EHP Ref: CR80957

15 December 2017

Mr Daniel Spelchan
A/Compliance Delivery Manager
South Queensland Compliance – Toowoomba
Environmental Services and Regulation
Department of Environment and Heritage Protection
P.O. Box 731
Toowoomba QLD 4350

Dear Mr Spelchan,

Subject: Alleged noise matter – Dalby Expansion Project (EPPG00972513)

COMMERCIAL IN CONFIDENCE

Arrow Energy Pty Ltd (Arrow) has received DEHP's (the Department) letter of 5 December 2017 (Letter) regarding a complaint for an alleged noise matter caused by the Dalby Expansion Project (DXP), and acknowledges the Department's request for the following information:

1. *A copy of all noise modelling undertaken as a requirement of condition (E2) of your Environmental Authority (EA) EPPG00972513 for all sensitive receptors;*

2. *A copy of all Noise Management Plans prepared as a requirement of condition (E3) of your EA for all sensitive receptors;*

3. *Evidence of implementation of all Noise Management Plans as required by condition (E4) of your EA for all sensitive receptors;*

4. *Evidence that all Noise Management Plans meets the criteria specified in condition (E5) of your EA for all sensitive receptors.*

Given the breadth of Arrow's activities across the seven petroleum lease tenures relevant to EPPG00972513, described below is specific information relating to the region surrounding the Daandine gas field only. This region has been selected as a landholder in the area has recently advised Arrow that they had lodged a noise complaint with the Department, and Arrow has assumed that this is the same complaint referred to in the Letter. This will enable the Department to consider information relevant to the locality of that landholder. Should this information not satisfy your request with respect to the alleged noise matter referred to in your Letter, please advise such that relevant information can be provided.

Owing to the sensitivity of the information contained in this Letter, disclosure of this information could reasonably be expected to prejudice Arrow's affairs. Accordingly, Arrow requests that the Department treat the information with confidence and notes that the information is provided in confidence for the Department's purposes only and in relation to the subject alleged noise matter only.

P +61 7 3105 3400 F +61 7 3105 3401 ARROW ENERGY PTY LTD ABN 73 078 521 936 LEVEL 19, 42 ALBERT STREET BRISBANE QLD 4000 GPO BOX 5262 BRISBANE QLD 4001 ASX CODE AOE info@arrowenergy.com.au arrowenergy.com.au

1. **A copy of all noise modelling undertaken as a requirement of condition (E2) of your Environmental Authority (EA) EPPG00972513 for all sensitive receptors**

To address point 1, **Appendix A** contains the following reports on noise modelling for the Daandine gas field:

- Daandine Expansion Project, Detailed Design Phase, Noise Impact Assessment – SLR (dated 23/09/2014); and
- Updated Noise Assessment for the Daandine Expansion Project – SLR (dated 15/03/2017).

2. **A copy of all Noise Management Plans prepared as a requirement of condition (E3) of your EA for all sensitive receptors**

In regard to point 2, attached in **Appendix B** are the following Arrow noise and vibration management plans relevant to Environmental Authority EPPG00972513:

- Environment Noise and Vibration Management Plan – Arrow Energy (dated September 2017) ("Arrow Noise Management Plan"); and
- Environmental Noise and Vibration Management Plan, Dalby Expansion Project (DXP) – Arrow Energy (dated March 2017) ("DXP Noise Management Plan").

These noise management plans provide an overview of the measures implemented by Arrow to manage noise and vibration impacts. The Arrow Noise Management Plan applies to all of Arrow tenures. The DXP Noise Management Plan is specific to DXP tenures and references the Arrow Noise Management Plan.

3. **Evidence of implementation of all Noise Management Plans as required by condition (E4) of your EA for all sensitive receptors**

In regard to point 3, Arrow follows the principles outlined within the Arrow Noise Management Plan and the DXP Noise Management Plan for its projects. Detailed planning and constraints analysis is conducted prior to the commencement of an activity that may create noise issues. This process is a component of standard field planning, designed to ensure that noise emissions from planned activities do not exceed EA noise limits at sensitive receptors. If estimates of noise indicate that EA noise levels may be exceeded, the Arrow Noise Management Plan and the DXP Noise Management Plan address how additional mitigation and/or alternative arrangements are considered.

Noise constraint analysis primarily involves identifying sensitive receptors and predicting the likely impacts or potential noise generating activities on the sensitive receptors via desktop assessments, modelling and/or site specific noise measurements.

As can be seen in the *Daandine Expansion Project, Detailed Design Phase, Noise Impact Assessment – SLR (23/09/2014)* at **Appendix A**, a comprehensive assessment was undertaken prior to the expansion of the Daandine Central Gas Processing Facility (CGPF), and noise mitigation was implemented in order to keep noise at or below pre-expansion levels. This objective was set based on more than 5 years operational experience in operating the CGPF during which time there had been no noise related enquiries relevant to CGPF operation from surrounding landholders, and in consideration of the surrounding industrial land use. The assessment included the verification of deemed background noise levels to establish more representative background noise levels and involved a site specific risk assessment. The detailed site-specific noise assessment undertaken ensured the accuracy of the predicted noise levels at all relevant sensitive receptors in the vicinity of the CGPF.

Based on the results of this noise assessment, the Daandine Expansion Project included the installation of acoustic enclosures for both existing gas compressors and new gas compressors.

In regard to implementation of the Arrow Noise Management Plan and DXP Noise Management Plan for this particular noise matter, immediately after Arrow was made aware of the matter by the landholder in June 2017, Arrow consulted its plans and modelling reports, and proceeded to prepare a noise monitoring plan. The plan was prepared for the monitoring of noise at the residence on the commercial property as well as background noise and sources. The monitoring was undertaken in July 2017 at locations as close to the residence as possible and adjacent to the property boundary. The report from this monitoring, *Daandine Noise Monitoring – SLR (dated 14 September 2017)* is at **Appendix C**.

Following assessment of the results of the monitoring (July 2017), Arrow consulted with the landholder and their legal representative for the purpose of reaching an alternative arrangement. Arrow has submitted a proposal to the landholder and will continue to work with the landholder towards reaching an alternative arrangement.

An assessment of options for additional noise mitigation at the CGPF was undertaken in October 2017 by Arrow's noise consultant. This study assessed numerous scenarios to further attenuate noise at the CGPF by way of barriers/walls and also assessed noise treatments at the sensitive receptor. The results of this study are presented in the *Noise Attenuation Feasibility Study – SLR (dated 10 November 2017)* at **Appendix C**.

The results of the noise monitoring (July 2017) confirmed that there are numerous significant noise sources in the area and that these noise sources are likely to impose noise upon the landholder. See *Daandine Noise Monitoring – SLR (dated 14 September 2017)* at **Appendix C.**

4. Evidence that all Noise Management Plans meets the criteria specified in condition (E5) of your EA for all sensitive receptors

In regard to point 4, the table below describes how Arrow meets the conditions specified in condition E5. Condition E5 requires that a Noise Management Plan must address but not be limited to the matters listed in E5(a) to (g).

EA EPPG00972513requirements for a Noise Management Plan	Evidence Noise Management Plan meets criteria
Condition E5(a) A location based noise assessment to determine compliance with the limits in Schedule E, Table 1 – Noise limits at sensitive receptors	Section 2 and Section 3 of the DXP Noise Management Plan. As this is a summary of site specific assessment results, the descriptions of the location based noise assessments are described in this DXP Noise Management Plan. Detailed descriptions of the noise assessments are located in specialist noise consultant reports **(see Appendix A).**
Condition E5(b) The measured and/or predicted noise level of these noise sources and activities at noise sensitive receptors, taking into account any tonal or impulsive noise impacts	
Condition E5(c) The reasonable and practicable control or abatement measures (including relocating the activity, hours of operation, or having an alternative arrangement in place with any potentially affected person) that can be undertaken to reduce identified intrusive noise sources	Section 4 of the DXP Noise Management Plan and Section 5 of Arrow Noise Management Plan **(see Appendix B)** Section 4 of the DXP Noise Management Plan **(see Appendix B)** lists specific noise control options for the DXP and expected attenuation from each option in line with the requirements of the EA. Section 5 of the Arrow Noise Management Plan **(see Appendix B)** describes the overall noise management strategy for Arrow, which is also considered when evaluating noise control options.
Condition E5(d) The level of noise at noise sensitive receptors that would be achieved from implementing these measures	
Condition E5(e) The handling of future noise complaints	Section 5 of the Arrow Noise Management Plan **(see Appendix B)**
Condition E5(f) Community liaison and consultation including but not limited to consultation processes for when night time activities (i.e. between 10:00 pm and 6:00 am) are likely to exceed 25 dBA	
Condition E5(g) Training of staff and contractors in best available noise management practices	

Arrow intends to continue to work cooperatively with the Department on this matter in a timely manner and appreciates the Department's consideration of the points raised in this response. Arrow has and will continue to work with the landholder to ensure that EA compliance is maintained.

Arrow would welcome the opportunity to further discuss this alleged noise matter with the Department at your earliest convenience.

Future written correspondence on this matter should be addressed to me, however should you have any further queries, please contact Scott Nairn on 07 3012 4098.

Yours sincerely,

sch4p4(6) Personal [redacted]

Yihua Xu
General Manager Asset (Surat)
yihua.xu@arrowenergy.com.au

Appendices

Appendix A

- Daandine Expansion Project, Detailed Design Phase, Noise Impact Assessment – SLR (23/09/2014)
- Updated Noise Assessment for the Daandine Expansion Project – SLR (15/03/2017)

Appendix B

- Environmental Noise and Vibration Management Plan – Arrow Energy (September 2017)
- Environmental Noise and Vibration Management Plan, Dalby Expansion Project (DXP) – Arrow Energy (March 2017)

Appendix C

- Daandine Noise Monitoring – SLR (14 September 2017)
- Noise Attenuation Feasibility Study – SLR (10 Nov 2017)

<u>Appendix A</u> **Noise Modelling as required by Condition E2**

- **Daandine Expansion Project, Detailed Design Phase, Noise Impact Assessment – SLR (23/09/2014)**

- **Updated Noise Assessment for the Daandine Expansion Project – SLR (15/03/2017)**

ARROW ENERGY

A13 - Daandine Expansion Project (EXECUTE Phase)

NOISE IMPACT ASSESSMENT

Arrow Energy Doc. No.: 05-G-REP-0054

Clough AMEC Doc. No.: 750560-0000-BA00-RPT-0002

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0	26/09/2014	IFU		JMi	GSc	Not Applicable
Revision	**Date**	**Description**	**Prepared**	**Reviewed**	**Approved**	**Client**

SLR

global environmental solutions

Daandine Expansion Project

Detailed Design Phase

Noise Impact Assessment

Report Number 620.10773R3

23 September 2014

Clough AMEC JV
100 Edward Street
Brisbane QLD 4001

Version: Revision 0

Daandine Expansion Project

Detailed Design Phase

Noise Impact Assessment

PREPARED BY:

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
Suite 7, 240 Waterworks Road
Ashgrove QLD 4060 Australia
(PO Box 844 Ashgrove QLD 4060 Australia)
T: +61 7 3858 4800   F: +61 7 3858 4801
brisbane@slrconsulting.com   www.slrconsulting.com

DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
620.10773R3	Revision 0	23 September 2014	Clemence Terraz Henrik Malker	Henrik Malker	Mark Caslin

Executive Summary

SLR Consulting Australia Pty Ltd (SLR) was engaged by the Clough AMEC Joint Venture (CAJV), on behalf of Arrow Energy Pty Ltd (Arrow), to assess noise emissions from the proposed Daandine Expansion Project located within the Daandine – Stratheden petroleum leases (PL). The project draws gas from the PL230 (Daandine) and PL252 (Stretheden) fields, and is located west of Dalby in central-western Queensland. The purpose of the assessment was to refine the noise modelling and proposed mitigation measures for the detailed design phase.

The Daandine Expansion Project includes the following acoustically significant new plant and equipment relevant to the noise assessment:

- At the CGPF
    - 3x Compressors including engines and coolers.
    - 1x Triethylene glycol (TEG) Unit.
    - 1x Flare.
    - 1x Cold Vent.
- Well Sites
    - 3x Multi-Well Sites.
    - 25x Single Well Sites (Phase 0).
    - 1x Multi-Well at the Surat Tek Park.

The scope of this report is to present the modelling methodology, noise modelling results and noise mitigation recommendations for the construction and operation of the Daandine Expansion Project.

OPERATIONAL NOISE ASSESSMENT

The most stringent criterion for the Daandine Expansion Project is 28 dBA during night-time operation as per the Environmental Authority (EA) Condition EPPG00972513 (Schedule E, Table 1). Refer to **Section 2**.

There are a number of dwellings in the study area. The dwellings are a mix of privately owned dwellings and Arrow owned dwellings. In this assessment, only privately owned dwellings are considered to be critical receptors (Arrow has the ability to negotiate special terms with their tenants and if required, improve the noise performance of the building's construction to meet the internal noise amenity). Refer to **Section 3**.

Unattended and attended noise measurements have been undertaken in July 2014 by SLR at different locations within the Daandine site in order to calibrate the SoundPLAN model. Refer to **Section 4**.

A noise model of the Daandine Expansion Project was developed in 2013 using the CONCAWE algorithm. The sound power levels of the significant noise sources were obtained from existing documentation and were then calibrated with the July 2014 noise measurements. Refer to **Section 5**.

Weather data for the site were obtained from nearby weather stations and analysed to determine the site prevailing weather conditions. Refer to **Section 5.3**.

Executive Summary

The following scenarios were modelled (refer to **Section 5.4.1**):

- Scenario 1 – “Existing (normal) Operation” - including existing CGPF and existing Daandine WTF
- Scenario 2 – “Existing (normal) Operation including Existing Wells” - Scenario 1 + existing wells
- Scenario 3a – “Future (normal) Operation” - including future CGPF and existing Daandine WTF
- Scenario 3b – “Future (electrified WTF) Operation” - including future CGPF and Daandine WTF electrified
- Scenario 4a – “Future (normal) Operation including Existing and Future Wells” - Scenario 3a + existing and future wells
- Scenario 4b – “Future (electrified WTF) Operation including Existing and Future Wells” - Scenario 3b + existing and future wells
- Scenario 5 – “Future Cumulative (normal) Operation including Existing and Future Wells” - scenario 4a + Kogan North Compressor Station and Daandine Power Station + existing and future wells
- Scenario 6 – “Future (upset) Operation”

Noise predictions for the modelling scenarios indicate that up to 7 sensitive receivers (privately owned dwellings) are potentially exceeding the EA criteria with the Daandine Expansion Project under adverse weather conditions. Refer to **Section 6.1**.

The 7 sensitive receivers are receivers ID 3, ID 40, ID 41, ID 55, ID 56, ID 80 and ID 100 (refer **Appendix B**).

Detailed cumulative assessment of the noise source contributions at the potentially impacted receivers showed the following:

- Receiver ID 3 is potentially impacted by noise emissions from the existing well DA-81.
- Receiver ID 80 is potentially impacted by noise emissions from the future well Stratheden-15
- Receiver ID 40 is potentially impacted (only marginally) by a combination of noise emissions mainly from the CGPF. The CGPF by itself is not predicted to exceed the noise criterion.
- Receiver ID 41 is potentially impacted by noise emissions form the CGPF, however with significant noise contribution from the Daandine WTF and both existing and future well sites as well.
- Receiver ID 55 and Receiver ID 56 are potentially impacted by a combination of noise emissions from the future CGPF, existing and future wells and the Daandine WTF.
- Receiver ID 100 is potentially impacted by a combination of noise emissions mainly from the future CGPF, however also by noise emissions from the existing wells (at least 5 of them) and the Power station.

In relation to the mitigations to the CGPF, a source ranking was undertaken which showed that the noise sources within the existing and future compressor buildings were the dominant noise sources and contributions from external noise sources (ie coolers, TEGs etc) were more than 10 dB lower. Therefore, mitigation measures were focused on reducing noise emissions from the compressor shelters. Three (3) levels of mitigation to the compressor shelters were assessed.

- Mitigation 1: Closing the shelters with steel cladding only, leaving one end open and gaps of 300 mm at the top and 400 mm at the bottom on the other three walls to meet the requirements for natural ventilation.

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- Mitigation 2: As per Mitigation 1 plus adding acoustic lining of 50 mm thickness on the inside of the walls.
- Mitigation 3: As per Mitigation 2 plus utilising acoustic louvers on the open gaps in the walls. Insertion loss data for Hudson 300 Series Acoustic Louvres has been used, which are typical 300 mm deep louvres.

Analysis of the results indicate that future predicted noise levels with Mitigation 1 are below the existing Daandine CGPF noise levels for normal and adverse weather conditions.

Future predicted noise levels with Mitigation 3 comply with the EA noise criteria for neutral weather conditions. A marginal exceedance (less than 1 dBA) is predicted for receivers ID55 and ID 56 and a 5 dBA exceedance is predicted for receiver ID100 under adverse weather conditions.

The predictions show that to achieve compliance with the EA conditions Arrow may have to negotiate an alternative arrangement with the receiver ID100.

It is also noted that the electrification of the Daandine WTF will reduce the noise levels at receptors ID 41, ID 55 and ID 56 especially with mitigation applied to the CGPF.

To mitigate the noise emissions at receiver ID 3 and ID 80, the following two (2) options should be considered:

- Reduce noise emissions from existing well DA-81 and the future well Stratheden-15
- Possibilities to enter an alternative arrangement with the affected residences.

It is acknowledged that computer noise modelling has been undertaken on a number of assumptions based on the most accurate and complete information available at the time. It is recommended that Factory Acceptance Testing (FAT) and onsite compliance testing is undertaken to compare the provided vendor data for the future plant items with measurement data, and if required, take additional measures to reduce noise levels.

CONSTRUCTION NOISE ASSESSMENT

Environmental computer noise modelling has been undertaken for the construction scenarios. The determined construction scenarios and their construction stages are:

1 Installation of New CGPF Components
   - 1.1. Construction of foundations
   - 1.2. Civil works

2 Completion/Work-over Rigs

3 Gathering Flowlines and Access Road Tracks
   - 3.1 Clear and grade
   - 3.2 Trenching
   - 3.3 Padding and backfilling
   - 3.4 Access road construction

For each construction stage a typical worst case has been determined, with equipment and mobile plant operating simultaneously at any one time. It has been assumed that all construction will be undertaken during daytime hours, as such only neutral weather conditions have been incorporated in the modelling.

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Installation of New CGPF Components

Predicted noise levels for the installation of new components at the CGPF comply with the daytime 40 dBA L_{Aeq} (external) criterion at all receptor locations. Furthermore, during shutdown periods at the CGPF construction during night-time may be required, however, construction activities would generate less noise emissions than the existing operation and no noise impacts would be anticipated.

Completion/Work-over Rigs

The offset distance to achieve the night-time noise criterion of 28 dBA L_{Aeq} for the completion/work-over rigs is predicted to between **2,020 m** and **6,470 m** (depending on the operation of the blooie line) under neutral weather conditions and between **3,880 m** and **11,530 m** (depending on the operation of the blooie line) under adverse weather conditions.

It should be noted that the noise emissions from the blooie line operation is highly directional, and the noise emissions and resulting offset distances to achieve the night-time noise criterion will be significantly less in the opposite direction of blooie line release. The blooie line is a surface pipe that 1) is used on an air drilling rig to discharge air, water and well cuttings 2) is used to discharge fluids coming up the well from the drilling rig during a kick. A diverter is used to send the fluids down the blooie line to the blooie pit.

Gathering Flowlines and Access Road Tracks

The offset distance to achieve the daytime noise criterion of 40 dBA L_{Aeq} for the construction stages associated with the gathering flowlines and access roads construction is predicted to between **340 m** and **630 m**.

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1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) was engaged by Clough AMEC Joint Venture (CAJV), on behalf of Arrow Energy Pty Ltd (Arrow), to assess noise emissions from the proposed Daandine Expansion Project located within the Daandine – Stratheden petroleum leases (PL). The project draws gas from the PL230 (Daandine) and PL252 (Stretheden) fields, and is located west of Dalby in central-western Queensland. The locality of the project area is marked in **Figure 1**. The purpose of the assessment was to refine the noise modelling and proposed mitigation measures through the detailed design phase.

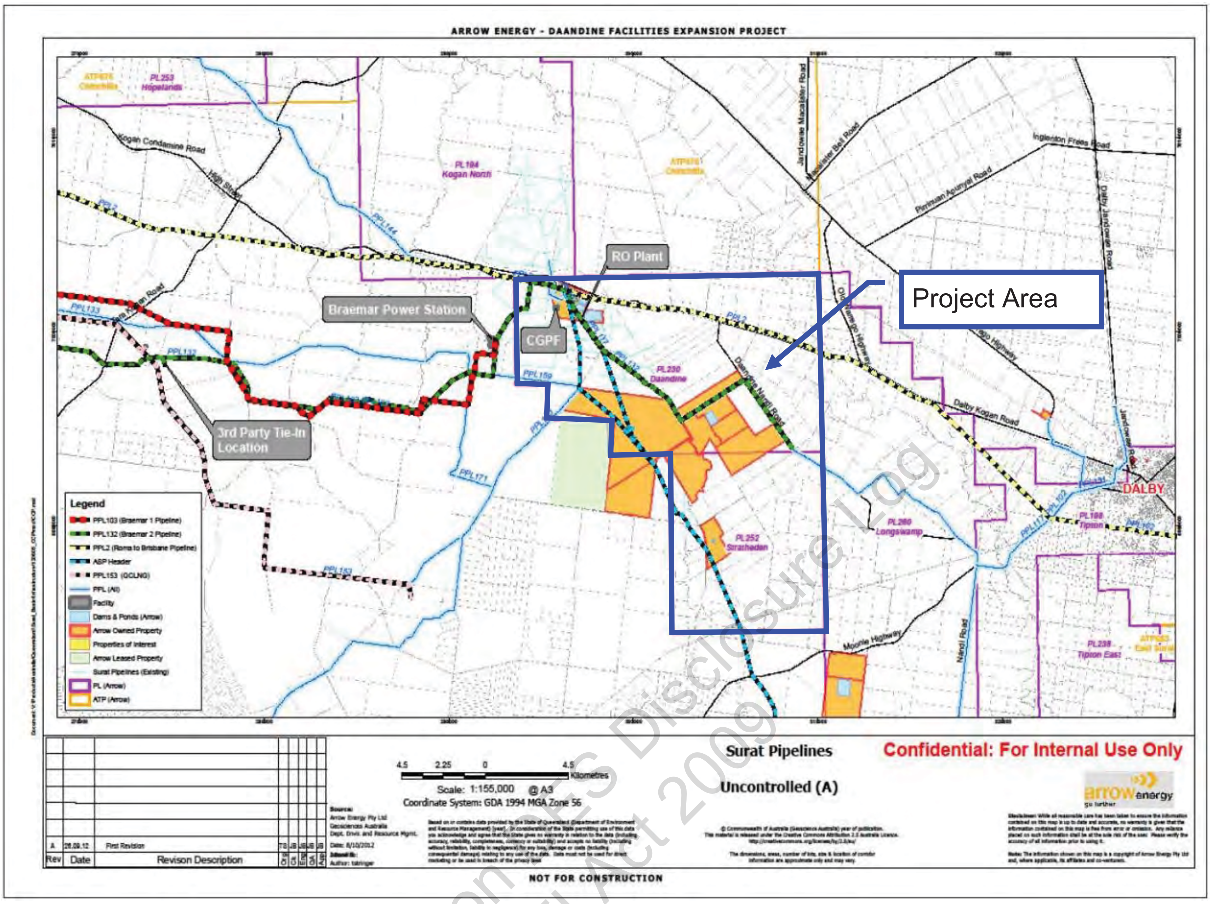
The Daandine Expansion Project includes the following acoustically significant new plant and equipment relevant to the noise assessment:

- At the CGPF
  - 3x Compressors including engines and coolers.
  - 1x Triethylene glycol (TEG) Unit.
  - 1x Flare.
  - 1x Cold Vent.
- Well Sites
  - 3x Multi-Well Sites.
  - 25x Single Well Sites (Phase 0).
  - 1x Multi-Well at the Surat Tek Park.

The scope of this report is to present noise measurement results from site survey, the modelling methodology, refined noise modelling results and noise mitigation recommendations for the Daandine Expansion Project through the detailed design phase.

Specific acoustic terminology is used within this assessment. An explanation of common acoustic terms is included as **Appendix A**.

Figure 1 Locality of the Daandine Expansion Project



2 NOISE CRITERIA

The Environmental Authority (EA) condition detailed in the EA No. EPPG00972513 provides noise criteria for the Daandine Expansion Project and are reproduced in **Table 1**.

Table 1 Noise Criteria from the EA Condition EPPG00972513 (Schedule E, Table 1)

Time Period	Metric	Short Term Noise Event	Medium Term Noise Event	Long Term Noise Event
7:00 am – 6:00 pm	$L_{Aeq,adj,15\ min}$	45 dBA	43 dBA	40 dBA
	Max $L_{pA,15\ min}$	55 dBA	51 dBA	45 dBA
6:00 pm – 10:00 pm	$L_{Aeq,adj,15\ min}$	40 dBA	38 dBA	35 dBA
	Max $L_{pA,15\ min}$	50 dBA	46 dBA	40 dBA
10:00 pm – 6:00 am	$L_{Aeq,adj,15\ min}$	28 dBA	28 dBA	28 dBA
	Max $L_{pA,15\ min}$	38 dBA	36 dBA	33 dBA
6:00 am – 7:00 am	$L_{Aeq,adj,15\ min}$	40 dBA	38 dBA	35 dBA
	Max $L_{pA,15\ min}$	50 dBA	46 dBA	40 dBA

Note: LAeq and Max LpA are to be measured over any 15 minute period
Deemed background noise levels for Schedule E, Table 1 – Noise Limits at Sensitive Receptors are:

- 7:00 am – 6:00 pm: 35 dBA
- 6:00 pm – 10:00 pm: 30 dBA
- 10:00 pm – 7:00 am: 25 dBA
- 6:00 am – 7:00 am: 30 dBA

A "long term noise event" is defined as a noise exposure lasting for greater than five (5) days, even when there are respite periods when noise is inaudible within those five (5) days. This is considered most appropriate for the operational assessment as the existing and future Daadine facility will be operating 24 hours a day, 7 days a week.

The deemed background noise levels were included in the criteria to ensure an unreasonably onerous noise criteria were not adopted in areas where background noise is very low say less than 25 dBA between 10 pm and 6 am. However, where background noise levels are higher than the deemed background noise levels, the resulting noise criteria by using the deemed background noise levels may become unreasonably onerous as well. There are background noise sources in the project area that Arrow is not operating such as Daandine Power Station, Wambo feedlot, B1 and B2 power stations, which may result in background noise levels higher than the deemed background noise levels for some receptors.

The existing and future Daadine facility will be operating 24 hours a day and the most stringent noise limit will be the night-time **28 dBA $L_{Aeq,adj,15\ min}$ (external)**.

It is assumed that all construction noise, except completion/work-over at wells, will be undertaken during the daytime only. Further, all construction activities are assumed to be potentially "long term noise event" as defined above. The most stringent construction (excluding completion/work-over at wells) noise limit will be **40 dBA $L_{Aeq,adj,15\ min}$ (external)**.

Completion/work-over at wells has been assumed as a 24 hours a day, 7 days a week operation. Therefore, the most stringent noise limit will be the night-time **28 dBA $L_{Aeq,adj,15\ min}$ (external)**.

In addition to the noise limits in **Table 1**, the adjustments detailed in **Table 2** are to be made if the noise is of tonal or impulsive character.

Table 2 Schedule E, Table 2 - Adjustments to be Added to Noise levels at Sensitive Receptors

Noise Characteristics	Adjustment to Noise
Tonal characteristic is just audible	+ 2 dBA
Tonal characteristic is clearly audible	+ 5 dBA
Impulsive characteristic is just audible	+ 2 dBA
Impulsive characteristic is clearly audible	+ 5 dBA

Low Frequency Noise

In addition to the noise limits in **Table 1**, the EA condition specifies that any noise below 315 Hz must not cause an environmental nuisance.

Low frequency noise from the petroleum activities is not considered to be an environmental nuisance under the above mentioned condition if monitoring (or modelling) shows that noise emissions do not exceed the following limits:

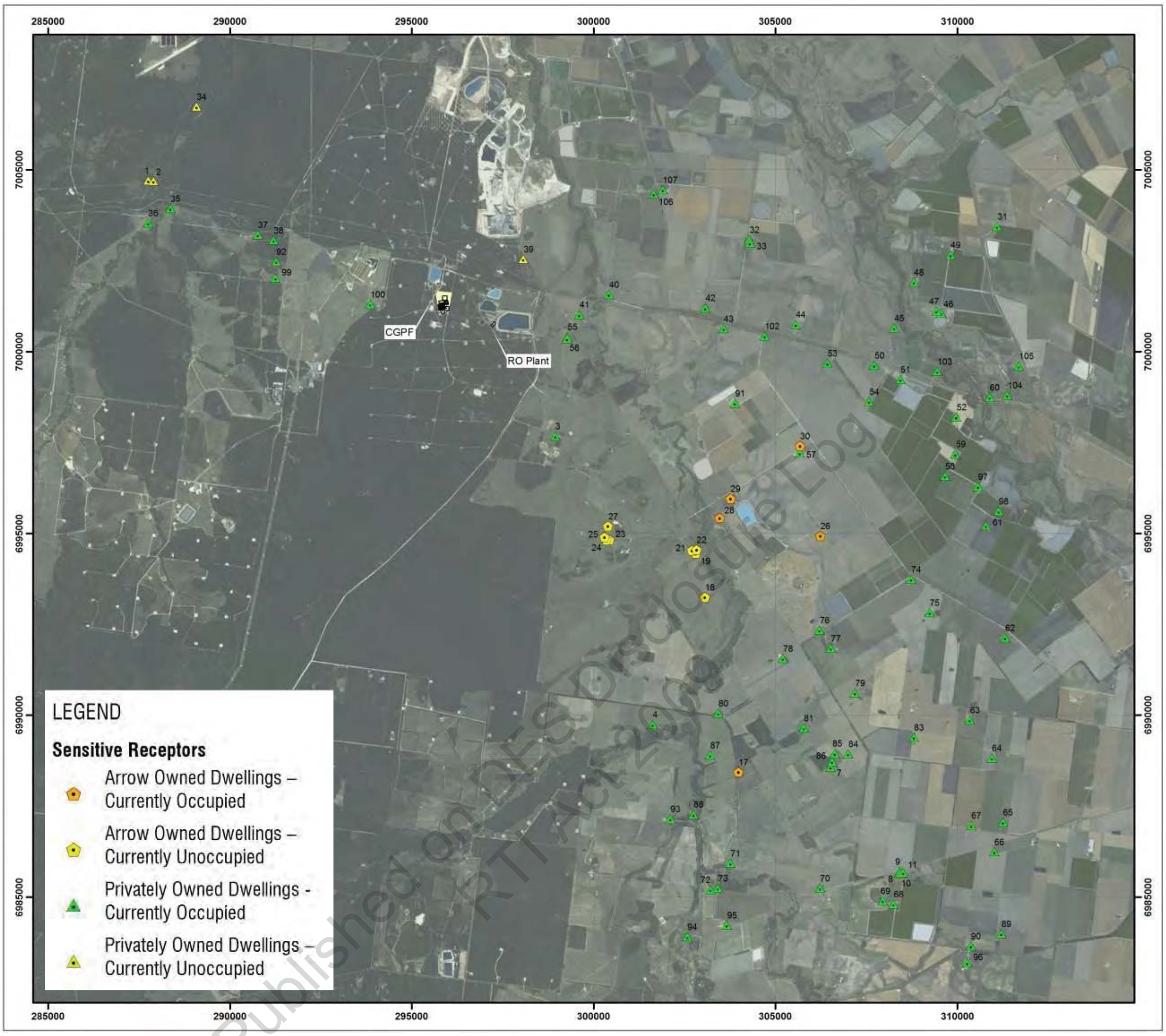
- 50 dBZ measured inside the sensitive receptor; and
- The difference between the internal A-weighted and Z-weighted noise levels is no greater than 15 dB.

A facade reduction of 5 dBZ has been assumed, resulting in an external low frequency limit of **55 dBZ L_{Aeq} (external)**. It should be noted that the latest draft Guideline *Assessment of Low Frequency Noise* from the Department of Environment and Heritage Protection (EHP) specifies a 5 dB less stringent criterion of 55 dBZ (internal) as the initial low frequency criterion.

3 SENSITIVE RECEPTORS

Sensitive receptors identified within the Daandine Expansion Project study area were provided by the CAJV, and include a mix of Arrow owned properties and privately owned properties. The location of the sensitive receptors, whether private or Arrow-owned, are shown graphically in **Appendix B** and on **Figure 2**.

Figure 2 Identified Noise Sensitive Receptors



3.1 Private Dwellings

Critical receptors for the Daandine Expansion project include a number of homesteads, as shown on **Figure 2** and detailed in **Appendix B**.

Private residences are allocated the most stringent applicable noise limit stipulated in **Section 2**.

3.2 Arrow Owned Dwellings

Several receptor locations within the Daandine Expansion Project study area have been identified as Arrow owned dwellings, as shown on **Figure 2** and detailed in **Appendix B**.

Arrow owned dwellings have been included in this assessment. However, these are not considered critical receptors for this assessment as Arrow has the ability to negotiate special terms with the tenants and if required, improve the noise performance of the building's construction to meet the internal noise amenity.

4 SITE SURVEY

Site survey and onsite measurements were undertaken by SLR on 23 July 2014 and 24 July 2014. The primary purpose of the measurements was to calibrate the existing noise model of the Central Gas Processing Facility (CGPF) and Water Treatment Facility (WTF). Noise measurements adjacent to the Kogan North Compressor Station and Daandine Power Station were also undertaken to estimate their noise emissions in order to add those two plants in the cumulative noise assessment.

4.1 CGPF Noise Survey

Noise measurements at the CGPF were undertaken on 23 July 2014. The measurement locations are indicated in **Figure 3**. Compressor K3 was not operating during the measurements and predictions to calibrate the model were therefore undertaken without the Compressor K3 in the model.

The existing noise model from the preliminary noise assessment in 2013 was calibrated based on site observations (ie gravel inside shelters) and measured noise levels throughout the site. The measured and predicted (after model calibration) onsite noise levels are presented in **Table 3**.

The calibration of the noise model resulted in approximately 4.5 dBA reduction of the overall noise emissions from the CGPF. The difference was probably due to previous noise data (sourced from David More and Associates Acoustic Report No R12027/D2645/Rev.4/18.02.14) that had contribution from more than one noise source when determining sound power levels (SWLs) from individual plant items.

Table 3 Calibration of CGPF Noise Model against Onsite Measurements (July 2014)

Measurement Locations	Sound Pressure Level (L_{Aeq} dBA)		
	Measured	Predicted	Difference
Meas Loc 1 - 10m from Shelter (K2) end	89.3	88.7	-0.6
Meas Loc 2 - 1.5m from K2 Air exchanger	87.4	87.1	-0.3
Meas Loc 4 - 5m from K2 Air Exchanger	83.5	82.6	-0.9
Meas Loc 5 – Internal in shelter between K2 and K4	98.4	98	-0.4
Meas Loc 6 - Between K2 and K4 Air Exchanger	90.5	89.5	-1
Meas Loc 7 - 5m from K4 Air Exchanger	85.6	84.3	-1.3
Meas Loc 8 - 36m from K4, 49m from shelter	76.2	75.1	**-1.1**
Meas Loc 9 – Internal in shelter between K4 and K6	98.2	98.3	0.1
Meas Loc 10 - Between K4 and K6 Air Exchanger	90.5	89.4	-1.1
Meas Loc 11 - 5m from K6 Air Exchanger	83	82.6	-0.4
Meas Loc 13 - 1.5m from K6 Air Exchanger	87.4	87.4	0
Meas Loc 14 - 35m from Shelter (K6) end at fence line	80	81	**1**
Meas Loc 15 - 10m from Shelter (K7) end	89.7	88.3	-1.4
Meas Loc 16 - 3m from Pressure Control V	93.7	93.7	0
Meas Loc 17 - North-west corner 97m from shelters	71.2	72	**0.8**
Meas Loc 19 - 5m from K7 Air Exchanger	82.9	82.3	-0.6
Meas Loc 21 - Between K7 and K5 Air Exchanger	89.9	88.9	-1
Meas Loc 22 - 5m from K5 Air Exchanger	84.1	83.8	-0.3
Meas Loc 23 - 5m from K1 Air Exchanger	80.3	82.5	2.2
Meas Loc 25 - 6m from Shelter (K1) end	90.5	91.8	1.3
Meas Loc 26 - 53m from K3, 66m from Shelter at northern fence line	73.8	73	**-0.8**
Meas Loc 28 - Towards ID39	50.6	60.4	9.8

Measurement Locations	Sound Pressure Level (L_{Aeq} dBA)		
	Measured	**Predicted**	**Difference**
Meas Loc 29 - Towards ID 100	53.3	50.9	-2.4
Meas Loc 38 – 1.5m from Compressor K1 exhaust	88.2	89.8	1.6
Meas Loc 39 – 1.5m from Compressor K2 exhaust	89	89.8	0.8
Meas Loc 43a - Adjacent TEG	80.9	81.5	0.6
Meas Loc 43b - Adjacent TEG exhaust	80.9	80.7	-0.2

Note: The Bold values are at boundary fence and further from specific plant items and thus representable of the overall noise emissions from the whole CGPF facility in those directions.

Table 3 indicates that the calibrated model, especially at the boundary fence and further from specific plant items, is calibrated to within ±1 dB with the measurements.

In addition to the CGPF onsite measurements indicated in **Table 3**, noise measurements were also undertaken further away from the CGPF in both the easterly and westerly directions towards the nearest sensitive receptors direction.

Table 4 CGPF Noise Model Predictions against Offsite Measurements (July 2014)

Measurement Locations	Sound Pressure Level (L_{Aeq} dBA)		
	Measured	**Predicted**	**Difference**
Meas Loc 28 – 250m in the easterly direction towards receivers ID41, 55 and 56	50.6	60.4	9.8
Meas Loc 29 – 500m in the westerly direction towards receiver ID 100	53.3	50.9	-2.4

The measurement location in the easterly direction was located behind the dam and received more local shielding from the topography than the model accounts for. This will however not affect noise emissions at greater distances. This measurement location also had reduced noise levels due to a slight easterly wind (receiver to source). The additional shield and slight wind explains the lower measured noise levels compared to the predicted noise levels.

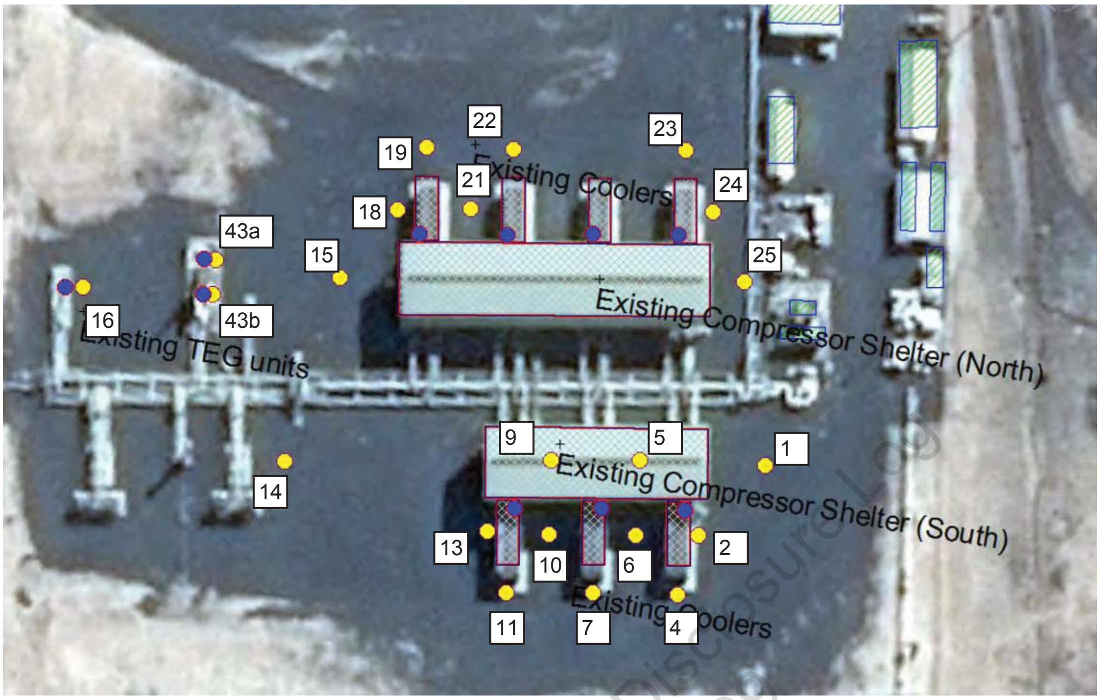
The measurement location in the westerly direction towards receiver ID100 had a slightly increased noise level due to the low easterly wind (source to receiver), explaining the measured noise levels being slightly higher than the predicted noise levels.

In addition to the attended noise measurements, a noise logger was installed at the north-western corner of the CGPF site for one week to check that the noise emissions from the CGPF during the attended measurements were representative of the CGPF typical worst case operation. Charts presenting summaries of the measured daily noise data are attached in **Appendix C1**. The charts present each 24 hour period by incorporating the L_{A10}, L_{Aeq} and L_{A90} noise levels for the corresponding 15 minute periods.

A noise level of 71 dBA was measured during the attended measurements at the noise logger locations (Location 17 in **Figure 3**). The daily noise graphs in **Appendix C1** shows that the noise emissions during the attended measurements were representative of the CGPF typical worst case operation, with noise emissions levels up to 5 dBA lower during extended periods. It is possible that some of the lower noise levels are due to weather conditions (ie wind speed and direction) rather than only due to lower noise source levels.

Figure 3 CGPF Noise Survey – Measurement Locations

Figure 4 CGPF Noise Survey – Measurement Locations - Zoomed



4.2 Daandine WTF Noise Survey

Noise measurements at 25 m from the generators adjacent to the existing Daandine WTF were undertaken on 24 July 2014. From observations of the exhausts of the generators, it was assumed that all generators were operational.

The measurement locations are shown in **Figure 5**. The existing noise model from the preliminary noise assessment in 2013 was calibrated based on the July 2014 measured noise levels. The measured and predicted (after model calibration) noise levels are presented in **Table 5**.

The calibration of the noise model resulted in approximately 6 dBA reduction of the overall noise emissions from the Daandine WTF. The difference was probably due to previous noise data (sourced from David More and Associates Acoustic Report No R12027/D2645/Rev.4/18.02.14) that had contribution from more than one noise source when estimating the sound power levels (SWLs) from individual plant items. Conservatively the noise model was calibrated to predict 1 dBA higher noise level than measured in case that all generators were not operational during the measurements.

Table 5 Daandine WTF Noise Model Calibration against Measurements (July 2014)

Measurement Locations	Sound Pressure Level (L_{Aeq} dBA)		
	Measured	Predicted	Difference
Meas Loc 44 – 25m from generators	69	70	1
Meas Loc 45 – 25m from generators	69.3	70	0.7

Figure 5 Noise Measurements adjacent to Existing Daandine WTF (July 2014)

4.3 Kogan North Compressor Station Noise Survey

Noise measurements adjacent to the existing Kogan North Compressor Station were undertaken on 24 July 2014. From observations of the cooling fans, all three compressors were operational during the measurements.

The measurement locations are shown in **Figure 6**. The measured noise levels are presented in **Table 6**.

Table 6 Kogan North Compressor Station Noise Measurements (July 2014)

Measurement Locations	Sound Pressure Level (L_{Aeq} dBA)
Meas Loc 30 – 150m from nearest compressor	60
Meas Loc 31 – 125m from nearest compressor	61
Meas Loc 32 – 140m from nearest compressor	58
Meas Loc 33 – 100m from nearest compressor	64

Figure 6 Noise Measurements adjacent to Kogan North Compressor Station (July 2014)

In addition to the attended noise measurements, a noise logger was installed at location 30 for one week to check that the noise emissions from the Kogan North Compressor Station during the attended measurements were representative of typical worst case operation. Charts presenting summaries of the measured daily noise data are attached in **Appendix C2**. The charts present each 24 hour period by incorporating the L_{A10}, L_{Aeq} and L_{A90} noise levels for the corresponding 15 minute periods.

A noise level of 60 dBA L_{Aeq} was measured during the attended measurements at the noise logger locations (Location 30 in **Figure 6**). The daily noise graphs in **Appendix C2** shows that the noise level varies significant during the monitoring period with measured noise levels between 52 dBA L_{Aeq} and 65 dBA L_{Aeq}. There was however only shorter periods with noise levels above 60 dBA L_{Aeq} and these periods are not believed to be representable of normal operations. The noise emissions captured during the attended measurements are therefore taken to be representable of normal operations with all compressors in operation.

4.4 Daandine Power Station Noise Survey

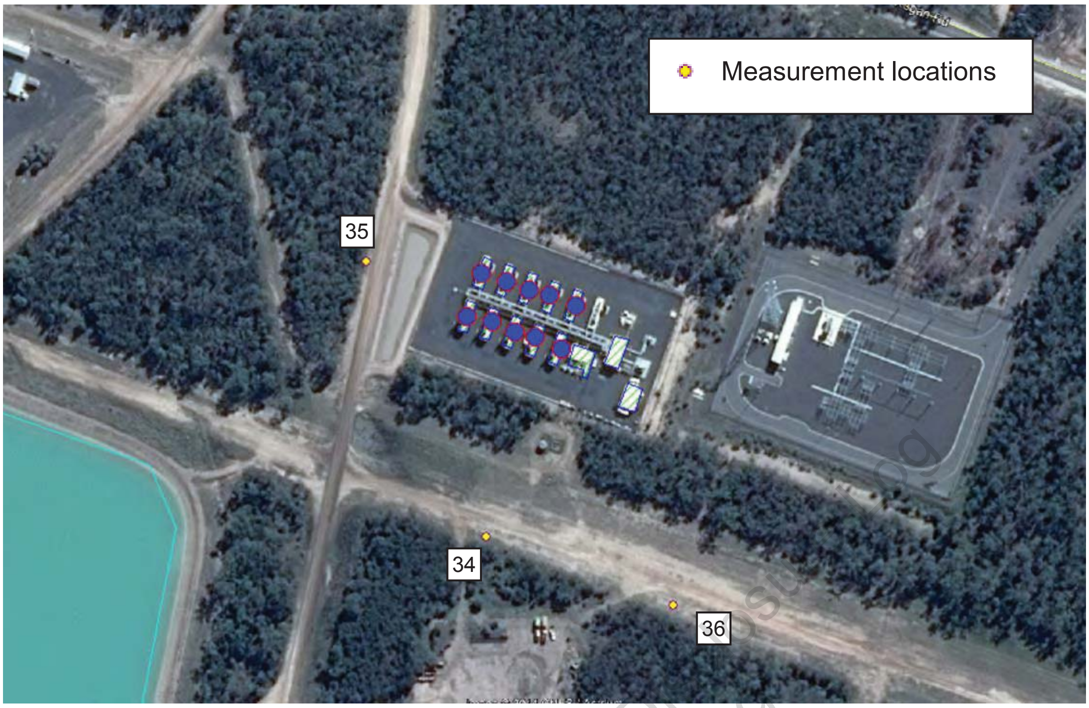
Noise measurements adjacent to the existing Daandine Power Station were undertaken on 24 July 2014.

The measurement locations are shown in **Figure 7**. The measured noise levels are presented in **Table 7**.

Table 7 Daandine Power Station Noise Measurements (July 2014)

Measurement Locations	Sound Pressure Level (L_{Aeq} dBA)
Meas Loc 34 – 110m from nearest generator	63
Meas Loc 35 – 60m from nearest generator	63
Meas Loc 36 – 175m from nearest generator	61

Figure 7 Noise Measurements adjacent to Daandine Power Station (July 2014)



In addition to the attended noise measurements, a noise logger was installed at location 36 for one week to check that the noise emissions from the Daandine Power Station during the attended measurements were representative of typical worst case operation. Charts presenting summaries of the measured daily noise data are attached in **Appendix C3**. The charts present each 24 hour period by incorporating the L_{A10}, L_{Aeq} and L_{A90} noise levels for the corresponding 15 minute periods.

A noise level of 61 dBA L_{Aeq} was measured during the attended measurements at the noise logger locations (Location 36 in **Figure 7**). The daily noise graphs in **Appendix C3** shows that the noise level was quite stable around 60 dBA L_{Aeq}, with only shorter periods deviating except on Saturday 2 August and Sunday 3 August which had lower noise emissions. This could be due to that the wind direction was South-easterly (receiver to source), which would explain slightly lower noise levels. The noise emissions during the attended measurements are taken to be representable of typical worst case operation.

5 NOISE MODELLING PROCEDURES

5.1 SoundPLAN

In order to calculate the noise emission levels at the various noise sensitive receptor locations, a SoundPLAN (Version 7.1) environmental computer model was developed. SoundPLAN is a software package which enables compilation of a sophisticated computer model comprising a digitised ground map (containing ground contours and buildings), the location and acoustic sound power levels of potentially critical noise sources on site and the location of receptors for assessment purposes.

The computer model can generate noise emission levels taking into account such factors as the source sound power levels and locations, distance attenuation, ground absorption, air absorption and shielding attenuation, as well as meteorological conditions, including wind effects.

5.2 CONCAWE

The CONCAWE prediction methodology was utilised within SoundPLAN. The CONCAWE prediction method is specially designed for large facilities and incorporates the influence of wind effects and the stability of the atmosphere.

The statistical accuracy of environmental noise predictions using CONCAWE was investigated by Marsh (Applied Acoustics 15 - 1982). Marsh concluded that CONCAWE was accurate to ±2 dBA in any one octave band between 63 Hz and 4 kHz and ± 1 dBA overall.

5.3 Meteorological Conditions

In accordance with the Ecoaccess Guideline *Planning for Noise Control* (PNC), consideration must be given to the effects of prevailing and worst case meteorological conditions (wind, temperature, humidity and temperature inversions) on noise propagation from the project.

Site representative meteorological data was predicted using a combination of TAPM and CALMET meteorological models. CALMET is a meteorological model that simulates hourly wind and other meteorological fields on a three dimensional gridded modelling domain. CALMET modelling was conducted using the nested CALMET approach, where the final results from a coarse grid run were used as the initial guess field for the fine grid run. This has the advantage that off-domain terrain features including slope flows, blocking effect can be allowed to take effect and the larger-scale wind flow provides a better start in the fine grid run.

Available hourly meteorological data from nearby Bureau of Meteorology (BOM) stations at Miles Constance Street (42112) and Dalby Airport (41522) were incorporated in the CALMET model for refining the model prediction. Details of the TAPM and CALMET meteorological model set up are outlined in the SLR air quality impact assessment report (620.10773R1 *Daandine Expansion Project Air Quality Impact Assessment*).

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Turner assignment scheme identifies six Stability Classes, A to F, to categorise the degree of atmospheric stability (see **Table 8**). These classes indicate the characteristics of the prevailing meteorological conditions.

The frequency of each stability class predicted by CALMET is presented in **Figure 8** and the distribution throughout the day in **Figure 9**. The results indicate a high frequency of conditions typical to Stability Class F. Stability Class F is indicative of very stable night time conditions, conducive to a low level of pollutant dispersion due to mechanical mixing.

