximity to sensitive receptors cannot be gauged; however, the noise level predictions in this report can provide guidance to inform the Project in helping to select suitable plant locations based on the distance to receptors. This will allow the Project to follow a noise management hierarchy based on the preferences given in the EPP (Noise):

1) Avoid the noise impact;
2) Minimise the noise impact, in the order of preference:
    a) Orientate an activity to minimise noise; and
    b) Utilise practical methods to mitigate noise at the source;
3) Manage the noise impact.

Additionally, the noise level predictions in this SREIS and in the EIS will be used to inform the Project in the selection of suitable site locations for plant and facilities by taking into consideration the contribution of individual plant toward cumulative noise impacts and the site environmental setting.

14.11 Commitments

Arrow committed to implement a number of avoidance, mitigation and management measures to reduce impacts on values in the Project development area. It is intended that noise and vibration generated by the Project will be managed as described in the Noise and Vibration chapter (Section 22) of the EIS. The commitments pertaining to noise presented in the EIS are listed below in Table 14-12.

New and revised commitments are also presented below in Table 14-13. This update has resulted from changes made to the project description since the EIS was finalised and the decision to further clarify the intent of a commitment (e.g. through the consolidation of similar commitments to avoid inconsistent wording). A full list of all Project commitments, including those that remain unchanged from the EIS, and details of those that have changed, are included in the Commitments Update (Appendix O) of this SREIS.

Table 14-12 Noise and Vibration Commitments as Presented in the EIS

No.	Commitment
B365	Arrow will undertake the selection of locations for production facilities and wells on the basis of many criteria including environmental and engineering constraints, and the setback distances for noise will be one of them.
B366	During the detailed design of the production facilities, the mitigation packages will be selected based on the attenuation required to achieve the Project criteria at the nearest receptor.
B367	The noise levels from the final design will be modelled to confirm that compliance with the Project criteria is still predicted.
B368	All complaints are registered, addressed and closed out.
B369	Applicable noise and vibration levels are met at the sensitive receptor.
B370	Where noise reduction devices are deemed necessary, ensure devices (such as mufflers, low-noise

No.	Commitment
	fans and possibly enclosures) are fitted and work correctly.
B371	Operate equipment and handle materials in a manner that does not cause unnecessary noise (e.g., excessive revving or dropping materials).
B372	Manage noise in accordance with the relevant EA conditions. Where night-time activities are planned (10.00 pm to 6.00 am) and are likely to exceed the prescribed noise criteria, conduct prior consultation with affected parties.
B373	Consult with those who may be affected by increased noise levels due to construction activities with particular reference to the type and timing of works.
B374	Conduct risk-based assessment or potential vibration monitoring during any construction activity that occurs within 100 m of a sensitive receptor that might be subject to vibration.
B375	Implement a grievance management system to manage noise complaints. If necessary, undertake noise monitoring of construction activities to facilitate a response to the grievance.
B376	Preferential selection of sites in sparsely populated areas.
B377	Site-specific detailed noise modelling of production facilities and the application of acoustic treatments where the modelled noise from facilities exceeds the established noise criteria at one or more sensitive receptors.
B378	Consideration of intrinsically quieter equipment or design of acoustic treatments such as hospital-grade exhaust systems and mufflers, or barriers and equipment housing will be given.
B379	Locate equipment associated with production wells and associated wellhead infrastructure at a distance of 70 m or more from a sensitive receptor.
B380	Consider the following factors prior to any blasting operations being conducted:; • The type of rock and stratigraphy being blasted and any associated faulting; • The distance of the blast site from sensitive receptors; • The type, size and number of charges used; • The depth and manner in which the charge is installed; • The meteorological conditions; and • Methods of controlling blast noise and vibration, such as mats or smaller blasts.
B381	Where practicable, schedule planned flaring events (e.g., those preceding shut-down maintenance) for the period between 6.00 am and 10.00 pm.
B382	Implement monitoring and inspection of avoidance, mitigation and management measures to ensure the residual impacts continue to be negligible throughout the lifetime of the Project.
B383	If directed by the administering authority in response to a valid noise complaint, undertake noise monitoring in accordance with the DERM (2000) Noise Measurement Manual.

Table 14-13 Revised and New Noise and Vibration Commitments.

No.	Revised / New Commitment	Rationale
B383	If directed by the administering authority in response to a valid noise complaint, undertake noise monitoring in accordance with the EHP (2013) Noise Measurement Manual.	Reference updated
B642	Following detailed design, strategies for management of noise impact from flaring will be incorporated into an environmental management plan associated with a site specific Environmental Authority application. These strategies would follow a management hierarchy based on the preferences given in the *Environmental Protection (Noise) Policy 2008*: 1. Avoid the noise impact (e.g. locating the position of the flare(s) in area(s) away from sensitive receptors wherever possible); 2. Minimise the noise impact, in the following order of preference: a) Orient the activity to minimise the noise, and b) Utilise practical methods to mitigate noise at the source; 3. Manage the noise impact.	New commitment
B643	Noise level predictions in this SREIS and in the EIS will also be used to inform the Project in the selection of suitable site locations for plant and facilities by taking into consideration the contribution of individual plant toward cumulative noise impacts and the site environmental setting.	New commitment