Table 8 Description of Atmospheric Stability Classes

Atmospheric Stability Class	Category Description
A	Very unstable Low wind, clear skies, hot daytime conditions
B	Unstable Clear skies, daytime conditions
C	Moderately unstable Moderate wind, slightly overcast daytime conditions
D	Neutral High winds or cloudy days and nights
E	Stable Moderate wind, slightly overcast night-time conditions
F	Very stable Low winds, clear skies, cold night-time conditions

Figure 8 Stability Class Distribution Predicted by CALMET for the Project Site (2011)

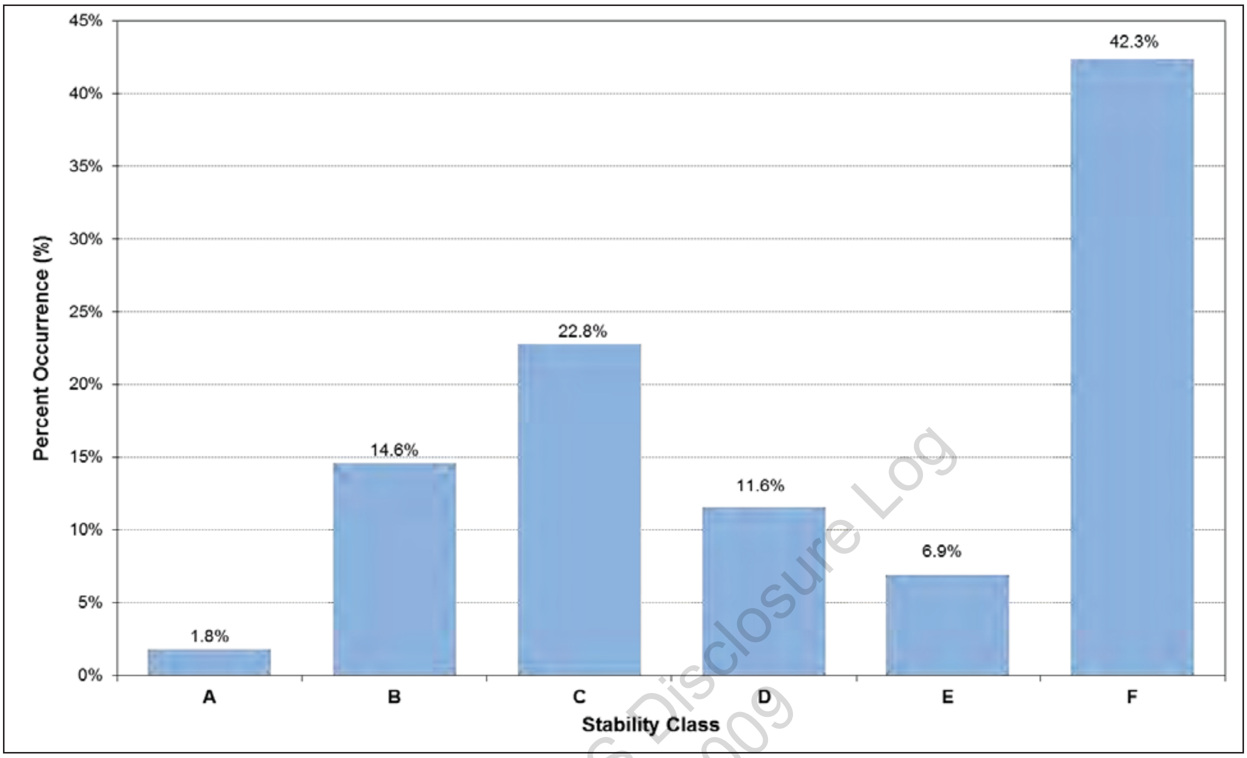
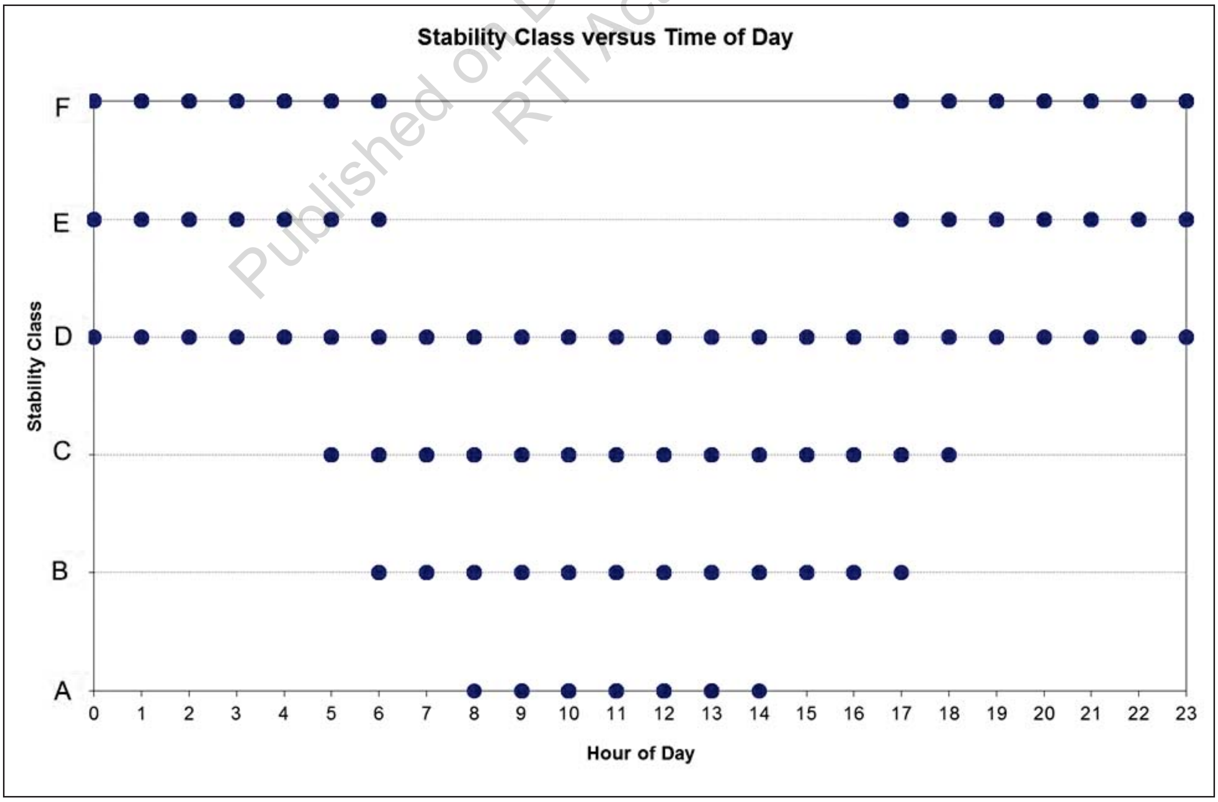


Figure 9 Stability Class Distribution throughout the Day



Based on the analysis of the predicted meteorological data, the weather conditions used to assess the effect of neutral and adverse meteorological conditions are shown in **Table 9**. In accordance with PNC only adverse weather conditions with occurrences of more than 30 percent during the relevant time period is included in the assessment.

The daytime construction noise will only be predicted for the neutral weather conditions. The operational noise will be predicted for both neutral and adverse weather conditions at all sensitive receptors in the project as these sources will operate 24 hours a day, 7 days a week.

Table 9 Meteorological Conditions – Neutral and Adverse

Parameter	Neutral Weather	Adverse Weather
Temperature	17°C	9°C
Humidity	80%	75%
Pasquill Stability Category	D	F
Wind Speed	0 m/s	2 m/s (Source > Receiver)

5.4 Noise Modelling Scenarios

5.4.1 Operation

The operational scenarios modelled for this assessment comprised the following eight (8) individual scenarios.

Scenario 1 – "Existing (normal) Operation"

- CGPF including:
  - 7 x Engines, Compressors and Coolers
  - 1 x TEG Unit
- WTF Operation including:
  - 15 x Generators
  - 4 x RO Containers including pumps and a/c
  - 4 x MF Containers including a/c
  - 2 x Service Containers including a/c

Scenario 2 – "Existing (normal) Operation including Existing Wells"

- CGPF and WTF Operation as per "Scenario 1".
- All 87 existing production wells.

Scenario 3a – "Future (normal) Operation"

- CGPF and WTF Operation as per "Scenario 1".
- CGPF Operational also including the following additional future operational plant:
  - 3 x Engines, Compressors and Coolers
  - 1 x TEG Unit

Scenario 3b – "Future (electrified WTF) Operation"

- CGPF Operational as per "Scenario 3a".
- Electrified Daandine WTF as per "Scenario 1" excluding the 15 power generators

Scenario 4a – "Future (normal) Operation including Existing and Future Wells"

- CGPF and WTF Operation as per "Scenario 3a".
- All 87 existing production wells, and 3x multi-well, 25x single-well future production wells (Phase 0), 1x multi-well at the Surat Tek Park.

Scenario 4b – "Future (electrified WTF) Operation including Existing and Future Wells"

- CGPF and WTF Operation as per "Scenario 3b".
- All 87 existing production wells, and 3x multi-well, 25x single-well future production wells (Phase 0), 1x multi-well at the Surat Tek Park.

Scenario 5 – "Future Cumulative (normal) Operation including Existing and Future Wells"

- CGPF, WTF and wells Operation as per "Scenario 4a".
- Daandine Power Station
- Kogan North Compressor Station

Scenario 6 – "Future (upset) Operation"

- Cold Vent and Flare Operations (CGPF)
- 3x Capacity Control Recycle Valves (CGPF)

Appendix D lists the sound power levels (SWLs) for items of operational plant contained in the operational scenarios. SWLs were obtained from measurements undertaken at the existing CGPF, Daandine WTF and well sites undertaken by David More and Associates[1] in 2011 and 2013. These measurements were complemented by SLR site survey undertaken in July 2014 (Refer to **Section 4**). For future plant and equipment associated with the CGPF and planned well sites, vendor data was provided by the CAJV.

5.4.2 Construction

The construction scenarios outlined in **Table 10** to **Table 12** have been assessed for the Daandine Expansion Project.

Table 10 Construction Stages – Installation of New CGPF Components

Construction Stage	Description	Typical Plant Types/No's	Notes
1.1 Construction of foundations	Constructing concrete foundations.	1 Concrete truck 1 Concrete pump 1 concrete vibrator	Worst case assumes all items operating simultaneously.
1.2 Civil works	Installing new components and extending the compressor sheds	1 250T crane for lifting in equipment 6 Welding rigs - diesel 6 Angle grinders 1 Pile rig 3 Franna 20t crane 2 scissor lifts/boom lifts 2 semi-trailers for delivery of equipment Hand tools	Worst case assumes all items operating simultaneously.

[1] David More and Associates Report reference R12027/D2645/Rev.4/18.02.14, dated 18 February 2014.

Table 11 Construction Stages – Completion Rigs

Construction Stage	Description	Typical Plant Types/No's	Notes
2.1 Completion/work-over	Rig setup and completion/work-over of well	1 Completion Drill rig Auxiliary plant typically including: - Genset - Hydraulic Power Unit - Booster Compressors - Blooie line	Assumes worst case completion/workover operation, including blooie line.

Table 12 Construction Stages – Gathering Flowlines and Access Road Tracks

Construction Stage	Description	Typical Plant Types/No's	Notes
3.1 Clear and grade	Clearing and levelling right of way	1 D8 dozer 1 14g grader 1 30t excavators 1 mulcher 1 Water truck	Worst case assumes all items operating simultaneously within a 200 m section. There will be 2 crews working in 2 different locations more than 1 km apart.
3.2 Trenching	Excavating the trench	1 30t excavators 1 Ute	Worst case assumes all items operating simultaneously. There will be 2 crews working in 2 different locations more than 1 km apart.
3.3 Padding and Backfilling	Padding the trench and lowering pipe and backfilling.	1 Padder 1 30t excavators 3 Side booms 1 Water truck	Worst case assumes all items operating simultaneously within a 200 m section. There will be 2 crews working in 2 different locations more than 1 km apart.
3.4 Access road construction	Clearing and levelling road surfaces, compaction and gravelling.	1 D8 dozer 1 14g grader 1 30t excavators 1 mulcher 1 Water truck 1 Vibratory roller 2 B-double side tippers	Worst case assumes all items operating simultaneously within a 200 m section.

Mobile plant SWL data used for computer noise modelling has been sourced from SLR's extensive noise source database, and are detailed in **Table 13**.

Table 13 SWLs of Construction Mobile Plant

Typical Model	SWL (L_{Aeq} dBA)
14G Grader	106
Angle grinder	110
B-double	106
Boom lift	105
Bored Piling Rig	110
Concrete pump and vibrator	110
Concrete truck	109
Crane 250 tonne	108
D8 Bulldozer	108

Typical Model	SWL (L_{Aeq} dBA)
Diesel Welding Machine	101
Excavator (30 tonne)	106
Franna Crane	102
Hand Tools	90
Padder	110
Scissor lift	99
Semi-Trailer	108
Sideboom tractor	104
Trencher	110
Ute	95
Vibrator roller	102
Water truck	104

Typical SWL data used for computer noise modelling of completion/work-over operations has been taken from SLR's extensive noise source database, which includes measured noise levels from several Coal Seam Gas (CSG) Drill Rigs, and are detailed in **Table 14**.

Table 14 SWLs of Completion/Work-over Operation

Construction Stage	Description	SWL (L_{Aeq} dBA)[1]
2.1a	Completion/work-over – air only running through the blooie line[2]	140
2.1b	Completion/work-over – mist running through the blooie line[2]	127
2.1c	Completion/work-over – mist running through the blooie line[2] plus special designed muffler	118

Note 1: Overall SWL includes noise from drill rig and all auxiliary systems operating during completion/work-over operations.

Note 2: The blooie line is a surface pipe that 1) is used on an air drilling rig to discharge air, water and well cuttings 2) is used to discharge fluids coming up the well from the drilling rig during a kick. A diverter is used to send the fluids down the blooie line to the blooie pit.

5.5 Noise Modelling Assumptions

Noise sources SWLs and their locations are listed in **Appendix D** and **Appendix E** respectively. SWLs listed in **Appendix D** contain octave band spectra and overall SWL in dBA L_{Aeq}.

The existing CGPF compressors and engines are located within 2 buildings with roof and partially closed sides. Those buildings are constructed out of a single layer metal sheeting and have been modelled to reflect this. In SoundPLAN, the CGPF compressors and engines were modelled as indoor point sources located inside industrial buildings (Refer to **Appendix E3** and **Appendix E4**).

The location of all existing and future planned single-well and multi-well sites within the Daandine Expansion Project was provided by The CAJV on Arrow's Figure *05-G1-Map-0012* and the excel spreadsheet *DDEXP wells* received on 24 June 2014 and incorporated in the 3D SoundPLAN noise model.

Arrow's Figure *05-G1-Map-0012* together with the wells currently operating as well as the future planned wells are shown in **Appendix E1** and **Appendix E2**.

For construction modelling, typical construction stages have been determined which are representative of worst case construction activities and associated mobile plant operating simultaneously at any one time.

6 NOISE MODELLING RESULTS - OPERATION

6.1 Predicted Noise Level at Receptors

Noise predictions for all eight (8) modelling scenarios (detailed in **Section 5.4.1**) at the identified sensitive receptors were undertaken for neutral and adverse weather conditions (refer to **Table 9**) and are presented in **Appendix F**, in **Table F1** and **Table F2** respectively.

Noise modelling results presented in **Table F1** and **Table F2** represents the operation of unmitigated plant configurations for all scenarios.

Results presented in **Table F1** and **Table F2** which are predicted to exceed the night-time noise criterion of 28 dBA L_{Aeq} (external) are represented in bold values. Arrow owned receptors and unoccupied dwellings in **Table F1** and **Table F2** are listed in grey shaded cells and not considered critical receptors. For more information on Arrow owned receptors, refer to **Section 3.2**.

A summary of the privately-owned dwellings – currently occupied and Arrow-owned dwellings – currently occupied predicted to exceed the night-time noise limit of 28 dBA L_{Aeq} (external) for each modelling scenario is presented in **Table 15** and **Table 16** respectively. The total number of potentially affected dwellings – currently occupied is the summation of the private and Arrow owned dwellings – currently occupied from both **Table 15** and **Table 16**.

Table 15 Predicted Total Number of Night-time Exceedances – Privately-owned Dwellings

Weather Conditions	Scenario 1 Existing (normal) Operation	Scenario 2 Existing (normal) Operation including Existing Wells	Scenario 3a Future (normal) Operation	Scenario 3b Future (electrified WTF) Operation	Scenario 4a Future (normal) Operation including Existing and Future Wells	Scenario 4b Future (electrified WTF) Operation including Existing and Future Wells	Scenario 5 Future Cumulative (normal) Operation including Existing and Future Wells	Scenario 6 Future (upset) Operation
Neutral Weather	1	2	1	1	4	4	4	1
Adverse Weather	4	5	4	4	7	7	7	4

Table 16 Predicted Total Number of Night-time Exceedances – Arrow Dwellings

Weather Conditions	Scenario 1 Existing (normal) Operation	Scenario 2 Existing (normal) Operation including Existing Wells	Scenario 3a Future (normal) Operation	Scenario 3b Future (electrified WTF) Operation	Scenario 4a Future (normal) Operation including Existing and Future Wells	Scenario 4b Future (electrified WTF) Operation including Existing and Future Wells	Scenario 5 Future Cumulative (normal) Operation including Existing and Future Wells	Scenario 6 Future (upset) Operation
Neutral Weather	0	0	0	0	0	0	0	0
Adverse Weather	0	0	0	0	1	1	1	0

Table 17 and **Table 18** below present a summary of the predicted noise levels exceeding the 28 dBA criteria under neutral and adverse weather conditions respectively for the Privately-Owned Dwellings – currently occupied only.

Table 17 Summary of Predicted Noise Levels and Exceedances – Neutral Weather Conditions – Privately-Owned Dwellings – Currently Occupied

Receptor ID	Predicted Noise Levels (L_{Aeq} dBA)								Exceedances (dB)							
	Sc 1	Sc 2	Sc 3a	Sc 3b	Sc 4a	Sc 4b	Sc 5	Sc 6	Sc 1	Sc 2	Sc 3a	Sc 3b	Sc 4a	Sc 4b	Sc 5	Sc 6
3	18	**40**	19	19	**40**	**40**	**40**	20	0	**12**	0	0	**12**	**12**	**12**	0
40	20	21	21	20	22	22	23	22	0	0	0	0	0	0	0	0
41	25	26	25	24	27	26	27	25	0	0	0	0	0	0	0	0
55	27	28	28	27	**33**	**32**	**33**	28	0	0	0	0	**5**	**4**	**5**	0
56	27	28	28	27	**33**	**33**	**33**	28	0	0	0	0	**5**	**5**	**5**	0
80	*<15*	*<15*	*<15*	*<15*	23	23	23	*<15*	0	0	0	0	0	0	0	0
100	**33**	**34**	**36**	**36**	**37**	**37**	**37**	**35**	**5**	**6**	**8**	**8**	**9**	**9**	**9**	**7**

Note: Predicted Levels and predicted exceedances have been rounded to the nearest decimal place

Table 18 Summary of Predicted Noise Levels and Exceedances – Adverse Weather Conditions – Privately-Owned Dwellings – Currently Occupied

Receptor ID	Predicted Noise Levels (L_{Aeq} dBA)								Exceedances (dB)							
	Sc 1	Sc 2	Sc 3a	Sc 3b	Sc 4a	Sc 4b	Sc 5	Sc 6	Sc 1	Sc 2	Sc 3a	Sc 3b	Sc 4a	Sc 4b	Sc 5	Sc 6
3	25	**41**	26	26	**41**	**41**	**41**	26	0	**13**	0	0	**13**	**13**	**13**	0
40	27	28	28	27	**29**	**29**	**30**	28	0	0	0	0	**1**	**1**	**2**	0
41	**32**	**33**	**32**	**31**	**34**	**33**	**34**	**31**	**4**	**5**	**4**	**3**	**6**	**5**	**6**	**3**
55	**34**	**35**	**34**	**34**	**38**	**37**	**38**	**34**	**6**	**7**	**6**	**6**	**10**	**9**	**10**	**6**
56	**33**	**35**	**34**	**34**	**38**	**38**	**38**	**34**	**5**	**7**	**6**	**6**	**10**	**10**	**10**	**6**
80	*<15*	*<15*	*<15*	*<15*	**29**	**29**	**29**	*<15*	0	0	0	0	**1**	**1**	**1**	0
100	**39**	**40**	**42**	**42**	**43**	**43**	**43**	**40**	**11**	**12**	**14**	**14**	**15**	**15**	**15**	**12**

The following sections give a more detailed assessment of the predicted noise levels for each modelling scenario.

6.1.1 Scenario 1

Noise levels from the existing operation of the CGPF and Daandine WTF (no well sites) are predicted to exceed the night-time noise limit by up to 5 dBA at one location under neutral weather conditions and by up to 11 dBA at 4 locations under adverse weather conditions.

Only receptor ID 100 is predicted to exceed the criterion under neutral weather conditions.

6.1.2 Scenario 2

Noise levels from the existing operation of the CGPF and Daandine WTF, including existing well sites, are predicted to exceed the night-time noise limit by up to 12 dBA at 2 locations under neutral weather conditions and by up to 13 dBA at 5 locations under adverse weather conditions.

Receptor ID 3 is the only receptor with predicted noise levels exceeding the criterion due to noise emissions from existing wells.

6.1.3 Scenario 3

Noise levels from the future operation of the CGPF including the Daandine WTF (no well sites) are predicted to exceed the night-time noise limit by up to 8 dBA at one location under neutral weather conditions and by up to 14 dBA at 4 locations under adverse weather conditions.

It is still only receptor ID 100 that is predicted to exceed the criterion under neutral weather conditions. Furthermore, it can be seen that only a marginal noise reduction can be seen at receptor ID 41 due to the electrification and removal of the generators at the Daandine WTF. The electrification of the Daandine WTF will however have more acoustic benefit if the CGPF noise emissions are reduced.

6.1.4 Scenario 4

Noise levels from the future operation of the CGPF and Daandine WTF, including existing and future well sites, are predicted to exceed the night-time noise limit by up to 12 dBA at 4 locations under neutral weather conditions and by up to 15 dBA at 7 locations under adverse weather conditions.

There are significant contributions from future planned wells to the predicted exceedances of the night-time criterion at receptor ID 55 and 56. Receptors ID 40 and ID 80 have only a marginal 1 dBA predicted exceedance under adverse weather conditions.

6.1.5 Scenario 5

Refer to the cumulative assessment in **Section 6.4**.

6.1.6 Scenario 6

Noise levels from the future low pressure flaring operation at the CGPF is predicted to exceed the night-time noise criterion by up to 7 dBA at one location under neutral weather conditions and by up to 12 dBA at 4 locations under adverse weather conditions.

There are no exceedances predicted for daytime flaring events under neutral weather conditions and only receptor ID 100 has predicted exceedances for night-time flaring events under neutral weather conditions.

It should be noted that flaring is an infrequent event that will generally only occur twice a year.

6.2 Low Frequency Noise

For the purposes of this assessment, the low frequency noise limits reviewed in **Section 2** have been analysed to assess compliance.

All identified receptors are predicted to comply with the 55 dBZ (external) low frequency noise criterion for all modelling scenarios under adverse weather conditions.

Therefore, given the low frequency noise criterion was not exceeded for any of the receptors, it has been determined that based on the noise surveys of existing plant and SWL information provided by the CAJV for the future plant, low frequency noise is unlikely to be a concern for the Daandine Expansion Project.

This assessment incorporates all sound power spectral information available at the time of modelling for all plant items including measurement data of existing plant.

6.3 Tonal Noise

The noise survey undertaken by SLR in July 2014 for the existing Daandine CGPF and Daandine WTF did not identify any tonality as a characteristic of the noise emissions. The noise measurements undertaken by David More and Associates[2] for the existing well sites did not identify any tonality as a characteristic of the noise emissions. Therefore no penalty has been applied to the predicted noise levels to account for tonality.

If the CGPF is found to emit tonal noise, through noise monitoring post-commissioning, it may result in a tonal noise at nearby critical receptors (depending upon factors such as frequency of tonal noise, source-receptor distance, topography etc). If noise emission levels at the receptor are found to be tonal, additional attenuation measures (to those specified in **Section 8**) may be required to adhere to the above mentioned criteria.

If a noise source is determined to be “tonal”; a +2dBA penalty is applied to the noise impact level for “just detectable” tones, and a +5dBA penalty is applied to the noise impact level for “prominent” tones.

6.4 Cumulative Assessment

This section presents a cumulative assessment including noise emissions from the Kogan North Compressor Station and Daandine Power Station as well as a breakdown of noise contributions from the different components (ie CGPF, Daandine WTF, existing and future wells) of the Daandine Expansion Project. The cumulative assessment is undertaken only for those seven (7) receptors in **Table 17** and **Table 18** which have predicted noise levels showing the potential for noise impacts.

The noise source contributions are presented in **Table 19** and **Table 20** for Scenario 5 “Future All Sources”.

[2] David More and Associates Report reference R12027/D2645/Rev.4/18.02.14, dated 18 February 2014.

Table 19 Noise Source Rankings at all Sensitive Receptors - Neutral Weather Conditions – Privately-Owned Dwellings

Receptor ID	Scenario 5 – Future (L_{Aeq} dBA)						
	CGPF Future	Daandine WTF (existing not electrified)	Existing Wells	Future Wells	Power Station	Kogan Compressor Station	Overall
3	19	10	**40**	16	7	4	**40**
40	20	14	13	12	10	7	23
41	24	20	18	20	13	9	27
55	27	21	21	**30**	14	10	**33**
56	27	21	21	**31**	14	10	**33**
80	1	-11	-18	23	-6	-9	23
100	**36**	11	28	-5	23	21	**37**

Note: Noise Source Contribution Bolded indicate a predicted exceedance of the criteria

Table 20 Noise Source Rankings at all Sensitive Receptors - Adverse Weather Conditions – Privately-Owned Dwellings

Receptor ID	Scenario 5 – Future (L_{Aeq} dBA)						
	CGPF Future	Daandine WTF (existing not electrified)	Existing Wells	Future Wells	Power Station	Kogan Compressor Station	Overall
3	26	17	**41**	24	13	9	**41**
40	27	21	21	19	16	12	**30**
41	**31**	27	26	26	19	15	**34**
55	**34**	27	**29**	**34**	20	16	**38**
56	**34**	27	**29**	**34**	20	16	**38**
80	6	-6	-10	**29**	-1	-3	**29**
100	**42**	18	**34**	4	**29**	27	**43**

Note: Noise Source Contribution Bolded indicate a predicted exceedance of the criteria

Table 19 and **Table 20** indicate that neither the Kogan North Compressor Station nor the Daandine Power Station contributes significantly to the overall noise level at any of the sensitive receptors.

Assessment of the dominant noise sources for each receptor that has predictions indicating potential noise impacts are included below.

Receptor ID 3

Both **Table 19** and **Table 20** show that the predicted noise level at receptor ID 3 are due to noise emissions from existing wells (ie DA-81). Well DA-81 is located approximately 80 m away from receptor ID 3.

Receptor ID 40

Table 19 and **Table 20** show that only a marginal two (2) dBA exceedance under adverse weather conditions is predicted for receptor ID 40. The future CGPF is the dominant noise source contributing with 6 dBA higher noise level than any other source.

Receptor ID 41

Table 19 and **Table 20** show that exceedances of up to a 6 dBA are predicted only during adverse weather conditions at receptor ID 41. The noise contribution is mainly from the future CGPF, however with significant noise contribution from the Daandine WTF and both existing and future well sites as well.

Receptor ID 55

Table 19 shows that there is 5 dBA predicted exceedance at receptor ID 55 from the combination of the future Phase 0 well (ie DA-69) and the Future CGPF under neutral weather conditions. Well site DA-69 is approximately 280 m from receptor ID 55 and has the louder generator type with SWL of 95 dBA.

Table 20 show that the predicted noise level at receptor ID 55 under adverse weather conditions have approximately equal contributions from the future CGPF and the future wells (ie DA-69). Exceedances of up to 10 dBA are predicted mainly due to noise emission from the future CGPF and the future DA-69 well site.

Receptor ID 56

Receptor ID 56 is located approximately 50 m from ID 55 and has similar distances to well site DA-69, the CGPF and Daandine WTF. Exceedances at receptor ID 56 have been predicted to be similar to the exceedances predicted for receptor 55 under neutral and adverse weather conditions mainly due to noise emission from the future CGPF and the future DA-69 well site.

Receptor ID 80

Table 19 and **Table 20** show that there is a marginal 1 dBA predicted exceedance at receptor ID 80 from the Phase 0 well (ie Stratheden-15) under adverse weather conditions.

Receptor ID 80 is located approximately 465 m from the future Phase 0 well site Stratheden-15. Well site Stratheden-15 has the louder generator type with SWL of 95 dBA.

Receptor ID 100

Table 19 and **Table 20** show that predicted noise levels of up to 9 dBA and 15 dBA under neutral and adverse weather conditions respectively at receptor ID 100 are dominated by noise contribution from the future CGPF.

There is also significant contribution from a number of existing well sites (DA27, DA27T, DA28, DA28T and DA46). The contribution from the Daandine Power Station is more than 10 dBA below that from the CGPF, however there is still a marginal 1 dBA predicted exceedance due to noise from the Daandine Power Station under adverse weather conditions.

In order to reduce the potential noise impact from the Daandine Expansion Project, noise mitigation to be considered are discussed in **Section 8**.

6.5 Noise Contour Maps

Noise contour maps are presented in **Appendix G** for all the modelling scenarios described in **Section 5.4.1**.

7 NOISE MODELLING RESULTS – CONSTRUCTION

7.1 Predicted Noise Levels – Installation of New CGPF Components

Noise levels from the two (2) construction modelling scenarios for the installation of new components at the CGPF (detailed in **Section 5.4.2**) are predicted to comply with the daytime 40 dBA L_{Aeq} (external) criterion at all receptor locations. Furthermore, the construction noise is predicted to be significantly lower compared to the existing CGPF and Daandine WTF operational noise emission levels.

7.2 Predicted Noise Levels – Completion/Work-over Rigs

The predicted noise emission levels in **Table 21** and **Table 22** assume propagation over flat, soft ground (ie open grassland) to a typical receptor. For construction stages that are limited to daytime activities only, predicted noise levels have only been modelled to incorporate neutral meteorological conditions. For construction stages that occur 24 hours a day (ie completion/work-overs), predicted noise levels have been modelled to incorporate both neutral and adverse weather conditions.

Table 21 Predicted Noise Levels at Various Offset Distances – Completion/Work-over Rigs

Stage	Activity	Weather Condition	Predicted Noise Level at Buffer Distance (L_{Aeq} dBA)						
			50m	100m	250m	500m	1,000m	2,000m	5,000m
2.1a	Completion (air only in blooie line[1])	Neutral	96	90	78	67	56	43	22
		Adverse	97	91	82	72	61	49	31
2.1b	Completion (mist in blooie line[1])	Neutral	81	75	64	55	45	35	17
		Adverse	83	76	68	60	51	41	25
2.1c	Completion (mist plus muffler on blooie line[1])	Neutral	73	66	55	46	37	27	< 15
		Adverse	74	67	59	51	43	34	18

Note 1: The blooie line is a surface pipe that 1) is used on an air drilling rig to discharge air, water and well cuttings 2) is used to discharge fluids coming up the well from the drilling rig during a kick. A diverter is used to send the fluids down the blooie line to the blooie pit.

Table 22 Buffer Distances for Various Predicted Noise Levels – Completion/Work-over Rigs

Stage	Activity	Weather Condition	Buffer Distance to Predicted Noise Level (m)								
			85 dBA	55 dBA	50 dBA	45 dBA	40 dBA	35 dBA	30 dBA	28 dBA	25 dBA
2.1a	Completion (air only in blooie line)	Neutral	130	1,000	1,420	2,000	2,830	3,990	5,640	6,470	7,960
		Adverse	150	1,480	2,170	3,170	4,630	6,770	9,900	11,530	14,480
2.1b	Completion (mist in blooie line)	Neutral	40	440	650	970	1,440	2,140	3,170	3,720	4,710
		Adverse	50	690	1,070	1,650	2,570	3,990	6,190	7,390	9,620
2.1c	Completion (mist plus muffler on blooie line)	Neutral	20	230	350	520	770	1,150	1,720	2,020	2,570
		Adverse	20	320	510	810	1,290	2,040	3,230	3,880	5,110

Note: The distances are calculated based on the predicted noise levels in **Table 21**.

The offset distance to achieve the night-time noise criterion of 28 dBA L_{Aeq} for the completion/work-over rigs is predicted to between **2,020 m** and **6,470 m** (depending on the operation of the blooie line) under neutral weather conditions and between **3,880 m** and **11,530 m** (depending on the operation of the blooie line) under adverse weather conditions. It should be noted that the noise emissions from the blooie line operation are highly directional, and the noise emissions and resulting offset distances to achieve the night-time noise criterion in **Table 21** and **Table 22** are a worst case.

7.3 Predicted Noise Levels – Gathering Flowlines and Access Road Tracks

The predicted noise emission levels in **Table 23** and **Table 24** assume propagation over flat, soft ground (ie open grassland) to a typical receptor under neutral meteorological conditions.

Table 23 Predicted Noise Levels at Various Offset Distances – Gathering Flowlines and Access Road Tracks

Stage	Activity	Weather Condition	Predicted Noise Level at Buffer Distance (L_{Aeq} dBA)						
			50m	100m	250m	500m	1,000m	2,000m	5,000m
3.1	Clear and grade	Neutral	68	62	51	42	33	23	< 15
3.2	Trenching	Neutral	64	57	45	35	26	16	< 15
3.3	Padding and backfilling	Neutral	70	64	53	43	34	24	< 15
3.4	Access road construction	Neutral	69	64	53	44	35	25	< 15

Table 24 Buffer Distances for Various Predicted Noise Levels – Gathering Flowlines and Access Road Tracks

Stage	Activity	Weather Condition	Buffer Distance to Predicted Noise Level (m)								
			85 dBA	55 dBA	50 dBA	45 dBA	40 dBA	35 dBA	30 dBA	28 dBA	25 dBA
3.1	Clear and grade	Neutral	20	170	260	380	570	850	1,270	1,490	1,900
3.2	Trenching	Neutral	10	110	160	240	340	500	740	860	1,080
3.3	Padding and backfilling	Neutral	20	190	280	420	630	940	1,400	1,640	2,080
3.4	Access road construction	Neutral	20	180	270	410	620	940	1,410	1,670	2,130

Note: The distances are calculated based on the predicted noise levels in **Table 23**.

The offset distance to achieve the daytime noise criterion of 40 dBA L_{Aeq} for the construction stages associated with the gathering flowlines and access roads construction is predicted to between **340 m** and **630 m**.

7.4 Topographical Effects on Noise Propagation

As previously stated, the predicted noise levels and buffer distances documented in **Sections 7.2** and **Section 7.3** assume propagation over flat, soft ground (ie open grassland) to a typical receptor.

Local topography can dramatically affect the propagation of noise, especially if the construction works is conducted through areas with steep terrain. The extent of change in noise levels due to topographical effects would be dependent on the level of shielding provided (which would be very much site specific). The actual degree of noise attenuation due to topographical shielding is a function of the frequency spectrum of the noise and the length of the diffracted noise path compared to the direct noise path.

Noise attenuation due to topographical shielding typically ranges from 5 dBA if line-of-sight between the noise source and receptor location is just obscured, and up to approximately 15 dBA where the topography provides optimal blocking of the sound transmission path. It is noted that during adverse weather conditions, noise attenuation due to topographical shielding would be less than that expected during neutral weather conditions.

8 NOISE MITIGATION

8.1 CGPF

The noise prediction results in **Section 6** identified receptor ID 100 as the receptor with the highest predicted noise levels due to the future CGPF. Therefore, the mitigation measures at the CGPF have been focused on reducing the noise levels at receptor ID 100 as far as reasonable and practicable.

The source ranking of existing and future CGPF with no mitigations in **Table 25** below shows that the contribution from the noise sources outside the Compressor Shelters (ie coolers, exhausts, TEG units and export gas pressure control valve) are more than 10 dBA below the contribution from the combined noise sources located within the Compressor Shelters. It should be noted that the exhausts have already been mitigated with hospital grade silencers. The mitigation measures have therefore been focused on applying changes to the Compressor Shelters to reduce the overall noise emissions from the site.

The following mitigation scenarios have been investigated for the CGPF (Refer to **Appendix E3** and **Appendix E4**):

1. Closing the shelters with steel cladding, leaving one end open and gaps of 300 mm at the top and 400 mm at the bottom on the other three walls to meet the requirements for natural ventilation.
2. As per Mitigation 1 plus adding acoustic lining of 50 mm thickness on the inside of the walls
3. As per Mitigation 2 plus utilising acoustic louvers on the open gaps in the walls. Insertion loss data for Hudson 300 Series Acoustic Louvres has been used, which are typical 300 mm deep louvres.

The predicted noise levels, including a breakdown per plant item, for the unmitigated existing and future scenarios as well as the three mitigation scenarios are presented in **Table 25** for the receptor ID 100. The corresponding tables for receptor ID 41, 55 and 56, which also have predicted noise levels from the CGPF above the noise criterion, are included in **Appendix H**.

Locations of the CGPF plant are shown in **Appendix E3**.

Table 25 Receptor ID 100 Predicted CGPF Noise Contributions for Mitigation Scenarios

CGPF Plant[1]	Neutral Weather Conditions					Adverse Weather Conditions				
	CGPF Existing	CGPF Future No Mitigation	CGPF Future – Mitigation 1	CGPF Future – Mitigation 2	CGPF Future – Mitigation 3	CGPF Existing	CGPF Future No Mitigation	CGPF Future – Mitigation 1	CGPF Future – Mitigation 2	CGPF Future – Mitigation 3
Existing Comp Shelter (A1)	29.3	-	-	-	-	35.6	-	-	-	-
Existing Comp Shelter (A2)	29.1	26.2	24.3	22.5	21.1	35.6	32.2	30.7	28.8	27.3
Existing Coolers (B)	21.0	18.9	18.9	18.9	18.9	27.1	25.0	25.0	25.0	25.0
Existing Comp Exhaust (J)	15.0	15.0	15.0	15.0	15.0	20.5	20.5	20.5	20.5	20.5
Existing TEG Unit (F1)	2.0	2.7	2.7	2.7	2.7	7.8	8.6	8.6	8.9	8.9
Export gas pressure control valve (H)	8.2	9.1	9.1	9.1	9.1	13.9	14.7	14.7	14.7	14.7
Future Comp Shelter (North) (C1+A1)		32.7	27.8	24.9	19.7		38.9	33.8	30.8	25.1
Future Comp Shelter (South) (C2)		31.7	27.8	25.4	20.1		37.7	33.8	31.3	25.5
Future Engine (CAT G3612) Exhaust (D)		6.1	6.1	6.1	6.1		10.9	10.9	10.9	10.9
Future TEG Unit (F2)		2.1	2.1	2.1	2.1		7.9	7.9	8.3	8.3
Future Coolers (South - 120-156) (E2)		17.1	17.1	17.1	17.1		23.2	23.2	23.2	23.2
Future Coolers (North - 120-156) (E1)		15.6	15.6	15.6	15.6		21.7	21.7	21.7	21.7
Total	**32.6**	**36.0**	**32.3**	**30.2**	**27.3**	**39.0**	**42.1**	**38.3**	**36.2**	**33.1**

Legend: [green] Achieves EA noise criterion of 28 dBA LAeq, [yellow] Lower than the existing noise levels.
Note 1: Refer to CGPF plant as shown in **Appendix E3**

Noise contour maps for each mitigation scenario are included in **Appendix I**. The noise contour maps for the above mitigation scenarios also include noise emissions from the future electrified Daandine WTF.

Table 25 and **Appendix H** show that with the implemented mitigation 1 measures at the CGPF as described above, the future Daandine Expansion Project CGPF noise emissions are predicted to be similar or less compared to the existing CGPF noise emission levels at the nearest identified receptors.

With all reasonable and practicable mitigation measures applied to the dominant noise sources at the CGPF (ie mitigation 3 measures) an exceedance of up to 5 dBA of the EA noise criterion is predicted at receiver ID 100 under adverse weather conditions. There is also a marginal exceedance of less than 1 dBA for receiver ID 55 and ID 56 under adverse weather conditions.

To achieve compliance of the EA conditions under all applicable weather conditions at all receptors, Arrow may need to negotiate an alternative arrangement with the affected residences (most likely narrowing to only one residence being receiver ID 100).

8.2 Upset Operation

It should be noted that flaring is an infrequent event that will generally only occur once a year for one (1) day. There are four (4) sensitive receptors with predicted exceedances of up to 12 dBA at receiver ID 100, up to 6 dBA at receivers ID 55 and ID 56 and up to 3 dBA at receiver ID 41 from the flare event. To mitigate the flare to comply with the night-time noise criterion at all sensitive receptors except receiver ID 100, a SWL of 117 dBA is required.

To further minimise potential impacts from flaring events at the nearest receptors, appropriate communication with affected residences will be important.

8.3 Well Sites

As detailed in **Section 6.4**, due to existing and future planned well sites, there are one (1) receptor predicted to exceed the night-time noise limit of 28 dBA L_{Aeq} by up to 13 dBA under adverse weather conditions (receptor ID 3). A further four (4) receptors are predicted to exceed the night-time noise criterion of 28 dBA L_{Aeq} by up to 6 dBA under adverse weather conditions (receptors ID 55, ID 56, ID 80, ID 100).

The following wells contribute to the predicted exceedances:

- Receptor ID 3: DA-81
- Receptor ID 55 and ID 56: DA-69
- Receptor ID 80: Stratheden-15
- Receptor ID 100: DA-27, DA-27T, DA-28, DA-28T and DA-46

To mitigate the noise levels at these receptors potential mitigation or replacement of the generators at the above well sites would need to be considered.

9 DISCUSSION AND CONCLUSIONS

SLR was engaged by the CAJV, on behalf of Arrow, to assess noise emissions from the proposed Daandine Expansion Project located within the Daandine – Stratheden PLs. The project draws gas from the PL230 (Daandine) and PL252 (Stretheden) fields, and is located west of Dalby in central western Queensland.

Environmental noise modelling has been undertaken to assess the construction and operational noise emissions associated with the Daandine Expansion Project and mitigation measures have been recommended where required.

9.1 Operational Noise Assessment

Noise predictions for the modelling scenarios indicate that up to seven (7) sensitive receptors (privately owned dwellings) are potentially exceeding the EA criteria with the Daandine Expansion Project under adverse weather conditions.

The sensitive receptors are receivers ID 3, ID 40, ID 41, ID 55, ID 56, ID 80 and ID 100 (refer **Appendix B**).

Detailed cumulative assessment of the noise source contributions at the potentially impacted receivers showed the following:

- Receiver ID 3 is potentially impacted by noise emissions from the existing well DA-81.
- Receiver ID 80 is potentially impacted by noise emissions from the future well Stratheden-15
- Receiver ID 40 is potentially impacted (only marginally) by a combination of noise emissions mainly from the CGPF. The CGPF by itself is not predicted to exceed the noise criterion.
- Receiver ID 41 is potentially impacted by noise emissions from the CGPF, however with significant noise contribution from the Daandine WTF and both existing and future well sites as well.
- Receiver ID 55 and Receiver ID 56 are potentially impacted by a combination of noise emissions from the future CGPF, existing and future wells and the Daandine WTF.
- Receiver ID 100 is potentially impacted by a combination of noise emissions mainly from the future CGPF, however also by noise emissions from the existing wells (at least 5 of them) and the Power station.

Three (3) levels of mitigation to the compressor shelters at the CGPF were assessed.

- Mitigation 1: Closing the shelters with steel cladding only, leaving one end open and gaps of 300 mm at the top and 400 mm at the bottom on the other three walls to meet the requirements for natural ventilation.
- Mitigation 2: As per Mitigation 1 plus adding acoustic lining of 50 mm thickness on the inside of the walls.
- Mitigation 3: As per Mitigation 2 plus utilising acoustic louvers on the open gaps in the walls. Insertion loss data for Hudson 300 Series Acoustic Louvres has been used, which are typical 300 mm deep louvres.

The results showed that future predicted noise levels with Mitigation 1 was below the existing Daandine CGPF noise levels for normal and adverse weather conditions.

Future predicted noise levels with Mitigation 3 comply with the EA noise criteria for neutral weather conditions. A marginal exceedance (less than 1 dBA) was predicted for receivers ID55 and ID 56 and a 5 dBA exceedance is predicted for receiver ID 100 under adverse weather conditions.

The predictions show that to achieve compliance with the EA conditions Arrow may have to negotiate an alternative arrangement with the receiver ID 100.

It is also noted that the electrification of the Daandine WTF will reduce the noise levels at receptors ID 41, ID 55 and ID 56 especially with mitigation applied to the CGPF.

To mitigate the noise emissions at receiver ID 3 and ID 80, the following two (2) options should be considered:

- Reduce noise emissions from existing well DA-81 and the future well Stratheden-15 by mitigating or replacing generators.
- Possibilities to enter an alternative arrangement with the affected residences.

It is acknowledged that computer noise modelling has been undertaken on a number of assumptions and based on the most accurate and complete information on sound power levels available at the time. It is recommended that Factory Acceptance Testing (FAT) and onsite compliance testing is undertaken to compare the provided vendor data for the future plant items with measurement data, and if required, take additional measures to reduce noise levels.

9.2 Construction Noise Assessment

Installation of New CGPF Components

Predicted noise levels for the installation of new components at the CGPF comply with the daytime 40 dBA L_{Aeq} (external) criterion at all receptor locations. Furthermore, during shutdown periods at the CGPF construction during night-time may be required, however, construction activities would generate less noise emissions than the existing operation and no noise impacts would be anticipated.

Completion/Work-over Rigs

The offset distance to achieve the night-time noise criterion of 28 dBA L_{Aeq} for the completion/work-over rigs is predicted to between **2,020 m** and **6,470 m** (depending on the operation of the blooie line) under neutral weather conditions and between **3,880 m** and **11,530 m** (depending on the operation of the blooie line) under adverse weather conditions. It should be noted that the noise emissions from the blooie line operation is highly directional and the noise emissions and resulting offset distances to achieve the night-time noise criterion will be significantly less in the opposite direction to blooie line release.

Gathering Flowlines and Access Road Tracks

The offset distance to achieve the daytime noise criterion of 40 dBA L_{Aeq} for the construction stages associated with the gathering flowlines and access roads construction is predicted to between **340 m** and **630 m**.

ACOUSTIC TERMINOLOGY

1. Sound Level or Noise Level

The terms “sound” and “noise” are almost interchangeable, except that in common usage “noise” is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

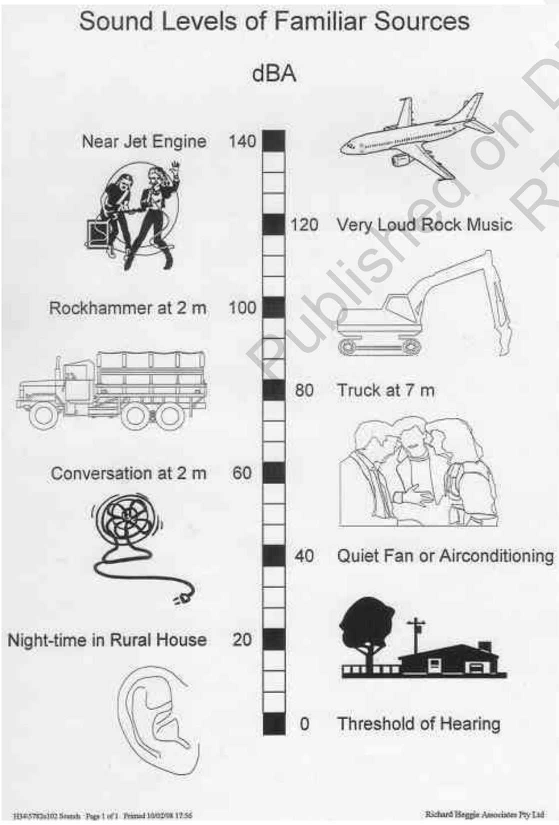
The symbols SPL, L or L_P are commonly used to represent Sound Pressure Level. The symbol L_A represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2 x 10^{-5} Pa.

2. “A” Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an “A-weighting” filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The figure below lists examples of typical noise levels



Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as “linear”, and the units are expressed as dB(lin) or dBZ.

3. Sound Power Level

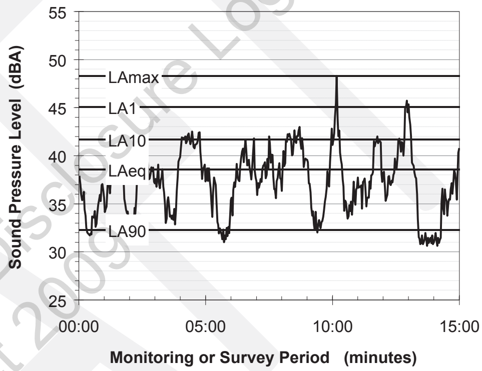
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or L_W, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4. Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

L_{Amax} (Max LpA)	The maximum noise level during the 15 minute interval
L_{A1}	The noise level exceeded for 1% of the 15 minute interval.
L_{A10}	The noise level exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.
L_{A90}	The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.
L_{Aeq}	The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the “repeatable minimum” L_{A90} noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or “average” levels representative of the other descriptors (L_{Aeq}, L_{A10}, etc).

5. Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than "broad band" noise.

6. Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7. Frequency Analysis

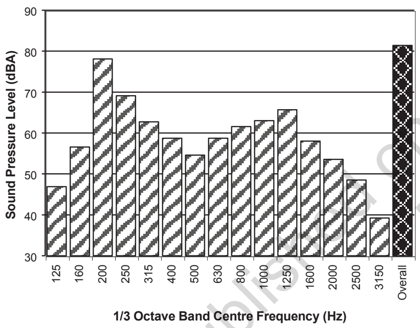
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8. Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of "peak" velocity or "rms" velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as "peak particle velocity", or PPV. The latter incorporates "root mean squared" averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/V_0), where V_0 is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used by some organizations.

9. Human Perception of Vibration

People are able to "feel" vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

10. Over-Pressure

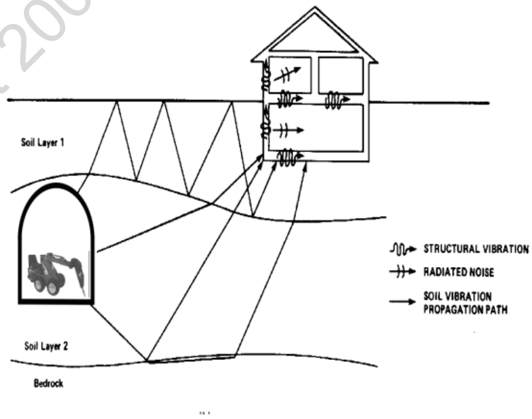
The term "over-pressure" is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed "structure-borne noise", "ground-borne noise" or "regenerated noise". This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

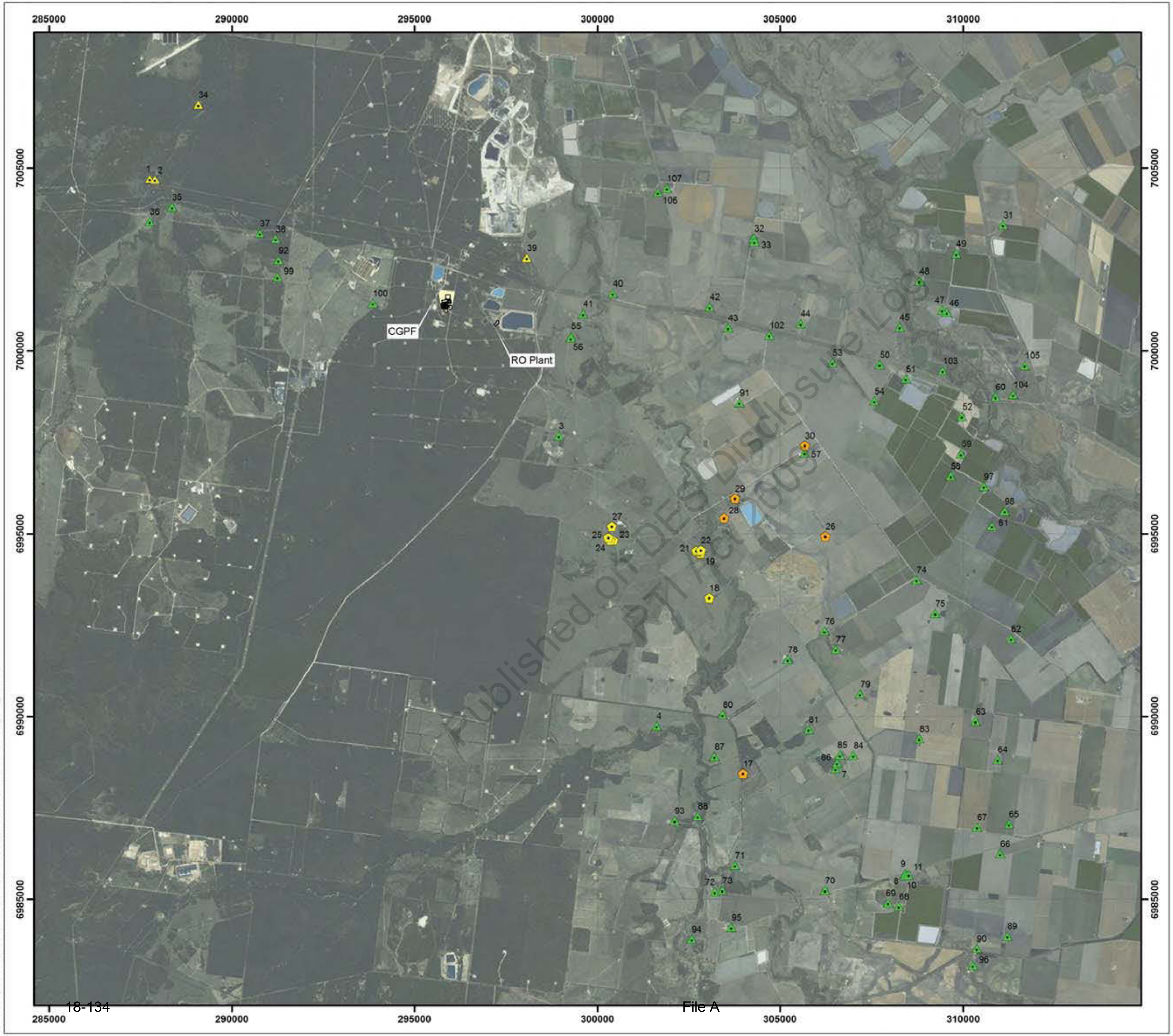
Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term "regenerated noise" is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise.

Sensitive Receptors



LEGEND

Sensitive Receptors

- Arrow Owned Dwellings – Currently Occupied
- Arrow Owned Dwellings – Currently Unoccupied
- Privately Owned Dwellings - Currently Occupied
- Privately Owned Dwellings – Currently Unoccupied
- Central Gas Processing Facility

N

0 1 2 3 4 5
Kilometers

Project No.:	620.10773
Date:	21/08/2014
Drawn by:	NT
Scale:	1:100,000
Sheet Size:	A3
Projection:	GDA 1994 MGA Zone 56

SLR
240 WATERWORKS RD
ASHGROVE
QUEENSLAND 4060
AUSTRALIA
T: 61 7 3858 4800
F: 61 7 3858 4801
www.slrconsulting.com

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Clough

Daandine Expansion Project

Sensitive Receptor Locations

FIGURE B1

G:\Drafting\620.10773 - Daandine Expansion\Figures\ArcGIS\SLR62010773_001_06.mxd

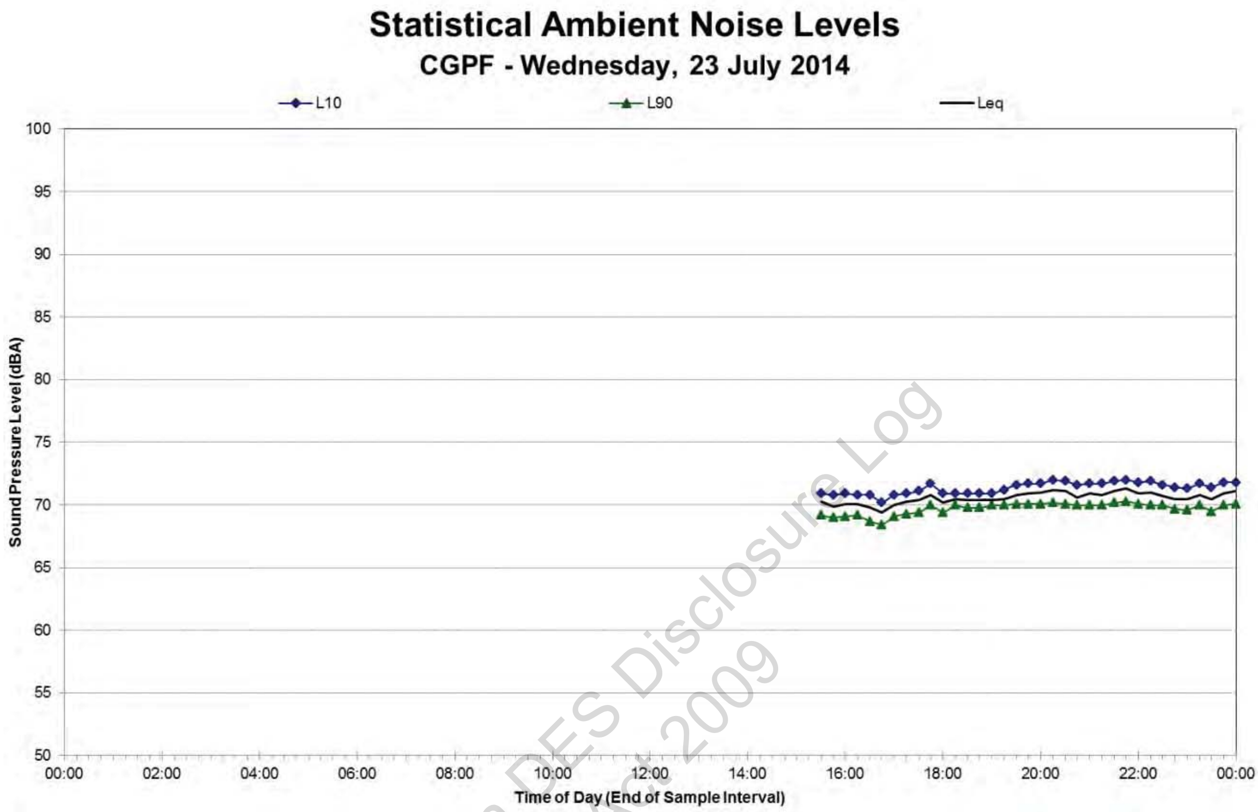
Table B1 Identified Sensitive Receptors

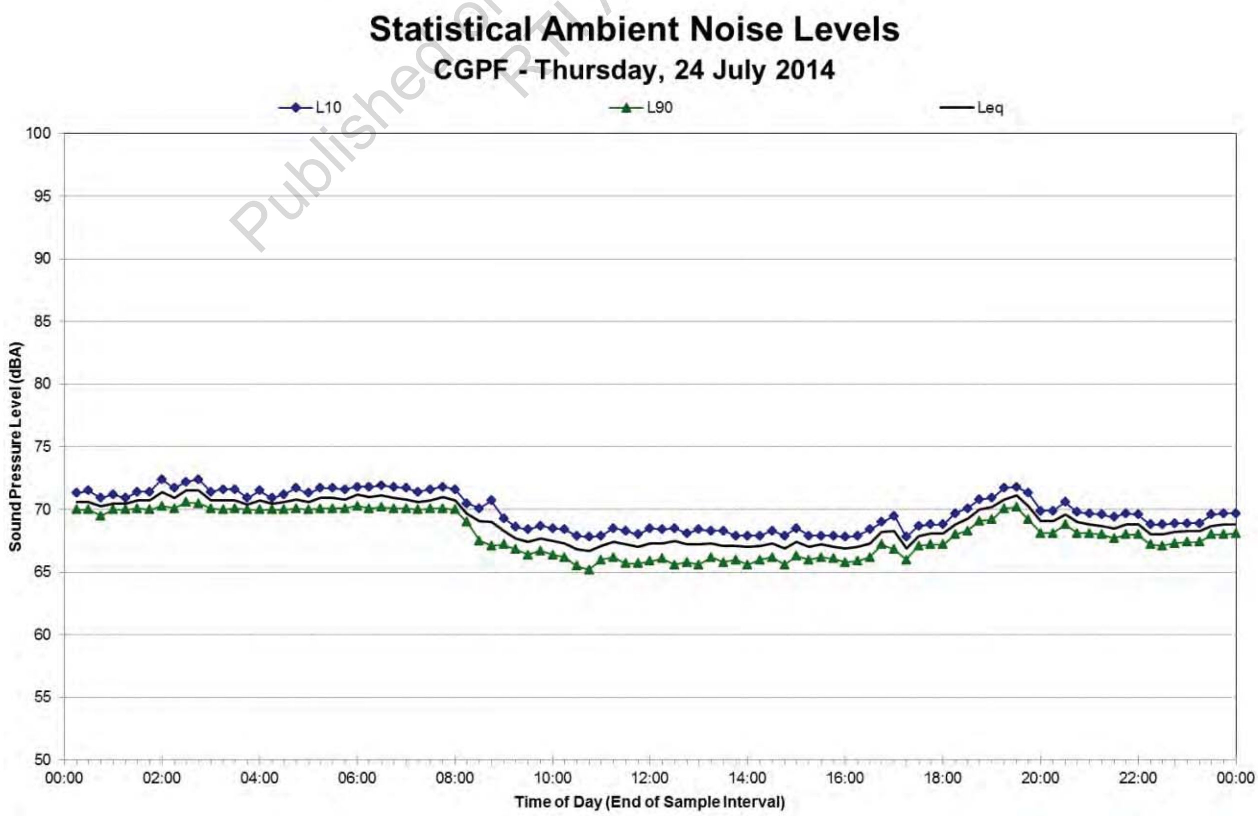
ID	Receiver Type	MGA56 x-coordinate	MGA56 y-coordinate
Privately Owned Dwellings - Currently Occupied			
3	Dwelling	sch4p4(6) Personal information, Information that coulc	
4	Dwelling		
7	Dwelling		
8	Dwelling		
9	Dwelling		
10	Dwelling		
11	Dwelling		
31	Dwelling		
32	Dwelling		
33	Dwelling		
35	Dwelling		
36	Dwelling		
37	Dwelling		
38	Dwelling		
40	Dwelling		
41	Dwelling		
42	Dwelling		
43	Dwelling		
44	Dwelling		
45	Dwelling		
46	Dwelling		
47	Dwelling		
48	Dwelling		
49	Dwelling		
50	Dwelling		
51	Dwelling		
52	Dwelling		
53	Dwelling		
54	Dwelling		
55	Dwelling		
56	Dwelling		
57	Dwelling		
58	Dwelling		
59	Dwelling		
60	Dwelling		
61	Dwelling		
62	Dwelling		
63	Dwelling		

ID	Receiver Type	MGA56 x-coordinate	MGA56 y-coordinate
64	Dwelling	sch4p4(6) Personal information	
65	Dwelling		
66	Dwelling		
67	Dwelling		
68	Dwelling		
69	Dwelling		
70	Dwelling		
71	Dwelling		
72	Dwelling		
73	Dwelling		
74	Dwelling		
75	Dwelling		
76	Dwelling		
77	Dwelling		
78	Dwelling		
79	Dwelling		
80	Dwelling		
81	Dwelling		
83	Dwelling		
84	Dwelling		
85	Dwelling		
86	Dwelling		
87	Dwelling		
88	Dwelling		
89	Dwelling		
90	Dwelling		
91	Dwelling		
92	Dwelling		
93	Dwelling		
94	Dwelling		
95	Dwelling		
96	Dwelling		
97	Dwelling		
98	Dwelling		
99	Dwelling - Field Survey 20/02/20147		
100	Dwelling - Field Survey 20/02/20147		
102	Dwelling - Field Survey 20/02/20147		
103	Dwelling - Field Survey 20/02/20147		
104	Dwelling - Field Survey 20/02/20147		
105	Dwelling - Field Survey 20/02/20147		
106	Dwelling - Field Survey 20/02/20147		

ID	Receiver Type	MGA56 x-coordinate	MGA56 y-coordinate
107	Dwelling - Field Survey 20/02/20147	sch4p4(6) Personal information	
Privately Owned Dwellings – Currently Unoccupied			
1	Dwelling - Unoccupied		
2	Dwelling - Unoccupied		
34	Dwelling - Unoccupied		
39	Dwelling - Unoccupied		
Arrow Owned Dwellings – Currently Occupied			
17	Arrow Owned	303990.39	6988434.01
26	Arrow Owned	306241.10	6994926.23
28	Arrow Owned	303474.14	6995425.92
29	Arrow Owned	303769.54	6995962.34
30	Arrow Owned	305682.82	6997407.44
Arrow Owned Dwellings – Currently Unoccupied			
18	Arrow Owned - Unoccupied	303066.64	6993242.64
19	Arrow Owned - Unoccupied	302817.05	6994451.62
21	Arrow Owned - Unoccupied	302710.13	6994528.39
22	Arrow Owned - Unoccupied	302838.24	6994546.69
23	Arrow Owned - Unoccupied	300439.15	6994819.66
24	Arrow Owned - Unoccupied	300353.12	6994820.71
25	Arrow Owned - Unoccupied	300307.98	6994898.34
27	Arrow Owned - Unoccupied	300402.31	6995200.60

UNATTENDED NOISE DATA - CGPF





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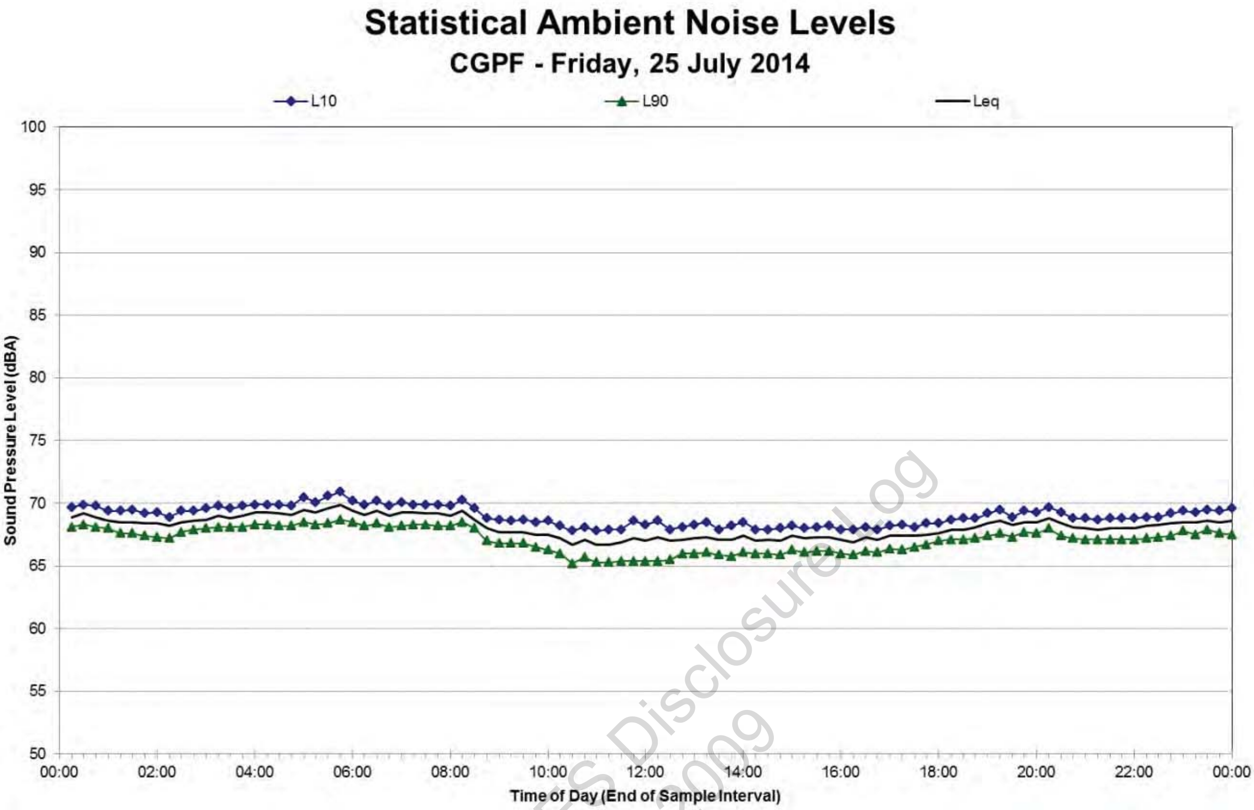

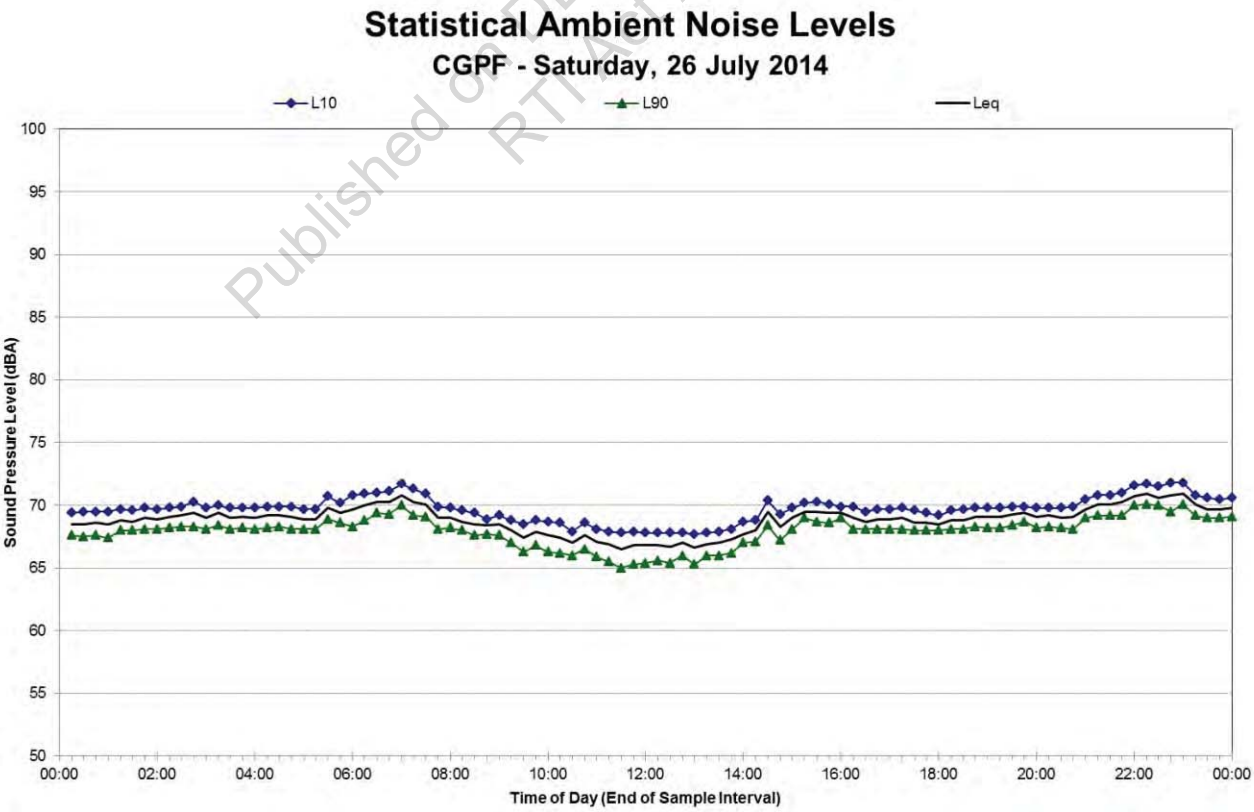

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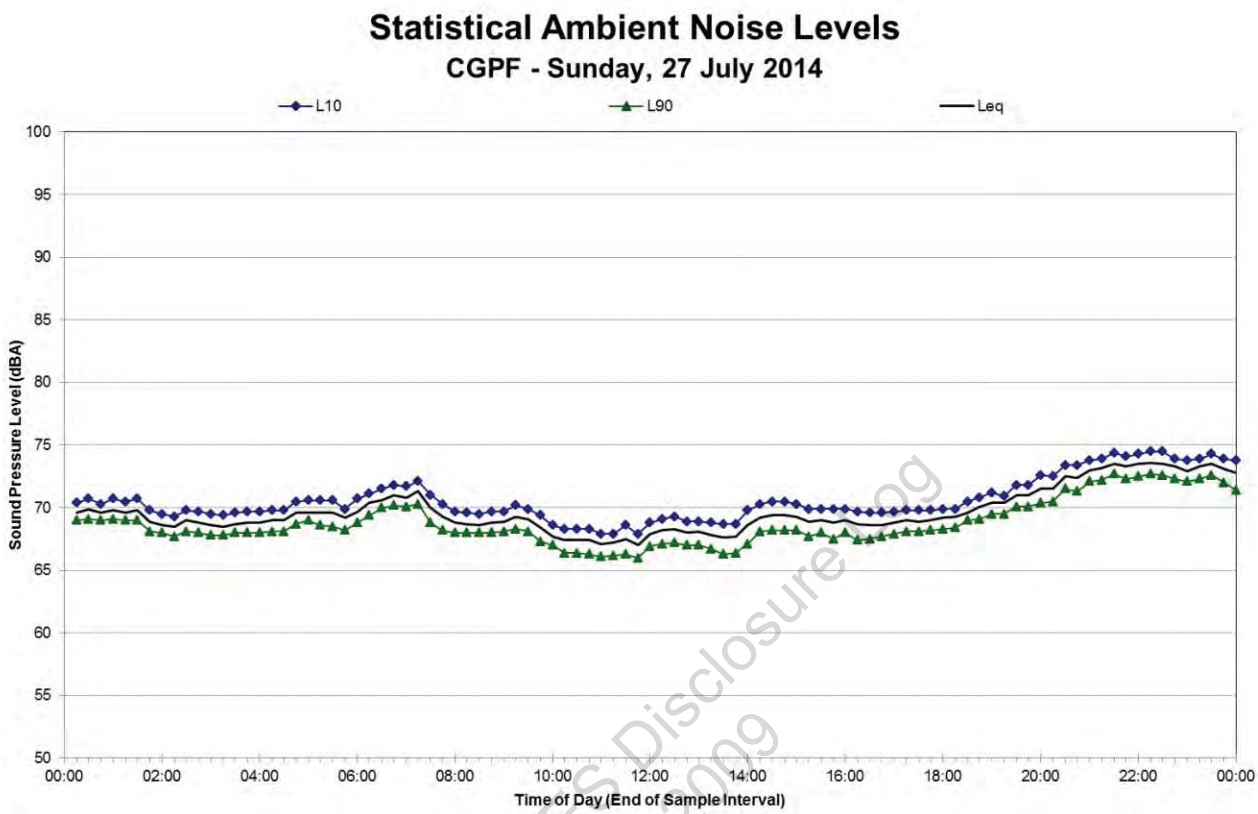

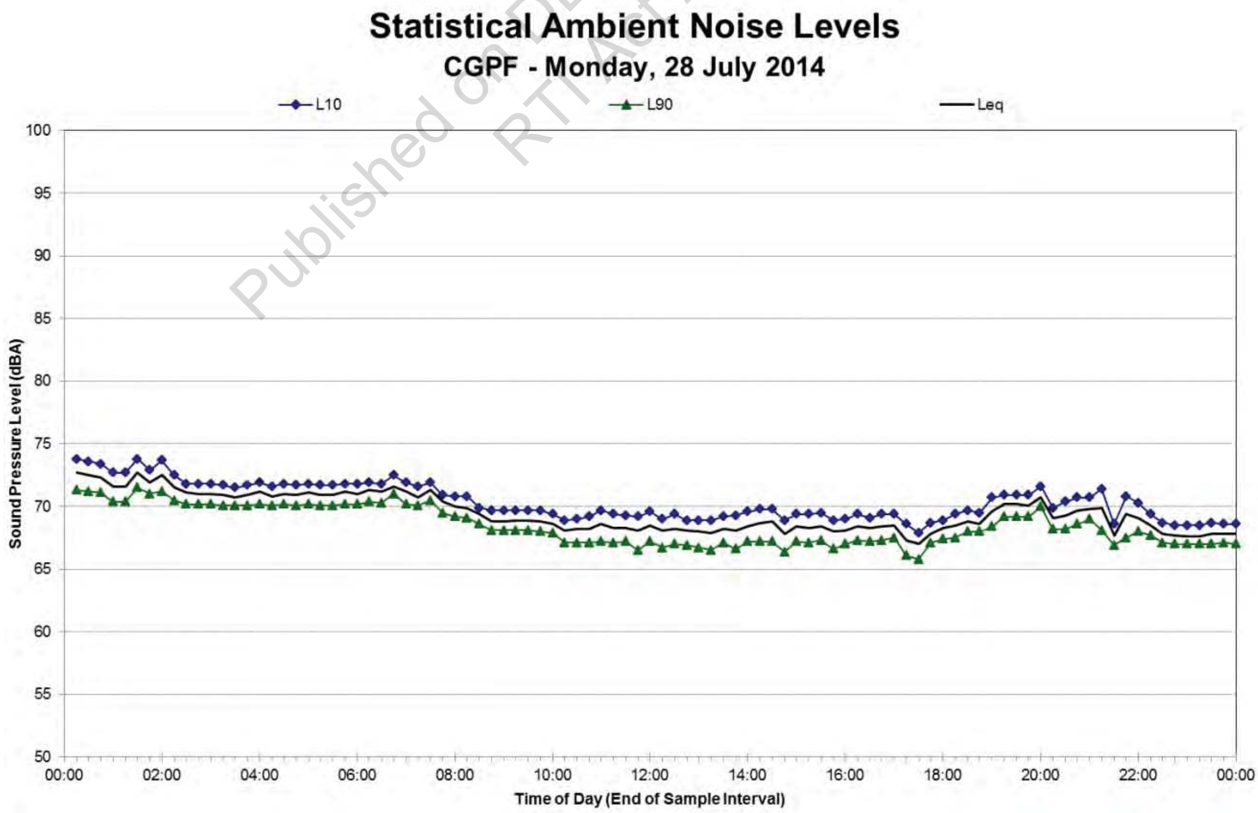

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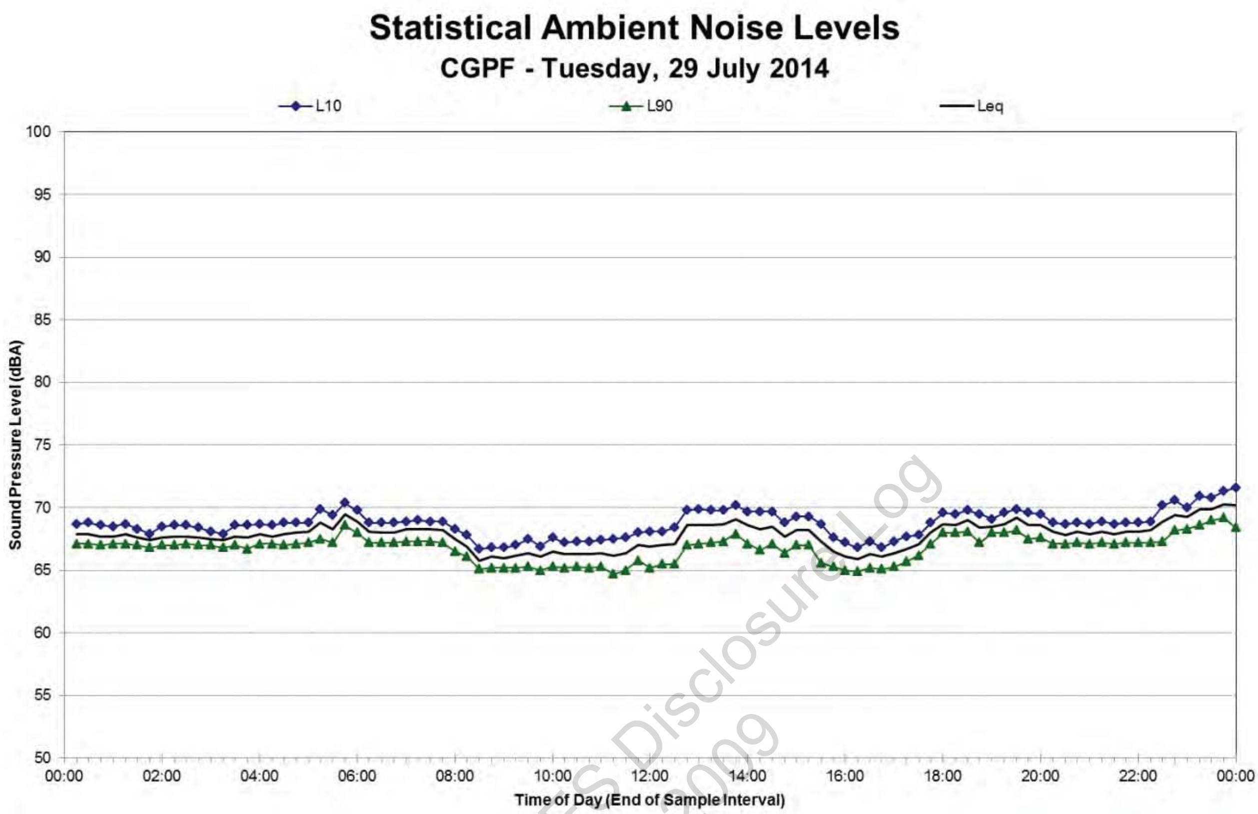

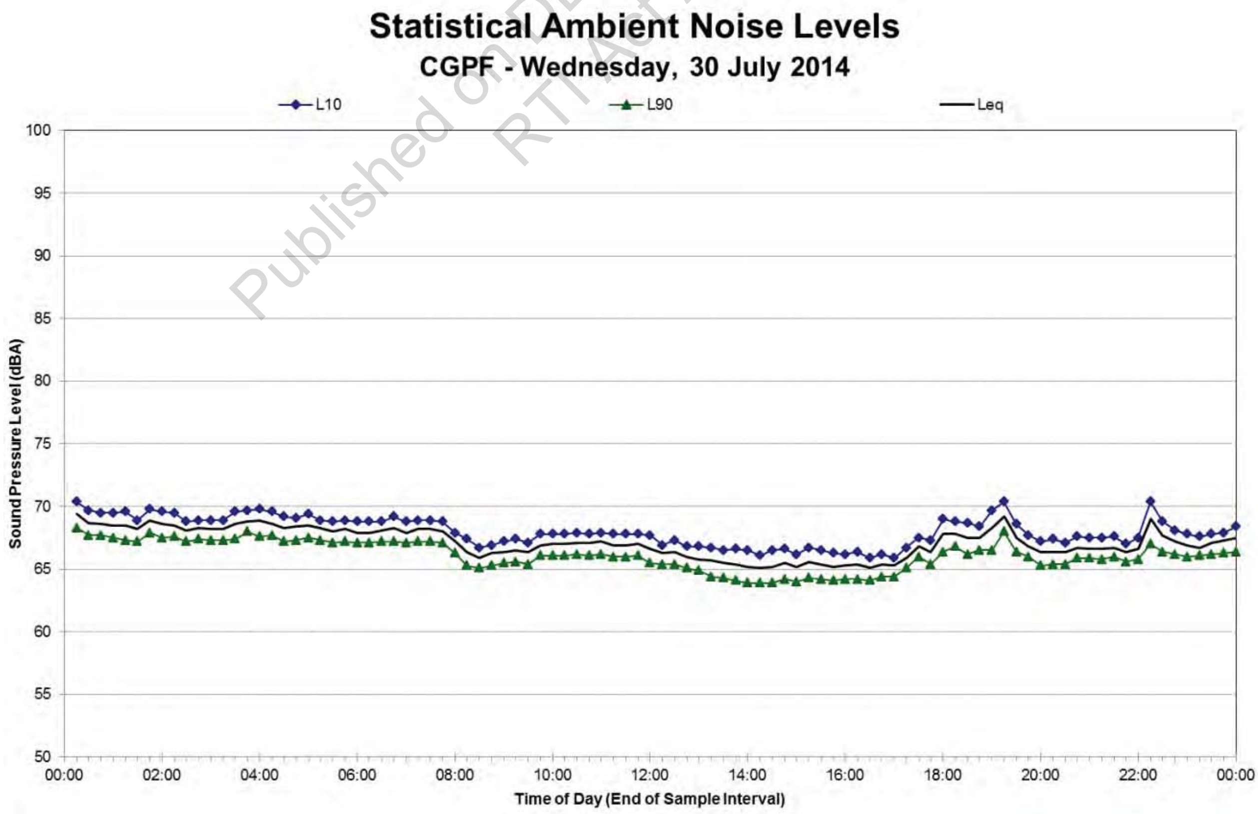

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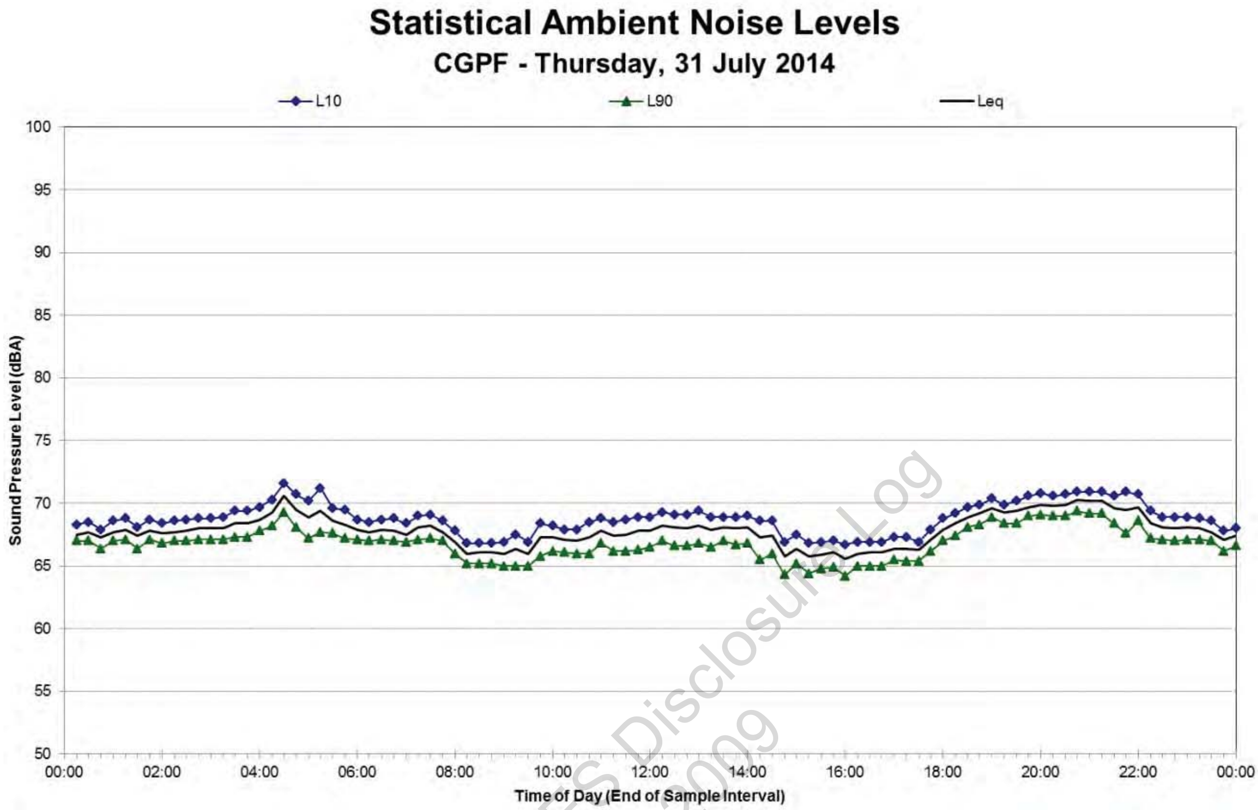

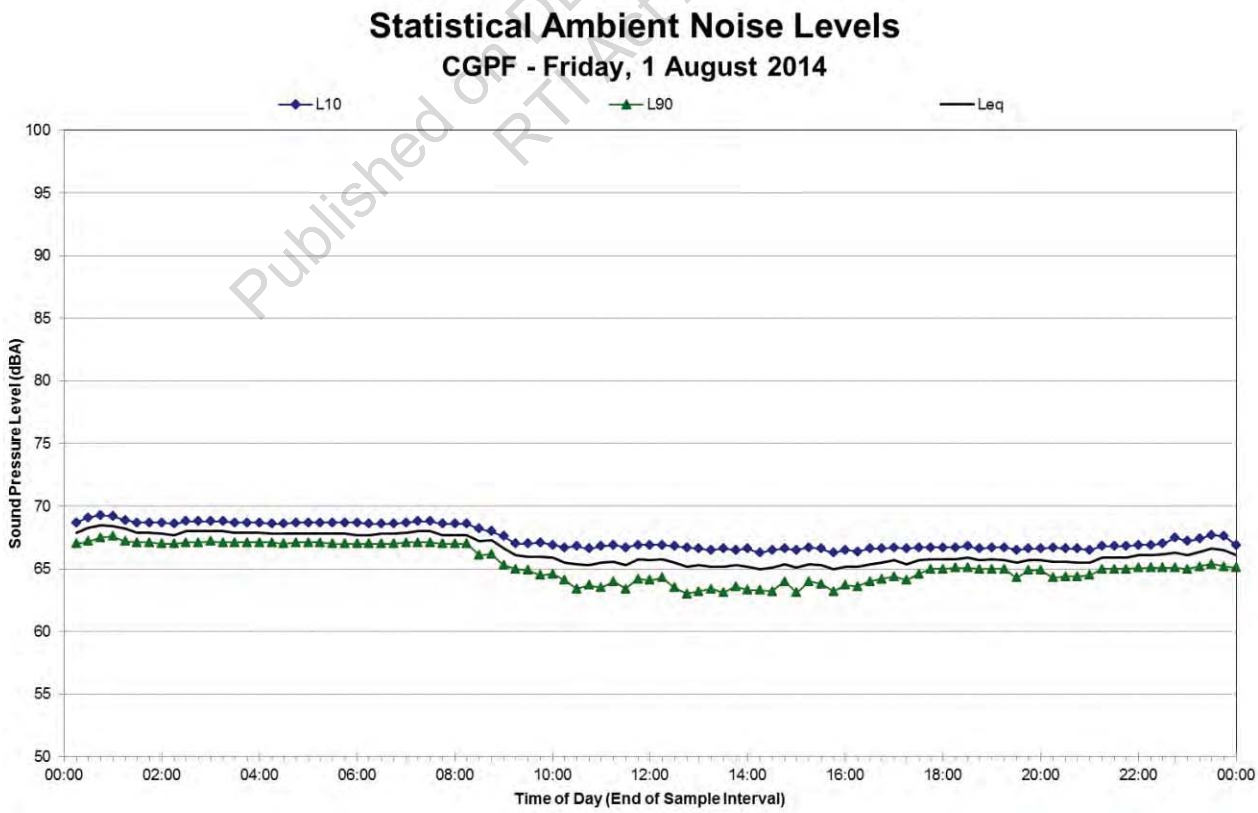

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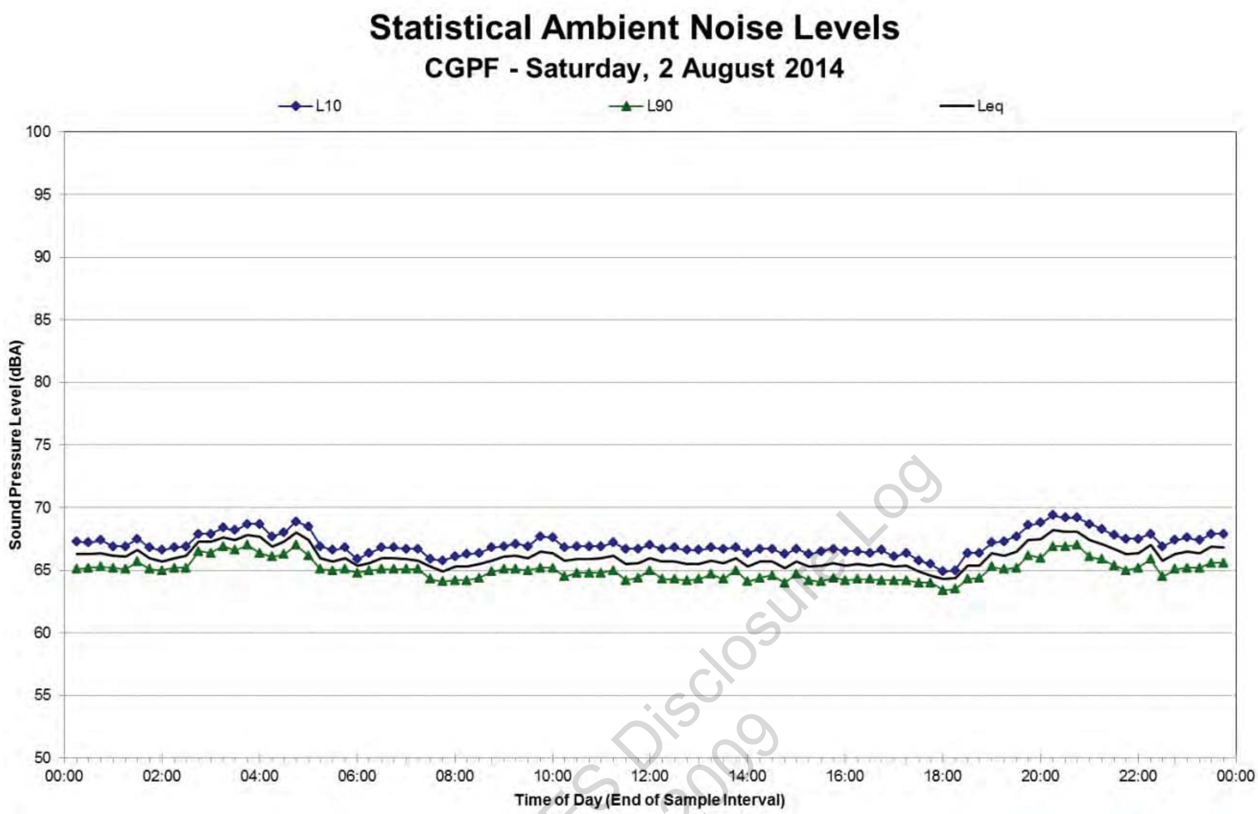

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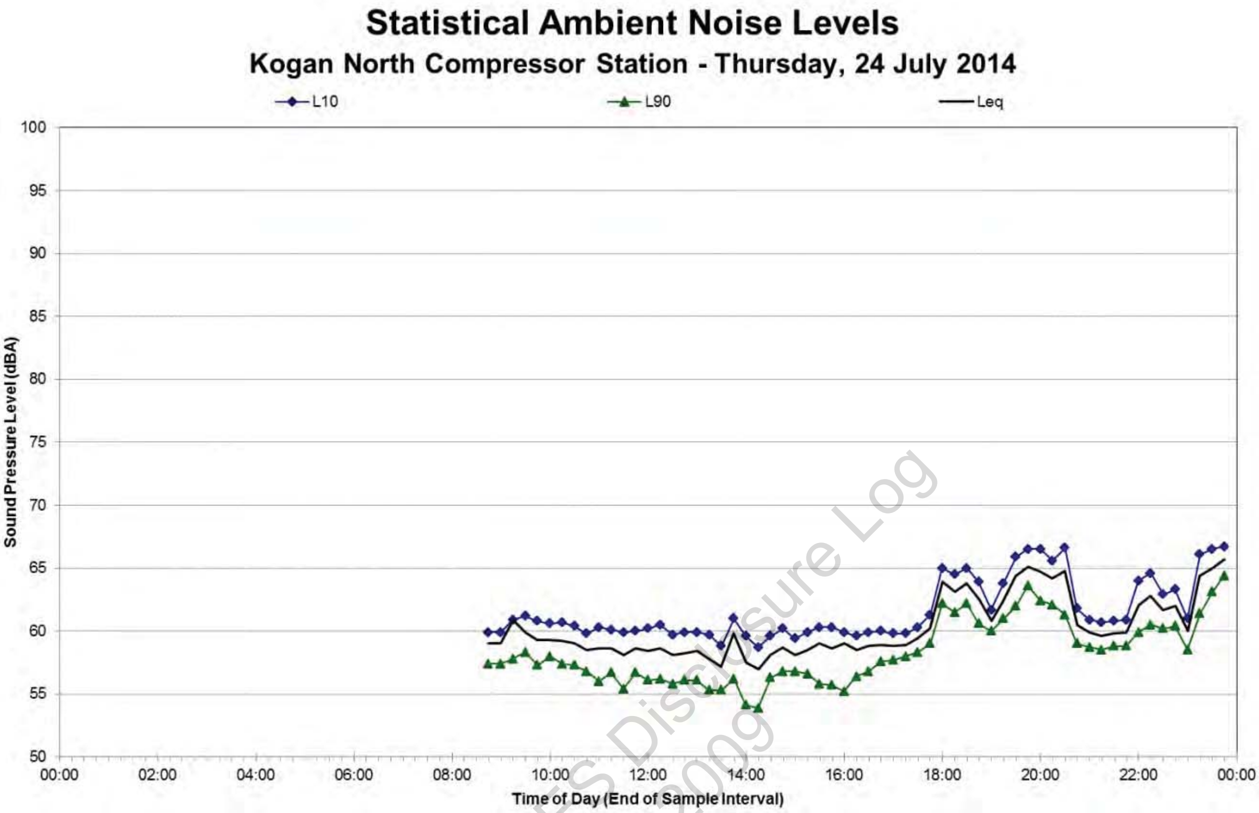

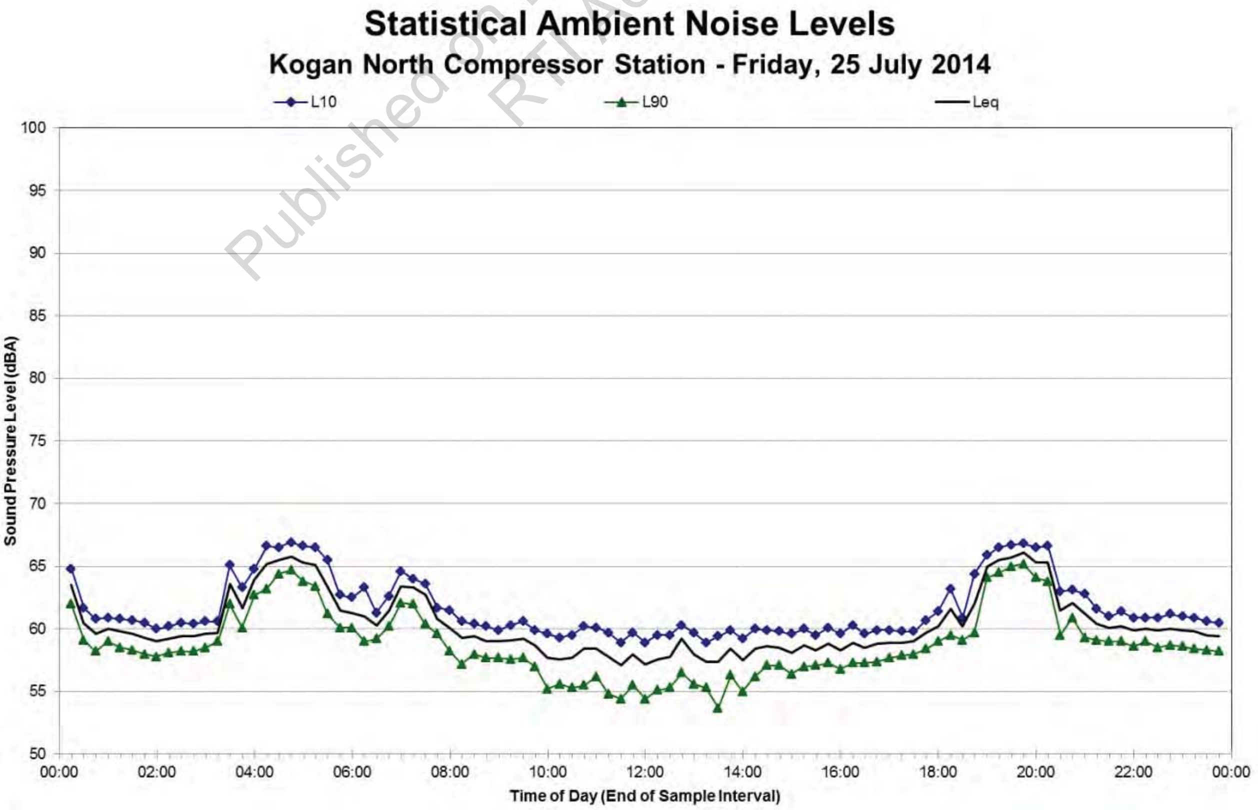

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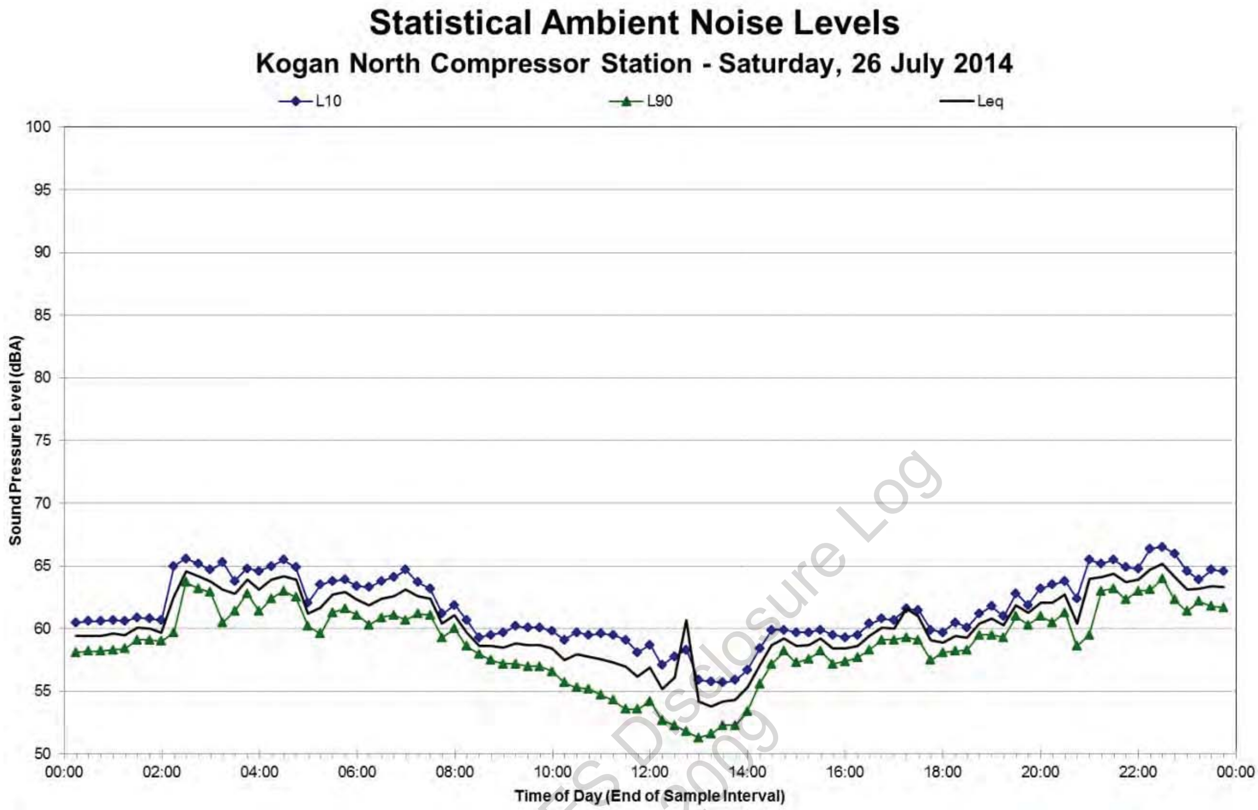

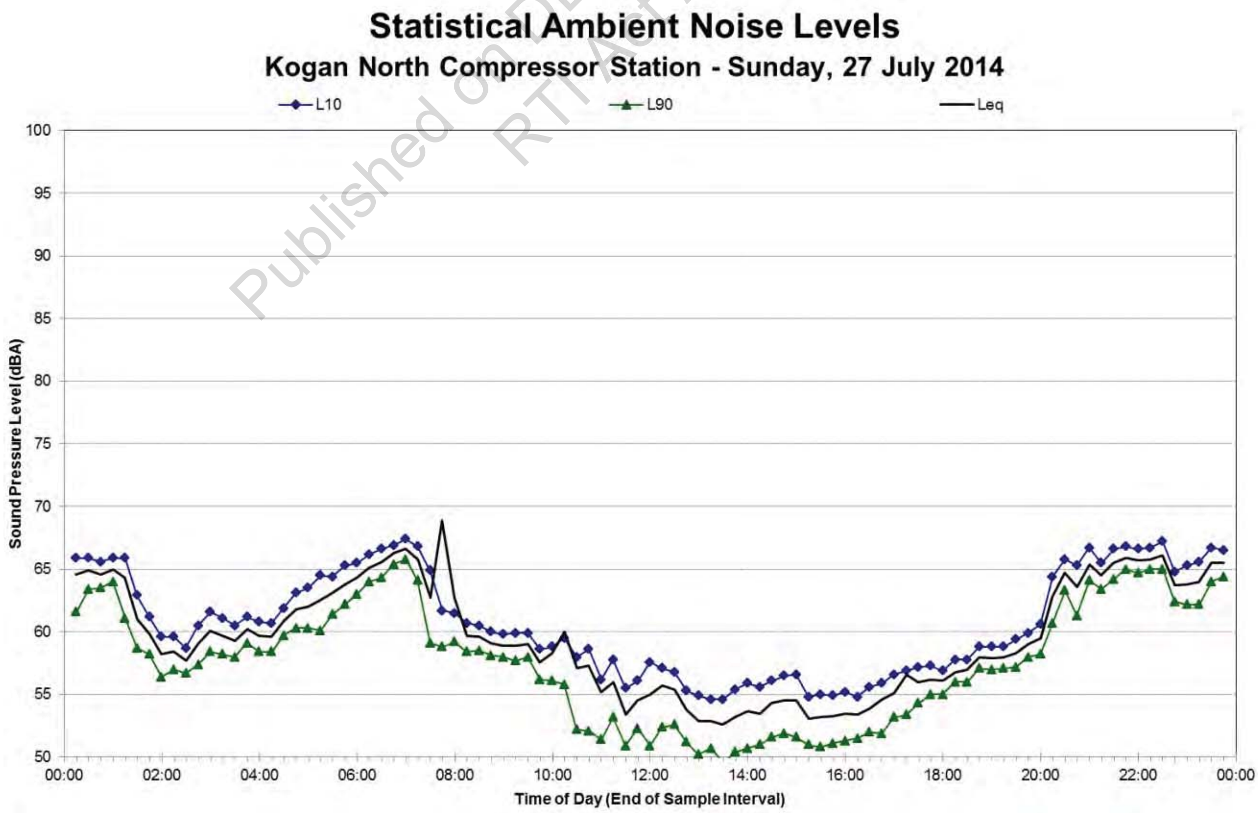

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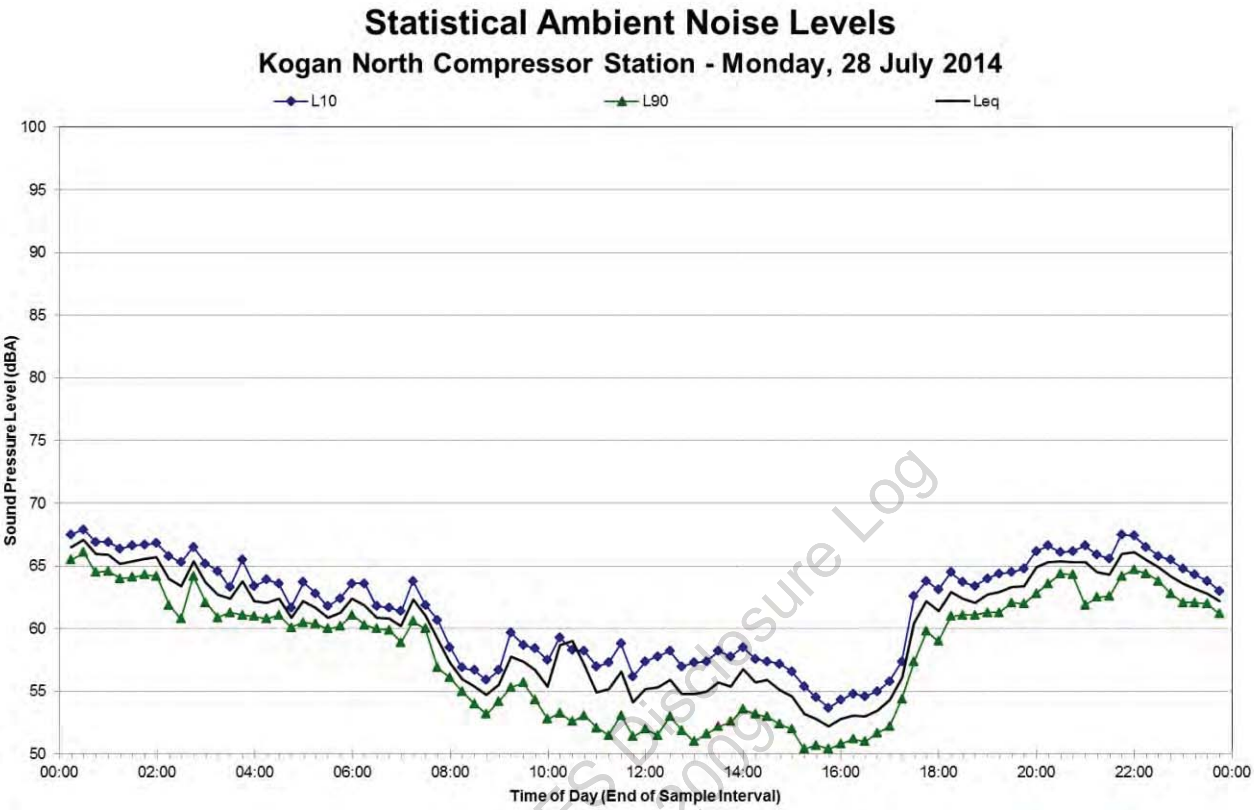

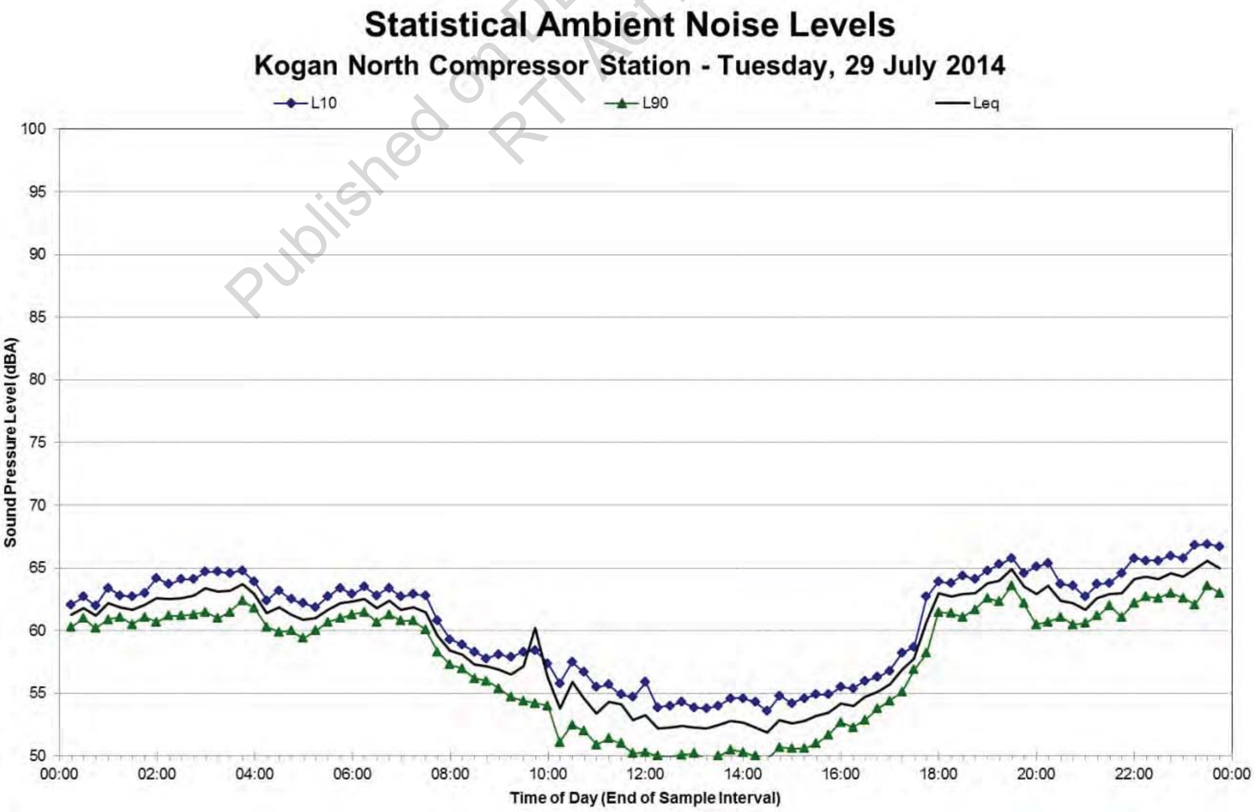

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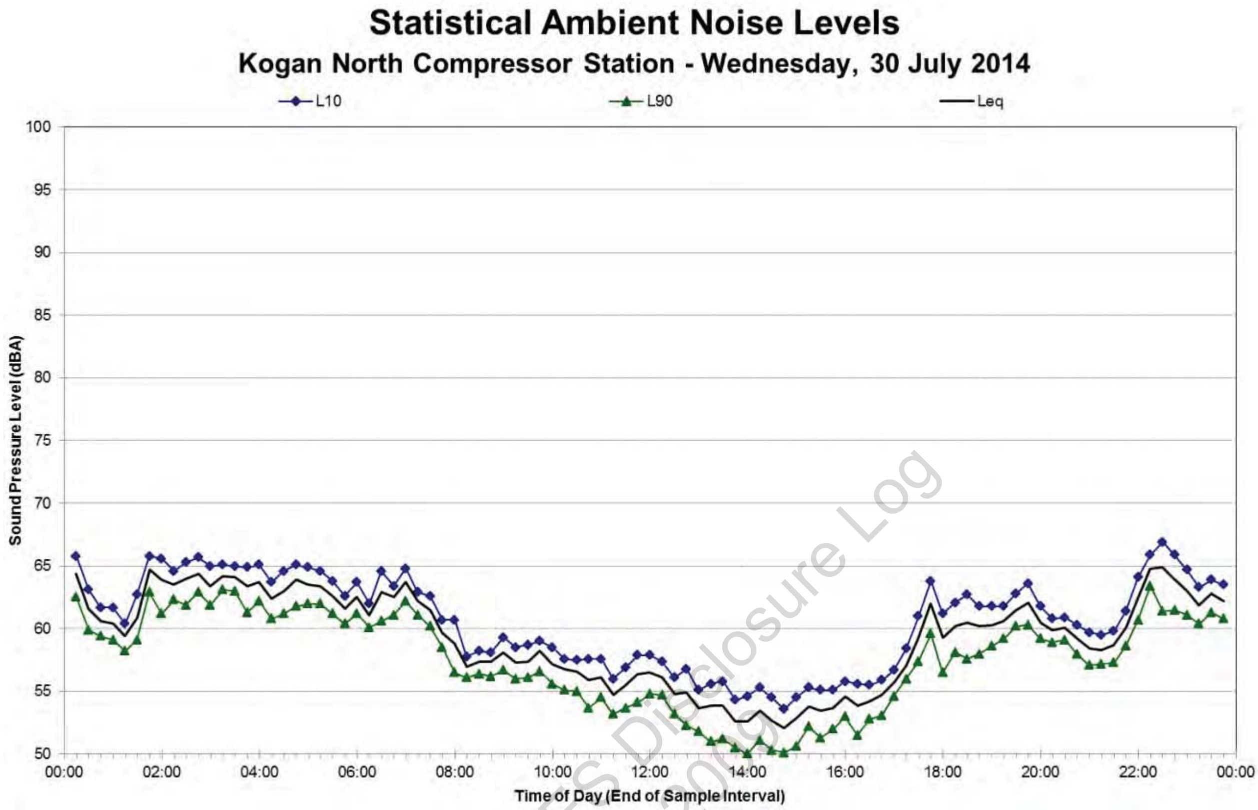

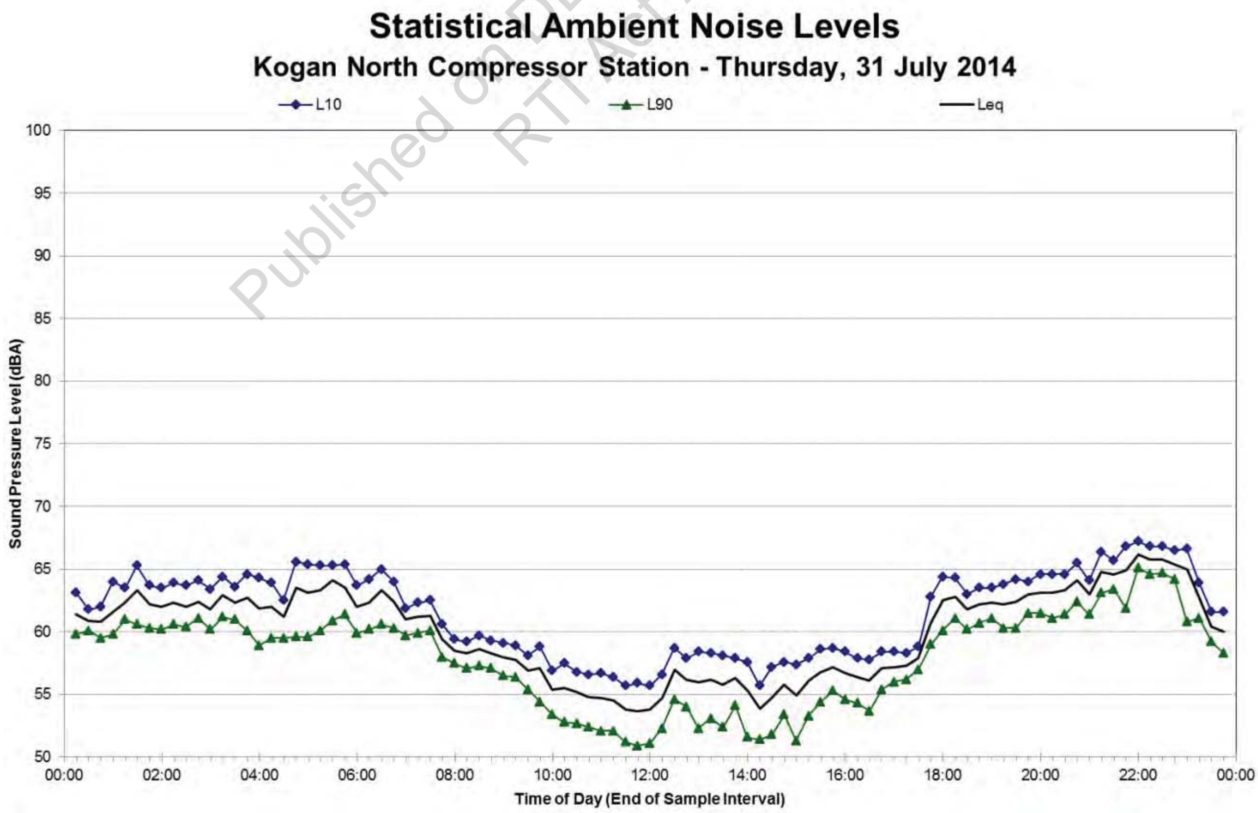

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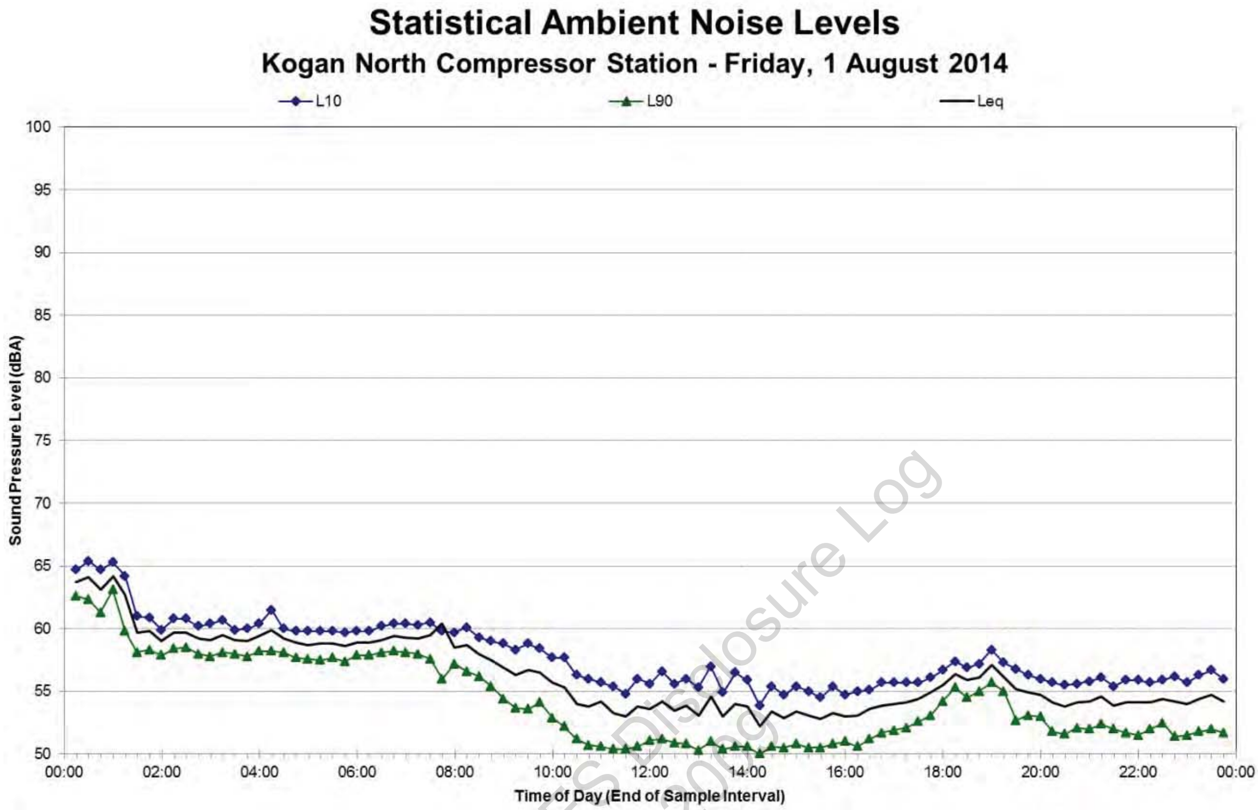

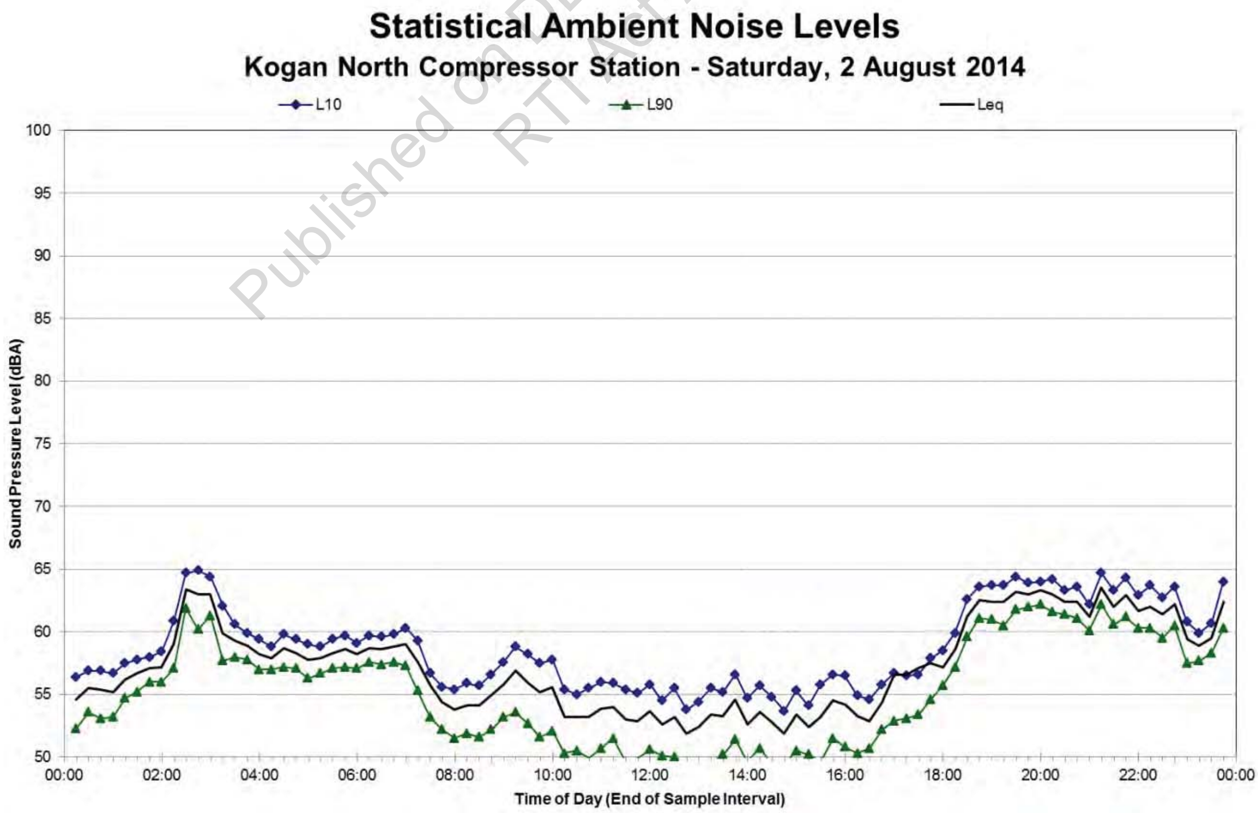

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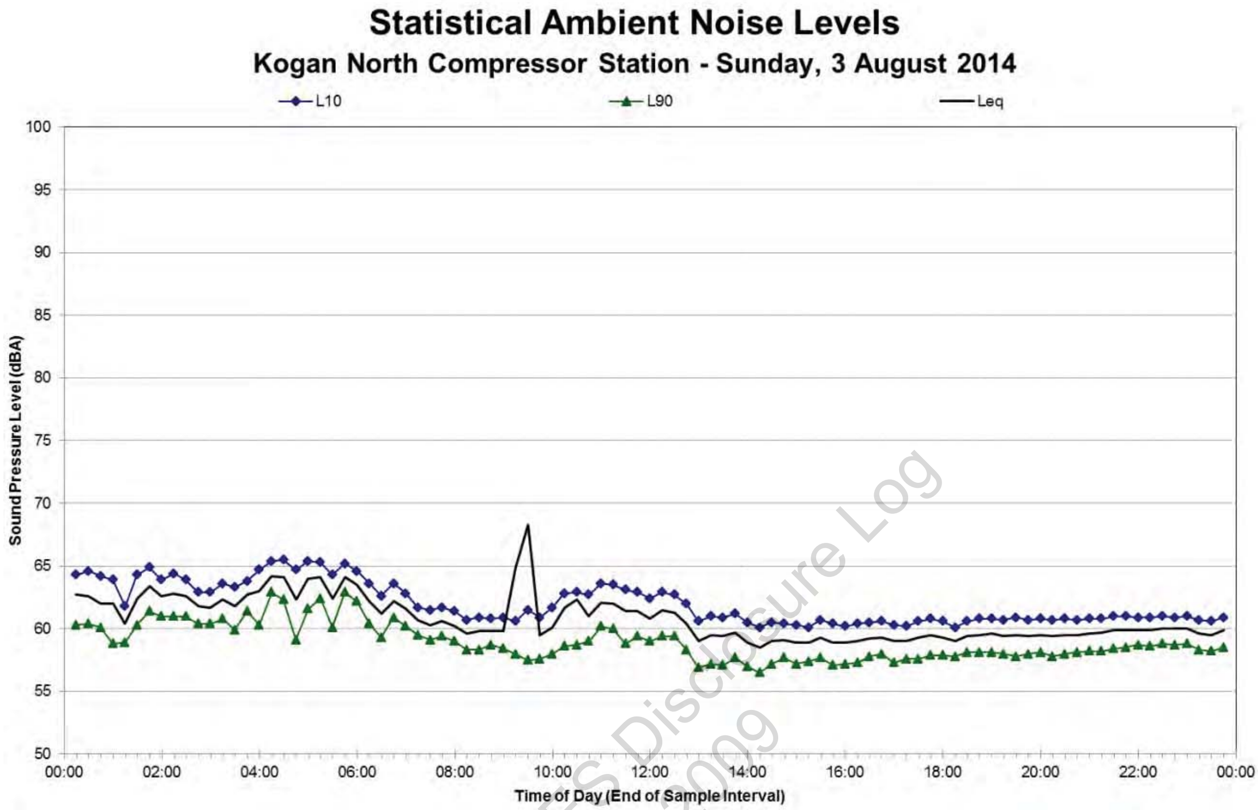
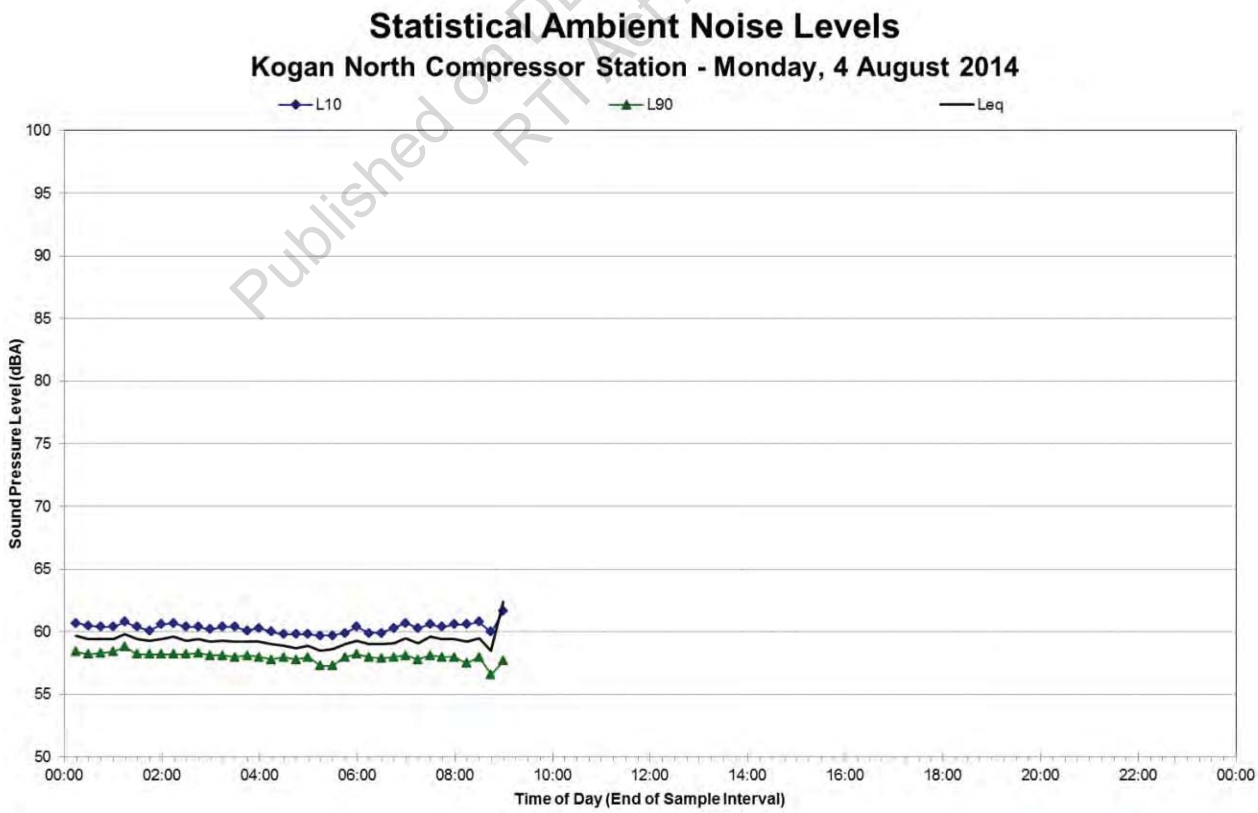
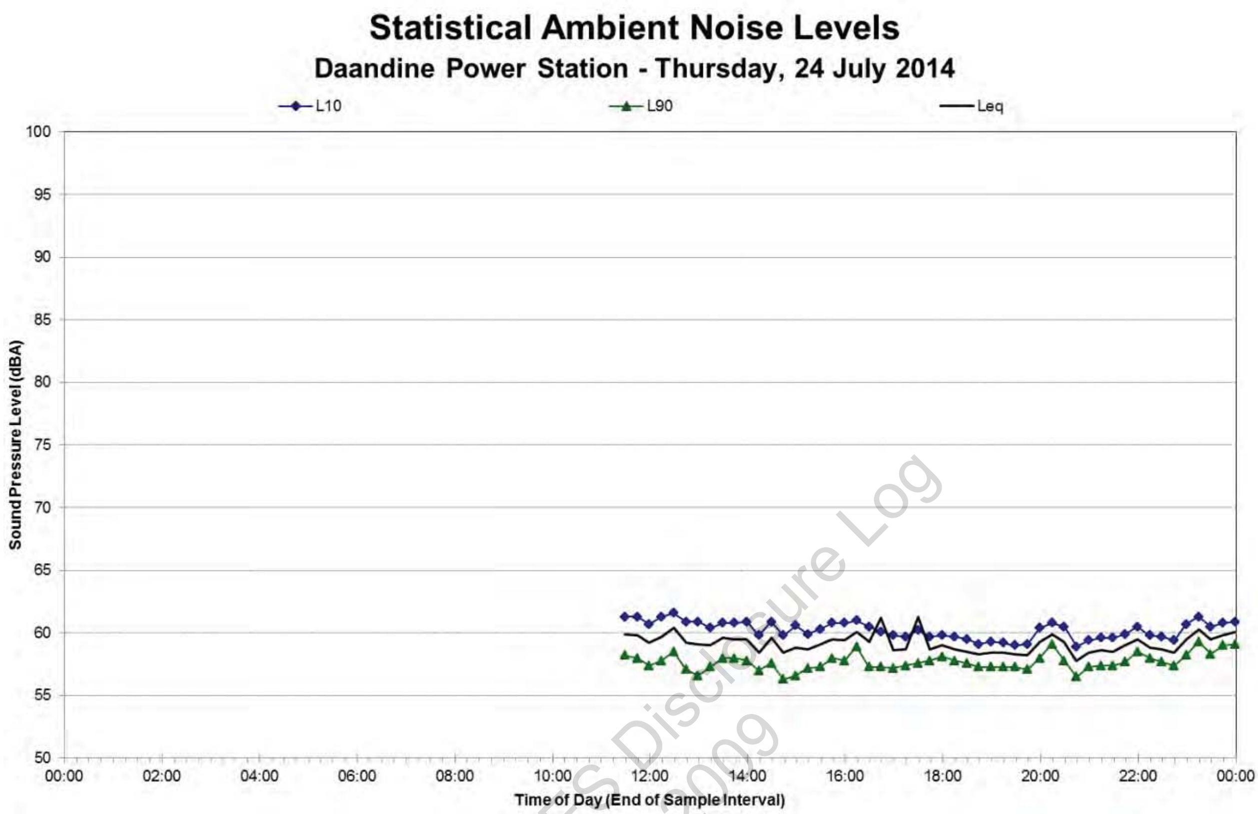
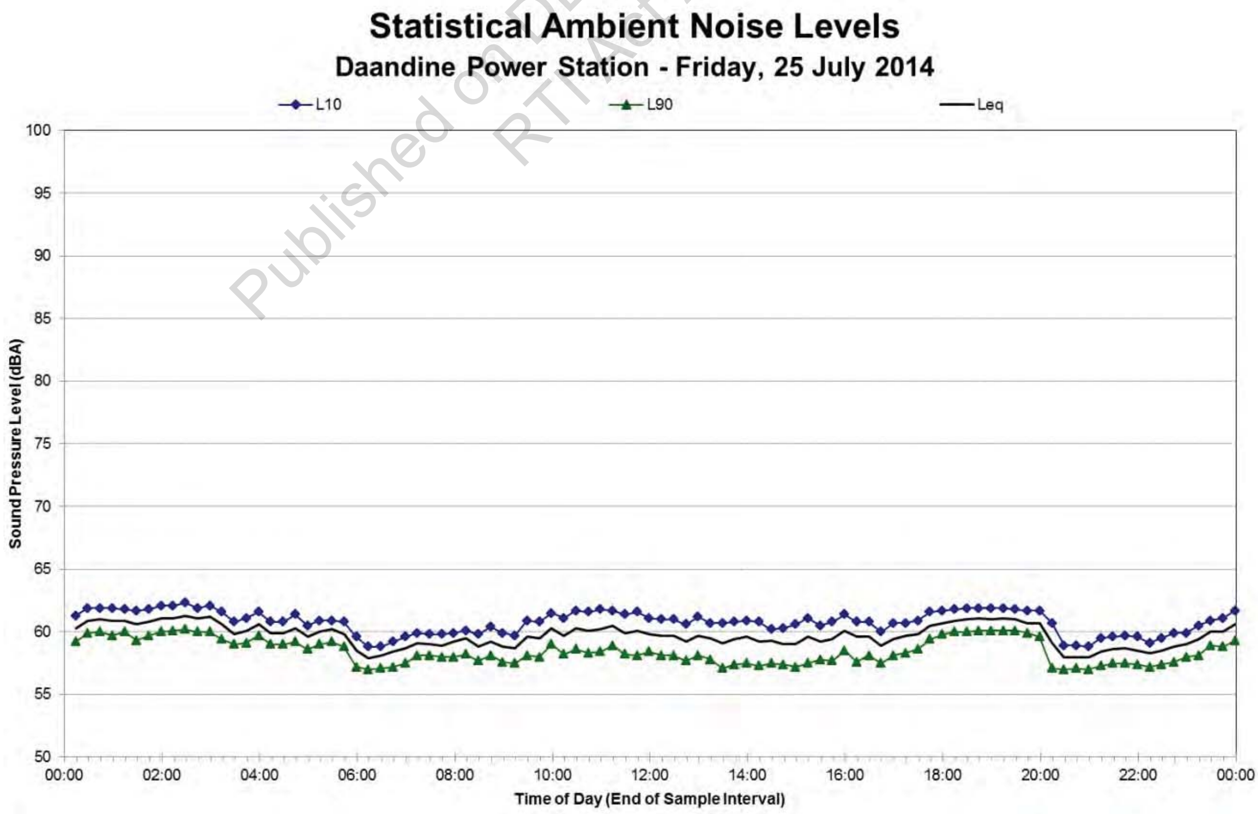
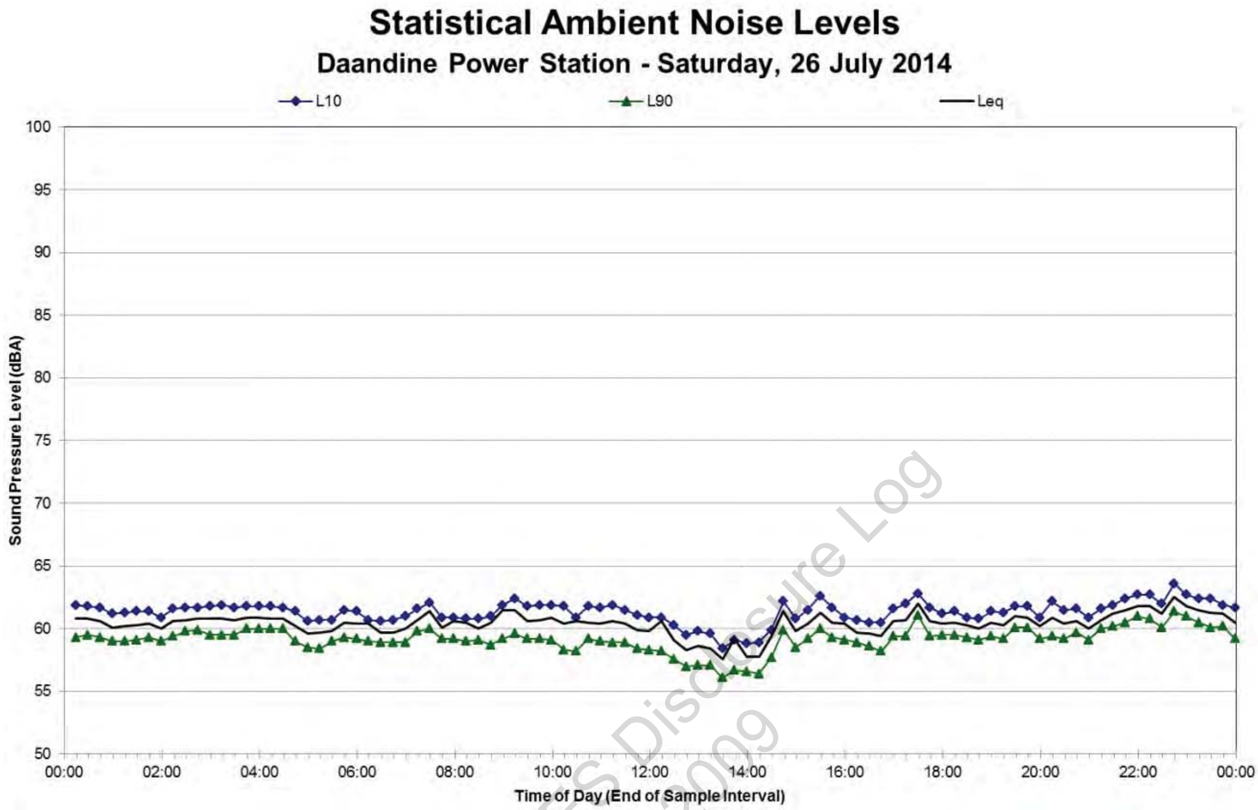


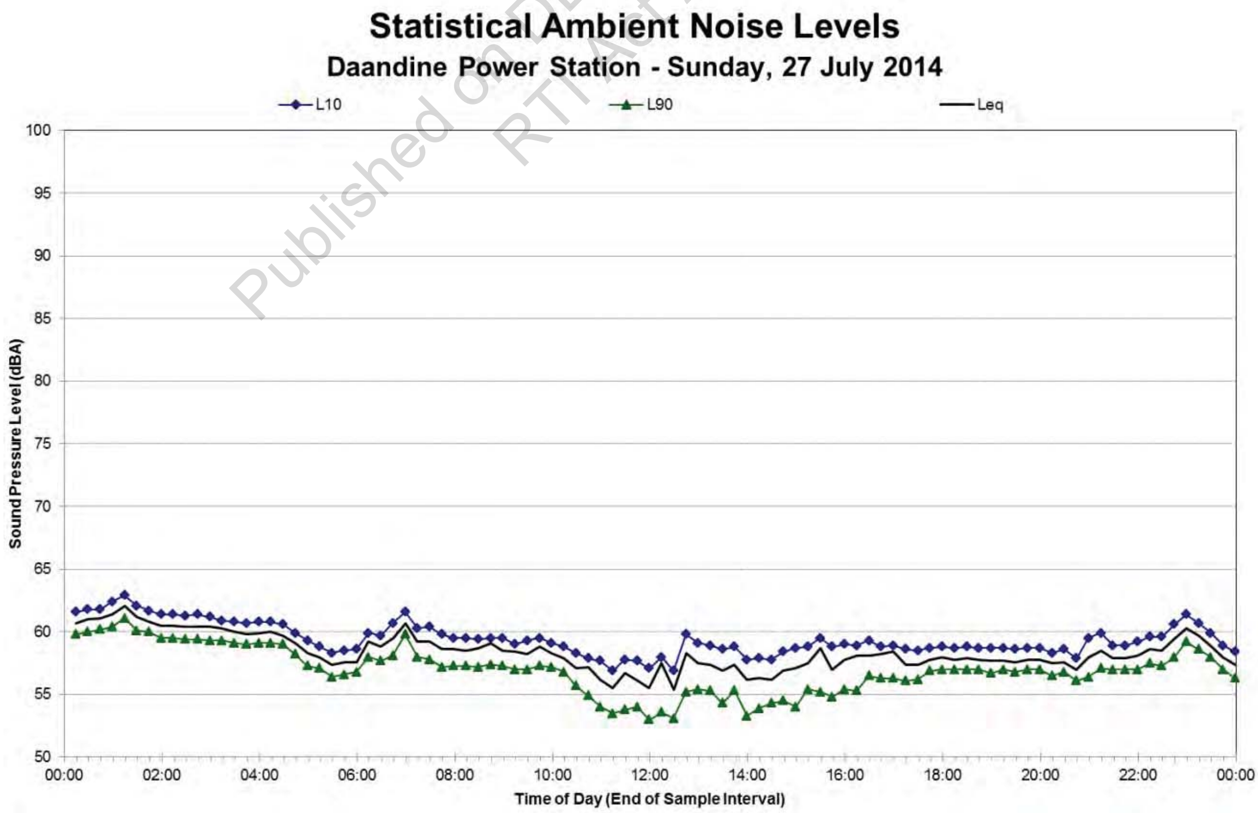



Statistical Ambient Noise Levels
Daandine Power Station - Thursday, 24 July 2014
L10
L90
Leq
Sound Pressure Level (dBA)
100
95
90
85
80
75
70
65
60
55
50
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00
Time of Day (End of Sample Interval)


Statistical Ambient Noise Levels
Daandine Power Station - Friday, 25 July 2014
L10
L90
Leq
Sound Pressure Level (dBA)
100
95
90
85
80
75
70
65
60
55
50
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00
Time of Day (End of Sample Interval)

UNATTENDED NOISE DATA - DAANDINE POWER STATION





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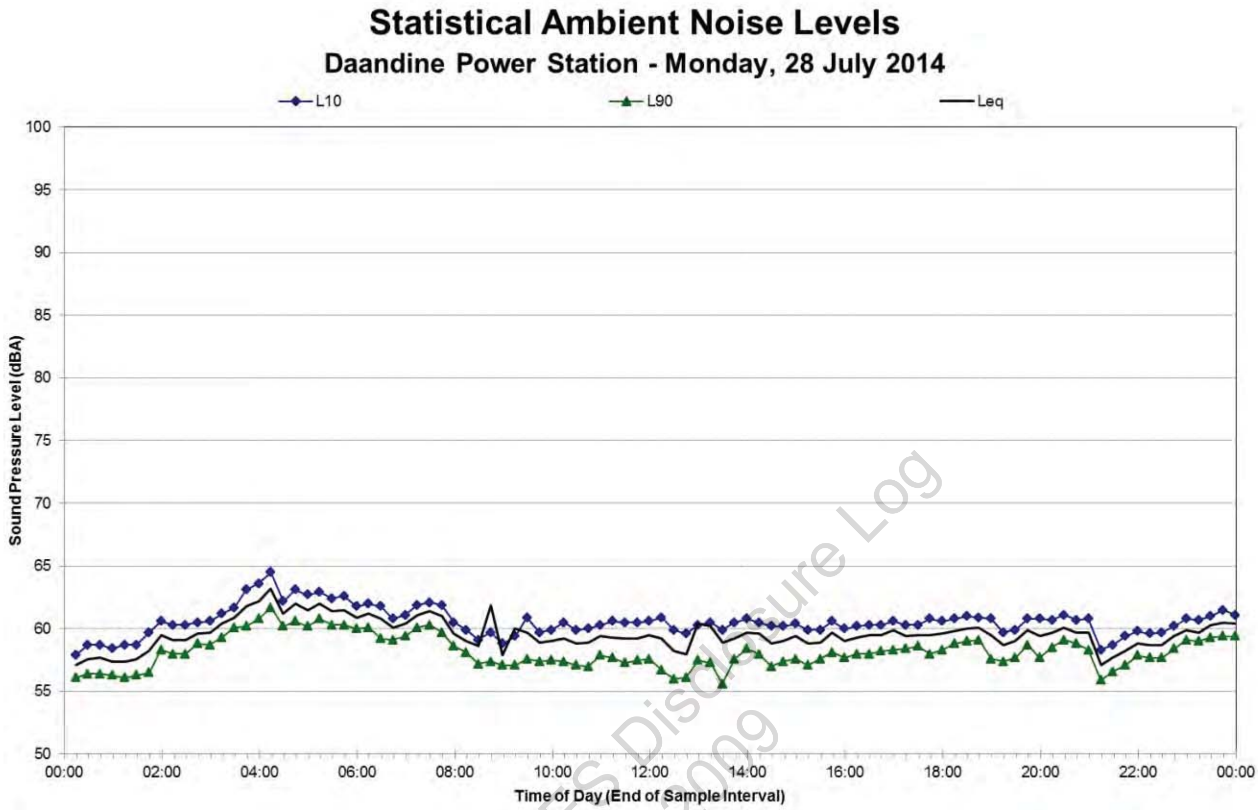

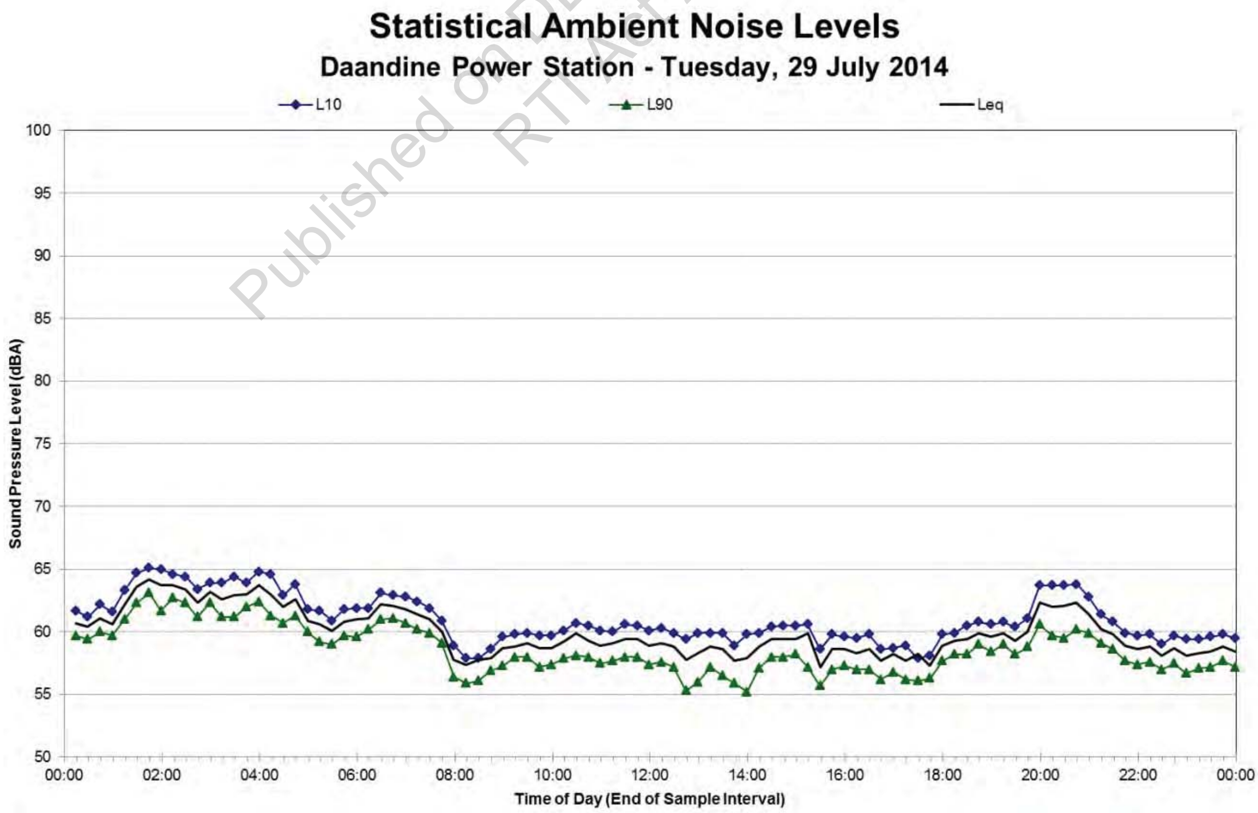

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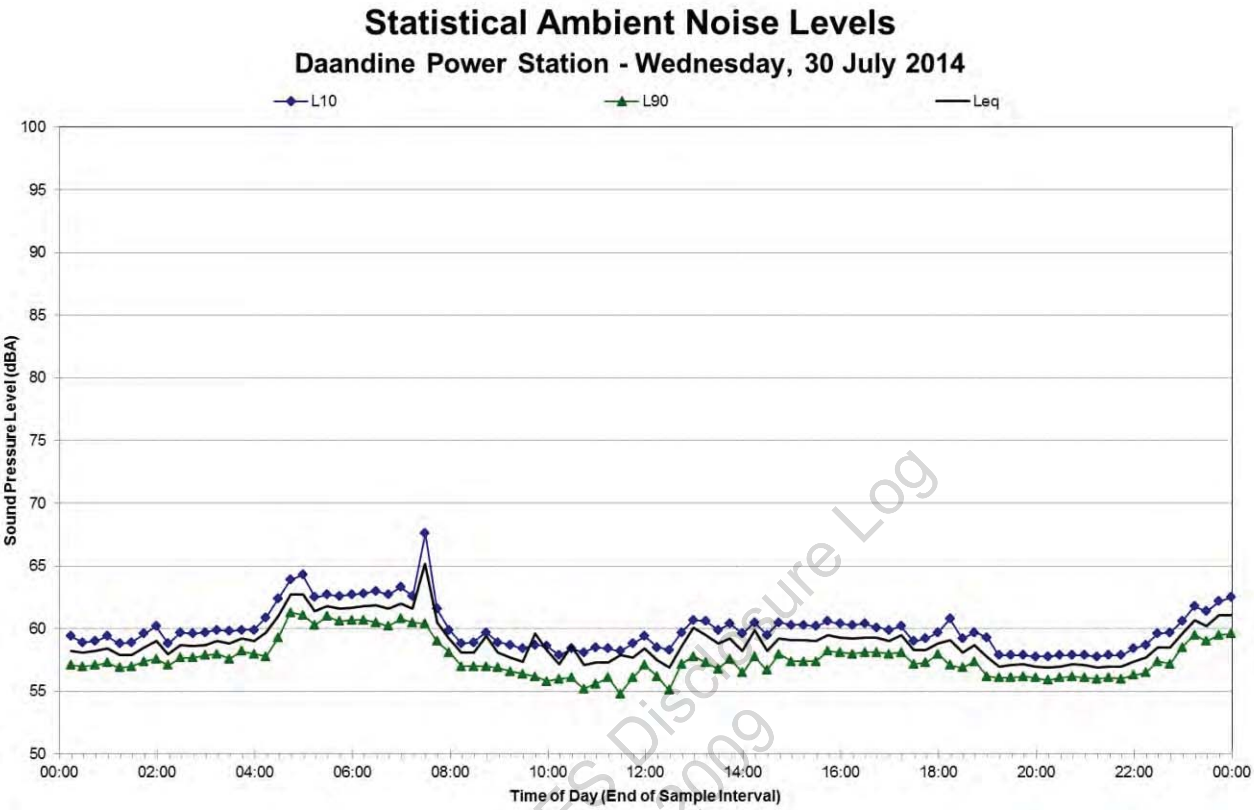

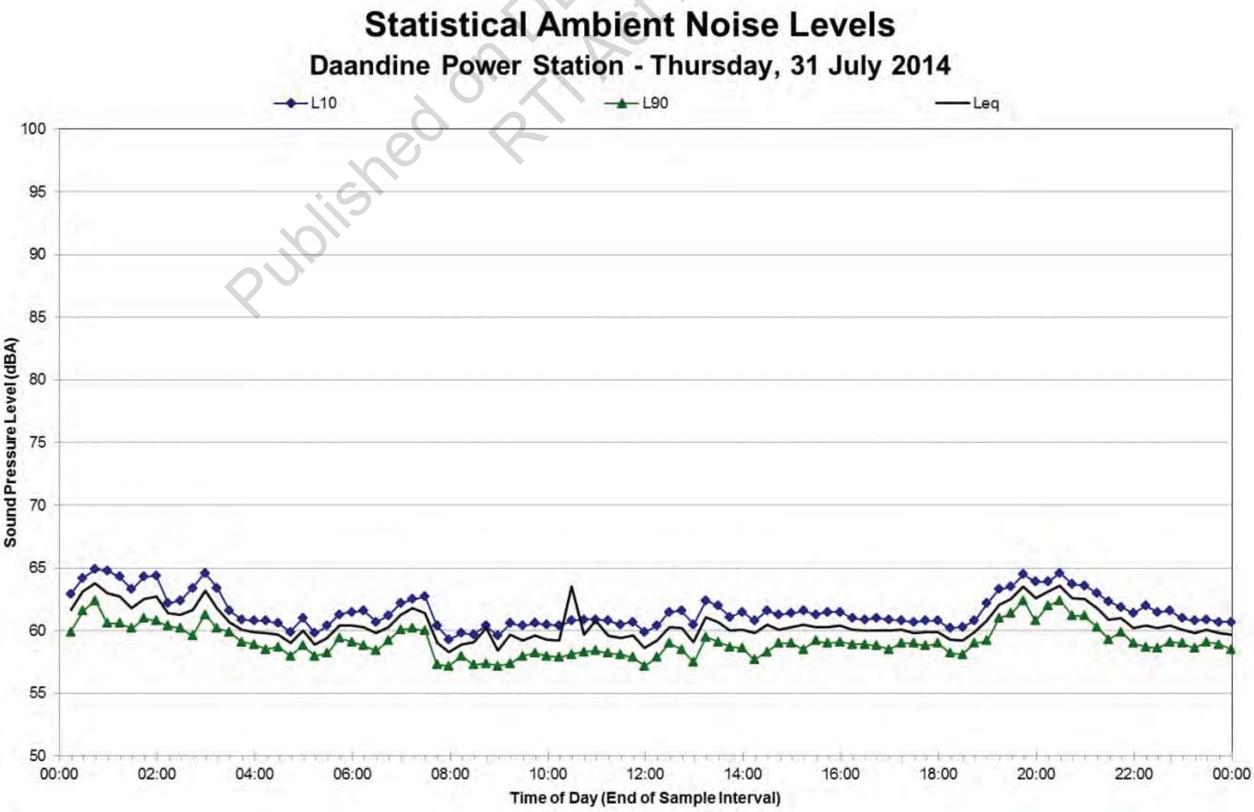

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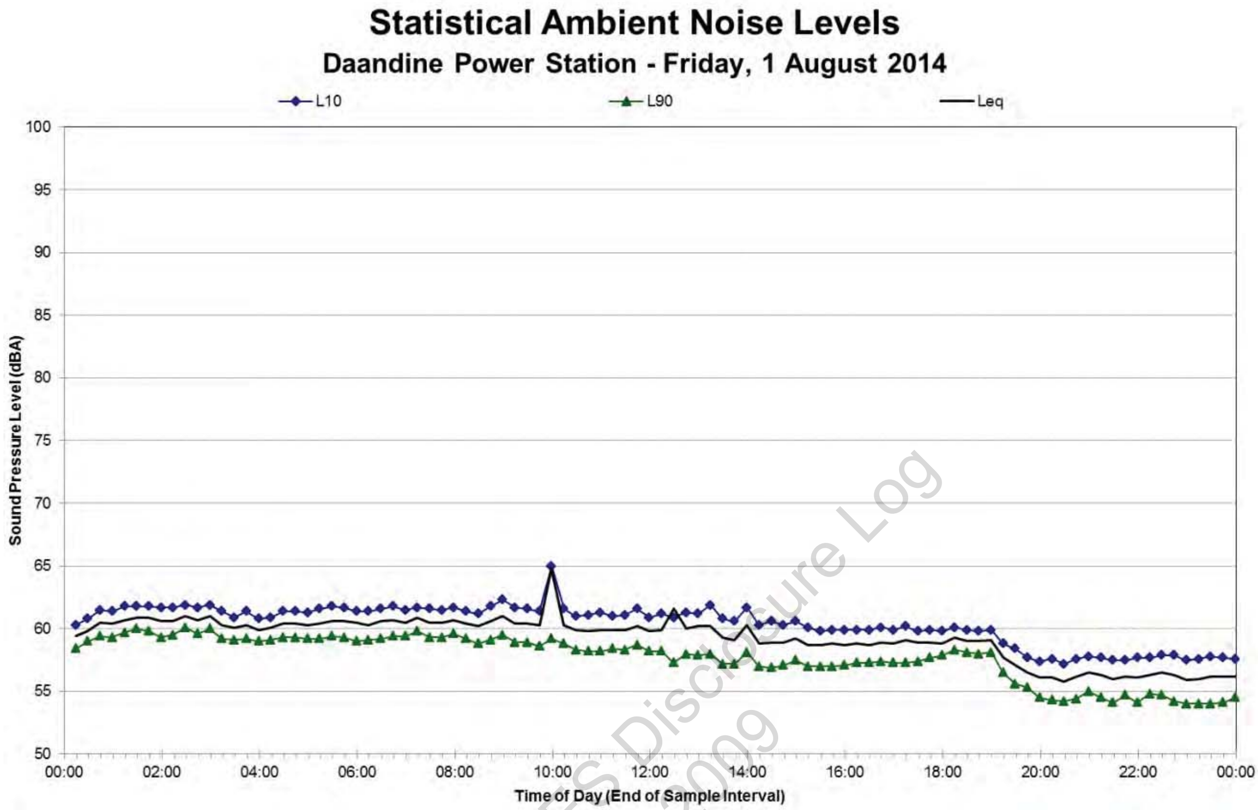

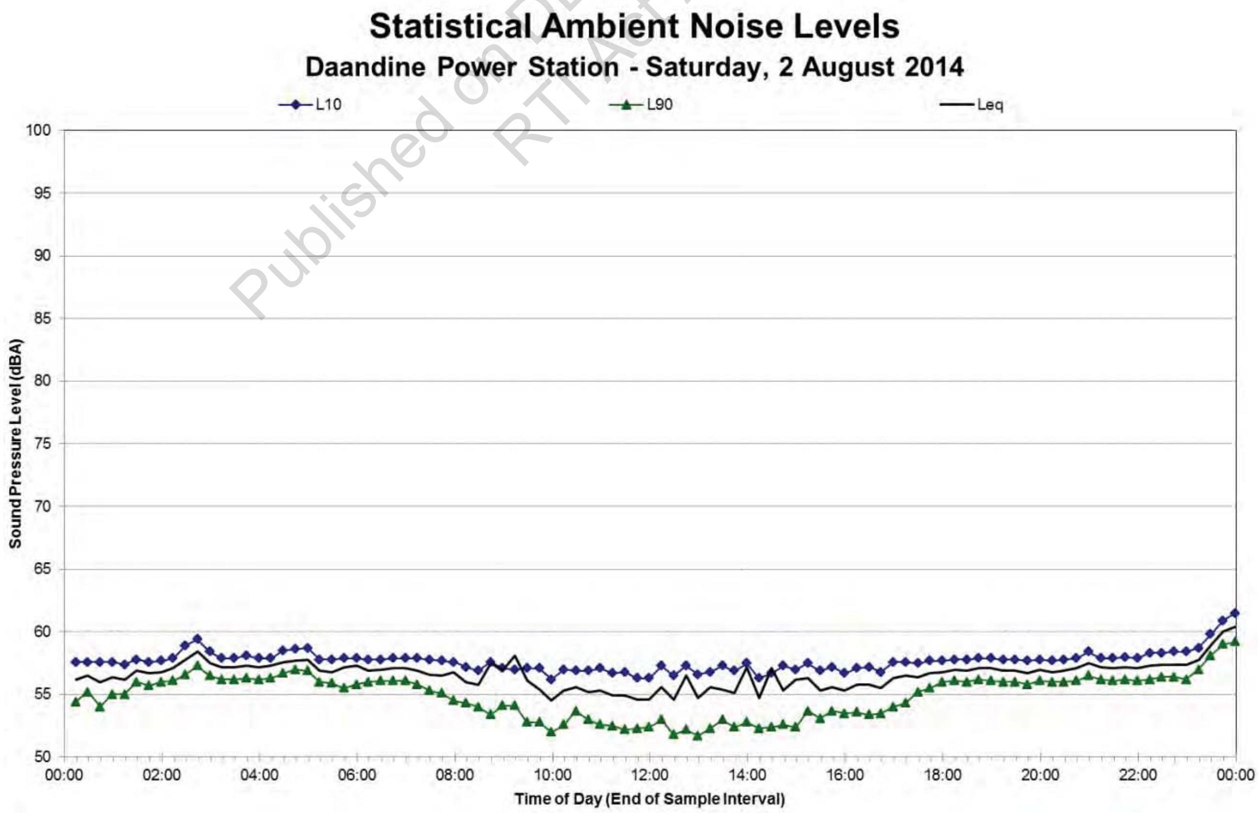

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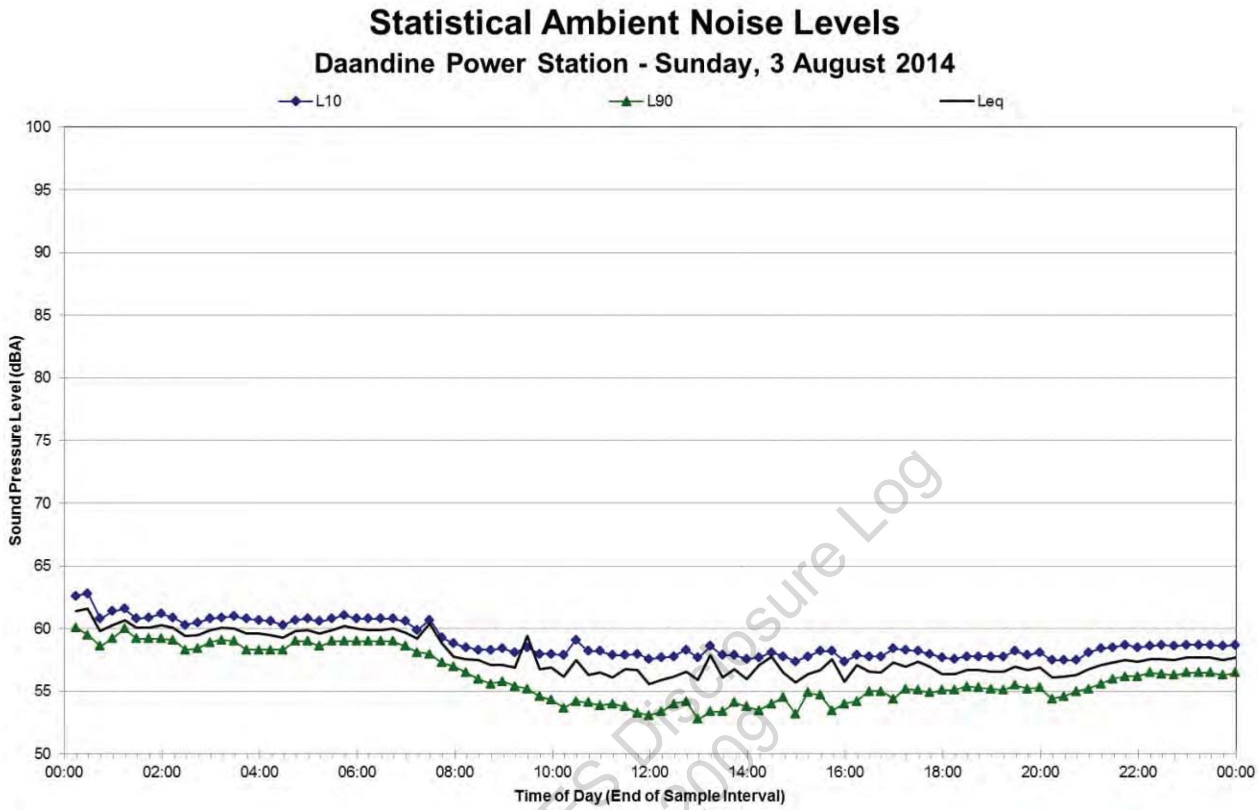
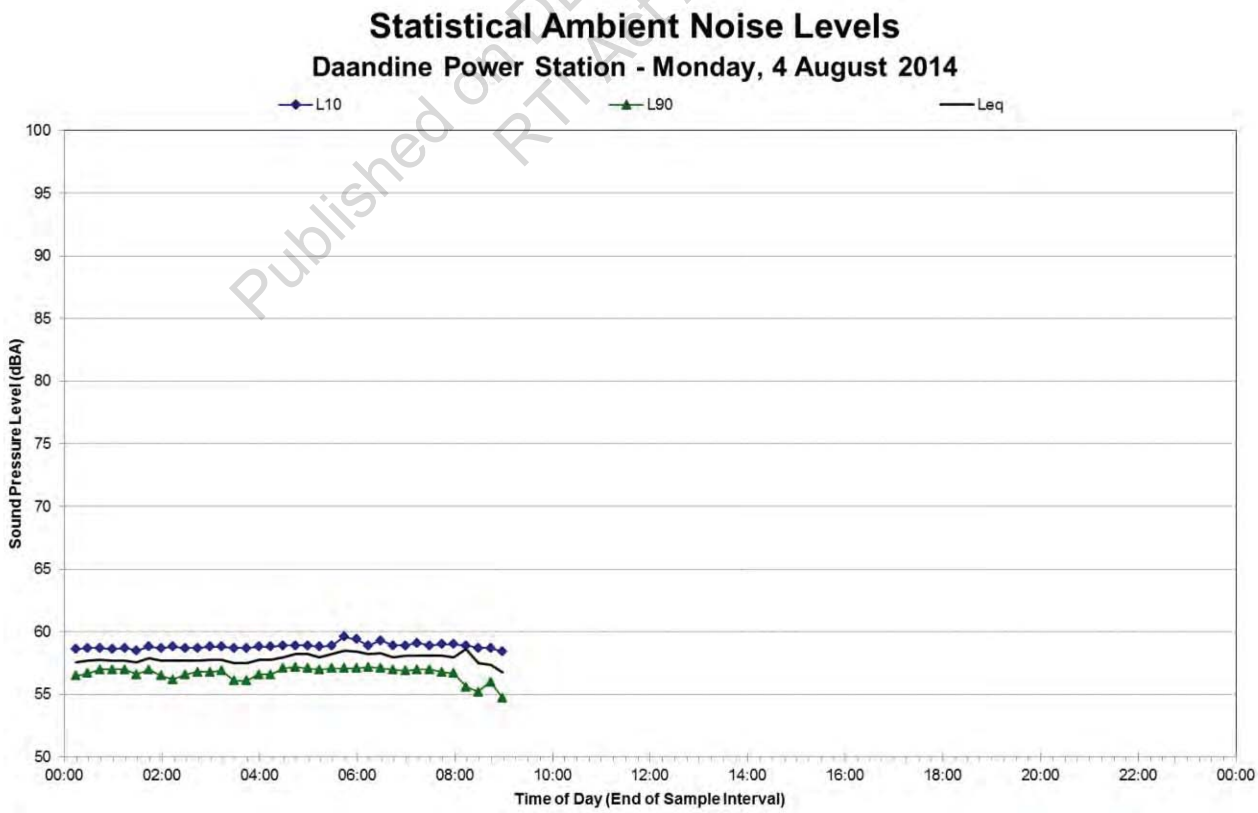




NOISE SOURCE SOUND POWER LEVELS

Table D1 Plant Noise Source Data

Plant	Plant Items	Source Area ID[0]	Source Height (m)	Number of Items	Sound Power Level (dBA) Octave Band Centre Frequency (Hz)									Overall SWL (dBA)
					31.5	63	125	250	500	1000	2000	4000	8000	
CGPF Existing	Export Gas Pressure Control Valve	H	1.5	1	56	73	84	85	89	96	104	109	103	111[16]
	Existing Compressors													
	Engine and compressor (inside sheds)	A	2	7	70	85	104	109	114	113	113	110	102	119[1]
	Existing Compressor Coolers	B	4.6	7										
	Existing Compressor Coolers (Front)				71	80	88	93	95	93	93	89	80	100[1]
	Existing Compressor Coolers (Each side)				71	80	88	93	95	93	93	89	80	100[1]
	Existing Compressor Coolers (Roof)				71	80	88	93	95	93	93	89	80	100[1]
	Compressor Exhausts	J	10	7	59	79	84	89	90	91	90	86	74	97[16]
	CGPF TEG Unit													
	TEG Pump	F1	1.5	1	66	63	72	71	78	88	79	68	65	89[11]
	TEG Reboiler Exhaust	F1	3.5	1	50	67	71	79	82	76	67	58	64	85[11]
CGPF Future	***CGPF Existing***	Refer to CGPF Existing items above												
	CGPF Additional TEG Unit													
	Additional TEG Pump	F2	1.5	1	66	63	72	71	78	88	79	68	65	89[11]
	Additional TEG Reboiler Exhaust	F2	3.5	1	50	67	71	79	82	76	67	58	64	85[11]

NOISE SOURCE SOUND POWER LEVELS

Plant	Plant Items	Source Area ID[0]	Source Height (m)	Number of Items	Sound Power Level (dBA) Octave Band Centre Frequency (Hz)									Overall SWL (dBA)
					31.5	63	125	250	500	1000	2000	4000	8000	
CGPF Future	**Future Engine –Caterpillar G3612.**													
	Mechanical (inside shed)	C	2	3	69	95	110	111	116	119	121	120	110	126[2]
	Air Inlet (inside shed)	C	2	3	-	-	-	-	90	90	106	117	119	121[2]
	Exhaust	D	16.5	3	18	46	55	62	69	77	84	90	89	93[16]
	Future Coolers AirXchange 120-2ZF Cooler	E	3.4	3										
	120-2ZF Cooler (Front/Back)				70	68	77	82	86	85	84	80	71	91[5]
	120-2ZF Cooler (Each Side)				74	72	81	86	90	89	88	84	75	95[5]
	120-2ZF Cooler (Top)				77	75	84	89	93	92	91	87	78	98[5]
	Future Coolers AirXchange 156-2ZF Cooler	E	4.8	3										
	156-2ZF Cooler (Front/Back)				73	71	80	85	89	88	87	83	74	94[6]
	156-2ZF Cooler (Each Side)				77	75	84	89	93	92	91	87	78	98[6]
	156-2ZF Cooler (Top)				79	77	86	91	95	94	93	89	80	100[6]
Reverse Osmosis Plant Electrified	RO container a/c	-	4	4	-	59	64	71	76	77	70	-	-	81[10]
	RO container, all 3 pumps	-	4	4	58	73	79	84	89	88	87	84	72	94[10]
	Service container a/c	-	4	2	-	56	63	70	73	71	65	-	-	77[10]
	Service container	-	4	2	53	68	75	79	84	83	82	79	67	89[10]
	MF container a/c	-	4	4	-	56	63	70	73	71	65	-	-	77[10]
	MF container	-	4	4	50	65	71	76	81	80	79	76	64	86[10]

NOISE SOURCE SOUND POWER LEVELS

Plant	Plant Items	Source Area ID[0]	Source Height (m)	Number of Items	Sound Power Level (dBA) Octave Band Centre Frequency (Hz)									Overall SWL (dBA)
					31.5	63	125	250	500	1000	2000	4000	8000	
Reverse Osmosis Plant Existing	Items from Reverse Osmosis Plant Electrified													
	Generators	-	4	15	60	75	84	87	92	90	87	82	71	96[10]
Wells	Built Well Site	-	2	1 per well site	Refer to Table D2[7]									
	Unbuilt Multi-well Site	-	2	1 per well site	-	-	-	-	100	-	-	-	-	100[8]
	Unbuilt Single Well Site	-	2	1 per well site	-	-	-	-	95	-	-	-	-	95[9]
	Surat Tek Plant	-	2	1 per well site	-	-	-	-	96	-	-	-	-	96[15]
Upset Operation	CGPF Flare	G	24	1	83	101	109	114	115	117	113	109	105	122[12]
	CGPF Cold Vent	G	16	1	-	96	105	108	106	104	99	93	86	112[13]
	Capacity Control Recycle Valves	K	1	3	89	86	95	94	101	111	102	91	88	112[14]
Kogan Compress or Plant	Generators	Refer to Appendix E1	3	3	80	91	99	97	97	104	106	100	89	110[16]
Daandine Power Station	Generators	Refer to Appendix E1	4.1	10	76	94	99	98	101	100	98	96	84	107[16]

Note 0: Refer to Appendix 0

Note 1: Source: David More & Associates Acoustic Report calibrated with measurements undertaken by SLR Staff – July 2014

Note 2: Source: Vendor data

Note 4 : Source: SLR database

Note 5 : Source: Daandine Expansion Project, Australia Arrow Energy CDG Compressor Project Document 750560-20010. Estimated SWL for Air cooler for engine coolant 120-2ZF is 83 dBA @1m, 66 dBA @ 15m

Note 6 : Source: Daandine Expansion Project, Australia Arrow Energy CDG Compressor Project Document 750560-20010. Estimated SWL for Air cooler for engine coolant 156-2ZF is 84 dBA @1m, 68 dBA @ 15m

Note 7: Source: Generator Models for Daandine and Stratheden Wells spreadsheet provided by Clough

Note 8: Assume 85 dBA @ 1.5m and 2 generators

Note 9: Refer to Generator Models for Daandine and Stratheden Wells spreadsheet provided by Clough. The maximum SWL for a well is 95 dBA. 95 dBa is therefore used conservatively when well SWL is not indicated.

Note 10: Source: David More & Associates Acoustic Report calibrated with measurements undertaken by SLR Staff – July 2014

Note 11:Source: SLR database calibrated with measurements undertaken by SLR Staff – July 2014

Note 12: As per Noise Emission Data Document Number Q10859-DS24 from GASCO, assume 100% Peak Flow

Note 13: Source: SLR database and Beis and Hansen Engineering Noise Control

Note 14:Source: Daandine Expansion Project, Australia Arrow Energy CDG Compressor Project Document 750560-20010. Assume 104 dBA @ 1m, 100% flowrate

Note 15:Source: Equipment Data Sheet for Gas Generator, 80 dB @ 1 m at Full load, 7 units

Note16: Measured by SLR staff – July 2014

Table D2 Specific Noise Source Data for Each Existing Well Site

Well Name	Build Date	Type	Make	Model	Comments	Noise - dBA
Daandine Existing Current Producing Wells – Phase 0						
Daandine-3	09/12/2006	Hydraulic	RDS	RDS-115HI 4.3L V6	OPEN ENGINE PACK (NO NOISE SUPRESSION)	95[1]
Daandine-5	23/01/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-6	05/07/2006	Electric	RDS	RDS-GS60 5.7L V8		93
Daandine-6T	*Same as DD-6*	*Same as DD-6*	*Same as DD-6*	*Same as DD-6*		93
Daandine-7	01/06/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-7T	*Same as DD-7*	*Same as DD-7*	*Same as DD-7*	*Same as DD-7*		95
Daandine-8	24/04/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-8T	*Same as DD-8*	*Same as DD-8*	*Same as DD-8*	*Same as DD-8*		95
Daandine-9	25/01/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-10	31/03/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-10T	*Same as DD-10*	*Same as DD-10*	*Same as DD-10*	*Same as DD-10*		95
Daandine-11	24/04/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-11T	*Same as DD-11*	*Same as DD-11*	*Same as DD-11*	*Same as DD-11*		95
Daandine-12	12/03/2008	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-12T	*Same as DD-12*	*Same as DD-12*	*Same as DD-12*	*Same as DD-12*		95
Daandine-13A	*No Date*	Electric	RDS	*No Model*		95[1]
Daandine-14	24/03/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-14T	*Same as DD-14*	*Same as DD-14*	*Same as DD-14*	*Same as DD-14*		95

Well Name	Build Date	Type	Make	Model	Comments	Noise - dBA
Daandine-15	27/03/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-15T	*Same as DD-15*	*Same as DD-15*	*Same as DD-15*	*Same as DD-15*		95
Daandine-18	22/03/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-18T	*Same as DD-18*	*Same as DD-18*	*Same as DD-18*	*Same as DD-18*		95
Daandine-19	21/08/2009	Electric	RDS	RDS-GS60 5.7L V8		93
Daandine-19T	*Same as DD-19*	*Same as DD-19*	*Same as DD-19*	*Same as DD-19*		93
Daandine-20	02/03/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-20T	*Same as DD-20*	*Same as DD-20*	*Same as DD-20*	*Same as DD-20*		95
Daandine-21	17/04/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-21T	*Same as DD-21*	*Same as DD-21*	*Same as DD-21*	*Same as DD-21*		95
Daandine-22	01/06/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-22T	*Same as DD-22*	*Same as DD-22*	*Same as DD-22*	*Same as DD-22*		95
Daandine-26	31/03/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-26T	*Same as DD-26*	*Same as DD-26*	*Same as DD-26*	*Same as DD-26*		95
Daandine-27	21/08/2009	Electric	RDS	RDS-GS60 5.7L V8		93
Daandine-27T	*Same as DD-27*	*Same as DD-27*	*Same as DD-27*	*Same as DD-27*		93
Daandine-28	05/08/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-28T	*Same as DD-28*	*Same as DD-28*	*Same as DD-28*	*Same as DD-28*		95
Daandine-29	05/08/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-29T	*Same as DD-29*	*Same as DD-29*	*Same as DD-29*	*Same as DD-29*		95
Daandine-30	25/03/2009	Electric	RDS	RDS-GS100 8.1L V8		95

Well Name	Build Date	Type	Make	Model	Comments	Noise - dBA
Daandine-30T	*Same as DD-30*	*Same as DD-30*	*Same as DD-30*	*Same as DD-30*		95
Daandine-31	02/03/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-31T	*Same as DD-31*	*Same as DD-31*	*Same as DD-31*	*Same as DD-31*		95
Daandine-32	22/03/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-32T	*Same as DD-32*	*Same as DD-32*	*Same as DD-32*	*Same as DD-32*		95
Daandine-33	13/11/2007	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-33T	*Same as DD-33*	*Same as DD-33*	*Same as DD-33*	*Same as DD-33*		90
Daandine-34	*No Date*	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-34T	*Same as DD-34*	*Same as DD-34*	*Same as DD-34*	*Same as DD-34*		95
Daandine-35	06/04/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-35T	*Same as DD-35*	*Same as DD-35*	*Same as DD-35*	*Same as DD-35*		95
Daandine-36	05/08/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-36T	*Same as DD-36*	*Same as DD-36*	*Same as DD-36*	*Same as DD-36*		95
Daandine-37T	06/04/2007	Electric	RDS	RDS-GS45 4.3L V6		92
Daandine-38	02/03/2009	Electric	RDS	RDS-GS100 8.1L V8		95
Daandine-38T	*Same as DD-38*	*Same as DD-38*	*Same as DD-38*	*Same as DD-38*		95
Daandine-39	05/12/2007	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-40	23/05/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-41	13/12/2007	Electric	RDS	RDS-GS45 4.3L V6		92
Daandine-42	11/12/2007	Electric	RDS	RDS-GS45 4.3L V6		92
Daandine-43	10/12/2007	Electric	RDS	RDS-GS45 4.3L V6		92

Well Name	Build Date	Type	Make	Model	Comments	Noise - dBA
Daandine-44	*No Date*	Electric	RDS	*No Model*		95[1]
Daandine-44T	*Same as DD-44*	*Same as DD-44*	*Same as DD-44*	*Same as DD-44*		95[1]
Daandine-45	22/09/2008	Electric	RDS	RDS-GS60 5.7L V8		93
Daandine-45T	*Same as DD-45*	*Same as DD-45*	*Same as DD-45*	*Same as DD-45*		93
Daandine-46	23/05/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-50	17/10/2008	Electric	RDS	RDS-GS60 5.7L V8		93
Daandine-51	17/10/2008	Electric	RDS	RDS-GS60 5.7L V8		93
Daandine-52	29/05/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-53	23/05/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-54	22/01/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-55	14/05/2008	Electric	RDS	RDS-GS45 4.3L V6		92
Daandine-56	30/05/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-57	23/05/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-58	04/04/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-59	29/05/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-60	23/05/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-61	29/05/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-62	07/06/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-63	30/05/2008	Electric	RDS	RDS-GS25 3.0L I4		90
Daandine-75	29/06/2006	Electric	RDS	RDS-GS60 5.7L V8		93
Daandine-76	09/02/2009	Electric	RDS	RDS-GS60 5.7L V8		93

NOISE SOURCE SOUND POWER LEVELS

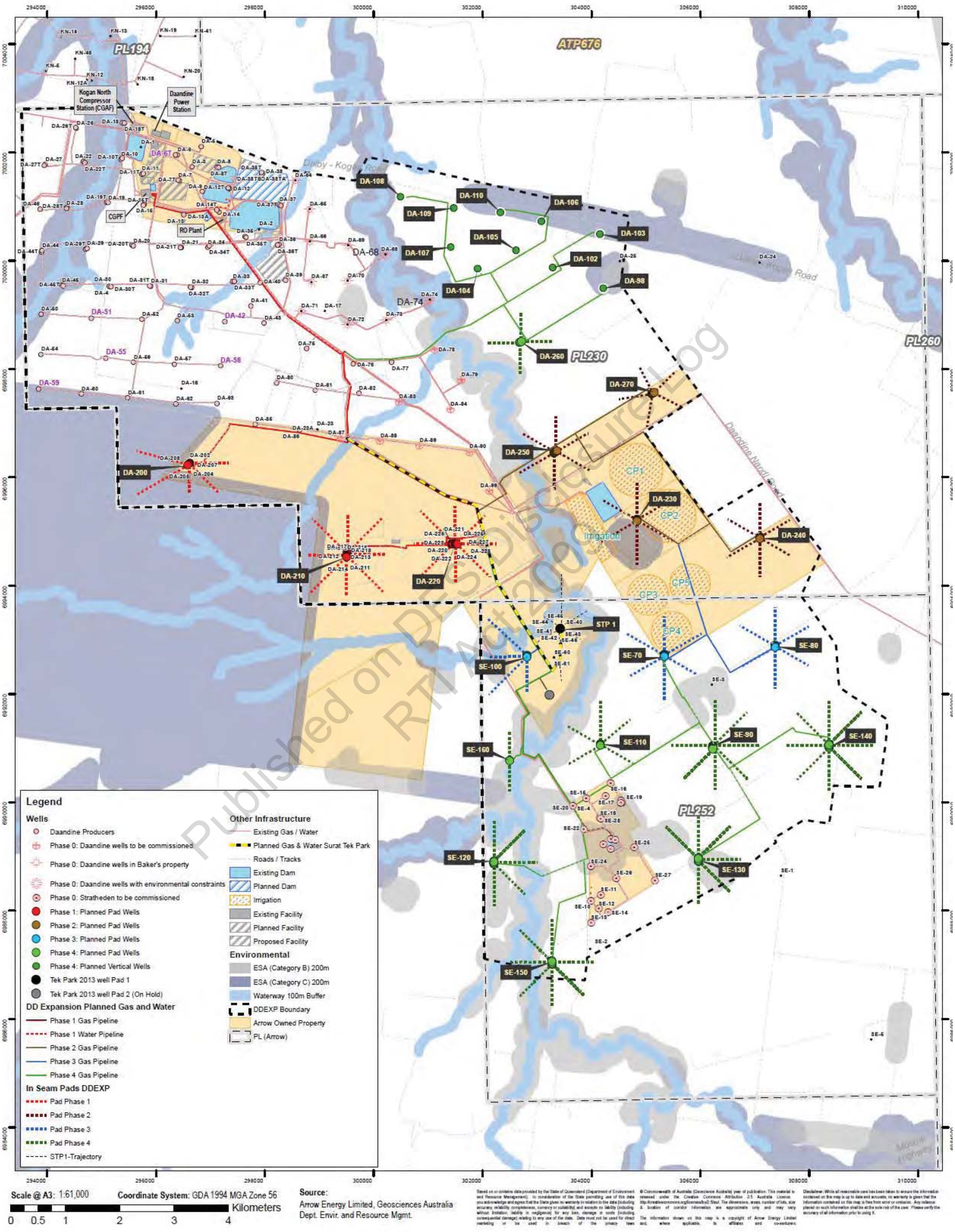
Well Name	Build Date	Type	Make	Model	Comments	Noise - dBA
Daandine-77	12/04/2007	Electric	RDS	RDS-GS45 4.3L V6		92
Daandine-80	27/10/2008	Electric	RDS	RDS-GS60 5.7L V8		93
Daandine-81	19/10/2009	Electric	RDS	RDS-GS60 5.7L V8		93
Daandine-82	18/04/2007	Electric	RDS	RDS-GS45 4.3L V6		92
Daandine-85	12/04/2007	Electric	RDS	RDS-GS45 4.3L V6		92
Daandine-86	18/04/2007	Electric	RDS	RDS-GS45 4.3L V6		92
Phase 0 – Planned Wells						
Daandine-64	NA	Electric	RDS	RDS-GS25 3.0L I5	fitted with silence pack	90
Daandine-65	NA	Electric	RDS	RDS-GS25 3.0L I6	fitted with silence pack	90
Daandine-66	NA	Electric	RDS	RDS-GS25 3.0L I7	fitted with silence pack	90
Daandine-67	NA	Electric	RDS	RDS-GS25 3.0L I8	fitted with silence pack	90
Daandine-69	NA	Electric	RDS	shared with DD68		95
Daandine-70	NA	Electric	RDS	shared with DD69		95
Daandine-71	NA	Electric	RDS	RDS-GS25 3.0L I8	fitted with silence pack	90
Daandine-72	NA	Electric	RDS	RDS-GS25 3.0L I9	fitted with silence pack	90
Daandine-73	NA	Electric	RDS	RDS-GS25 3.0L I10	fitted with silence pack	90
Daandine-78	18/11/2007	Electric	RDS	RDS-GS45 4.3L V6		92
Daandine-79	06/04/2007	Electric	RDS	RDS-GS45 4.3L V6		92
Daandine-83	17/10/2008	Electric	RDS	RDS-GS60 5.7L V8		93
Daandine-84	08/11/2005	Electric	RDS	RDS-GS60 5.7L V8		93
Daandine-87	06/04/2007	Electric	RDS	RDS-GS45 4.3L V6		92

NOISE SOURCE SOUND POWER LEVELS

Well Name	Build Date	Type	Make	Model	Comments	Noise - dBA
Daandine-88	06/04/2007	Electric	RDS	RDS-GS45 4.3L V6		92
Daandine-89	12/04/2007	Electric	RDS	RDS-GS45 4.3L V6		92
Daandine-90	17/10/2008	Electric	RDS	RDS-GS60 5.7L V8		93
Daandine-99	06/02/2009	Electric	RDS	RDS-GS60 5.7L V8		93
SE-13	21/02/2009	Electric	RDS	RDS-GS100 8.1L V8		95
SE-15	07/03/2008	Electric	RDS	RDS-GS100 8.1L V8		95
SE-19	06/04/2009	Electric	RDS	RDS-GS100 8.1L V8		95
SE-22	13/06/2009	Electric	RDS	RDS-GS100 8.1L V8		95
SE-24	13/06/2009	Electric	RDS	RDS-GS100 8.1L V8		95
SE-25	13/06/2009	Electric	RDS	RDS-GS100 8.1L V8		95
SE-27	*Same as SE-25*	*Same as SE-25*	*Same as SE-25*	*Same as SE-25*		95

Note 1 : Refer to Note 9 in Table A

NOISE SOURCES LOCATIONS - WELLS



NOISE SOURCES LOCATIONS – OPERATING WELLS

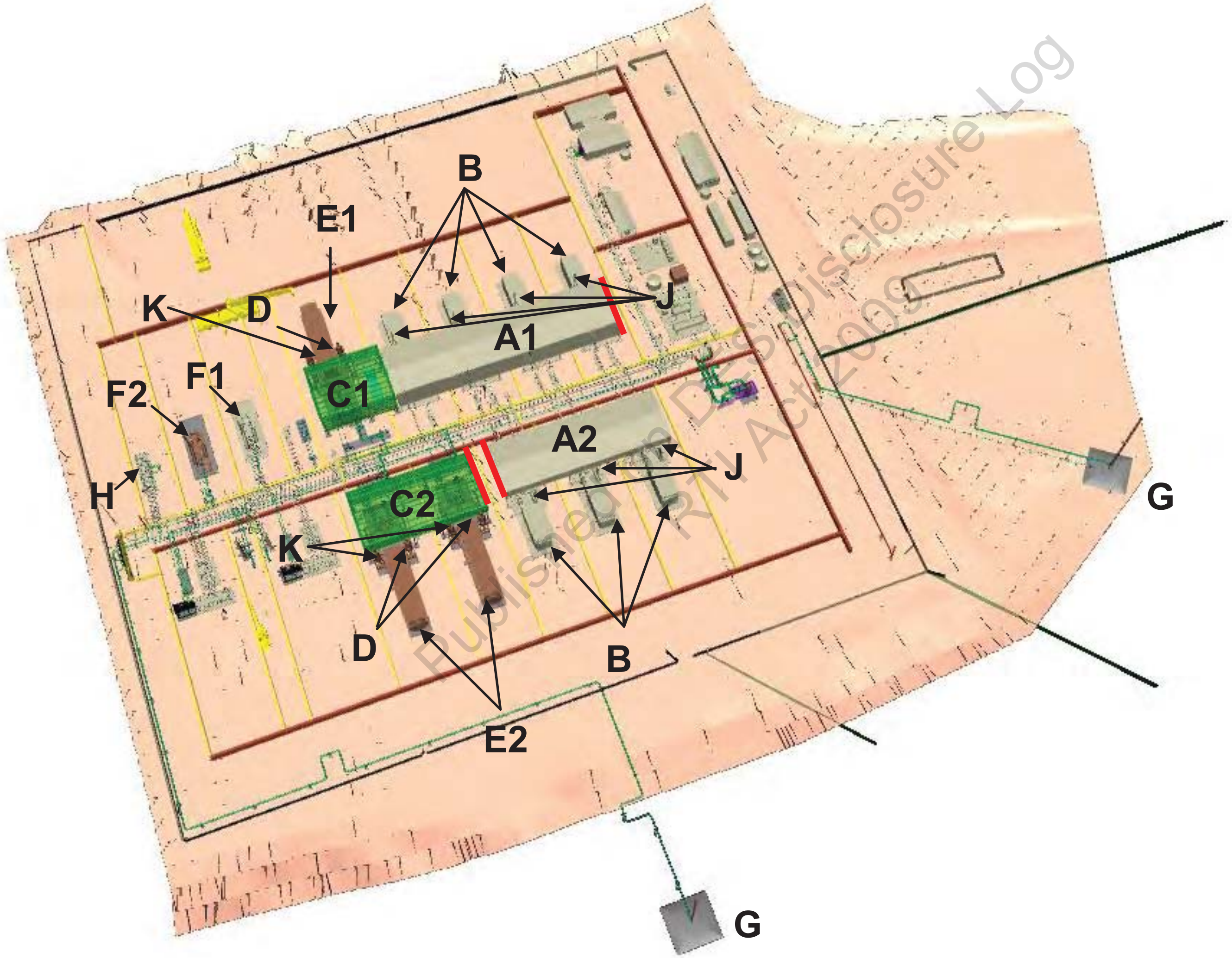
EXISTING	UNIQUEID	STATUS
DAANDINE EXISTING CURRENT PRODUCING WELLS- PHASE0	Daandine-13A	Existing producing
	Daandine-46	Existing producing
	Daandine-50	Existing producing
	Daandine-51	Existing producing
	Daandine-52	Existing producing
	Daandine-53	Existing producing
	Daandine-54	Existing producing
	Daandine-55	Existing producing
	Daandine-56	Existing producing
	Daandine-57	Existing producing
	Daandine-58	Existing producing
	Daandine-59	Existing producing
	Daandine-60	Existing producing
	Daandine-61	Existing producing
	Daandine-62	Existing producing
	Daandine-63	Existing producing
	Daandine-76	Existing producing
	Daandine-77	Existing producing
	Daandine-80	Existing producing
	Daandine-81	Existing producing
	Daandine-82	Existing producing
	Daandine-85	Existing producing
	Daandine-86	Existing producing
	Daandine-10	Existing producing
	Daandine-11	Existing producing
	Daandine-12	Existing producing
	Daandine-14	Existing producing
	Daandine-15	Existing producing
	Daandine-18	Existing producing
	Daandine-19	Existing producing
	Daandine-20	Existing producing
	Daandine-21	Existing producing
	Daandine-22	Existing producing
	Daandine-26	Existing producing
	Daandine-27	Existing producing
	Daandine-28	Existing producing
	Daandine-29	Existing producing
	Daandine-3	Existing producing
	Daandine-30	Existing producing
	Daandine-31	Existing producing
	Daandine-32	Existing producing
	Daandine-33	Existing producing
	Daandine-34	Existing producing
	Daandine-35	Existing producing
	Daandine-36	Existing producing
	Daandine-38	Existing producing
	Daandine-39	Existing producing

EXISTING	UNIQUEID	STATUS
	Daandine-44	Existing producing
	Daandine-45	Existing producing
	Daandine-5	Existing producing
	Daandine-6	Existing producing
	Daandine-7	Existing producing
	Daandine-8	Existing producing
	Daandine-9	Existing producing
	Daandine-10T	Existing producing
	Daandine-11T	Existing producing
	Daandine-12T	Existing producing
	Daandine-14T	Existing producing
	Daandine-15T	Existing producing
	Daandine-18T	Existing producing
	Daandine-19T	Existing producing
	Daandine-20T	Existing producing
	Daandine-21T	Existing producing
	Daandine-22T	Existing producing
	Daandine-26T	Existing producing
	Daandine-27T	Existing producing
	Daandine-28T	Existing producing
	Daandine-29T	Existing producing
	Daandine-30T	Existing producing
	Daandine-31T	Existing producing
	Daandine-32T	Existing producing
	Daandine-33T	Existing producing
	Daandine-34T	Existing producing
	Daandine-35T	Existing producing
	Daandine-36T	Existing producing
	Daandine-37T	Existing producing
	Daandine-38T	Existing producing
	Daandine-40	Existing producing
	Daandine-41	Existing producing
	Daandine-42	Existing producing
	Daandine-43	Existing producing
	Daandine-44T	Existing producing
	Daandine-45T	Existing producing
	Daandine-6T	Existing producing
	Daandine-75	Existing producing
	Daandine-7T	Existing producing
	Daandine-8T	Existing producing

NOISE SOURCES LOCATIONS – OPERATING WELLS

FUTURE	UNIQUEID	STATUS
Phase-0 planned wells	Daandine-64	sch4p4(6) Persor
	Daandine-65	
	Daandine-66	
	Daandine-67	
	Daandine-69	
	Daandine-70	
	Daandine-71	
	Daandine-72	
	Daandine-73	
	Daandine-78	DA_TBC1
	Daandine-79	DA_TBC1
	Daandine-83	DA_TBC1
	Daandine-84	DA_TBC1
	Daandine-87	DA_TBC1
	Daandine-88	DA_TBC1
	Daandine-89	DA_TBC1
	Daandine-90	DA_TBC1
	Daandine-99	DA_TBC1
	SE-27	SE_Existing
	SE-25	SE_Existing
	SE-13	SE_Existing
	SE-24	SE_Existing
	SE-22	SE_Existing
	SE-19	SE_Existing
	SE-15	SE_Existing
	STP	8 wells on pad (phase-0)
Phase- 1 Pads	P_DA 200-205	5 wells on pad (phase-1)
	P_DA 210-218	8 wells on pad (phase-1)
	P_DA 220-229	9 wells on pad (phase-1)

NOISE SOURCES LOCATIONS - CGPF



A Existing Compressor Sheds

B Existing Compressor Coolers

C Future Compressor Sheds

D Future Engine G3612 Exhaust

E Future 120-2ZF and 156-2ZF Coolers

F TEG Units

G Flare and Cold Vent

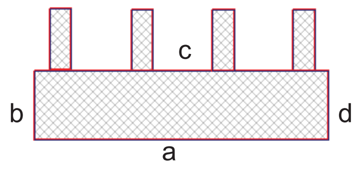
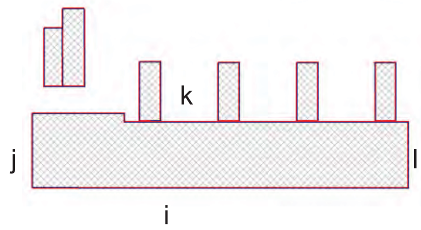
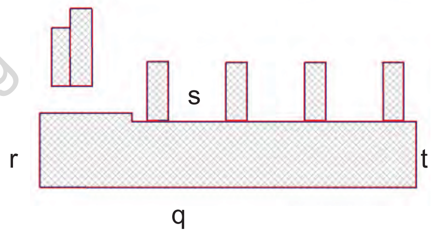
H Export Gas Pressure Control valve

J Existing Compressor Exhausts

K Capactiy Control Recycle Valves

Open

NOISE SOURCES LOCATIONS – EXISTING AND FUTURE CGPF WALLS DETAILED WITH AND WITHOUT MITIGATION

CGPF existing		CGPF Future unmitigated		CGPF Future mitigated	
Building A1 		Building A1+C1 		Building A1+C1 	
Façade a 	300 mm gap 4700 mm steel cladding 2000 mm gap	Façade i 	300 mm gap 4700 mm steel cladding 2000 mm gap	Façade q 	300 mm gap 6300 mm steel cladding 400 mm gap
Façade b 	7000 mm Opening	Façade j 	2000 mm steel cladding 5000 mm opening	Façade r 	300 mm gap 6300 mm steel cladding 400 mm gap
Façade c 	300 mm gap 1700 mm steel cladding 5000 mm gap	Façade k 	300 mm gap 1700 mm steel cladding 5000 mm gap	Façade s 	300 mm gap 6300 mm steel cladding 400 mm gap

NOISE SOURCES LOCATIONS – EXISTING AND FUTURE CGPF WALLS DETAILED WITH AND WITHOUT MITIGATION

Façade d

7000 mm Opening

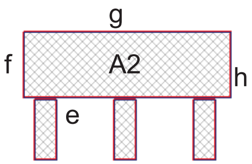
Façade l

7000 mm Opening

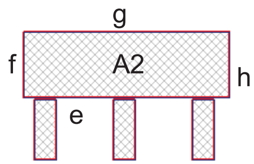
Façade t

7000 mm Opening

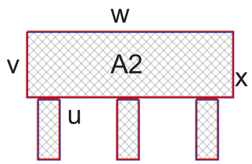
Building A2



Building A2



Building A2

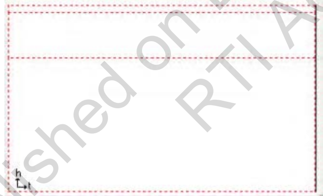


Façade e

300 mm gap
1700 mm steel cladding

5000 mm gap

Façade e



300 mm gap
1700 mm steel cladding

5000 mm gap

Façade u

300 mm gap

6300 mm steel cladding

400 mm gap

Façade f

7000 mm Opening

Façade f

7000 mm Opening

Façade v

7000 mm Opening

NOISE SOURCES LOCATIONS – EXISTING AND FUTURE CGPF WALLS DETAILED WITH AND WITHOUT MITIGATION

Façade g

300 mm gap

4700 mm steel cladding

2000 mm gap

Façade g

300 mm gap

4700 mm steel cladding

2000 mm gap

Façade w

300 mm gap

6300 mm steel cladding

400 mm gap

Façade h

7000 mm Opening

Façade h

7000 mm Opening

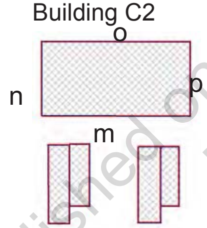
Façade x

300 mm gap

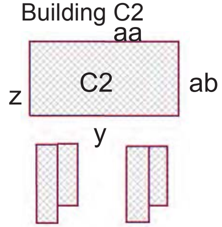
6300 mm steel cladding

400 mm gap

Building C2



Building C2



Façade m

300 mm gap
1700 mm steel cladding

5000 mm gap

Façade y

300 mm gap

6300 mm steel cladding

400 mm gap

NOISE SOURCES LOCATIONS – EXISTING AND FUTURE CGPF WALLS DETAILED WITH AND WITHOUT MITIGATION

Façade n

2000 mm steel cladding

5000 mm opening

Façade z

300 mm gap

6300 mm steel cladding

400 mm gap

Façade o

300 mm gap

4700 mm steel cladding

2000 mm gap

Façade aa

300 mm gap

6300 mm steel cladding

400 mm gap

Façade p

2000 mm steel cladding

5000 mm opening

Façade ab

2000 mm steel cladding

5000 mm opening

Table F1 Predicted Noise Levels at Receptor Locations – Neutral Weather Conditions

ID	Receiver Type	Predicted Noise Level (dBA L_{Aeq})							
		Scenario 1	Scenario 2	Scenario 3a	Scenario 3b	Scenario 4a	Scenario 4b	Scenario 5	Scenario 6
Privately Owned Dwellings – Currently Occupied									
3	Dwelling	18	**40**	19	19	**40**	**40**	**40**	20
4	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
7	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
8	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
9	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
10	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
11	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
31	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
32	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
33	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
35	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
36	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
37	Dwelling	<15	16	18	18	18	18	19	17
38	Dwelling	17	18	19	19	19	19	20	18
40	Dwelling	20	21	21	20	22	22	23	22
41	Dwelling	25	26	25	24	27	26	27	25
42	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
43	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
44	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
45	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
46	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
47	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
48	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
49	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
50	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
51	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
52	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
53	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
54	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
55	Dwelling	27	28	28	27	**33**	**32**	**33**	28
56	Dwelling	27	28	28	27	**33**	**33**	**33**	28
57	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
58	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
59	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
60	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
61	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
62	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
63	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
64	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
65	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
66	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15

PREDICTED NOISE LEVELS

ID	Receiver Type	Predicted Noise Level (dBA L_{Aeq})							
		Scenario 1	Scenario 2	Scenario 3a	Scenario 3b	Scenario 4a	Scenario 4b	Scenario 5	Scenario 6
Privately Owned Dwellings – Currently Occupied									
67	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
68	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
69	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
70	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
71	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
72	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
73	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
74	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
75	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
76	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
77	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
78	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
79	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
80	Dwelling	<15	<15	<15	<15	23	23	23	<15
81	Dwelling	<15	<15	<15	<15	18	18	18	<15
83	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
84	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
85	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
86	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
87	Dwelling	<15	<15	<15	<15	20	20	20	<15
88	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
89	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
90	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
91	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
92	Dwelling	17	18	20	20	20	20	21	19
93	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
94	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
95	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
96	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
97	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
98	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
99	Dwelling	18	19	20	20	21	21	21	20
100	Dwelling	**33**	**34**	**36**	**36**	**37**	**37**	**37**	**35**
102	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
103	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
104	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
105	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
106	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
107	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15

PREDICTED NOISE LEVELS

ID	Receiver Type	Predicted Noise Level (dBA LAeq)							
		Scenario 1	Scenario 2	Scenario 3a	Scenario 3b	Scenario 4a	Scenario 4b	Scenario 5	Scenario 6
Privately Owned Dwellings – Currently Unoccupied									
1	Dwelling - Unoccupied	<15	<15	<15	<15	<15	<15	<15	<15
2	Dwelling - Unoccupied	<15	<15	<15	<15	<15	<15	<15	<15
34	Dwelling - Unoccupied	<15	<15	<15	<15	<15	<15	<15	<15
39	Dwelling - Unoccupied	28	29	29	29	30	30	31	31
Arrow Owned Dwellings – Currently Occupied									
17	Arrow Owned	<15	<15	<15	<15	25	25	25	<15
26	Arrow Owned	<15	<15	<15	<15	<15	<15	<15	<15
28	Arrow Owned	<15	<15	<15	<15	<15	<15	<15	<15
29	Arrow Owned	<15	<15	<15	<15	<15	<15	<15	<15
30	Arrow Owned	<15	<15	<15	<15	<15	<15	<15	<15
Arrow Owned Dwellings – Currently Unoccupied									
18	Arrow Owned - Unoccupied	<15	<15	<15	<15	25	25	25	<15
19	Arrow Owned - Unoccupied	<15	<15	<15	<15	17	17	17	<15
21	Arrow Owned - Unoccupied	<15	<15	<15	<15	18	18	18	<15
22	Arrow Owned - Unoccupied	<15	<15	<15	<15	17	17	17	<15
23	Arrow Owned - Unoccupied	<15	<15	<15	<15	22	22	22	<15
24	Arrow Owned - Unoccupied	<15	<15	<15	<15	21	21	21	<15
25	Arrow Owned - Unoccupied	<15	<15	<15	<15	22	22	22	<15
27	Arrow Owned - Unoccupied	<15	<15	<15	<15	21	21	21	<15

Note: Shaded rows are Arrow owned dwellings and privately owned dwellings – currently unoccupied. These are not considered critical receivers for this assessment as Arrow has the ability control the occupancy of these properties and/or to negotiate special terms with the tenants.

***Bold** values indicate exceedances of the noise limit – only applicable to privately owned dwellings – currently unoccupied.*

Table F2 Predicted Noise Levels at Receptor Locations – Adverse Weather Conditions

ID	Receiver Type	Predicted Noise Level (dBA L_{Aeq})							
		Scenario 1	Scenario 2	Scenario 3a	Scenario 3b	Scenario 4a	Scenario 4b	Scenario 5	Scenario 6
Privately Owned Dwellings – Currently Occupied									
3	Dwelling	25	**41**	26	26	**41**	**41**	**41**	26
4	Dwelling	<15	<15	<15	<15	18	18	18	<15
7	Dwelling	<15	<15	<15	<15	21	21	21	<15
8	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
9	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
10	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
11	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
31	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
32	Dwelling	<15	<15	<15	<15	<15	<15	16	<15
33	Dwelling	<15	<15	<15	<15	15	<15	16	<15
35	Dwelling	<15	<15	17	17	17	17	17	16
36	Dwelling	<15	<15	<15	<15	16	15	16	<15
37	Dwelling	23	23	25	25	25	25	25	23
38	Dwelling	24	25	26	26	27	27	27	24
40	Dwelling	27	28	28	27	**29**	**29**	**30**	28
41	Dwelling	**32**	**33**	**32**	**31**	**34**	**33**	**34**	**31**
42	Dwelling	18	18	19	18	20	20	20	19
43	Dwelling	15	16	17	16	18	18	19	17
44	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
45	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
46	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
47	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
48	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
49	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
50	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
51	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
52	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
53	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
54	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
55	Dwelling	**34**	**35**	**34**	**34**	**38**	**37**	**38**	**34**
56	Dwelling	**33**	**35**	**34**	**34**	**38**	**38**	**38**	**34**
57	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
58	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
59	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
60	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
61	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
62	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
63	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
64	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
65	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
66	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15

ID	Receiver Type	Predicted Noise Level (dBA L_{Aeq})							
		Scenario 1	Scenario 2	Scenario 3a	Scenario 3b	Scenario 4a	Scenario 4b	Scenario 5	Scenario 6
Privately Owned Dwellings – Currently Occupied									
67	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
68	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
69	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
70	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
71	Dwelling	<15	<15	<15	<15	16	16	16	<15
72	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
73	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
74	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
75	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
76	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
77	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
78	Dwelling	<15	<15	<15	<15	20	20	20	<15
79	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
80	Dwelling	<15	<15	<15	<15	**29**	**29**	**29**	<15
81	Dwelling	<15	<15	<15	<15	25	25	25	<15
83	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
84	Dwelling	<15	<15	<15	<15	18	18	18	<15
85	Dwelling	<15	<15	<15	<15	20	20	20	<15
86	Dwelling	<15	<15	<15	<15	20	20	20	<15
87	Dwelling	<15	<15	<15	<15	27	27	27	<15
88	Dwelling	<15	<15	<15	<15	20	20	20	<15
89	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
90	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
91	Dwelling	<15	<15	<15	<15	18	18	18	16
92	Dwelling	25	25	27	27	27	27	28	25
93	Dwelling	<15	<15	<15	<15	17	17	17	<15
94	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
95	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
96	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
97	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
98	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
99	Dwelling	25	26	28	28	28	28	28	26
100	Dwelling	**39**	**40**	**42**	**42**	**43**	**43**	**43**	**40**
102	Dwelling	<15	<15	<15	<15	<15	<15	16	<15
103	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
104	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
105	Dwelling	<15	<15	<15	<15	<15	<15	<15	<15
106	Dwelling	18	19	19	19	20	20	21	20
107	Dwelling	17	18	19	18	19	19	20	19

ID	Receiver Type	Predicted Noise Level (dBA L_{Aeq})							
		Scenario 1	Scenario 2	Scenario 3a	Scenario 3b	Scenario 4a	Scenario 4b	Scenario 5	Scenario 6
Privately Owned Dwellings – Currently Unoccupied									
1	Dwelling - Unoccupied	<15	<15	<15	<15	<15	<15	16	<15
2	Dwelling - Unoccupied	<15	<15	<15	<15	<15	<15	16	<15
34	Dwelling - Unoccupied	<15	<15	<15	<15	<15	<15	16	<15
39	Dwelling - Unoccupied	35	36	36	36	37	37	38	37
Arrow Owned Dwellings – Currently Occupied									
17	Arrow Owned	<15	<15	<15	<15	31	31	31	<15
26	Arrow Owned	<15	<15	<15	<15	<15	<15	<15	<15
28	Arrow Owned	<15	<15	<15	<15	22	22	22	<15
29	Arrow Owned	<15	<15	<15	<15	20	20	20	<15
30	Arrow Owned	<15	<15	<15	<15	<15	<15	<15	<15
Arrow Owned Dwellings – Currently Unoccupied									
18	Arrow Owned - Unoccupied	<15	<15	<15	<15	30	30	30	<15
19	Arrow Owned - Unoccupied	<15	<15	<15	<15	25	25	25	<15
21	Arrow Owned - Unoccupied	<15	<15	<15	<15	25	25	25	<15
22	Arrow Owned - Unoccupied	<15	<15	<15	<15	24	24	25	<15
23	Arrow Owned - Unoccupied	<15	17	16	16	29	29	29	16
24	Arrow Owned - Unoccupied	<15	<15	<15	<15	28	28	28	<15
25	Arrow Owned - Unoccupied	<15	18	17	16	29	29	29	17
27	Arrow Owned - Unoccupied	<15	18	17	17	28	28	28	17

Note: Shaded rows are Arrow owned dwellings and privately owned dwellings – currently unoccupied. These are not considered critical receivers for this assessment as Arrow has the ability control the occupancy of these properties and/or to negotiate special terms with the tenants.

***Bold** values indicate exceedances of the noise limit – only applicable to privately owned dwellings – currently unoccupied.*

Appendix

Report 620.10773R3

Noise Contour Maps

MITIGATION OF CGPF NOISE CONTRIBUTION AT RECEIVERS ID 41, ID 55 AND ID 56

Table H1 Receptor ID 41 Predicted CGPF Noise Contributions for Mitigation Scenarios

CGPF Plant[1]	Neutral Weather Conditions					Adverse Weather Conditions				
	CGPF Existing	CGPF Future No Mitigation	CGPF Future – Mitigation 1	CGPF Future – Mitigation 2	CGPF Future – Mitigation 3	CGPF Existing	CGPF Future No Mitigation	CGPF Future – Mitigation 1	CGPF Future – Mitigation 2	CGPF Future – Mitigation 3
Existing Comp Shelter (A1)	20.4	-	-	-	-	27.6	-	-	-	-
Existing Comp Shelter (A2)	18.3	18.4	13.9	12.0	8.9	25.4	25.5	20.8	18.6	15.1
Existing Coolers (B)	10.7	11.0	11.0	11.0	11.0	17.4	17.7	17.7	17.7	17.7
Existing Comp Exhaust (J)	4.7	4.7	4.7	4.7	4.7	11.0	11.0	11.0	11.0	11.0
Existing TEG Unit (F1)	-12.6	-12.7	-12.7	-12.7	-12.7	-5.7	-5.8	-5.8	-5.8	-5.8
Export gas pressure control valve (H)	-7.6	-7.6	-7.6	-7.6	-7.6	-0.3	-0.3	-0.3	-0.3	-0.3
Future Comp Shelter (North) (C1+A1)		20.8	21.4	18.4	17.6		27.9	28.5	25.2	24.4
Future Comp Shelter (South) (C2)		15.8	13.5	11.5	10.7		22.4	19.8	17.6	16.5
Future Engine (CAT G3612) Exhaust (D)		-7.1	-7.1	-7.1	-7.1		-0.6	-0.6	-0.6	-0.6
Future TEG Unit (F2)		-12.7	-12.7	-12.7	-12.7		-5.8	-5.8	-5.8	-5.8
Future Coolers (South - 120-156) (E2)		6.8	6.8	6.8	6.8		13.6	13.6	13.6	13.6
Future Coolers (North - 120-156) (E1)		1.4	1.4	1.4	1.4		7.8	7.8	7.8	7.8
Total	22.8	24.0	23.2	20.8	20.0	29.9	31.0	30.1	27.5	26.6

Legend: Achieves EA noise criterion, Lower than the existing noise levels.

Note 1: Refer to CGPF plant as shown in ***Appendix E3***

MITIGATION OF CGPF NOISE CONTRIBUTION AT RECEIVERS ID 41, ID 55 AND ID 56

Table H2 Receptor ID 55 Predicted CGPF Noise Contributions for Mitigation Scenarios

CGPF Plant[1]	Neutral Weather Conditions					Adverse Weather Conditions				
	CGPF Existing	CGPF Future No Mitigation	CGPF Future – Mitigation 1	CGPF Future – Mitigation 2	CGPF Future – Mitigation 3	CGPF Existing	CGPF Future No Mitigation	CGPF Future – Mitigation 1	CGPF Future – Mitigation 2	CGPF Future – Mitigation 3
Existing Comp Shelter (A1)	22.2	-	-	-	-	29.4	-	-	-	-
Existing Comp Shelter (A2)	21.7	21.2	17.0	15.1	12.3	28.8	28.3	23.9	21.8	18.7
Existing Coolers (B)	13.9	14.2	14.2	14.2	14.2	20.6	20.9	20.9	20.9	20.9
Existing Comp Exhaust (J)	7.5	7.5	7.5	7.5	7.5	13.7	13.7	13.7	13.7	13.7
Existing TEG Unit (F1)	-13.0	-14.2	-14.2	-14.2	-14.2	-6.3	-7.5	-7.5	-7.5	-7.5
Export gas pressure control valve (H)	-10.3	-11.8	-11.8	-11.8	-11.8	-3.9	-5.6	-5.6	-5.6	-5.6
Future Comp Shelter (North) (C1+A1)		22.5	23.0	20.4	19.2		29.6	29.9	27.2	25.9
Future Comp Shelter (South) (C2)		19.7	17.7	15.8	14.1		26.4	24.2	22.0	20.1
Future Engine (CAT G3612) Exhaust (D)		-4.3	-4.3	-4.3	-4.3		2.0	2.0	2.0	2.0
Future TEG Unit (F2)		-12.2	-12.2	-12.2	-12.2		-5.4	-5.4	-5.4	-5.4
Future Coolers (South - 120-156) (E2)		10.7	10.7	10.7	10.7		17.5	17.5	17.5	17.5
Future Coolers (North - 120-156) (E1)		2.2	2.2	2.2	2.2		8.3	8.3	8.3	8.3
Total	25.4	26.5	25.5	23.6	22.4	32.4	33.5	32.3	30.2	28.9

Legend: Achieves EA noise criterion, Lower than the existing noise levels.

*Note 1: Refer to CGPF plant as shown in **Appendix E3***

MITIGATION OF CGPF NOISE CONTRIBUTION AT RECEIVERS ID 41, ID 55 AND ID 56

Table H3 Receptor ID 56 Predicted CGPF Noise Contributions for Mitigation Scenarios

CGPF Plant[1]	Neutral Weather Conditions					Adverse Weather Conditions				
	CGPF Existing	CGPF Future No Mitigation	CGPF Future – Mitigation 1	CGPF Future – Mitigation 2	CGPF Future – Mitigation 3	CGPF Existing	CGPF Future No Mitigation	CGPF Future – Mitigation 1	CGPF Future – Mitigation 2	CGPF Future – Mitigation 3
Existing Comp Shelter (A1)	22.1	-	-	-	-	29.2	-	-	-	-
Existing Comp Shelter (A2)	21.6	21.3	16.9	15.0	12.3	28.7	28.3	23.8	21.7	18.7
Existing Coolers (B)	13.9	14.1	14.1	14.1	14.1	20.6	20.8	20.8	20.8	20.8
Existing Comp Exhaust (J)	7.5	7.5	7.5	7.5	7.5	13.6	13.6	13.6	13.6	13.6
Existing TEG Unit (F1)	-13.1	-14.5	-14.5	-14.5	-14.5	-6.5	-7.9	-7.9	-7.9	-7.9
Export gas pressure control valve (H)	-9.5	-12.1	-12.1	-12.1	-12.1	-3.1	-5.9	-5.9	-5.9	-5.9
Future Comp Shelter (North) (C1+A1)		22.5	22.9	20.3	19.1		29.5	29.8	27.0	25.7
Future Comp Shelter (South) (C2)		19.8	18.1	16.0	14.6		26.5	24.6	22.2	20.7
Future Engine (CAT G3612) Exhaust (D)		-4.4	-4.4	-4.4	-4.4		1.9	1.9	1.9	1.9
Future TEG Unit (F2)		-13.2	-13.2	-13.2	-13.2		-6.6	-6.6	-6.6	-6.6
Future Coolers (South - 120-156) (E2)		10.6	10.6	10.6	10.6		17.4	17.4	17.4	17.4
Future Coolers (North - 120-156) (E1)		2.0	2.0	2.0	2.0		8.0	8.0	8.0	8.0
Total	25.3	26.5	25.5	23.5	22.4	32.3	33.5	32.3	30.1	28.9

Legend: [green] Achieves EA noise criterion, [yellow] Lower than the existing noise levels.

*Note 1: Refer to CGPF plant as shown in **Appendix E3***

MEMORANDUM

620.11142-M01-v0.1.docx

TO:	Kelsey Bawden	FROM:	Matthew Bryce	DATE:	15 March 2017
COMPANY:	Arrow Energy				
EMAIL:	Kelsey.Bawden@arrowenergy.com.au				
SUBJECT:	**Updated Noise Assessment for the Daandine Expansion Project**				

1 Overview

In September, 2014, SLR Consulting Australia Pty Ltd (SLR) prepared a noise impact assessment for the Daandine Expansion Project (our ref 620.10773R3, dated 23 September 2014). Arrow Energy now proposes to include a small inlet fuel compressor at the Daandine Central Gas Processing Facility (CGPF) so that inlet gas can be used to fuel the larger compressor engines, rather than 'letting down' pipeline gas to fuel the compressors. This will result in some efficiency gains for the facility. However, as the proposed inlet fuel compressor will generate noise emissions from the CGPF, Arrow Energy wish to confirm that the overall cumulative impacts on noise amenity are not significantly changed.

Following Arrow Energy's request, the SoundPLAN model was rerun to assess the changes in noise levels at surrounding sensitive receptors with noise emissions from the inlet fuel compressor included. The results were then compared to the results presented in the original noise impact assessment report (620.10773R3).

The results of this additional modelling are provided in this memorandum.

2 Input Data & Model Configuration

The 2014 noise model was re-run using the same set up as described in the original noise impact assessment report. All model inputs with the exception of an additional gas engine exhaust, air cooled heat exchanger, gearbox and screw compressor associated with the proposed inlet fuel compressor remain consistent with those used in the original noise impact assessment report. For a full description of the modelling methodology, please refer to the original noise impact assessment report (620.10773R3).

Table 1 shows the noise levels associated with the additional noise sources that were included in the assessment.

Table 1 Inlet Fuel Compressor – Noise Sources

Noise Source[1]	Sound Pressure Level, dB Octave Band Centre Frequency, Hz									Overall, dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Gas engine (P48GLD)[2]										
Unattenuated[3]	97	104	121	118	108	104	98	87	75	112
With exhaust muffler[3]	88	83	97	91	83	82	81	72	57	89
Air cooled heat exchanger[4]	50	58	83	90	87	87	84	74	61	94
Gearbox	48	60	84	86	83	85	83	74	61	92
Screw compressor[5]	--	78	80	90	91	85	84	82	77	93

1. Source: "PtL Daandine and Tipton Project – Noise Emission Data – SDAG01-VAL-ENV-DST-00002, prepared by Jereh for Arrow Energy
2. Sound pressure levels from microphone position 1 metre away and 1 metre to the side of the exhaust outlet
3. Only the exhaust with muffler was included in final assessment (ie the unattenuated exhaust was not included)
4. Sound pressure levels from microphone position 1 metre below each fan side of the exhaust outlet
5. Measured at 1 metre

3 Modelling Results and Discussion

The noise modelling undertaken in September 2014 indicated that the CGPF building was the dominant source of noise emission from the Daandine site.

Table 2 shows the predicted noise levels at selected receptors based on the additional noise sources as added to the final design for the Daandine CGPF expansion project (refer to 620.10773R3). That design included partial enclosure of the CGPF building with metal sheet cladding.

Table 2 Predicted Noise Levels – New Inlet Fuel Compressor Noise Sources

Receptor	Neutral Weather Predicted Noise Level, dBA			Adverse Weather Predicted Noise Level, dBA		
	CGPF building[1]	CGPF building + new compressor (with engine exhaust muffler)	Difference	CGPF building	CGPF building + new compressor (with engine exhaust muffler)	Difference
41	21.9	22.1	0.2	28.7	28.9	0.2
55	24.7	24.9	0.2	31.4	31.6	0.2
56	24.6	24.8	0.2	31.4	31.6	0.2
100	32.1	32.1	0	38.1	38.2	0.1

1. Partial enclosure of the CGPF building with metal sheet cladding.

A complete receptor list and predicted levels is shown in **Appendix A**, with exceedances of the project noise limit highlighted.

It can be seen that the additional noise sources, including the gas engine exhaust with a muffler, doesn't result in a significant noise increase at the selected receptors relative to the total site.

A review of the individual noise sources indicated that the dominant noise source/s would remain the open east and west 'ends' of the CGPF building as described in previous assessments.

****

We trust the above is sufficient for your immediate needs. If you have any queries or require anything further, please contact the undersigned.

Yours sincerely

sch4p4(6) Personal infor

MATTHEW BRYCE

Checked/
Authorised by: MC

Predicted Noise Levels: New Inlet Fuel Compressor with Gas Engine Exhaust Muffler – All Receptors

Receptor	Neutral Weather			Adverse Weather		
	Predicted Noise Level, dBA			Predicted Noise Level, dBA		
	CGPF building	CGPF building + new compressor (with engine exhaust muffler)	Difference	CGPF building	CGPF building + new compressor (with engine exhaust muffler)	Difference
1	6.3	6.3	0	11.7	11.8	0.1
2	6.5	6.6	0.1	12	12.1	0.1
3	17.6	17.8	0.2	24.7	24.8	0.1
4	3.3	3.5	0.2	8.1	8.3	0.2
7						
8						
9						
10						
11						
17						
18	3.5	3.7	0.2	8.6	8.8	0.2
19	4.8	5.1	0.3	10.2	10.4	0.2
21	5	5.3	0.3	10.4	10.7	0.3
22	4.9	5.2	0.3	10.3	10.5	0.2
23	8.2	8.4	0.2	14.3	14.5	0.2
24	7.5	7.6	0.1	13.5	13.7	0.2
25	8.5	8.7	0.2	14.7	14.9	0.2
26	2.1	2.4	0.3	7	7.3	0.3
27	8.9	9.1	0.2	15.1	15.3	0.2
28	5.4	5.6	0.2	10.8	11.1	0.3
29	5.4	5.6	0.2	10.8	11.1	0.3
30	3.8	4.1	0.3	8.9	9.1	0.2
31	0.2	0.4	0.2	4.9	5.1	0.2
32	7.4	7.6	0.2	13	13.2	0.2
33	7.4	7.6	0.2	13	13.2	0.2
34	6.3	6.4	0.1	11.8	11.9	0.1
35	7.7	7.7	0	13.4	13.5	0.1
36	6.7	6.8	0.1	12.3	12.3	0
37	14.4	14.4	0	21.1	21.1	0
38	15.7	15.8	0.1	22.6	22.6	0
39	27.4	27.6	0.2	34	34.1	0.1
40	18.4	18.6	0.2	25.2	25.4	0.2
41	21.9	22.1	0.2	28.7	28.9	0.2
42	10.6	10.8	0.2	16.7	16.9	0.2
43	8.7	8.9	0.2	14.5	14.7	0.2
44	5.7	5.9	0.2	10.9	11.1	0.2
45	2.6	2.8	0.2	7.4	7.6	0.2

SLR Consulting Australia Pty Ltd Level 2, 15 Astor Terrace Spring Hill QLD 4000 Australia
(PO Box 26 Spring Hill QLD 4004) T: +61 7 3858 4800 F: +61 7 3858 4801
E: brisbane@slrconsulting.com www.slrconsulting.com
ABN 29 001 584 612

46	1.7	1.9	0.2	6.4	6.7	0.3
47	1.8	2	0.2	6.5	6.8	0.3
48	2.1	2.3	0.2	6.9	7.1	0.2
49	1.1	1.3	0.2	5.9	6.1	0.2
50	3.1	3.3	0.2	7.9	8.2	0.3
51	2.2	2.5	0.3	7	7.3	0.3
52	0.2	0.5	0.3	5	5.3	0.3
53	4.5	4.8	0.3	9.5	9.8	0.3
54	2.9	3.2	0.3	7.8	8.1	0.3
55	24.7	24.9	0.2	31.4	31.6	0.2
56	24.6	24.8	0.2	31.4	31.6	0.2
57	3.6	3.9	0.3	8.7	8.9	0.2
58	0.2	0.5	0.3	4.9	5.2	0.3
59	0.4	0.6	0.2	5.1	5.4	0.3
60	0.1	0.4	0.3	4.9	5.1	0.2
61						
62						
63						
64						
65						
66						
67						
68						
69						
70						
71	0.2	0.4	0.2	4.9	5.1	0.2
72						
73						
74						
75						
76	0.8	1.1	0.3	5.6	5.9	0.3
77	0.4	0.6	0.2	5.1	5.4	0.3
78	0.8	1	0.2	5.6	5.8	0.2
79						
80	0.8	1	0.2	5.6	5.8	0.2
81						
83						
84						
85						
86						
87	2.1	2.3	0.2	6.9	7	0.1
88	1.3	1.4	0.1	6	6.2	0.2
89						
90						
91	6.9	7.2	0.3	12.6	12.9	0.3

92	16.7	16.8	0.1	23.5	23.6	0.1
93	1.3	1.5	0.2	6.1	6.3	0.2
94						
95						
96						
97						
98						
99	17.2	17.2	0	24	24.1	0.1
100	32.1	32.1	0	38.1	38.2	0.1
102	6.6	6.9	0.3	12.1	12.3	0.2
103	1.4	1.7	0.3	6.2	6.4	0.2
104						
105						
106	10.9	11.2	0.3	17.3	17.5	0.2
107	10.2	10.4	0.2	16.5	16.7	0.2

NOTE: Where a predicted value is not provided for a receptor, the separation distance between the receptor and the noise source/s is approaching or exceeds the 20 km model domain and the predicted values may be considered to be very low (ie less than 1 dBA).

Appendix B Noise Management Plan as required by Condition E3

- **Environment Noise and Vibration Management Plan – Arrow Energy (September 2017)**

- **Environmental Noise and Vibration Management Plan, Dalby Expansion Project (DXP) – Arrow Energy (March 2017)**

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Environmental Noise and Vibration Management Plan

Version	2.0
Released	September 2017
Document Owner	Environment Manager
Document Author	Senior Advisor Environment & Carbon
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Security Classification	Restricted

Please see document administration section for more information

Table of Contents

1 Background

Arrow Energy (Arrow) activities in the gas fields of Queensland have the potential to generate various noise sources, from permanent installations such as well pad facilities and compressor stations; intermittent operations such as drilling and workovers, and ancillary operations such as rig movements, water trucks and heavy construction and earth moving equipment. Noise and vibration from these activities have the potential to impact upon environmental and social values.

Arrow has developed a strategy to minimise the potential impacts of noise and vibration from its project activities. This noise and vibration management plan (NVMP) provides an overview of the strategy and procedures developed by Arrow to manage noise and vibration impacts from gas field project areas.

1.1 Purpose and Scope

1.1.1 Purpose

Arrow has both a legal and social responsibility to manage noise and vibration from its operations. This NVMP has been prepared to satisfy these obligations for Arrow gas field project areas and complements the overarching Arrow Health, Safety and Environment Management System (HSEMS).

The objectives of this NMVP are to:

- Facilitate compliance with relevant State legislation, regulations and approvals
- Facilitate compliance with noise aspects of Arrow's *Amenity* Standard
- Provide a framework for Arrow to:
  - Minimise noise emissions from Arrow assets and activities
  - Engage stakeholders including landholders and local communities in assisting Arrow in the identification and management of noise emissions;
  - Identify, monitor and prioritise the management of noise emissions present on Arrow assets and activities; and
  - Minimise nuisance noise emissions to sensitive receptors.

1.1.2 Scope

This NVMP identifies noise impacts from potential sources within Arrow's gas field activities and provides an overview of the strategy, methods and controls to be implemented by Arrow to avoid, minimise and manage the impact of noise from assets and activities to sensitive receptors.

The NVMP is to be implemented by all Arrow personnel conducting activities that have the potential to create noise nuisance throughout the pilot appraisal, construction, production, decommissioning, and rehabilitation phases of the project.

This NVMP applies to activities carried out within Arrow's gas field tenements as illustrated in Figure 1.

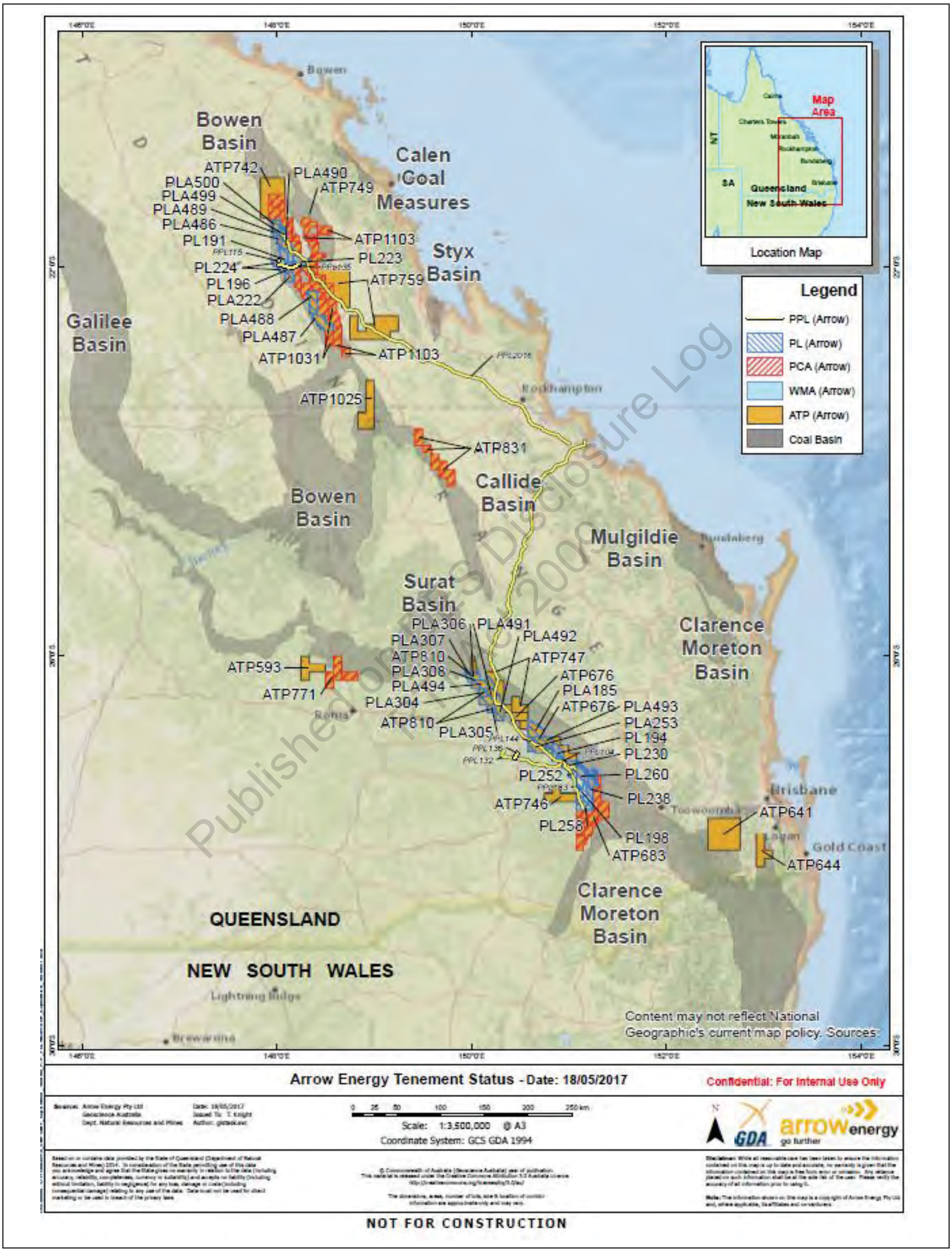

Figure 1: Arrow Energy Gas Field Tenements

Supporting noise management plans may be developed which complement the overarching noise management plan such as:

- Site specific noise management plans; and/or
- Activity specific noise management plans:
  - Construction noise management plans
  - Drilling noise management plans

These may be required to address specific noise issues associated with a site or to address minimum requirements of Environment Authority (EA) conditions which are not specifically covered by this overarching management plan.

Site/activity specific noise management plans are designed to be used in conjunction with this overarching plan.

2 Roles and Responsibilities

Arrow project personnel are responsible for the environmental performance of their activities, for complying with relevant approval / permit requirements and for ensuring that all environmental objectives associated with the work are achieved.

Arrow project personnel must also be mindful of the General Environmental Duty (GED) as outlined in the *Environmental Protection Act 1994* (Qld) (EP Act). Section 319(1) of the EP Act states that *"a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practical measures to prevent or minimise the harm."*

Roles and responsibilities covered by this NMVP for each stage is summarised in Table 1.

Table 1: Roles and responsibilities covered by this NMVP

Stage	Role	Responsibility
Planning	Business unit responsible for activity	• Identify noise producing activities
		• Consider EA limits
		• Establish the existing noise environment – Conduct constraints analysis of noise producing activities – Consider preliminary mitigation measures
		• Conduct desktop assessment and/or engage suitably qualified person to conduct detailed environmental modelling and assessment where required.
Mitigation		• Apply appropriate noise control and management measures where required
		• Review effectiveness of the adopted control and management measures
Engagement	Project delivery/land access/ER&TM	• Undertake community liaison and consultation
		• Negotiate alternative arrangements and mediation for residents where required
	Legal	• Review any alternative arrangement prior to engagement
	Finance	• Review any alternative arrangement prior to engagement
Ensure compliance	Business unit responsible for activity	• Undertake regular training in noise compliance (e.g. tool box talks, training in equipment operating procedures)
	Environment Representative	• Conduct desktop assessment and/or engage suitably qualified person when a noise complaint is received to conduct detailed environmental modelling and assessment.
		• Arrange for field noise assessment to take place by a suitably qualified person as required.
		• Provide advice to business units in relation to noise impacts
		• Maintain HSEMS documents in relation to noise management
		• Prepare technical reports and summaries for EHP as required

3 Legal and other requirements

Application of legislation, regulations, guidance and strategies enacted by the State of Queensland regarding noise management in Arrow project areas are described in the following sections.

3.1 State Legislation and Strategies

An overview of the relevant Queensland legislation, strategies and standards considered in the development of the NMVP are presented in Table 2.

Table 2: State Legislation and Strategies

Act / Regulation / Code	Summary
***Environmental Protection Act* 1994 (EP Act)**	The objective of the EP Act is to protect Queensland's environment by promoting ecologically sustainable development. Management and assessment of noise in Queensland is governed by the EP Act and implemented through the *Environment Protection Regulation 2008* and *Environmental Protection (Noise) Policy 2008*. Arrow has been issued EAs under the EP Act which authorise activities. The EAs include provisions for development and implementation of noise management procedures and prescribe noise limits that Arrow must achieve at sensitive receptors (Section 3.1.1). The EP Act also requires Arrow to take all reasonable and practicable measures to prevent or minimise environmental harm.
***Environmental Protection Regulation 2008* (EP Reg)**	The EP Reg recommends limits to the hours that construction activities can occur. Furthermore, Chapter 5, part 3 of the EP Reg describes the standards that must be used when measuring noise such as *AS1055-1997 Acoustics – Description and measurement of environmental noise* or the *Noise Measurement Manual 3rd edition (2000)* (DERM, 2000).
***Environmental Protection (Noise) Policy 2008* (EPP Noise)**	The EPP Noise is subordinate legislation developed to achieve the object of the EP Act in relation to the acoustic environment. The purpose of the EPP Noise is achieved by: • Identifying environmental values that are enhanced or protected; • Stating acoustic quality objectives for enhancing or protecting environmental values; • Providing a framework for making consistent, equitable and informed decisions about the acoustic environment. The EPP Noise prescribes a management hierarchy for noise: (1) avoid, (2) minimise, and (3) management, which is adopted into Arrow's Noise Management Strategy. The EPP Noise also includes acoustic quality objectives based on the World Health Organisation (WHO) guidelines with environmental noise criteria on avoiding health and wellbeing impacts.
Land Access Code	The Land Access Code under the *Petroleum and Gas (Production and Safety) Act 2014* imposes mandatory conditions concerning the conduct of resource activities on private land; including an obligation to minimise noise emissions on private land by operating vehicles at appropriate speeds.
Guideline for Noise Assessment: Prescribing Noise Conditions for Environmental Authorities for Petroleum and Gas Activities	This guideline prescribes best practice noise limits for petroleum and gas activities.

3.1.1 Prescribed Noise Limits

Noise limits are generally prescribed in Arrow Energy EAs. Arrow is to operate within or below these noise limits at sensitive receptors.

Where alternative arrangements are in place at a sensitive receptor or where noise related agreements are made as part of the Conduct and Compensation Agreements (CCAs) or equivalent, the noise limits in EAs do not apply for the duration that arrangements are in place. Alternative arrangements are discussed in further detail in Section 5.1.2.2.

Arrow currently operates under a range of noise limits which are detailed in each EA. Where noise limits are not specified in an EA the noise limits specified in Table 3, which:

- have been adapted from the EHP's Streamlined Model Conditions for Petroleum Activities, and
- are consistent with recently approved noise limits from EHP

can be used to assess potential impact.

If the noise possesses tonal or impulsive characteristics, the noise measured / modelled is to include the adjustments detailed in Table 4. Prescribed noise limits must be considered when planning the location of noise generating activities (Section 5) and Arrow must be able to demonstrate this in the event of a valid noise complaint.

Table 3: General Noise Limits

Time period	Metric	Short Term Noise Event	Medium Term Noise Event	Long Term Noise Event
7:00 am – 6:00 pm	$L_{Aeq, adj, 15 min}$	45 dBA	43 dBA	40 dBA
6:00 pm – 10:00 pm	$L_{Aeq, adj, 15 min}$	40 dBA	38 dBA	35 dBA
10:00 pm – 6:00 am	$L_{Aeq, adj, 15 min}$	28 dBA	28 dBA	28 dBA
	Max $L_{pA, 15 min}$	55 dBA	55 dBA	55 dBA
6:00 am – 7:00 am	$L_{Aeq, adj, 15 min}$	40 dBA	38 dBA	35 dBA
10:00 pm – 6:00 am (drilling and construction on ATPs)	$L_{Aeq, adj, 15 min}$	30 dBA [b]	30 dBA [b]	30 dBA [b]

[a] Note – the noise limits have been set based on the following deemed background noise levels (L_{ABG})

7:00 am – 6:00 pm:	35 dBA	10:00 pm – 6:00 am:	25 dBA
6:00 pm – 10:00 pm:	30 dBA	6:00 am – 7:00 am:	30 dBA

[b] Measured indoors or 35 dBA – 40 dBA external (using a 5 – 10 dBA façade reduction assumption)

Table 4: Adjustments to be added to Noise Levels at Sensitive Receptors

Noise Characteristic	Adjustment to Noise
Tonal characteristic is just audible	+ 2 dBA
Tonal characteristic is clearly audible	+ 5 dBA
Impulsive characteristic is just audible	+ 2 dBA
Impulsive characteristic is clearly audible	+5 dBA

Emission of noise below 315 Hz must not cause an environmental nuisance and noise must not exceed the following limits as per respective EA conditions:

a) 60 dB(C) measured outside the sensitive receptor; and
b) The difference between the external dB(A) and dB(C) noise levels is no greater than 20 dB; or
c) 50 dB(Z) measured inside the sensitive receptor; and
d) the difference between the A-weighted and Z-weighted noise levels is no greater than 15 dB.

3.1.2 Vibration Criteria

Vibration criteria are only specified in the *Model Streamlined Conditions* for blasting activities. Human response criteria and vibration values for cosmetic damage are presented in Table 5 and Table 6. These criteria presented in this section are useful to assess the potential impact due to vibration.

Table 5: Human response to construction vibration

Vibration level	Response
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential developments will cause a complaint, but can be tolerated if prior warning and explanation has been given to residents.
10.0 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure at this level.

Table 6: Guide to vibration values for cosmetic damage

Type of building	Component peak particle velocity (ppv)	
	4 to 15 Hz	15 Hz and above
Unreinforced or light framed structures Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz

3.2 Arrow Health Safety and Environment Management System

Arrow's HSEMS provides a framework for environmental and safety practices across its operations. The framework is consistent with *AS 4801: 2000 Occupational Health and Safety Management Systems* and *AS/NZS ISO 14001:2004 Environmental Management Systems.*

This NVMP complements the requirements of the HSEMS, in particular, the Arrow Environmental Standard *Amenity*. This standard provides minimum requirements to reduce the risk of amenity impacts (including noise) associated with Arrow activities.

The NVMP provides additional guidance for the management of environmental issues and supports the development of asset/activity/department based guidelines and work instructions, in order to secure compliance with legal requirements as well as deliver on company environmental standards.

Mode 2 contractors will work under their own environmental management plans.

The Arrow approach to environmental management is illustrated in Figure 2.

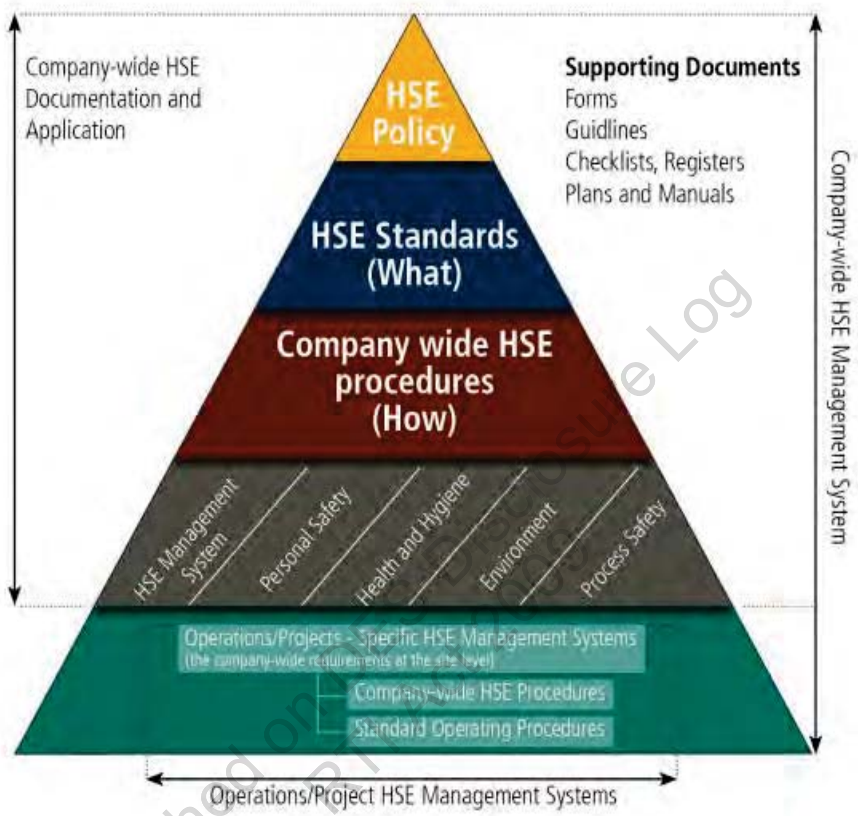

Figure 2: Approach to Environmental Management

4 Noise Sources

4.1 Existing Noise Environment

Areas where Arrow has tenures are predominantly rural and industrial with land uses such as grazing, pre-existing gas field development and overlapping mining tenure. Existing infrastructure typically includes a number of rural secondary roads linking the major regional road network as well as numerous CSG field access roads and mining activity. Existing noise sources are generally typical of rural roads and include fauna (birds and insects), traffic and local sources associated with mining activity and rural based human occupation.

In the absence of site specific background noise monitoring data, deemed background noise is provided in Table 7.

Table 7: Deemed background noise

Time period	Deemed background noise level (dBA)
7:00 am – 6:00 pm	35
6:00 pm – 10:00 pm	30
10:00 pm – 6:00 am	25

4.2 Pilot Field/Appraisal Activities

Pilot field/appraisal activities undertaken on Arrow tenure can potentially result in noise impacts. Noise generating pilot field/appraisal activities include core drilling and seismic surveys. Site preparation may be required prior to pilot field/appraisal activities. The noise sources and representative sound levels associated with site preparation activities are discussed further in Section 4.2.2.

4.2.1 Seismic Surveys

Seismic surveys produce a detailed image of the geology beneath the earth's surface in order to plan well locations. At any given noise sensitive location, seismic surveys typically occur during daytime. Seismic surveys generally involve the use of a truck fitted with a vibratory plate which is lowered to the ground and actuated to produce a vibration source. Other types of surveys can involve light vibration units (portable) or light explosive buried charges. Seismic surveys carried out with trucks are usually carried out along existing roads, whilst surveys carried out by other means can take place away from existing roads. The duration of seismic surveys is a few hours in a given area and can be considered a short-term noise impact. Typical sound power levels caused by seismic activities are shown in Table 8.

4.2.2 Core Drilling

Core holes are drilled to obtain more detailed information of the geology beneath the earth's surface, including identifying the depths of key formations and CSG reservoirs. The key equipment employed to drill core holes is the core drilling rig. Truck mounted rigs are built for this purpose and as such have less noise impact compared to the rigs required to drill production wells.

Drilling activities are scheduled to occur on a 24 hour basis, 7 days per week, for a period of between two and three weeks, dependent on estimated total depths.

Table 8: Typical sound power levels

Operational activity	Noise source	Overall sound power level (L_{Aeq})
Core drilling	Core drilling rig	112 dBA
Seismic survey	Seismic truck	107 dBA
	Mulcher	110 dBA

4.3 Construction

4.3.1 General Construction

General construction activities undertaken on Arrow tenure can potentially result in noise impacts. Such construction noise impacts may include both tonal noise (e.g. reverse beepers) and impulsive noise (e.g. piling). At any given noise sensitive location, construction activities typically occur during daytime.

Construction noise levels inevitably depend upon the number of plant and equipment operating at any one time and on their precise location relative to the sensitive receptor(s). Therefore, a sensitive receptor may experience a range of values representing “minimum” and “maximum” construction noise emissions.

Vibration impact from construction activities associated on Arrow tenure is expected to be minimal. The minimisation of construction noise sources is outlined in Section 5.2.1. Vibration management and general assessment for construction activities is further described in Section 6.

Representative sound power levels of typical general construction noise sources are presented in Table 9.

Table 9: Typical sound power levels of general construction noise at the source

Noise source	Sound Power Level (L_{Aeq})
4WD vehicle	92 dBA
Air compressor (660CFM)	103 dBA
Backhoe	100 dBA
Bobcat	98 dBA
Compactor (CAT825)	106 dBA
Concrete pump	110 dBA
Concrete truck	109 dBA
Dozer (D9)	106 dBA
Dozer (D8)	108 dBA
Excavator – Large (60T)	111 dBA
Excavator – Medium (30T)	106 dBA
Excavator – Small (12T)	103 dBA
Front-end loader (CAT988)	107 dBA
Generator	92 dBA
Grader	106 dBA
Hand-held grinder	110 dBA
Lighting tower	95 dBA
Mobile crane – 20T	102 dBA
Mobile crane – 50T	105 dBA
Mobile crushing and screening unit	122 dBA
Articulated dump truck	110 dBA
Padder	110 dBA
Reverse alarm/beeper	105 dBA
Rockhammer (attached on excavator)	122 dBA
Vibratory roller	107 dBA
Scraper	108 dBA
Side boom	107 dBA
Trencher	115 dBA
Truck – B-double	106 dBA
Water cart	104 dBA
Welding rig	101 dBA

[a] Indicative sound power levels are sourced from various EIS and noise impact assessments including:

Savery & Associates Pty Ltd (2015) *Noise Modelling Study Bowen Basin FEED study*, Document No SP0550, Revision 2, Prepared for Clough AMEC Joint Venture
Santos GLNG Project
Wandoan Coal Project EIS – Parsons Brinkerhoff Pty Ltd
Narrows Crossing Pipeline EMP
Daunia Coal Mine Project EIS

4.3.2 Drilling

Drilling activities, which typically involves drilling, stimulation and flaring activities, are likely to be the greatest potential noise source to surrounding sensitive receptors. Drilling activities operate on a 24 hour basis and can last from anywhere between two days up to a month depending on the depth of the well, type of well and the geology of the area. Drilling activities can produce impulsive noise (e.g. impacts of drill tools) as well as constant noise.

Well stimulation techniques are used to enhance openings in the coal seams and increase the pathways for gas to flow. Stimulation activities can be repeated every three to six hours over a one to two day period where a number of diesel engines may operate simultaneously. Noise from diesel engines vary according to load and speed, but the main component of the sound is the fundamental rotation speed. Normally, stimulation is only performed once in the life of a well.

Flaring occurs during drilling to dispose of gas that cannot be processed in a safe manner. Flaring is a minor source of noise relative to the total noise of drilling activities and is only discernable in the context of other well lease construction noise within relatively short distances from the flare.

Indicative sound power levels for typical plant items associated with drilling are listed in Table 10.

Table 10: Typical Sound Power Levels of Drilling Related Noise Sources

Noise Source	Sound Power Level (L_{Aeq})
Drill rig (mud)	117 dBA
Drill rig (air)	122 dBA
Completion drill rig	117 dBA
Hydraulic stimulation	120 dBA
Cavitation stimulation	120 dBA
Impacts of drill rods/casings	100-110 dBA (LAmax)
Flaring	110 dBA

4.4 Operations

Operational activities in Arrow project areas are predominantly long-term sources of noise. Noise generating operational activities include operating wells, compressor stations and treatment facilities, and accommodation facilities. Indicative sound power levels for these operational activities are listed in Table 11 and are discussed further in the following sections.

4.4.1 Well Leases

The operation of wells is a long term noise event that occurs on a 24-hour basis. The main noise impacts from the operation of wells relate to:

- Wellhead motors – typically produce a low frequency hum;
- Diesel powered generators – where distributed power is not available;
- Trucks – to transport produced water from the appraisal wells to receiving facilities; and
- Flaring – occurs in the event of emergency, maintenance and commissioning periods, as well as in the operation of appraisal wells to assess well characteristics.
- High velocity gas flows especially through orifice plates

General operation and maintenance activities may include a truck visit on a weekly basis and is not considered a significant noise impact.

4.4.2 Treatment Facilities and Compressor Stations

The operation of compressor stations and treatment facilities involves various noise generating activities. Compressor stations are significant noise generating facilities that require specialist acoustical assessment and design to reduce the potential for causing noise nuisance. Noise levels generated by compressor stations are dependent on a number of factors including the number of compressor engines within the facility, the make, model and type of compressor (i.e. screw vs reciprocating) and the fuel source (e.g. gas vs electricity). Flaring and venting also occurs during events of emergency, maintenance and commissioning periods to safely release pressure from gas plant equipment.

4.4.3 Accommodation Facilities

Both temporary and long-term accommodation facilities are present throughout Arrow projects areas. Although the noise impact is considered limited, the most significant noise sources associated with accommodation facilities include domestic air conditioning units, power generation plant and vehicular traffic. Noise levels from vehicles are generally no greater than the noise levels normally experienced from traffic on local roads.

Table 11: Typical Sound Power Levels Associated with Operational Facilities at the Source

Operational Activity	Noise Source	Sound Power Level (L_{Aeq})
Appraisal wells	Flaring	110 dBA
	Trucks (B-double)	106 dBA
	Generator (Diesel Generator set)	92 dBA
Production wells	Generator (CSG generators)	93 dBA
	Well head pumps	93 dBA
Compressor stations	Field compressor station (screw drive engines)	110 – 115 dBA
	Field compressor station (reciprocating engines)	120 – 125 dBA
	Compressor station flare stack package	126 dBA
Accommodation facilities	A/C units (per 100 beds)	80 dBA
	Generator	99 dBA

4.5 Decommissioning and Rehabilitation

Decommissioning and rehabilitation will occur progressively throughout the life of each project as operational activities cease and exhausted facilities are decommissioned. However, final decommissioning and rehabilitation will occur at the end of the gas production in accordance with relevant approvals and regulatory requirements.

Noise sources during decommissioning and rehabilitation activities are expected to be similar to those described in general construction (Section 4.3.1). Excavation and demolition of structures is expected to generate the highest noise levels.

5 Noise Management

Figure 3 illustrates the framework to manage noise emissions in Arrow tenures. This framework has been developed based on the noise management principles and hierarchy of the EPP noise:

- **Avoid** – plan the activity and engage with affected stakeholders to minimise noise impacts;
- **Minimise** – implement noise mitigation measures; and
- **Manage** – conduct monitoring and ensure compliance with Arrow's HSEMS.

The strategy for managing noise emissions also complies with the mandatory requirements in Arrow's *Amenity Standard*. A more detailed step-wise implementation of the strategy to manage noise emissions is outlined in Figure 4 and discussed in Sections 5.1 - 5.3.

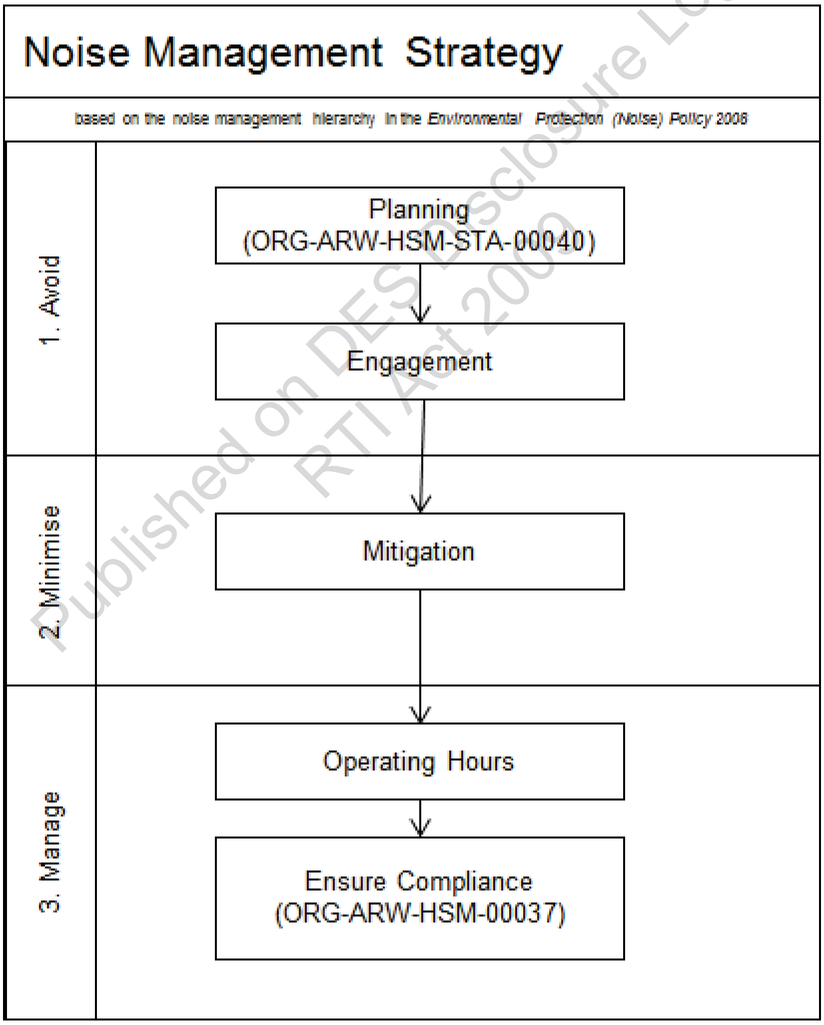

Figure 3: Strategy to manage noise emissions

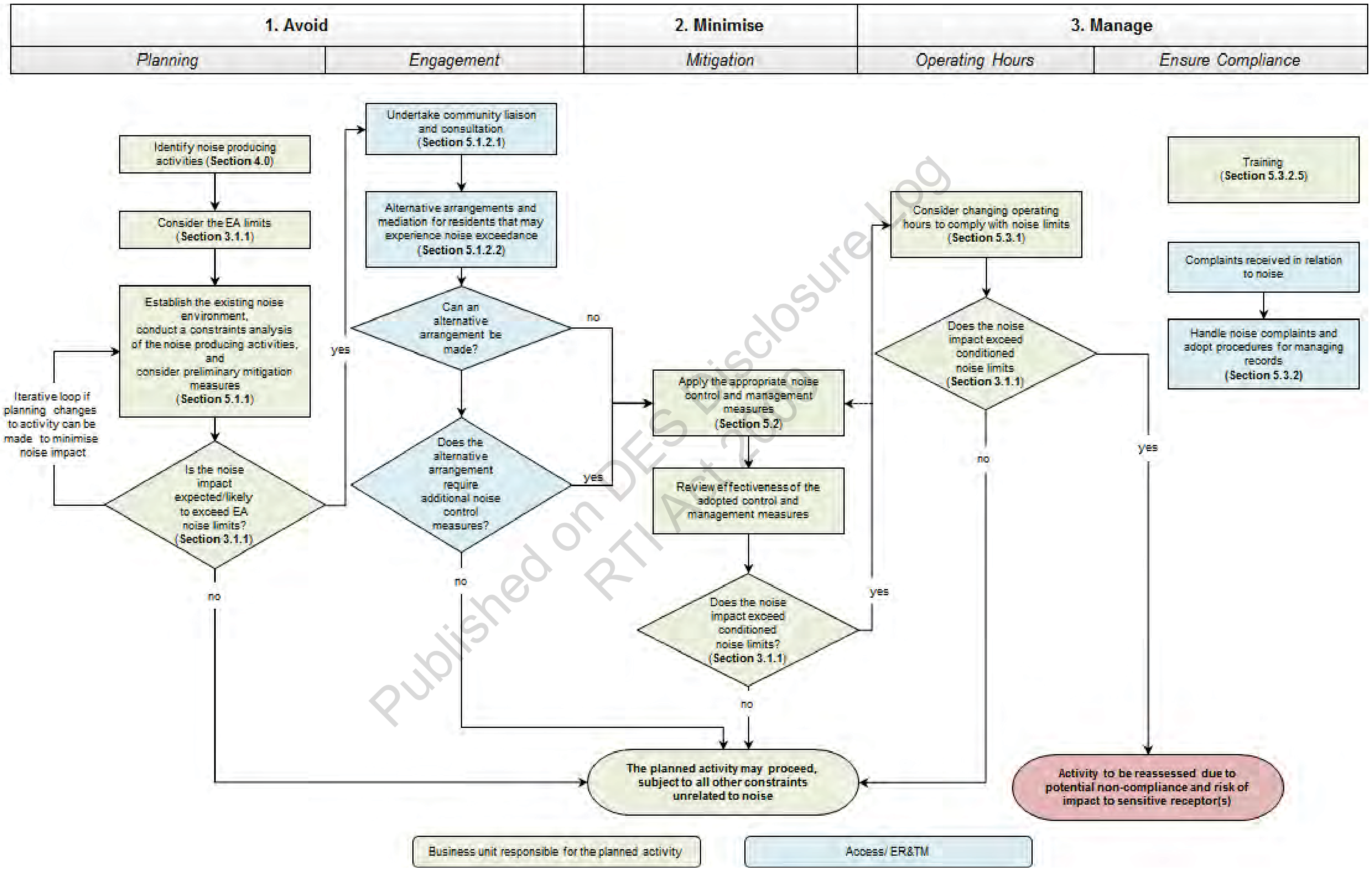

Figure 4: Process to Manage Noise Emissions

5.1 Avoid

5.1.1 Planning

5.1.1.1 Constraint Analysis

A constraint analysis is to be conducted prior to the operation or installation of equipment or an activity that is likely to create noise nuisance. This process is a component of standard field planning designed to ensure that noise emissions from planned activities do not exceed EA noise limits at sensitive receptors.

Noise constraint analysis primarily involves identifying sensitive receptors and predicting the likely impacts or potential noise generating activities on the sensitive receptors via modelling and/or site specific noise measurements.

For non-complex noise sources such as construction, drilling and flares, a noise screening tool has been developed that estimates required separation distances between activities and sensitive receivers. This noise screening tool can be used to determine whether EA noise limits are likely to be exceeded for any planned activity.

Where it is identified that proposed activities are likely to exceed the EA noise limits and impact on sensitive receptor(s), a site specific noise assessment will typically be performed. This assessment may include the verification of deemed background noise levels to establish more representative background noise levels and would involve a site specific risk assessment. The detailed site-specific noise assessment should ensure the accuracy of the predicted noise levels at the sensitive receptor(s) and, where required, will adequately assess the cumulative impact of multiple noise sources and risks in a given region.

After consideration of any preliminary mitigation measures from the results of the constraints analysis, a decision will be made about whether to implement the proposed mitigation or proceed with engaging potentially affected parties and making alternative arrangements (Section 5.1.2.2). Findings are to be communicated to internal stakeholders where applicable.

5.1.2 Engagement

5.1.2.1 Community Liaison and Consultation with Landholders

Community consultation and/or consultation with landholders prior to proceeding with noise generating activities is an important step in forging mutually beneficial relationships between all involved parties.

Based on the results of the constraints analysis, residents that are likely to experience noise impacts in exceedance of EA noise limits are to be informed as early as possible prior to works proceeding. Where practicable, noisier works are to be scheduled to occur at times which are least intrusive to residents.

Under Arrow's policy, *Constructive Community Engagement Policy*, Arrow outlines its commitment to constructively engage with the community in areas where we have planned activities. Under this policy it is a requirement for all staff to:

- Carry out formal and informal risk assessments of work environments; and
- Where there is a potential for an incident to develop, community engagement should be undertaken.

Where potential noise impacts have been identified, community engagement should be designed to:

- Inform community members and stakeholders of the activities and associated noise emissions and how they may be affected;
- Provide an opportunity for the community to ask questions and raise any concerns relating to the projected noise emissions from the activities.
- Provide an avenue for complaints regarding noise emissions and thus enable strategies to minimise disturbance; and
- Provide Arrow with feedback from the community for incorporation into the future activities where appropriate.

Any consultation is to be undertaken through Arrow External Relations and/or land access teams (as appropriate). In accordance with Arrow's *Constructive Community Engagement Policy* all staff and contractors have a responsibility to involve Arrow's External Relations team of any planned community liaison.

5.1.2.2 Alternative Arrangements

Residents that may experience noise levels in excess of the limits specified in the EA (identified in the constraints planning) are to be approached with a view to reach an agreement signed by both parties. Written agreements are determined on a case-by-case basis and must address relevant requirements prescribed in the EA.

As per the EA conditions, where alternative arrangements are made and agreed in writing with each person affected by the noise emissions, the noise limits of the EA will no longer apply at that location for the period of the alternative arrangements.

Residents with a Conduct and Compensation Agreement (CCA) may already have a clause on noise emissions that has similar effects as an alternative arrangement. It must be noted that only landholders of the properties under which Arrow activities are planned to be held will have CCAs. Alternative arrangements may need to be negotiated with potential impacted landholders without CCAs.

An agreement for alternative arrangements may include, but not necessarily be limited to a range of noise abatement measures to be installed at a sensitive receptor and/or provision of alternative accommodation for the duration of the defined noise nuisance impact.

Appropriate consultation with external relations, land liaison officers and Arrow legal department is required if contemplating negotiating alternative arrangements with an affected party.

5.2 Minimise

Potential noise mitigation measures are to be considered for each noise generating activity, in terms of whether they are:

- Feasible (capable of being put in practice subject to assets and activities constraints and use); and
- Reasonable (the benefit of the measure outweighs the various costs involved).

For these reasons, the level of noise at sensitive receptors achieved from implementing noise mitigation measures can only be determined on a case-by-case basis.

Table 12: Potential Noise Mitigation Principles and Measures

Noise Mitigation Principles	Potential Mitigation Measures
Avoidance of noise limit exceedances	- Locate activities at suitable buffer distances from nearest sensitive receptors through field planning and alternative arrangements - Switch off all noise generating plant and equipment - Consideration of operating time constraints (e.g. day time operation only)
Alter the orientation of an activity to minimise noise	- Alter the orientation of noise emitting facades of plant and equipment away from nearest sensitive receptor(s) - Utilise natural shielding (e.g. local topography from hills and other earth mounds)
Utilisation of best available technology – substitution with quieter equipment or process	- Select plant with the lowest noise source emission levels and limit the simultaneous operation of noise generating equipment.
Engineering noise controls at the noise source	- Locate plant in acoustically rated enclosures or buildings or install silencers to exhausts and attenuators to ventilation openings, incorporate absorptive acoustic panels on the inside of wall panels, shelters and roofs which are used to cover the facility. - Provide vibration isolation to equipment to avoid structure borne noise sources to impede the propagation path between the noise source and the nearest receptor.
Treatment of the noise propagation path	- Install temporary noise barriers within close proximity of the noise sources to impeded the propagation path between the noise sources and the nearest receptor.
Treatment of the noise at the receptor	- Community liaison and alternative arrangements as appropriate.

5.2.1 Construction

Noise from construction activities are to be managed using the procedures in this NMVP. The following outline of noise control measures are applicable to construction works, and are largely taken from *AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites*. Some noise control measures selected based on site-specific applicability are as follows:

- The best orientation of the activity to minimise noise is selected, wherever practicable given other constraints
- The quietest plant and equipment that can be practically used to undertake the work is selected.
- Temporary noise barriers may be used depending on the situation.
- Regular maintenance of equipment is undertaken in order to keep it in good working order, wherever possible.
- The following work practice control strategies are available:
  - Construction work to occur, wherever possible, within the daytime period
  - Operators of construction equipment to be made aware of the potential noise impacts and of techniques to minimise noise emission through a continuous process of operator education.
  - Reversing alarms within construction areas generally cannot be avoided for safety reasons. Consideration should be given to sourcing “quiet” white noise alarms whose tonal character diminishes quickly with distance and self-adjusting alarms which adjust emission levels relative to the local background noise level.
  - Horn signals are kept to a low volume, where feasible.

5.2.2 Drilling

For drilling activities, noise controls may be incorporated into the layout of the drill-rig sites depending on the results of the initial constraints analysis (e.g. directing relevant activities away from the nearest dwelling) as required.

Acoustic treatment of noise sources on a drill rig is also possible and can result in significant reduction in potential noise impact, such as:

- installing noise curtains on the hydraulic power unit (HPU);
- lagging exhausts;
- fitting radiator attenuators; and
- installation of a vent chute on the drill rig.

5.2.3 Operation

Noise mitigation measures for the operation of facilities is to be determined on a case by case basis taking into account: the location of the assets and activities; the relative location of sensitive receivers; any intervening topographic features or vegetation; and the proximity of the operations to the nearest sensitive receptor.

Assessment and treatment of noise from significant noise-generating facilities is carried out by experts in industrial noise assessment and are subject to detailed design process. For general facilities, the orientation of various infrastructure to reduce noise nuisance is assessed and a minimum separation distance to achieve compliance is determined through noise impact assessment previously described.

5.3 Manage

5.3.1 Operating Hours

Where possible construction activities will be conducted during the daytime when ambient noise levels are higher with less difference between the new noise and the prior ambient noise environment.

5.3.2 Ensure Compliance

5.3.2.1 Handling Noise Complaints

In the event that a noise complaint is received, Arrow's *Complaints Management System* is to be followed.

In order to confirm the nature of a complaint, the following actions will be taken:

- Identify possible noise generating activities in the vicinity of the affected premises/location to evaluate the likely impact of Arrow activities;
- Arrow representative to attend the site during the period when most impact is occurring to assess level of potential impact.

Where a medium or high level of potential impact is possible, a more detailed noise assessment is to be conducted, including:

1. calculating and/or modelling impacts (desktop assessment c.f. Section 5.3.2.4) on the sensitive receptor from identified noise-generating activities in the local area; and/or
2. field noise assessment from the sensitive receptor.

All modelling, calculations and field noise assessments are to be undertaken by a suitably qualified and experienced person.

Should investigations show that EA noise limits are being exceeded at a sensitive receptor, consideration will need to be given to suitable noise attenuation or other measures to ensure unacceptable noise impacts are not being experienced at the sensitive receptor.

Responsibilities for actions to address complaints and communication required with the party making the complaint are outlined in the *Complaints Management System* document. It is noted that EA conditions require notification to the regulator of any non-compliances with the EA. As required, this needs to be addressed during response to a valid complaint.

More details on actions outlined above which may be taken to address complaints are contained in the following sections.

5.3.2.2 Complaints Records Management

Complaints are recorded as required under Arrow's *Complaints Management System*. In relation to noise complaints the following details should be recorded:

- Name, address and contact number of complainant;
- Time and date of valid complaint;
- Reasons for the complaint as stated by the complainant;
- Investigations undertaken in response to the complaint;
- Conclusions formed;
- Actions taken to resolve the complaint;
- Any abatement measures to mitigate the cause of the valid complaint; and
- Name and contact details of the person responsible for resolving the valid complaint.

5.3.2.3 Mediation Process for Unresolved Noise Complaints

Under the premise that a CCA or an alternative arrangement has been agreed upon, a dispute clause may be included in the agreement whereby the mediation process for unresolved noise complaints may include:

- One party provides the other party with a dispute notice which details the matters in dispute and the outcome sought by the party issuing the dispute notice;
- After the issue of the dispute notice, the parties will meet and attempt to resolve the dispute in a timely way by acting in good faith;
- If the parties cannot reach agreement within the specified time frame after the initial meeting, either party may request the appointment of a mediator;
- If the parties cannot agree on the appointment of a mediator, either party may request the Queensland President of the Australian Institute of Arbitrators and Mediators to appoint a mediator;
- The parties acknowledge and agree the mediator has the power to determine procedure and cost of the mediation in dispute; and
- If the dispute is not resolved within the specified period of the appointment of a mediator, either party may seek resolution in the Land Court or if the item in dispute is outside of the jurisdiction of that court, a court of competent jurisdiction.

5.3.2.4 Desktop Assessment

In the event of a valid noise complaint is received by Arrow, the noise profile for infrastructure and equipment closest to the sensitive receptor should be reviewed and located on a map including:

- well or wells and the equipment at each of these wells;
- drill rigs at each of these wells;
- construction activities within a radius of approximately 4,000 m of the sensitive receptor;
- other noise generating activities in the vicinity of the sensitive receptor including those not connected with Arrow's activities.

If this desktop assessment indicates noise impact is unlikely to be caused by Arrow activities then this is to be communicated to the affected party and the issue closed out as per the *Complaints Management System*.

If the desk top assessment indicates noise impact is likely to be caused by Arrow activities then a field noise assessment is to be conducted.

5.3.2.5 Field Noise Assessment

If the noise source is not identified or it is uncertain whether or not the noise limit is being exceeded, consideration should be given to conducting a field noise assessment.

Information required to conduct a field noise assessment:

- map showing the location of affected party, all Arrow facilities in the vicinity of the affected party and topography as required for desktop assessment;
- map showing the location of other potential noise sources in the vicinity (non Arrow).

Field noise assessment should include:

- $L_{AN,T}$ (where N equals the statistical levels of 1, 10 and 90 and T = 15 minutes);
- $L_{Aeq,\ adj,\ 15\ mins}$
- Background noise level as $L_{A,\ 90,\ 15\ mins}$;
- Max $Lp_{A,\ 15\ mins}$;
- The level and frequency of occurrence of impulsive or tonal noise and any adjustment and penalties to measured noise levels;
- Atmospheric conditions including temperature, relative humidity and wind speed and directions;
- Effects due to any extraneous factors such as traffic noise;
- Location, date and time of monitoring;
- If the complaint concerns low frequency noise, Max $Lp_{Z,\ 15\ mins}$; and
- If the complaint concerns low frequency noise, one third octave band measurements in dB(LIN) for centre frequencies in the 10 – 200 Hz range for both the noise source and the background noise in the absence of the noise source.

The field noise assessment must be conducted in accordance with the current editions of the EHP's *Noise Measurement Manual 2000* or *AS 1055-1997 Acoustics - Description and Measurement of Environmental Noise*.

5.3.2.6 Training

Awareness training in this management plan and any relevant noise-related policies/procedures will be undertaken for staff identified as requiring this competency.

Where potential impacts to sensitive receptors associated with particular activities, e.g. construction projects, are identified, noise management will be included in site-specific environmental management plans for these activities. Staff and contractors involved in the activity will be required to attend a briefing on the management plan as part of the kick-off meeting for the project and adhere to the plan throughout the site works.

Regular tool-box meetings are also conducted which may include key noise management principles and reinforce any noise-related issues that arise during the course of exploration and construction.

6 Vibration Management

The main source of potential vibration impact is during construction. The attenuation of ground vibration levels with distance for a range of common mechanical construction vibration sources is shown in Figure 5.

This shows that normal construction processes are unlikely to generate vibration levels over 1 mm/s at receiver distances greater than 100 m. Beyond this distance, it is highly unlikely that structural damage to buildings or human discomfort will occur. Vibration impacts should be managed through planning and avoiding construction activities within distances to sensitive receptors where vibration impacts may be expected.

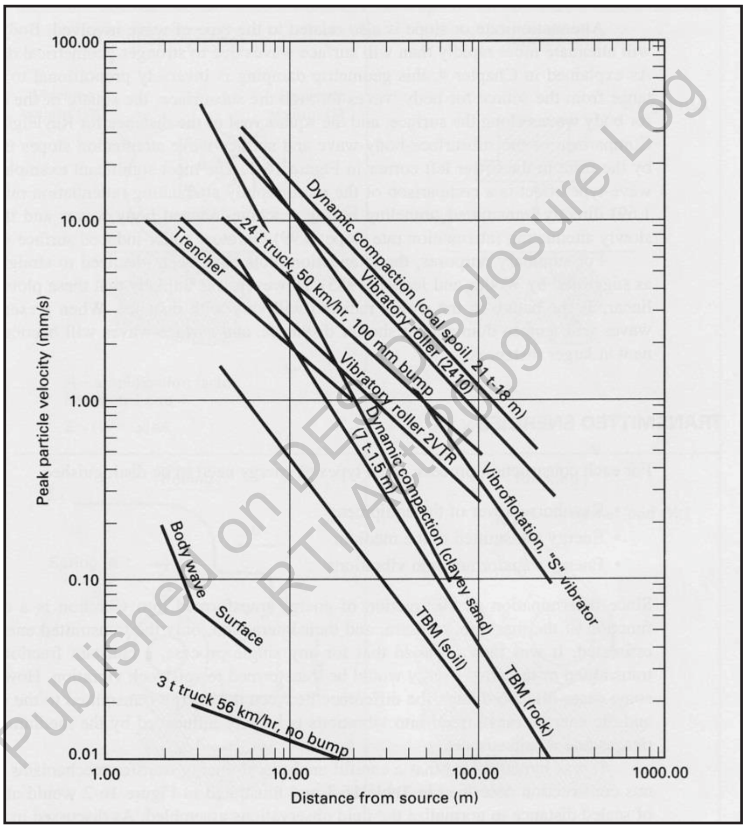

Figure 5: Attenuation of ground vibration with distance from mechanical equipment[1]

In the unlikely event that construction activities result in vibration impacts at sensitive receptors:

- Assess whether vibration may adversely impact any structures.
- In consultation with receptors/landowners, consider relocating any livestock that may be sensitive to vibration.
- Conduct such activities only during daylight hours, Monday to Saturday.
- Inform all potentially affected receptors of the expected timing and duration of activities.

[1] Source: p247 *Construction Vibrations*; Dowding 2000

7 Commitment by the CEO

The current Arrow Health Safety and Environment Policy statement signed by the Chief Executive Officer (Figure 6), stands as the environmental commitment to ensure that Arrow has the adequate allocation of staff and resources to the establishment and operation of the Noise Management Plan.

arrow energy
go further

target zero

Health Safety and Environment Policy

Policy statement

Safe work is essential to having a **strong business**.
Arrow is committed to:

- achieving target zero - no harm to people
- protecting the environment.

Expectations

All personnel are expected to:

- be 'fit for duty'
- follow the 12 Life Saving Rules
- stop work or intervene when faced with a situation believed to be unsafe
- comply with HSE Management System requirements and HSE legislation
- plan ahead to minimise and manage Health Safety and Environment (HSE) risks.

Measures

Arrow will fully support the implementation of this Policy by:

- providing sufficient resources, systems and training to effectively manage HSE risks
- setting out clearly the HSE requirements and regulatory obligations via the HSE Management System
- ensuring that HSE requirements are met
- tracking HSE performance and setting targets for continuous improvement
- learning from incidents to improve our HSE performance
- protecting personnel from occupational injuries and illnesses
- conducting an annual HSE Management System review to confirm effectiveness
- promoting fitness for work including zero tolerance to working or driving under the influence of drugs or alcohol
- minimising the environmental impact of our operations
- efficiently and responsibly using energy and natural resources to provide our products and services
- implementing the principles of sustainable development.

Behaviours

We expect all Arrow staff and contractors to be visible safety leaders, create safe work environments and ensure the safety of others. Arrow supports them in exhibiting this behaviour which is consistent with the **SAFER** framework:

S **Safety leadership**: everyone has a role to play in practicing visible safety leadership.

A **Assess the risks**: be aware of hazards and use risk assessment tools to keep safe. Ensure effective controls are in place.

F **Follow the rules**: understand and follow the rules. Stop and ask when unsure.

E **Engage in safety conversations**: Have the courage to undertake safety conversations and, the character to accept them with respect.

R **Respect**: apply visible safety leadership with respect.

HSE leadership and performance will be assessed in the appraisal of all staff.

Scope and responsibility

This Policy applies to all personnel involved in Arrow activities, including contractors.

Each employee, contractor and service provider is responsible for actively following this Policy.

Line managers are responsible for the safety of their teams via the implementation of this policy and the HSE Management System.

sch4p4(6) Personal informati

Qian Mingyang, Chief Executive Officer
March 2017

ORG-ARW-HSM-POL-00001 revision 4
This document has been created using ORG-ARW-MT-TEM-00001 v2.0

Safe Work. Strong Business.

Figure 6: Arrow's Health Safety and Environment Policy

8 Review

The NVMP is a living document and shall be reviewed at least every two years or sooner if any of the following occur:

- The plan is not adequately managing noise;
- Legislative requirements change;
- Activities within Arrow tenures change; and/or
- The area of activity changes.

Reviews and change to the NVMP are to be communicated to relevant Arrow project personnel.

9 References

Department of Environment and Heritage Protection (DEHP) (2012) *Guideline: Prescribing noise conditions for petroleum activities,* Queensland

Department of Environment and Resource Management (DERM) (2000) *Noise Measurement Manual*, 3rd Edition, Queensland.

Dowding, C. (2000), *Construction Vibrations*, International Society of Explosives.

Standards Association of Australia (1981) *AS 2436-1981* Guide to Noise Control on Construction, Maintenance and Demolition Sites

Standards Association of Australia (1996) *AS/NZS ISO 14001:1996 Environmental Management Systems*

Standards Association of Australia (1997) *AS1055-1997 Acoustics – description and measurement of environmental noise*

10 Definitions

Term	Definition
Alternative arrangement	A written agreement between the holder of this environmental authority and an affected or potentially affected person at a sensitive receptor for a defined noise nuisance impact and may include an agreed period of time for which the arrangement is in place. An agreement for alternative arrangement may include, but not necessarily be limited to a range of noise abatement measures to be installed at a sensitive receptor and/or provision of alternative accommodation for the duration of the defined noise nuisance impact.
ATP	Authority to Prospect
A-weighted sound pressure level	A measure of sound adjusted to the 'A' frequency weighting network
Background noise level	The sound pressure level, measured in the absence of the noise under investigation, as the LA90,T being the A-weighted sound pressure level exceeded for 90 percent of the measurement time period T of not less than 15 minutes, using Fast response.
CCA	Conduct and Compensation Agreement
CSG	Coal seam gas
Daytime	The period after 7 am on a day to 6 pm on the day
dB	Decibels
dB(A)	Decibels measured on the 'A' frequency
dB(C)	Decibels relative to the carrier
dB(LIN)	Unweighted decibels
dB(Z)	Decibels measured on the 'Z' frequency weighting network
E&A	Exploration and appraisal
EA	Environmental Authority
EHP	Queensland Department of Environment and Heritage Protection
EP Act	Environmental Protection Act 1994
EP Reg	Environmental Protection Regulation 2008
EPP Noise	Environmental Protection (Noise) Policy 2008
Evening	The period after 6 pm on a day to 10 pm on the day
HPU	Hydraulic power unit
HSEMS	Health, safety and environment management system
$L_{A1, adj, 1 hr}$	The A-weighted sound pressure level, adjusted for tonal character or impulsiveness, that is exceeded for 1% of a 1 hour period when measured using time-weighting 'F'.
$L_{A10, adj, 1 hr}$	The A-weighted sound pressure level, adjusted for tonal character or impulsiveness, that is exceeded for 10% of a 1 hour period when measured

Term	Definition
	using time-weighting 'F'.
L_{A90}	Noise level (in decibels - A-weighted) exceeded for 90 per cent of the measurement period
$L_{A90,\ adj,\ 15\ mins}$	The A-weighted sound pressure level, adjusted for tonal character, that is equal to or exceeded for 90% of any 15 minutes sample period equal, using Fast response
L_{Aeq}	Equivalent continuous (or 'average') noise level (in decibels - A-weighted) over a measurement period
$L_{Aeq,\ adj,\ 1\ hr}$	An A-weighted sound pressure level of a continuous steady sound, adjusted for tonal character, that within a 1 hour period has the same mean square sound pressure of a sound that varies with time
$L_{Aeq,\ adj,\ 15\ mins}$	An A-weighted sound pressure level of a continuous steady sound, adjusted for tonal character, that within a 15 minute period has the same square sound pressure of a sound that varies with time
L_{Amax}	Maximum noise level measured in A-weighted sound pressure
Evening	The period after 6 pm on a day to 10 pm on the day
LpZ	Low frequency sound pressure level
Max L_{pA}	Absolute maximum instantaneous level
Max $L_{pA,\ 15min}$	The absolute maximum instantaneous A-weighted sound pressure level, measured over 15 minutes.
Medium-term noise event	Noise exposure, when perceived at a sensitive receptor, that persists for an aggregate period not greater than five (5) days and does not reoccur for a period of at least four (4) weeks. Re-occurrence is deemed to apply where a noise of comparable level is observed at the same receptor location for a period of one hour or more, even if it originates from a different source or location
Night time	The period after 10 pm on a day to 7 am on the next day.
NMVP	Noise and vibration management plan
Noise	Noise is broadly defined in the EP Act as a vibration of any frequency, whether emitted through air or another medium. The term 'noise' is a subjective quality and is often used to refer to unwanted or intrusive sound. Noise becomes a nuisance when there is an unreasonable interference with an acoustic value. Nuisance noise can be continuous or intermittent, but the effect is such that there is a material interference with property or the personal comfort or quality of life of persons.
Sensitive receptor	Means an area or place where noise (including low frequency, vibration and blasting) is measured to investigate whether nuisance impacts are occurring and includes: - dwelling (including residential allotment, mobile home or caravan park, residential marina, or other residential premises, motel, hotel or hostel; or - a library, childcare centre, kindergarten, school, university or otehr educational institution; - a medical centre, surgery or hospital; or

Term	Definition
	- a protected area; or - a public park or garden that is open to the public (whether or not on payment of money) for use other than for sport or organised entertainment; or - a work place used as an office or for business or commercial purposes, which is not part of the petroleum activity(ies) and does not include employees accommodation or public roads.
Short-term noise event	Noise exposure, when perceived at a sensitive receptor, persists for an aggregate period not greater than eight hours and does not re-occur for a period of at least seven (7) days. Re-occurrence is deemed to apply where a noise of comparable level is observed at the same receptor location for a period of one hour or more, even if it originates from a different source or source location.
Suitably qualified person	Means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis to performance relative to the subject matter using the relevant protocols, standards, methods or literature.

11 Document Administration

Revision history

Revision	Revision Date	Revision Summary	Author
1.0	December 2015	Generic NMVP created	K. Bawden
2.0	September 2017	Updated NMVP following routine review	K. Bawden

Related documents

Document Number	Document title
ORG-ARW-HSM-POL-00001	Health Safety and Environment Policy
20121114-CSD-POL-CCE	Constructive Community Engagement Policy
ORG-ARW-CEM-POL-00012	Complaints Management System Policy
ORG-ARW-HSM-STA-00040	Amenity Standard
ORG-ARW-HSM-PRO-00064	Environmental Noise & Vibration Management Procedure

Acceptance and release

Author

Position	Incumbent	Release Date
Senior Advisor Environment & Carbon	Kelsey Bawden	September 2017

Stakeholders and reviewers

Position	Incumbent	Review Date
Technical Environment Team Lead	T Rutter	November 2015
Senior Environment Advisor Operations	T Jocumsen	November 2015
Senior Environment Advisor Development	N Gifford	November 2015
Access Support Manager, Site Access	C Charlton	November 2015
Team Lead Community Engagement, External Relations	P Tucker	November 2015

Approver(s)

Position	Incumbent	Approval Date
Joanne Flint	Environment Manager	September 2017

Report
S00-ARW-ENV-PLA-00005

Environmental Noise and Vibration Management Plan

Dalby Expansion Project (DXP)

Version	6
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Please see document administration section for more information

Table of Contents

1 Introduction

1.1 Purpose

Arrow Energy (Arrow) has gas producing assets in the Surat Basin to the west of Brisbane. Production areas contained within PL194, PL198, PL230, PL238, PL252, PL258 and PL260 are known as the Dalby Expansion Project (DXP) and are regulated under Environmental Authority (EA) No. EPPG00972513. These producing gas fields have existing infrastructure of coal seam methane gas production wells, interconnecting pipelines, central gas processing facilities (CGPF) and water treatment facilities (WTF).

The Environmental Authority (EA) defines noise limits for petroleum activities within the stated Petroleum Leases (PLs) and requires that noise emissions are considered in planning and undertaking any works. Where potential for noise levels to exceed the specified noise limits at sensitive receptors is identified, Arrow is required to prepare a noise management plan which shows how the noise limits at sensitive receptors will be met in the event of receiving a valid noise complaint.

Environmental noise assessments conducted within DXP have identified there are some activities which have potential to cause possible noise limit exceedances at a small number of sensitive receptors in certain weather and operational situations. As a result, this noise management plan has been prepared that meets the EA requirements.

1.2 Scope

This noise management plan covers only aspects of operations and EA requirements that are specific to DXP area. The Arrow Generic Noise and Vibration Management Plan (ORG-ARW-HSM-PLA-00043) covers non-site specific details such as:

- General roles and responsibilities in relation to noise management across Arrow
- Legal and Arrow specific requirements in relation to noise management
- Description of noise sources specific to Arrow activities
- Arrow's general noise and vibration management strategy
- Commitment by the CEO to environmental compliance

Arrow's generic noise management plan has been designed to include all the requirements set out by the Department of Environment and Heritage Protection for petroleum activity noise management plans outlined in EHP's Guideline *Prescribing noise conditions for petroleum activities.*

In addition to generic noise management requirements, there are specific requirements in the DXP EA. These are addressed in this plan which is used in conjunction with the overarching *Environmental Noise and Vibration Management Plan* to manage noise within the DXP area. The EA noise management plan requirements and the location of where these requirements are met in Arrow's management system are described in Table 1.

Table 1: Noise Management Plan Requirement and Location of

DXP EA requirements for a Noise Management Plan	Location
A location based noise assessment to determine compliance with the limits in Schedule E, Table 1 – Noise limits at sensitive receptors	Section 2 and Section 3 of this Noise Management Plan. As this a summary of site specific assessment results, the description of the location based noise assessments are described in this NMP. Detailed descriptions of the noise assessments are located in specialist noise consultant reports.
The measured and/or predicted noise level of these noise sources and activities at noise sensitive receptors, taking into account any tonal or impulsive noise impacts;	
The reasonable and practicable control or abatement measures (including relocating the activity, hours of operation, or having an alternative arrangement in place with any potentially affected person) that can be undertaken to reduce identified intrusive noise sources.	Section 4 of this Noise Management Plan and Section 5 of Arrow's Generic Noise and Vibration Management Plan. Section 4 of this document lists specific noise control options for the DXP and expected attenuation from each option in line with the requirements of the EA. Section 5 of the generic plan describes the overall noise management strategy for Arrow which is also considered when evaluating noise control options.
The level of noise at noise sensitive receptors that would be achieved from implementing these measures;	
The handling of future noise complaints.	Section 5 of Arrow's Generic Noise and Vibration Management Plan.
Community liaison and consultation including but not limited consultation processes for when night time activities (i.e. between 10:00 pm and 6:00 am) are likely to exceed 25 dBA.	
Training of staff and contractors in best available noise management practices.	

2 Background

2.1 Environmental Authority Requirements

Environmental Authority No. EPPG00972513 requirements relating to noise are presented in this section in line with Schedule E of the EA. Noise conditions in the EA are from E2 to E10.

Condition E2

Prior to undertaking petroleum activities that will result in short term, medium term or long term noise events that are likely to impact on sensitive receptor, the holder of this environmental authority must model or calculate any potential noise emissions from the relevant petroleum activity and determine if noise emissions are likely to exceed the noise levels specified in *Schedule E, Table 1 – Noise Limits at Sensitive Receptors*.

Condition E3

If noise modelling or the calculations indicates that petroleum activities are likely to exceed the noise levels specified in *Schedule E, Table 1 – Noise limits at sensitive receptors*, the holder of this environmental authority must prepare a Noise Management Plan prior to undertaking petroleum activities, which demonstrates how the noise limits specified in *Schedule E, Table 1 – Noise limits at sensitive receptors* will be achieved in the event of a valid noise complaint.

Condition E4

Despite condition E3, for any petroleum activities existing at the time of issue of this environmental authority, if noise modelling or the calculations indicates that petroleum activities are likely to exceed the noise levels specified in *Schedule E, Table 1 – Noise limits at sensitive receptors*, the holder of this environmental authority must implement a Noise Management Plan, which demonstrates how the noise limits specified in *Schedule E, Table 1 – Noise limits at sensitive receptors* will be achieved in the event of a valid noise compliant.

Condition E5

The Noise Management Plan must address, but not be limited to, the following matters:

(a) a location based noise assessment to determine compliance with the limits in *Schedule E, Table 1 – Noise limits at sensitive receptors*
(b) the measured and/or predicted noise level of these noise sources and activities at noise sensitive receptors, taking into account any tonal or impulsive noise impacts;

(c) the reasonable and practicable control or abatement measures (including relocating the activity, hours of operation, or having an alternative arrangement in place with any potentially affected person) that can be undertaken to reduce identified intrusive noise sources;
(d) the level of noise at noise sensitive receptors that would be achieved from implementing these measures;
(e) the handling of future noise complaints;
(f) community liaison and consultation including but not limited consultation processes for when night time activities (i.e. between 10:00 pm and 6:00 am) are likely to exceed 25 dBA; and
(g) training of staff and contractors in best available noise management practices.

Condition E6

The emission of noise from the licensed place must not result in levels greater than those specified in *Schedule E, Table 1 – Noise limits at sensitive receptors* in the event of a valid complaint about noise being made to the administering authority.

Schedule E, Table 1 – Noise Limits at Sensitive Receptors

Time Period	Metric	Short Term Noise Event	Medium Term Noise Event	Long Term Noise Event
7:00 am – 6:00 pm	$L_{Aeq,adj,15min}$	45 dBA	43 dBA	40 dBA
	Max $L_{pA,15min}$	55 dBA	51 dBA	45 dBA
6:00 pm – 10:00 pm	$L_{Aeq,adj,15min}$	40 dBA	38 dBA	35 dBA
	Max $L_{pA,15min}$	50 dBA	46 dBA	40 dBA
10:00 pm – 6:00 am	$L_{Aeq,adj,15min}$	28 dBA	28 dBA	28 dBA
	Max $L_{pA,15min}$	38 dBA	36 dBA	33 dBA
6:00 am – 7:00 am	$L_{Aeq,adj,15min}$	40 dBA	38 dBA	35 dBA
	Max $L_{pA,15min}$	50 dBA	46 dBA	40 dBA

L_{Aeq} and Max L_{pA} are to be measured over any 15 minute period

Deemed background noise levels (L_{ABG}) for Schedule E: Table 1 – Noise Limits at Sensitive Receptors are:
7:00 am – 6:00 pm: 35 dBA
6:00 pm – 10:00 pm: 30 dBA
10:00 pm – 6:00 am: 25 dBA
6:00 am – 7:00 am: 30 dBA

Condition E7

If the noise subject to a complaint is tonal or impulsive, the adjustments detailed in *Schedule E, Table 2 – Adjustments to be Added to Noise Levels at Sensitive Receptors* are to be added to the measured noise level(s) to derive $L_{Aeq,adj,15min}$.

Schedule E, Table 2 – Adjustments to be Added to Noise Levels at Sensitive Receptors

Noise Characteristic	Adjustment to Noise
Tonal characteristic just audible	+ 2 dBA
Tonal characteristic clearly audible	+ 5 dBA
Impulsive characteristic just audible	+ 2 dBA
Impulsive characteristic clearly audible	+ 5 dBA

Condition E8

Where alternative arrangements are in place with any affected person as referred to by Condition (E5)(c), the noise limits in *Schedule E, Table 1 – Noise Limits at Sensitive Receptors* do not apply at that location for the duration for which the alternative arrangements are in place.

Condition E9

Notwithstanding Condition E2, emission of any noise below 315 Hz must not cause an environmental nuisance.

Condition E10

Low frequency noise from the petroleum activities is not considered to be an environmental nuisance under Condition E9 if monitoring shows that noise emissions do not exceed the following limits:

(a) 50 dB(Z) measured inside the sensitive receptor; and
(b) the difference between the internal A-weighted and Z-weighted noise levels is no greater than 15 dB.

2.2 Summary of Environmental Noise Studies Conducted for the DXP

The primary noise sources associated with the DXP are:

- drill rigs;
- gas compression facilities (CGPF plants);
- Water Treatment Facility (WTF) at Tipton[1];
- Low pressure flaring at Daandine CGPF;
- well head equipment (hydraulic power units (hydrapacks) and generators); and
- construction projects.

In accordance with Condition E2, Arrow has had detailed noise assessments conducted within the Daandine, Tipton West and Kogan gas production fields of all of these primary noise sources. For the existing CGPFs (Daandine and Tipton West) and WTFs (Daandine and Tipton West), this includes computer noise modelling to evaluate noise impact at potential sensitive receptors, whilst for all other plant and equipment it includes computer noise modelling to estimate separation distances to achieve compliance with the noise limit criteria of the environmental authority.

More details on methodology and assumptions used in the noise assessments are contained in the detailed modelling and assessment reports.

Key assumptions made in the bulk of the noise modelling include:

- flat ground between the source and receptors;
- noise radiates hemispherically from the noise source;
- uniform ground absorption factor of -0.5; and
- light breeze from the noise source to the receptor.

Hence, noise modelling results are considered likely to represent a worst case scenario based on normal operations or maximum operating conditions. The outcomes of these noise assessments are summarised in this noise management plan.

2.3 Background Noise and Sensitive Receptors

The areas surrounding Daandine and Tipton tenure are predominantly rural and industrial with land uses such as grazing, feedlot, pre-existing gas field development and gas fired power stations. Existing infrastructure typically includes a number of rural secondary roads linking the major regional road network. Existing noise sources are generally typical of rural roads and include fauna (birds and insects), traffic and local sources associated with local industrial uses (feedlot activity and power stations).

[1] Note that the Daandine WTF was modified to operate on electricity rather than gas fired generators in 2015. This has significantly reduced any noise impact from the WTF at Daandine.

In the EA, deemed background noise for rural and isolated areas which are as listed in Table 2, has been applied.

Table 2: Deemed background noise

Time period	Deemed background noise level (dBA)
7:00 am – 6:00 pm	35
6:00 pm – 10:00 pm	30
10:00 pm – 6:00 am	25

The EA limits have been set based on allowable increase in background noise levels as follows:

- 7:00 am – 6:00 pm: 35 + 5 dBA
- 6:00 pm – 10:00 pm: 30 + 5 dBA
- 10:00 pm – 6:00 am: 25 + 3 dBA

The nearest sensitive receptors (SR1 – SR8), Arrow CGPFs and WTF and other surrounding noise sources are displayed in the following figures:

- Daandine - Figure 1
- Tipton - Figure 2

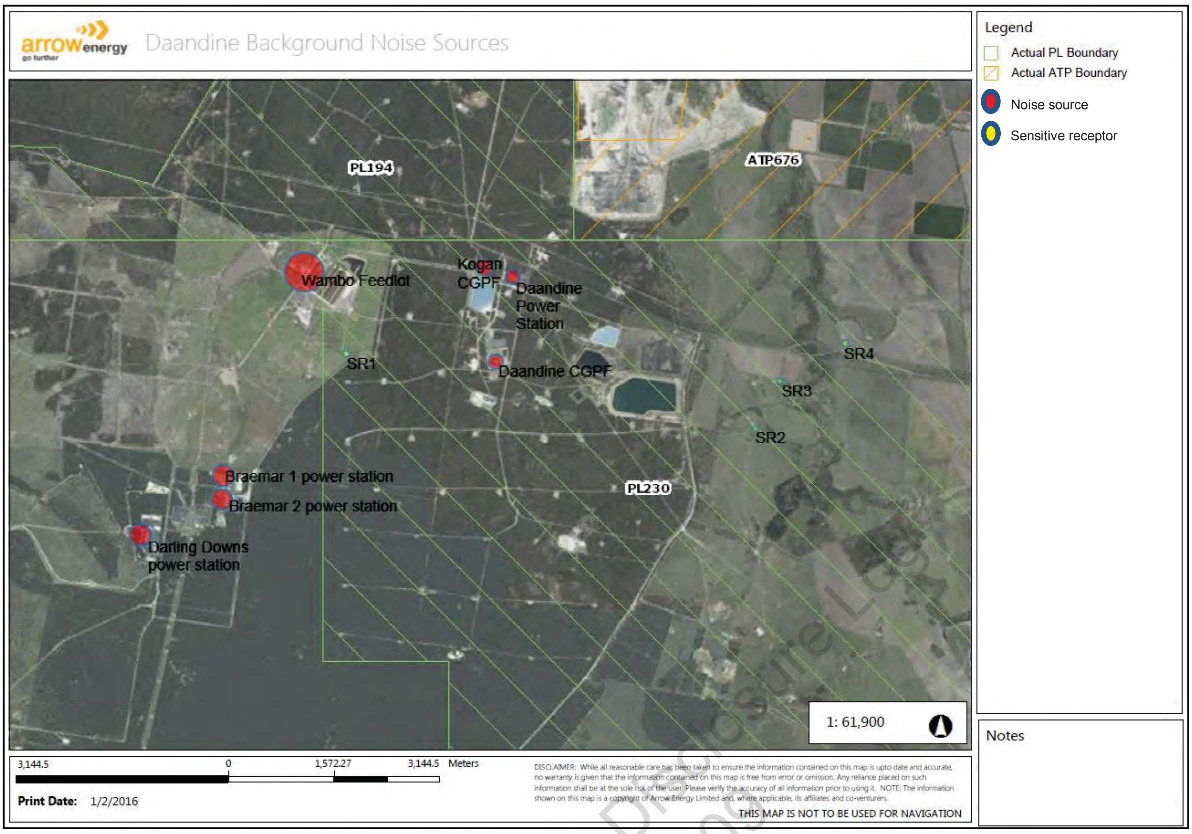

Figure 1: Daandine CGPF location and surrounding noise sources

Figure 2: Tipton CGPF and WTF location and surrounding noise sources

2.4 Daandine CGPF

2.4.1 Compressors

Predicted separation distances from the Daandine CGPF required to achieve compliance with the noise limits due to the compressors operating under neutral and adverse meteorological conditions were assessed in 2014 and further assessed with an additional inlet fuel gas compressor that is scheduled to be installed as part of the “Produce the Limit” project in 2017. The weather conditions used to assess the effect of neutral and adverse meteorological conditions are shown in Table 3.

Predicted separation distances from the CGPF to achieve compliance with the noise limits under these meteorological conditions are shown in Table 4. In the assessment, deemed EHP background noise levels of rural/isolated are assumed to be present and all ten compressors are assumed to be operating in order to predict worst case separation distances. The additional assessment conducted in 2017 assessed the impact of the additional inlet fuel compressor. This assessment showed there was negligible increase to noise impact from the operation of the inlet fuel compressor[2].

[2] This was due to design considerations i.e. selecting the quietest engine package and designing an exhaust silencer to attenuate the loudest noise source. Modelling showed that these attenuation

Table 3: Meteorological conditions – neutral and adverse

Parameter	Neutral Weather	Adverse Weather
Temperature	17°C	9°C
Humidity	80%	75%
Pasquil Stability Category	D	F
Wind Speed	0 m/s	2 m/s (source to receptor)

Table 4: Predicted separation distances to achieve compliance with noise limits

Noise source	Meteorological Conditions	Predicted distance at which noise source complies with noise limit (m) for different time periods and meteorological conditions			
		Daytime (0700 to 1800 hrs) 40 dBA	Evening (1800 to 2200 hrs) 35 dBA	Night-time (2200 – 0600 hrs) 28 dBA	Early morning (0600 – 0700 hrs) 35 dBA
Daandine CGPF (all ten main compressors operating) and inlet fuel compressor operating [a]	Neutral	1,280	1,810	2,820	1,810
	Adverse	1,630	2,710	4,080	2,710

a Note that the Daandine WTF was changed from gas fired generators to electricity in 2015 effectively eliminating the noise impact due to the WTF

The predicted potential noise levels due to the Daandine CGPF relative to surrounding sensitive receptors is shown in Figure 3 under neutral weather conditions and in Figure 4 under adverse weather conditions.

measures achieved the desired ‘no net increase’ in noise impact from the facility and further attenuation measures to the inlet fuel package (e.g. enclosure) would not result in any decrease in predicted environmental noise impact.

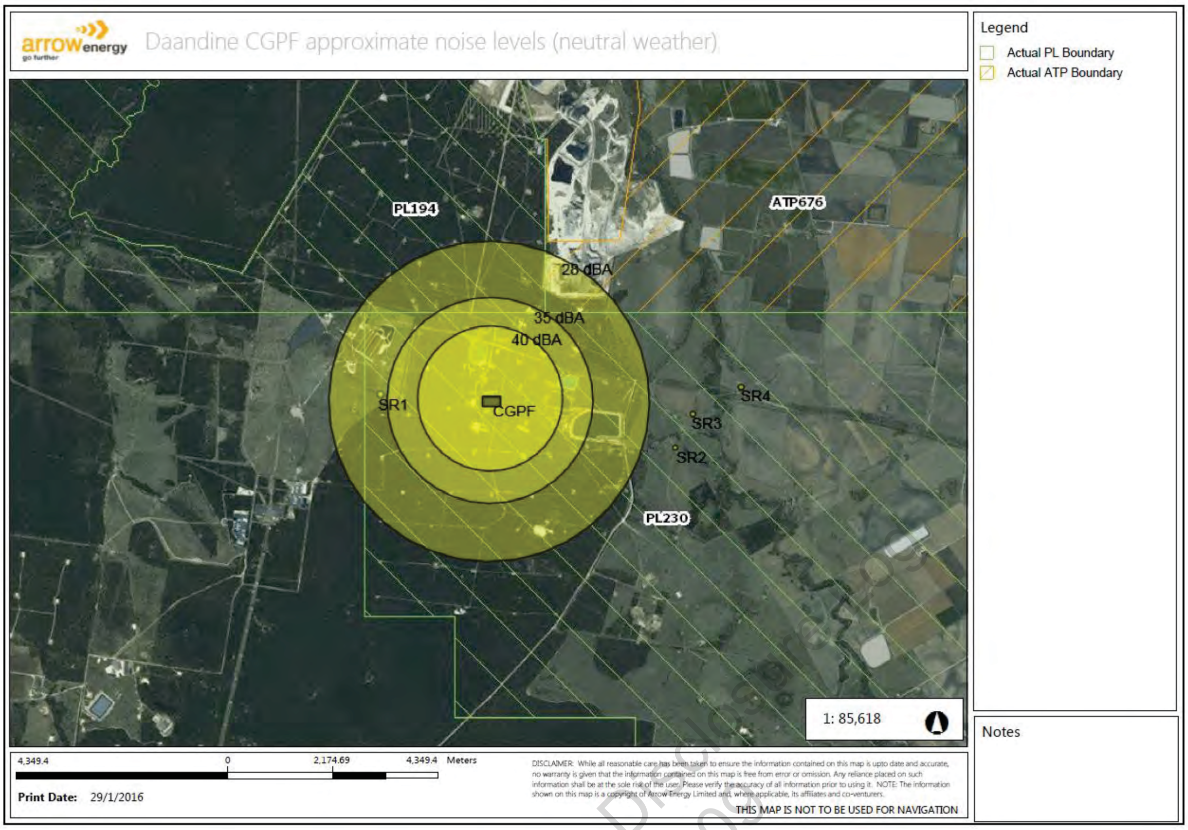

Figure 3: Daandine CGPF potential noise levels (neutral weather)

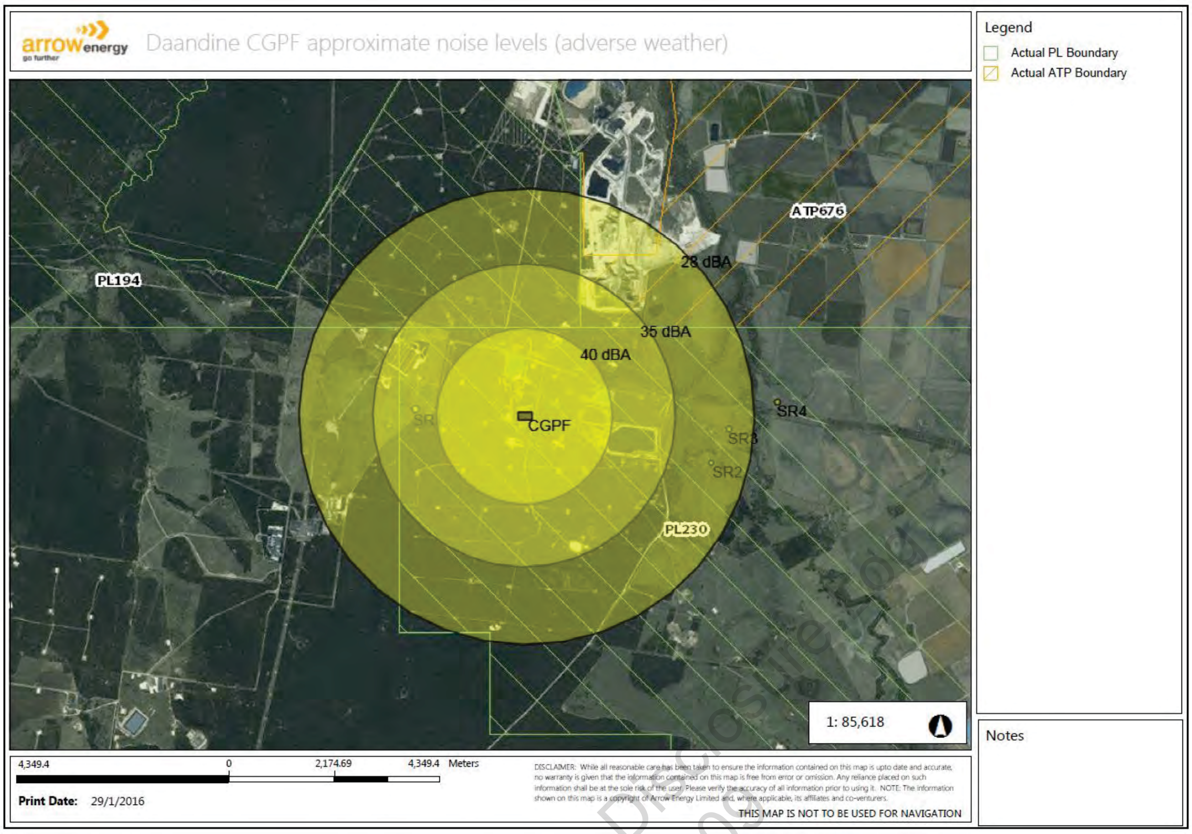

Figure 4: Daandine CGPF potential noise levels (adverse weather)

The modelling shows there is the potential to exceed noise limits at the following sensitive receptors under the following conditions:

- Under neutral weather conditions:
  - At SR1 during the night time (2200 – 0600)
- Under adverse weather conditions:
  - At SR1, SR2 and SR3 during the night time (2200 – 0600); and
  - At SR1 during the evening (1800 – 2200) and early morning (0600 – 0700).

It is noted also that the noise modelling results are designed to represent a worst case scenario for each receptor and are only expected to potentially occur at certain times due to varying meteorological conditions, background noise levels and varying operations.

2.4.2 Low Pressure Flare

Predicted separation distances from the Daandine CGPF required to achieve compliance with the noise limits due to the operation of the LP flare, in upset conditions, under neutral and adverse meteorological conditions were assessed in 2014.

Predicted separation distances from the LP flare to achieve compliance with the noise limits under these meteorological conditions are shown in Table 5. In the assessment, deemed EHP background noise levels of rural/isolated are assumed to be present and the LP flare was assumed to be operating at 100% peak flow (~59 MMscfd or 63 TJ/day) in order to predict worst case separation distances.

Table 5: Predicted separation distances to achieve compliance with noise limits

Noise source	Meteorological Conditions	Predicted distance at which noise source complies with noise limit (m) for different time periods and meteorological conditions			
		Daytime (0700 to 1800 hrs) 40 dBA	Evening (1800 to 2200 hrs) 35 dBA	Night-time (2200 – 0600 hrs) 28 dBA	Early morning (0600 – 0700 hrs) 35 dBA
Daandine LP flare	Neutral	1,390	2,070	3,110	2,070
	Adverse	1,790	2,740	4,100	2,740

The predicted potential noise levels due to the Daandine LP flare operating relative to surrounding sensitive receptors is shown in Figure 5 under neutral weather conditions and in Figure 6 under adverse weather conditions.

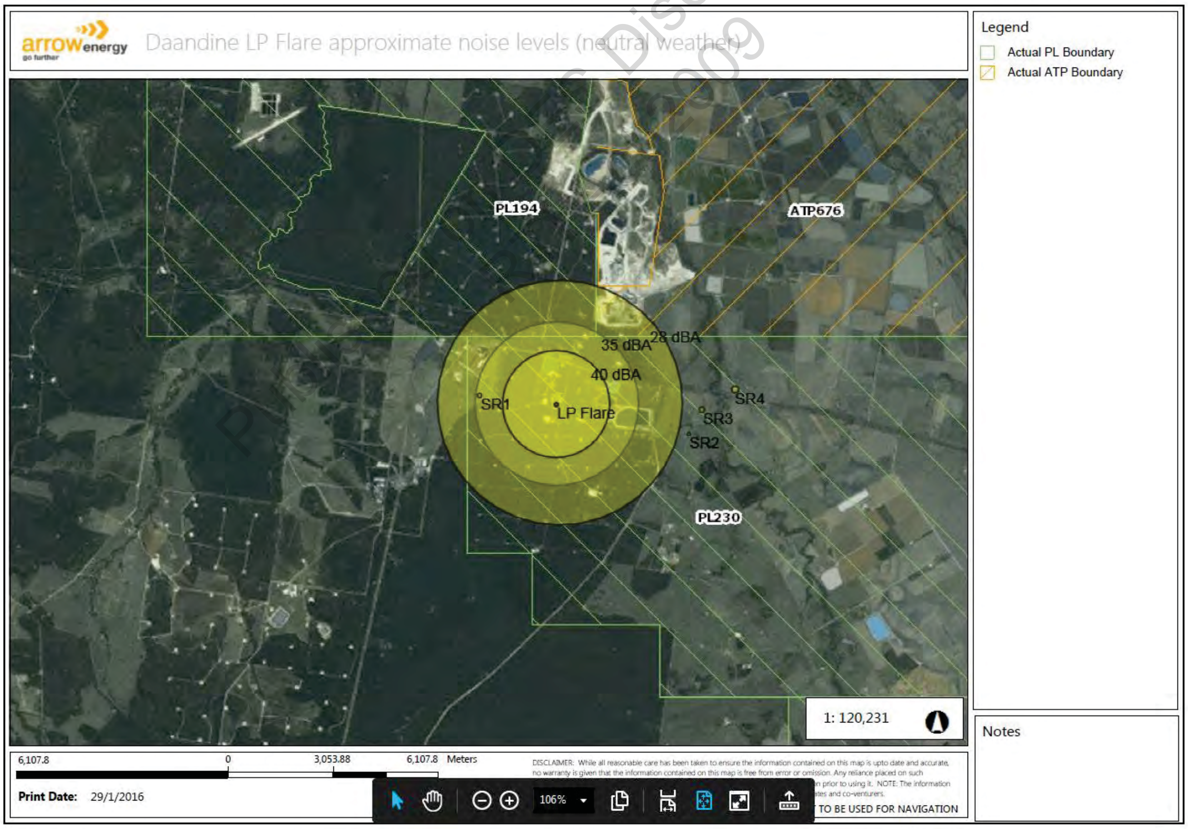

Figure 5: Daandine LP Flare potential noise levels (neutral weather)

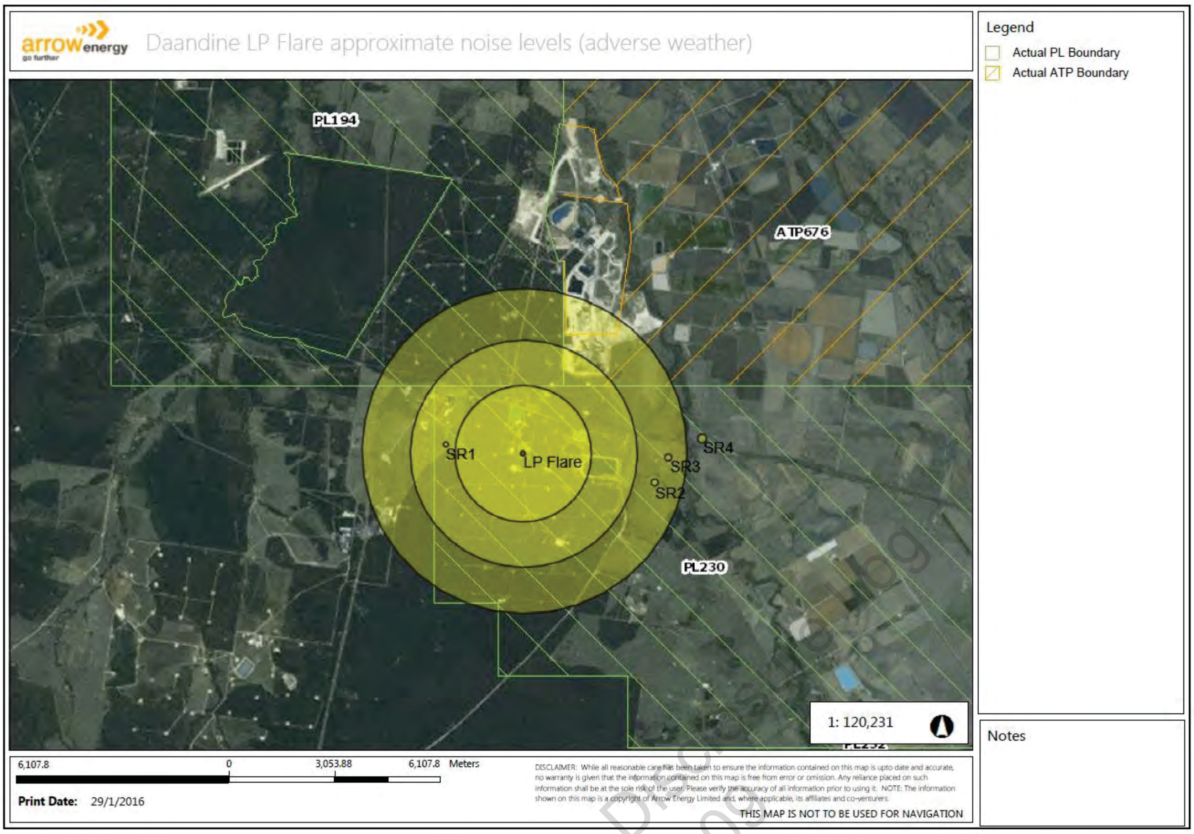

Figure 6: Daandine LP Flare potential noise levels (adverse weather)

The modelling shows there is the potential to exceed noise limits at the following sensitive receptors under the following conditions:

- Under neutral weather conditions:
  - At SR1 during the night time (2200 – 0600)
- Under adverse weather conditions:
  - At SR1, SR2 and SR3 during the night time (2200 – 0600); and
  - At SR1 during the evening (1800 – 2200) and early morning (0600 – 0700).

It is noted also that the noise modelling results are designed to represent a worst case scenario for each receptor and are only expected to potentially occur at certain times due to varying meteorological conditions, background noise levels and varying operations.

2.5 Tipton CGPF and WTF

Predicted separation distances from the Tipton CGPF and WTF required to achieve compliance with the noise limits under worst case meteorological conditions have been assessed on numerous occasions with the latest assessment in 2014.

The modelling indicates that there is the possibility of EA noise level exceedances if sensitive receptors are located within the separation distances listed in Table 6.

Table 6: Predicted separation distances to achieve compliance with noise limits

Noise source	Predicted Distance at which noise source complies with noise limit (m) for different time periods			
	Daytime (0700 to 1800 hrs) 40 dBA	Evening (1800 to 2200 hrs) 35 dBA	Night-time (2200 – 0600 hrs) 28 dBA	Early morning (0600 – 0700 hrs) 35 dBA
Tipton WTF (all three generators operating	380	550	1,000	550
Tipton CGPF (five compressors operating)	2,200	3,000	5,000	3,000
Tipton CGPF (all six compressors operating)	2,300	3,200	5,400	3,200

The predicted potential noise levels due to the Tipton CGPF and WTF relative to surrounding sensitive receptors is shown in Figure 3 under worst case weather conditions and assuming all six compressors are operating.

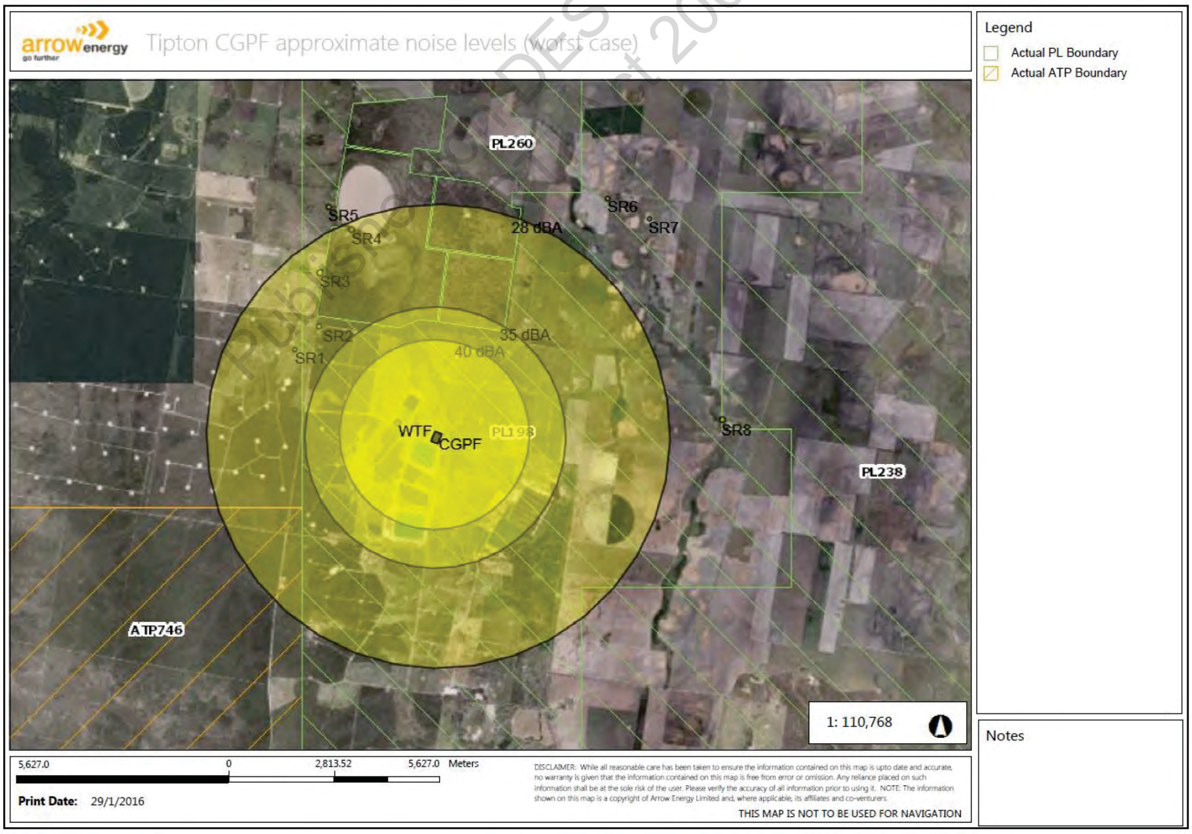

Figure 7: Tipton CGPF and WTF potential noise levels (worst case conditions)

The modelling shows there is the potential to exceed noise limits at the following sensitive receptors during the night time period (2200 – 0600):

- At SR1, SR2, SR3 and SR4

It is noted also that the noise modelling results are designed to represent a worst case scenario for each receptor and are only expected to potentially occur at certain times due to varying meteorological conditions, background noise levels and varying operations.

2.6 Well Site Equipment Noise

At some of the production wells there is equipment operating – either a hydraulic pack or oil lift or a gas generator, and this equipment generates noise. Most of this equipment has been installed with a 'silence' pack. Some of the older equipment has a muffler for the exhaust and no specific sound control for the engine itself.

For the different equipment which can operate at a production well, there is the possibility of EA noise level exceedances if sensitive receptors are located within the separation distances listed in Table 7.

Table 7: Predicted production well noise source and separation distance to achieve compliance with noise limits

Noise Source	Predicted Distance at which noise source complies with noise limit (m) for different time periods			
	Daytime (0700 to 1800 hrs) 40 dBA	Evening (1800 to 2200 hrs) 35 dBA	Night-time (2200 – 0600 hrs) 28 dBA	Early morning (0600 – 0700 hrs) 35 dBA
25 kVA hydrapack	< 300	< 300	400	< 300
Unsilenced 5 cylinder hydrapack	350	530	900	530
45 kVA hydrapack	< 300	< 300	370	< 300
Silenced V6 hydrapack	< 300	< 300	330	< 300
Unsilenced V6 hydrapack	500	740	1400	740
60 kVA hydrapack	< 300	< 300	370	< 300
Silenced V8 hydrapack	< 300	< 300	400	< 300
100 kVA hydrapack	< 300	< 300	530	< 300
120 kVA hydrapack	< 300	370	660	< 300
Generator pack	< 300	400	700	400

2.7 Drill Rig Noise

There are a number of different rigs which can operate within the DXP, including:

- drilling rigs for well holes;
- completion rigs;
- work over rigs;

- water bore rigs.

At least one of each of the above types of rig have been noise assessed, with the sound power level determined and then modelled to ascertain at what separation distance the various noise limits are complied with.

Based on computational noise modelling, there is the possibility of EA noise level exceedances if sensitive receptors are located within the separation distances detailed in Table 8.

Table 8: Predicted separation distances required to achieve noise limits from drill rig operations

Noise Source	Predicted Distance at which noise source complies with noise limit (m) for different time periods			
	Daytime (0700 to 1800 hrs) 40 dBA	Evening (1800 to 2200 hrs) 35 dBA	Night-time (2200 – 0600 hrs) 28 dBA	Early morning (0600 – 0700 hrs) 35 dBA
Drill rig	900	1,350	2,350	1,350
Completion rig (mist plus muffler on blooie line)	770	1,150	2,020	1,150
Completion rig (mist in blooie line (no muffler)	1,440	2,140	3,720	2,140

Note that noise impact from the blooie line operation are highly directional. Given normal controls and directing the blooie line away from sensitive receptors, typical separation distances are >1,350 metres to achieve the 35 dBA noise limit and > 2,350 metres to achieve the 28 dBA noise criteria. As the sound power levels from each drill rig are slightly different and drilling operations and are of a temporary nature, the required separation distance should be estimated on a case by case basis taking into account the sound power level of the drill rig, surrounding sensitive receptors and likelihood for potential impact.

2.8 Construction Noise

There are a number of different construction activities that can occur within the DXP, including:

- production facilities, including:
  - site preparation
  - equipment installation
  - site rehabilitation
- internal roadways:
  - site preparation
  - road construction
  - road maintenance

- well sites
  - site preparation
  - equipment installation
  - site rehabilitation
- pipelines
  - site preparation
  - pipeline installation
  - site rehabilitation

Predicted separation distances to achieve various noise criteria are listed in Table 9.

These modelled distances are taken from noise modelling conducted as part of the Bowen Gas Project environmental assessments completed in 2015. The modelled separation distances can be applied to the DXP as the modelling assumed noise propagation over flat, soft ground (open grassland) which is also considered to provide conservative separation distances.

Table 9: Separation distances to achieve predicted noise levels – construction equipment

Noise Source	Predicted Distance at which noise source complies with noise limit (m) for different time periods			
	Daytime (0700 to 1800 hrs) 40 dBA	Evening (1800 to 2200 hrs) 35 dBA	Night-time (2200 – 0600 hrs) 28 dBA	Early morning (0600 – 0700 hrs) 35 dBA
Truck	850	1,200	1,900	1,200
Front End Loader	1,200	1,750	2,750	1,750
Excavator, 20T	1,000	1,450	2,450	1,450
Dozer (201 kW)	950	1,350	2,250	1,350
Grader (205 kW)	950	1,350	2,250	1,350
Scraper (109 kW)	850	1,200	1,950	1,200
Rock saw	1,050	1,500	2,400	1,500
Crane	350	550	1,050	550
Bobcat	250	400	750	400
Welding generator	550	800	1,300	800
Air compressor	400	600	1,100	600

Construction noise modelling was also conducted as part of the Daandine Expansion project for construction of gathering flowlines and access road tracks. The noise modelling predicted the separation distances listed in Table 10 under neutral weather conditions.

Table 10: Separation distances to achieve predicted noise levels – construction activities

Noise Source	Predicted Distance at which noise source complies with noise limit (m) for different time periods			
	Daytime (0700 to 1800 hrs) 40 dBA	Evening (1800 to 2200 hrs) 35 dBA	Night-time (2200 – 0600 hrs) 28 dBA	Early morning (0600 – 0700 hrs) 35 dBA
Clear and grade	570	850	1,490	850
Trenching	340	500	860	500
Padding and backfilling	630	940	1,640	940
Access road construction	620	940	1,670	940

3 Environmental Noise Impact Assessment

3.1 Daandine CGPF and LP Flare Noise Impact

3.1.1 Compressors

The noise modelling indicates there is the possibility of EA noise level exceedances due to the CGPF operation at the following sensitive receptor locations under the following conditions:

- Under neutral weather conditions:
  - At SR1 during the night time (2200 – 0600)
- Under adverse weather conditions:
  - At SR1, SR2 and SR3 during the night time (2200 – 0600); and
  - At SR1 during the evening (1800 – 2200) and early morning (0600 – 0700).

The modelled exceedances at SR2 and SR3 are between 2 and 4 dBA over the night time limit under worst case conditions. The noise levels under neutral conditions are estimated to comply with the night time noise limit. Subjectively a change in noise level of 1 to 2 dBA is not discernible to the human ear, whilst a change of 3 dBA is just discernible. Therefore, the modelled exceedance is potentially just discernible to the human ear under worst case meteorological conditions and in periods where background noise levels are very low.

The modelled noise level exceedance at SR1 is:

- 4 dBA over the night time noise criteria under neutral weather conditions and 10 dBA over the night time noise criteria under worst case meteorological conditions; and
- 3 dBA over the evening and morning noise criteria under adverse meteorological conditions

The predicted exceedances at SR1 are potentially just discernable when background noise levels are very low in adverse meteorological conditions during the evening and morning periods and at night time under most meteorological conditions. When adverse meteorological conditions exist, and background noise levels are very low, the noise impact from the CGPF is predicted to be clearly perceptible.

Whilst the night-time EA limit is modelled to be potentially exceeded at SR1, the World Health Organisation's (WHO) recommended noise criterion for sleep disturbance of 35 dBA[3] is not predicted to be exceeded under most conditions. Further, no noise complaints have been received to date, indicating that the level of noise impact at receptor SR1 is not causing noise nuisance.

[3] This is based on the WHO recommended noise criterion for sleep disturbance ($L_{A,\ eq,\ 8h}$) for a continuous noise source of 30 dBA (internal) (WHO, 1999) adjusted to 35 dBA (external) to account for a conservative 5 dBA façade reduction (conservatively assuming a wide open window type and window setting) (EHP, 2015).

Receptor SR1 is identified as Arrow's most sensitive receptor in regards to noise impact from the Daandine CGPF.

3.1.2 Low Pressure Flare

The noise modelling indicates there is the possibility of EA noise level exceedances due to LP flare operation at the following sensitive receptor locations under the following conditions:

- Under neutral weather conditions:
  - At SR1 during the night time (2200 – 0600)
- Under adverse weather conditions:
  - At SR1, SR2 and SR3 during the night time (2200 – 0600); and
  - At SR1 during the evening (1800 – 2200) and early morning (0600 – 0700).

Noise levels from low pressure flaring operation at the CGPF is predicted to potentially exceed the night-time noise criterion by up to 7 dBA at SR1 under neutral weather conditions and 12 dBA under adverse meteorological conditions.

Noise levels are predicted to exceed the night-time noise criteria at SR2 and SR3 only under adverse meteorological conditions and by less than approximately 4 dBA.

It is also noted that flaring only occurs under upset conditions and is an infrequent event. Therefore, the likelihood of maximum flaring rates occurring in conjunction with worst case meteorological conditions for each receptor is low. Flaring also only occurs in emergency situations to relieve pressure from the CGPF when the gas cannot be used commercially. Planned CGPF maintenance events are scheduled for the daytime avoiding the worst case potential noise impacts at night time. Also, in general, flaring events are not at maximum flaring rates (equivalent to the entire compression facility shut down) and under these conditions the noise impacts are expected to be much less.

To further mitigate potential noise impacts from flaring events at the nearest receptors, appropriate communication/consultation when it is known that flaring events may occur with potentially affected residents is important.

3.2 Tipton CGPF and WTF Noise Impact

The noise modelling indicates there is the possibility of EA noise level exceedances due to the CGPF and WTF operation at the following sensitive receptor locations under certain conditions:

- SR1, SR2, SR3 and SR4 at night time (2200 – 0600)

The modelled exceedance at the sensitive receptors is less than 4 dBA under worst case meteorological conditions.

Subjectively a change in noise level of 1 to 2 dB(A) is not discernible to the human ear, whilst a change of 3 dB(A) is just discernible. Therefore, compared to the night-time noise limit this 4 dB(A) modelled exceedance would potentially be just discernible to the human ear at the above sensitive receptors.

Whilst the night-time EA limit is modelled to be potentially exceeded at these sensitive receptors under worst case conditions and conservative modelling assumptions, the WHO recommended noise criterion for sleep disturbance of 35 dBA is not predicted to be exceeded. Further, no noise complaints have been received indicating that the level of noise impact at these sensitive receptors is not causing noise nuisance.

In the event of a noise complaint being received, procedures outlined in Arrow's generic noise and vibration management plan are to be followed including the potential for conducting a field noise assessment for the particular location.

3.3 Well Site Equipment Noise Impact

If any known sensitive receptor is located within the separation distances nominated in Table 7 of a production well with an operating engine or hydrapack, then it is possible that the noise limits could be exceeded at this sensitive receptor.

If any of the equipment at these wells can be removed then this should be undertaken at the earliest convenience or replaced with quieter equipment. If removal or replacement of the equipment is not an option then consideration should be given to other potential noise control measures, including:

- construction of an acoustic barrier, which could be an earth berm or solid fence
- not operating the equipment during the most sensitive time – night time
- keeping the equipment well maintained
- installation of sound absorption material on the inside of covers, roof, etc
- minimisation of any vibrating panels on the equipment

From Table 7 if only silenced equipment is considered, then a sensitive receptor would have to be within 700 metres of a well engine for any of the noise limits to possibly be exceeded.

If a valid noise complaint is received then a field noise assessment could be conducted to confirm the noise source and evaluate the magnitude of the noise impact.

3.4 Drill Rig Noise Impact

If a drill rig is to be located within the separation distances nominated in Table 8 of a sensitive receptor, it is possible that the noise limit/s will be exceeded whilst the rig is operating at this well. The potential for impact is dependent on the specific rig used for the drilling activity, hours of operation, relationship with the landholder/receptor, and meteorological conditions present during the activity.

If a valid noise compliant is received then a field noise assessment could be conducted to confirm the noise source and evaluate the magnitude of the noise impact.

3.5 Construction Noise Impact

If construction is to be located within the separation distances nominated in Section 2.8 of a sensitive receptor, for one or more of the time periods nominated, then it is possible that the noise limit(s) will be exceeded.

The noise management strategy outlined in Arrow's overarching *Environmental Noise and Vibration Management Plan* is to be used to avoid, minimise and manage any potential noise impact from construction activities.

If a valid noise compliant is received then a field noise assessment could be conducted to confirm the noise source and evaluate the magnitude of the noise impact.

4 Control or Abatement Measures

Various noise mitigation measures are described in Arrow's generic noise and vibration management plan (ORG-ARW-HSM-PLA-00043) which should be considered when evaluating noise control options. Further detail on potential options for noise mitigation measures specific to the DXP EA requirements are described in this chapter.

Noise control options for DXP noise sources may include:

- Relocation or rescheduling of the activity
- Equipment selection
- Attenuation of reflected noise
- Acoustic barriers
- Acoustic enclosures
- Alternative arrangements with affected parties

4.1 Relocation or Rescheduling the Activity

The impact of the noise of an Arrow activity, at a sensitive receptor, is a function of at least:

- the source of the noise level,
- the nature of the noise (factors such as impulsive, tonal, steady state, time varying),
- the separation distance
- intervening topography and vegetation
- meteorological factors present at the time the noise occurs.

Steady state or constant noise (e.g. compressors) is generally more acceptable than impact or impulsive noise (e.g. pipes banging together). Noise during the daytime will be less intrusive than the same noise during the evening, due to higher ambient noise levels during the daytime compared to the evening. The greatest noise impact (for the same noise) is during the night, as this is when the ambient noise levels are at their lowest.

Relocating the Arrow activity further away from the sensitive receptor will decrease the noise level of this source at the sensitive receptor. Calculation of the increased separation distance (compared to the current separation distance) would provide an indication of the noise level reduction.

If a 24 hour per day Arrow activity has resulted in a valid noise complaint, then not conducting this activity during the night time would reduce its noise impact of this activity.

4.2 Equipment Selection

Forward planning for noise control is a very effective means of ensuring that valid noise complaints are unlikely to be received. Once it is known where a noise source is to be located, then the following tables can be used to evaluate required separation distances to achieve compliance with noise limits:

- Table 4 – Daandine CGPF
- Table 5 – Daandine Low Pressure Flare
- Table 6 – Tipton CGPF and WTF
- Table 7 – Engine packs operating on well sites
- Table 8 – Drill rigs

If it is not possible to locate the noise source at these separation distances then additional noise control measures, such as silence packs, acoustic barriers or acoustic enclosures, should be considered.

The selection of equipment can generally include additional items such as ‘quiet packs’ or ‘noise control options’. If the proposed location of the equipment is within the nominated minimum separation distance/s to one or more sensitive receptors, then it could be feasible to adequately control the level of noise at the noise source, by means of noise control options for the equipment.

If noise control options are available, then the manufacturer should be able to provide detail of the magnitude of noise level reduction which can be achieved. Knowing the additional noise level reduction achieved by the inclusion of a noise control option will enable determination of the revised minimum separation distance and potential for exceedances of the noise limits at the closest noise sensitive receptor.

In some circumstances there may be a number of different items of equipment and/or manufacturers that are all capable of performing the work required. If there are sensitive receptors close to the proposed location for this equipment, then potential noise impact and purchase of quieter equipment should be considered, particularly if it results in reduction of likelihood of potential exceedance of the noise limits.

Production levels should also be considered. Whilst a particular selection of equipment may achieve the required level of production, it may have to operate at design (100%) capacity to achieve this. Purchase of equipment with a greater than required capacity will result in this equipment running at less than design capacity and possibly quieter than the smaller unit operating at design capacity.

The predicted attenuation from different acoustic treatments which may be feasible for long term noise operating equipment is shown in Table 8.10 – 8.12 in *Surat Gas Project Noise and Vibration Impact Assessment Report* (Sonus, November 2011).

Detailed acoustic treatment options and predicted attenuation levels for the Daandine CGPF are evaluated in detail in design assessments conducted for the Daandine Expansion Project.

4.3 Reflected Noise

If there are reflective surfaces near to noise sources, then these can result in reflected as well as direct path noise:

- one reflective surface can increase the noise level by approximately 3 dB(A) (for example, relative to the receptor, a hard smooth wall behind the noise source);
- two reflective surfaces can increase the noise level by approximately 6 dB(A) (for example, two walls at right angles and the noise source at the junction of these walls); and
- three reflective surfaces can increase the noise level by approximately 9 dB(A) (for example, two walls at right angles and a partial roof over and the noise source located in the corner just below the roof).

Locating a noise source within an acoustic enclosure (box) with hard reflective internal surfaces could increase the noise level close to the noise source by up to 10 dB(A).

By placing absorptive materials (e.g. acoustic foam, carpet, thermal insulation such as glassfibre, perforated timber, plaster, sheet metal of fibrous cement sheet panelling, etc) on the reflective surfaces the noise level at the receptor can be reduced.

4.4 Acoustic Barriers

The most effective location for acoustic barriers is as close to the noise source or as close to the receptor as possible. Generally it will only be appropriate to locate an acoustic barrier close to the noise source (not the receptor).

The magnitude of noise level reduction achieved by an acoustic barrier is dependent upon all of the following:

- height of the barrier;
- length of the barrier;
- materials of construction of the barrier;
- no gaps in the barrier.

In locating an acoustic barrier, care should be taken

- not to interfere with access ways or access to plant and equipment,
- materials appropriate to the location are selected (e.g. non-combustible) and
- the barrier does not interfere with operator's line of sight to plant and equipment.

Acoustic barriers must be of gap free construction and generally a surface area density of at least 10 kg/m² is required. Given that the acoustic barrier has no gaps and has an adequate surface area density, then the magnitude of noise level reduction will be directly related to the height and length of the barrier. The length of the barrier is important to minimise flanking transmission (noise passing around the end/s of the barrier).

The magnitude of noise level reduction achieved by an acoustic barrier can be calculated. The calculation is based on the difference between the direct path of the sound from source to receiver compared to the additional distance of the path of the sound over the top and around the ends of the barrier. An acoustic barrier that removes line of sight from source to receiver would reduce the source noise level, at the receiver, by approximately 5 dB(A). In practical terms a noise level reduction of up to approximately 10 dB(A) can be reasonably achieved by an acoustic barrier, given that it is located adjacent to the noise source and between the noise source and the receiver, and is of adequate height and length.

Examples of possible materials of construction for acoustic barriers (which complies with the surface area density criteria of at least 10 kg/m^2 are:

- reinforced concrete;
- concrete block;
- brick;
- hebel panel;
- sheet metal at least 2 mm thick;
- minimum 7.5 mm thick fibrous cement sheet;
- earth mound;
- lapped timber palings, for example, kiln dried softwood palings at least 15 mm thick and overlapped a minimum 25 mm or at least 19 mm thick and overlapped a minimum 15 mm;
- any combination of the above.

4.5 Acoustic Enclosures

Acoustic enclosures can be partial, or can completely enclose the item of equipment. Very high noise level reductions can be achieved with full acoustic enclosures, but because the equipment has been fully enclosed, ventilation must be introduced (both supply and exhaust, and this must be acoustically treated as well), together with specialty seals for access doors. Also, consideration must be given to possibly creating a confined space and/or a space requiring special consideration due to its ability to contain explosive gases.

Acoustic enclosures are generally full internally lined with acoustic absorbent material.

Acoustic enclosures require specialist design to achieve noise level reductions of the magnitude of 20 to 30 dB(A), and to ensure adequate ventilation, not creating a confined space and hazardous area considerations.

4.6 Alternative Arrangements with Affected Parties

The EA allows for alternative arrangements to be reached with affected parties. “Alternative arrangement” is defined in the EA as

> *"a written agreement between the holder of this environmental authority and an affected or potentially affected person at a sensitive receptor for a defined noise nuisance impact and may include an agreed period of time for which the arrangement is in place. An agreement for alternative arrangements may include, but not necessarily be limited to a range of noise abatement measures to be installed at a sensitive receptor and/or provision of alternative accommodation for the duration of the defined noise nuisance impact."*

As per the EA conditions, where alternative arrangements are made and agreed in writing with each person affected by the noise emissions, the noise limits of the EA will no longer apply at that location for the period of the alternative arrangements.

Residents with a Conduct and Compensation Agreement (CCA) may already have a clause on noise emissions that has similar effects as an alternative arrangement. It is noted that only landholders of the properties under which Arrow activities are planned to be held will have CCAs. Alternative arrangements may need to be negotiated with potential impacted landholders without CCAs.

Appropriate consultation with external relations, land liaison officers and Arrow legal department is required if contemplating negotiating alternative arrangements with an affected party.

5 References

Department of Environment and Heritage Protection (EHP) (2012) *Guideline: Prescribing noise conditions for petroleum activities,* Queensland

Department of Environment and Heritage Protection (EHP) (2015) *Guideline: Planning for noise control*, Queensland

Department of Environment and Resource Management (DERM) (2000) *Noise Measurement Manual*, 3rd Edition, Queensland.

Standards Association of Australia (1981) *AS 2436-1981* Guide to Noise Control on Construction, Maintenance and Demolition Sites

Standards Association of Australia (1996) *AS/NZS ISO 14001:1996 Environmental Management Systems*

Standards Association of Australia (1997) *AS1055-1997 Acoustics – description and measurement of environmental noise*

World Health Organization (WHO) (1999), *Guidelines for Community Noise*, World Health organization, Geneva

6 Definitions

Term	Definition
Alternative arrangement	A written agreement between the holder of this environmental authority and an affected or potentially affected person at a sensitive receptor for a defined noise nuisance impact and may include an agreed period of time for which the arrangement is in place. An agreement for alternative arrangement may include, but not necessarily be limited to a range of noise abatement measures to be installed at a sensitive receptor and/or provision of alternative accommodation for the duration of the defined noise nuisance impact.
A-weighted sound pressure level	A measure of sound adjusted to the 'A' frequency weighting network
Background noise level	The sound pressure level, measured in the absence of the noise under investigation, as the LA90,T being the A-weighted sound pressure level exceeded for 90 percent of the measurement time period T of not less than 15 minutes, using Fast response.
CCA	Conduct and Compensation Agreement
CSG	Coal seam gas
Daytime	The period after 7 am on a day to 6 pm on the day
dB	Decibels
dB(A)	Decibels measured on the 'A' frequency
dB(C)	Decibels relative to the carrier
dB(LIN)	Unweighted decibels
dB(Z)	Decibels measured on the 'Z' frequency weighting network
E&A	Exploration and appraisal
EA	Environmental Authority
EHP	Queensland Department of Environment and Heritage Protection
EP Act	Environmental Protection Act 1994
EP Reg	Environmental Protection Regulation 2008
EPP Noise	Environmental Protection (Noise) Policy 2008
Evening	The period after 6 pm on a day to 10 pm on the day
HSEMS	Health, safety and environment management system
$L_{A1, adj, 1 hr}$	The A-weighted sound pressure level, adjusted for tonal character or impulsiveness, that is exceeded for 1% of a 1 hour period when measured using time-weighting 'F'.
$L_{A10, adj, 1 hr}$	The A-weighted sound pressure level, adjusted for tonal character or impulsiveness, that is exceeded for 10% of a 1 hour period when measured using time-weighting 'F'.
L_{A90}	Noise level (in decibels - A-weighted) exceeded for 90 per cent of the measurement period

Term	Definition
$L_{A90,\ adj,\ 15\ mins}$	The A-weighted sound pressure level, adjusted for tonal character, that is equal to or exceeded for 90% of any 15 minutes sample period equal, using Fast response
L_{Aeq}	Equivalent continuous (or 'average') noise level (in decibels - A-weighted) over a measurement period
$L_{Aeq,\ adj,\ 1\ hr}$	An A-weighted sound pressure level of a continuous steady sound, adjusted for tonal character, that within a 1 hour period has the same mean square sound pressure of a sound that varies with time
$L_{Aeq,\ adj,\ 15\ mins}$	An A-weighted sound pressure level of a continuous steady sound, adjusted for tonal character, that within a 15 minute period has the same square sound pressure of a sound that varies with time
L_{Amax}	Maximum noise level measured in A-weighted sound pressure
Evening	The period after 6 pm on a day to 10 pm on the day
LpZ	Low frequency sound pressure level
Max L_{pA}	Absolute maximum instantaneous level
Max $L_{pA,\ 15min}$	The absolute maximum instantaneous A-weighted sound pressure level, measured over 15 minutes.
Medium-term noise event	Noise exposure, when perceived at a sensitive receptor, that persists for an aggregate period not greater than five (5) days and does not reoccur for a period of at least four (4) weeks. Re-occurrence is deemed to apply where a noise of comparable level is observed at the same receptor location for a period of one hour or more, even if it originates from a different source or location
Night time	The period after 10 pm on a day to 7 am on the next day.
NMP	Noise management plan
Noise	Noise is broadly defined in the EP Act as a vibration of any frequency, whether emitted through air or another medium. The term 'noise' is a subjective quality and is often used to refer to unwanted or intrusive sound. Noise becomes a nuisance when there is an unreasonable interference with an acoustic value. Nuisance noise can be continuous or intermittent, but the effect is such that there is a material interference with property or the personal comfort or quality of life of persons.
Sensitive receptor	Means an area or place where noise (including low frequency, vibration and blasting) is measured to investigate whether nuisance impacts are occurring and includes: - dwelling (including residential allotment, mobile home or caravan park, residential marina, or other residential premises, motel, hotel or hostel; or - a library, childcare centre, kindergarten, school, university or other educational institution; - a medical centre, surgery or hospital; or - a protected area; or - a public park or garden that is open to the public (whether or not on payment of money) for use other than for sport or organised entertainment; or - a work place used as an office or for business or commercial purposes, which is

Term	Definition
	not part of the petroleum activity(ies) and does not include employees accommodation or public roads.
Short-term noise event	Noise exposure, when perceived at a sensitive receptor, persists for an aggregate period not greater than eight hours and does not re-occur for a period of at least seven (7) days. Re-occurrence is deemed to apply where a noise of comparable level is observed at the same receptor location for a period of one hour or more, even if it originates from a different source or source location.
Suitably qualified person	Means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis to performance relative to the subject matter using the relevant protocols, standards, methods or literature.

7 Document Administration

This document has been created using ORG-ARW-IMT-TEM-00005 v4.0

Revision history

Revision	Revision Date	Revision Summary	Author
0	May 2012	Original Noise Management Plan	David Moore & Associates Pty Ltd
1	June 2012	Noise management plan amended to align with Arrow Energy existing procedure documentation	
2	June 2012	Noise Management Plan amended to include construction activities	
3	February 2013	FINAL	
4	December 2013	Noise Management Plan amended to include Tipton WTF	
5	February 2014	Noise Management Plan amended to include Arrow Energy comments updated EA number and condition wording and location of Tipton WTF	
6	March 2017	Updated noise management plan including latest modelling results for Daandine expansion (3 additional compressors at the CGPF and attenuation of existing compressors), electrification of the Daandine WTF (to attenuate noise) and installation of attenuated inlet fuel gas compressor (PtL) at Daandine CGPF. Also aligned with Arrow's overall Noise and Vibration Management Plan (ORG-ARW-HSM-PLA-00043)	K. Bawden

Related documents

Document Number	Document title
ORG-ARW-HSM-PLA-00043	Environmental Noise and Vibration Management Plan – Generic Plan

Acceptance and release

Author

Position	Incumbent	Release Date
Senior Advisor Environment & Carbon TA3 Greenhouse, Noise & Air Quality	Kelsey Bawden	March 2017

Stakeholders and reviewers

Position	Incumbent	Review Date
Environment Manager	Joanne Flint	March 2017
Environment Manager Operational & Field Activities	Scott Nairn	March 2017

Approver(s)

Position	Incumbent	Approval Date
Joanne Flint	Environment Manager	March 2017

Appendix C **Additional Studies**

- **Daandine Noise Monitoring – SLR (14 September 2017)**

- **Noise Attenuation Feasibility Study – SLR (10 Nov 2017)**

14 September 2017

620.11142.00300-L01-v1.0.docx

Arrow Energy Pty Ltd
GPO Box 5262
BRISBANE QLD 4001

Attention: Kelsey Bawden

Dear Kelsey

Daandine
Noise Monitoring

SLR Consulting Australia Pty Ltd (SLR) was engaged by Arrow Energy (Arrow) to undertake noise monitoring in the Daandine gas field. Unattended noise monitoring and attended noise measurements were undertaken at various locations surrounding the Daandine Central Gas Processing Facility (CGPF), during the period 5 to 21 July 2017, to investigate the noise level contribution from the noise generating facilities at the area adjacent to the Wambo Feedlot receptor location.

The survey locations of interest, including the unattended noise monitoring locations, are illustrated in **Figure 1**, attached after the last page of this letter.

All items of acoustic instrumentation employed during the noise monitoring were a Type 1 and set to 'Fast' response in reference to the relevant Australian Standards and the Queensland Department of Environment and Heritage Protection (DEHP) *Noise Measurement Manual*. The noise monitoring equipment was checked for calibration before and after each set of noise measurements using a Bruel&Kjaer Type 4231 Sound Level Calibrator and no significant drift (greater than ±0.5 dBA) in calibration signal level was observed. Weather data was collected during the monitoring period from a Vantage Vue weather station placed in an open area of terrain to the east of the survey area (see **Figure 1**).

During the 15 minute attended measurements, the operator identified the character and duration of acoustically significant ambient noise sources. Wherever possible, the operator quantified noise sources and made a qualitative assessment of the prevailing weather conditions.

The operating conditions of the industrial noise sources with potential to impact ambient noise levels at the Wambo Feedlot sensitive receptor were understood to be as follows:

- Daandine CGPF operation varied from running five (5) to eight (8) compressors during the monitoring period.
- Kogan CGPF operation varied from running two (2) to three (3) compressors during the monitoring period.
- The Daandine Power Station operated under normal operating conditions during the monitoring period.

SLR Consulting Australia Pty Ltd Level 2, 15 Astor Terrace Spring Hill QLD 4000 Australia
(PO Box 26 Spring Hill QLD 4004) +61 7 3858 4800 +61 7 3858 4801
E: brisbane@slrconsulting.com www.slrconsulting.com
ABN 29 001 584 612

- The Darling Downs Power Station generated steadily, with increased output in the evening periods, until 14 July, then shut down for the rest of the monitoring period.
- The Braemar Power Stations generated at varying levels most evenings and some morning periods. They did not generate during the night-time periods.

A summary of the observations made during the noise survey is presented in **Table 1**.

Table 1 Summary of observations

Monitoring Location	Observations
1	*7 July 12:12 am* - 10 °C, 92 % humidity, 0 m/s wind speed. Noise contribution from the Daandine CGPF ranged from 37 dBA to 42 dBA. When Kogan CGPF was also audible and the combined sources were dominant, measured at 45 dBA. *Note* - At an intermediate location along the Right Of Way (ROW) that was between the Daandine CGPF and the Kogan CGPF, with both CGPFs dominant, the noise level measured up to 46 dBA under similar conditions.
	19 July 9:19 pm - 11 °C, 61 % humidity, 2.2m/s wind speed from SW. Daandine CGPF not clearly audible, Braemar power stations mostly dominant 33 dBA to 38 dBA.
	21 July 1:44 am - 8 °C, 71 % humidity, 1 m/s wind speed from SSW. Daandine CGPF mostly dominant approx. 28 dBA, but noise from Braemar power stations audible. Suspected well engine noise audible from the south.
2	*19 July 8:52 pm* - 12 °C, 60 % humidity, 2.2 m/s wind speed from SW. Braemar power stations mostly dominant 33 dBA to 36 dBA. Short periods of “venting” type noise from Braemar power stations 45 -54 dBA.
	21 July 2:06 am – 7 °C, 71 % humidity, 1 m/s wind speed from SSW. Daandine CGPF audible and mostly dominant 28 dBA. Braemar power stations audible approx. 26 dBA. Suspected well engine noise audible from the south.

The key points from **Table 1** are:

- During meteorological conditions that had the potential to enhance the noise propagation toward the receptor location, noise from the Daandine CGPF was observed to result in sound pressure levels in the range of 37 dBA to 42 dBA, at Location 1. The estimated level at the receptor location would be approximately 1 dB less than the value measured at Location 1.
- During meteorological conditions that had the potential to enhance the noise propagation toward the receptor location, noise from Kogan CGPF was clearly audible at Location 1. When noise from the Kogan CGPF and the Daandine CGPF were together dominating the ambient noise environment, noise levels of up to 45 dBA were observed at Location 1.

- When the wind speed was elevated and the wind direction was from the south west, a cross wind condition, noise from the Daandine CGPF was at times less audible than noise from the Braemar Power Stations at the monitoring locations. The Braemar Power Stations are south west of the monitoring locations (see **Figure 1**).
- Venting type noise from the Braemar Power Stations was clearly audible for short periods (less than one (1) minute) at Location 2. The sound pressure levels during the venting events reached up to 54 dBA. It is noted that the wind direction was observed to be from the Braemar Power Stations toward the monitoring location during the measurement period.
- During the night-time attended measurements on 21 July 2017 there was audible noise from the south that was suspected be from a well engine. The noise was not heard during the night-time attended measurements on 7 July 2017.

It is noteworthy that noise from the Daandine Power Station was not audible at either of the monitoring locations, and as such is not considered to be acoustically significant when considering the overall noise levels at the Wambo Feedlot receptor.

It should be noted that observations made during the noise surveys also included audible noise from insects, animals, road traffic and machinery noise from the Wambo Feedlot.

I trust this meets your current requirements. Please call if you have any queries or comments.

Yours sincerely

sch4p4(6) Personal informat

JAMES BOLAND
Acoustics and Vibration

Checked: MC
Authorised by: MC

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SLR

L2, 15 ASTOR TERRACE
SPRING HILL
QUEENSLAND 4000
AUSTRALIA
T: 61 7 3858 4800
F: 61 7 3858 4801
www.slrconsulting.com

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Project No.:	620.11142
Date:	30-Aug-2017
Drawn by:	PM
Scale:	1:35,000
Sheet Size:	A4
Projection:	GDA 1994 MGA Zone 56

LEGEND

- Noise Sources
- Monitoring Location
- Sensitive Receptor

File A

arrow energy go further

N
W E
S

0 200 400 600 800
m

Arrow Energy Pty Ltd

Daandine Gas Field

Noise Survey Locations

FIGURE 1

10 November 2017

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Arrow Energy Pty Ltd
GPO Box 5262
BRISBANE QLD 4001

Attention: Lisa Turner

Dear Lisa

Danndine CGPF
Noise Attenuation
Feasibility Study

SLR was engaged to investigate the feasibility of using noise walls to attenuate noise emission from the Daandine CGPF, to better understand the potential for mitigating nose levels at the Wambo Feedlot residence (Receptor 100). An investigation into the potential for effective noise control at the receptor dwelling was also undertaken, based on the information currently available.

SLR used the existing Daandine Expansion Project noise model (DDEXP model), and noise wall design constraints provided by Arrow, to undertake modelling of various scenarios that were optimised to achieve compliance with the noise limits prescribed in Environmental Authority EPPG00972513 (EA).

Recent noise monitoring in the area surrounding the Daandine CGPF indicated that the measured noise levels in the vicinity of Receptor 100 correlated well with the predicted noise levels from the DDEXP model. However, the model has not been verified by detailed measurements of the facility since the expansion and source locations and sound power levels have been assumed to be representative for the purpose of this study.

The following pages outline the noise modelling methodology, details of the optimised noise wall configurations and a discussion about noise control at the receptor location.

Yours sincerely

sch4p4(6) Personal informatio

JAMES BOLAND
Acoustics and Vibration

Checked: MC
Authorised by: MC

1 Noise Limits

1.1 Environmental Authority EPPG00972513

Schedule E of EPPG00972513 (EA) sets out the requirements relating to noise emission for the facility covered in this study. Schedule E Table 1 sets out the noise limits at sensitive receptors that are to be used to assess compliance in noise modelling studies for the Daandine CGPF.

Given the normal 24/7 operation of the Daandine CGPF, the controlling noise limit will be the night-time long term limit of 28 dB LAeq.

There is also the requirement to assess for the impact of low frequency noise at the sensitive receptors. The EA prescribes and external low frequency noise limit of 50 dB(Z) inside the receptor and requires that the difference between the internal A-weighted and Z-weighted noise levels are no greater than 15 dB.

1.2 Environmental Protection (Noise) Policy 2008

Schedule 1 of the Environmental Protection (Noise) Policy 2008 (EPP Noise) prescribes an internal night-time acoustic quality objective for a dwelling at 30 dB LAeq,adj,1 hr.

2 Noise Modelling Methodology

The existing Daandine Expansion Project noise model (DDEXP model) was used to model noise walls that screened the significant noise sources associated with the Daandine CGPF. Attenuation scenarios were modelled using both neutral and adverse meteorological settings contained in the existing DDEXP model.

The design constraints for the noise attenuation feasibility modelling were as follows:

1. Two (2) drawings were provided by Arrow that showed the potential location for noise walls (“Site map Rev 2 (with edge on north face.docx” and “05-DWG-0602-A13 (2) – A13 – DDEXP – CGPF 0- Overall Site Layout – Plan.pdf”).
2. The two openings shown on the drawing can be considered completely closed in the noise model – they represent where either a roller door or sliding door would be required for vehicle access.
3. Initial height of the wall of 10 metres would be a suitable (height of the shed). Suggest a maximum height of 15 metres as an initial height constraint for preliminary modelling.
4. For the wall on the fence line, assume a container wall the entire length of the fence line – 10 m high.

Modelling scenarios were developed that included the use of noise walls in both of the available alignments, at the west site boundary fence line and next to the western end of the compressor sheds. A range of noise wall configurations were modelled within the design constraints to understand the attenuation available from different wall configurations, and to optimise the arrangements within the design constraints.

To arrive at the optimal design, the following scenarios were assessed in detail:

- Scenario 1 – One (1) long section of container wall running along the west site boundary. The container wall was arranged 26 containers long (158 m long) and three (3) containers high (9.6 m high).
- Scenario 2 - One (1) long section of main wall running north to south across the entire available alignment. Various wall heights, starting from 10 m, were modelled as part of this scenario.

- Scenario 3 – A shorter main wall running north to south including a return section that ran east to west across that part of the available alignment. Various wall heights, starting from 10 m, were modelled as part of this scenario.
- Scenario 4 - Same as for Scenario 2, with the addition of a container wall along the west site boundary. This scenario was modelled to assess the significance of emission from the noise sources located to the west "outside" the main noise walls such as the TEG plant items.

The following **Table 1** outlines the optimised wall configurations that result in predicted compliance with the 28 dB LAeq noise limit at Receptor 100. Figures showing the wall locations are presented in **Section 3**.

Table 1 Modelled Wall Details

Scenario	Wall Location/s	Wall Height/s
1	One container wall that ran along the entire west site boundary.	9.6 m (3 x containers high)
2	One wall section that ran from north to south along the entire specified main wall alignment.	17.5 m
3	One wall section that ran north to south for part of the specified alignment, including a return that ran from east to west within the constraints.	17.5 m
4	One wall in the same location as for Scenario 2, including the addition of a container wall along part of the west site boundary, within the constraints.	Main Wall 15.0 m Container Wall 9.6 m (3 x containers high)

2.1 Noise Wall Material Properties

All noise walls were modelled using the default "Hard reflective barrier" setting provided in SoundPLAN v7.4. A discussion of the impact from reflected noise is contained in **Section 3.2**.

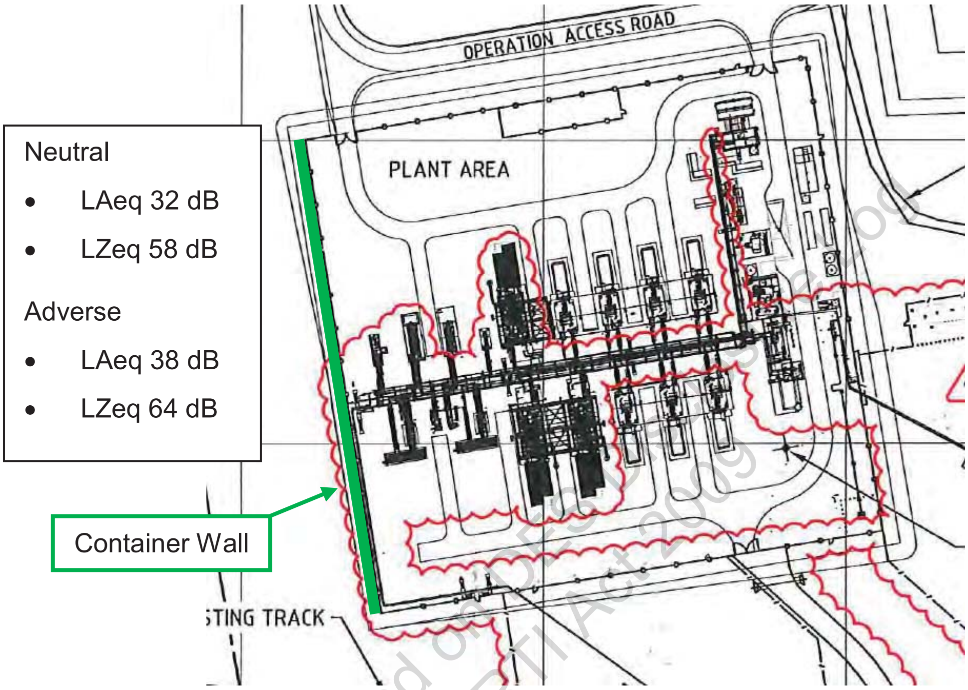
The height of the container wall was assumed to be 9.6 m, based on three containers at a height of 3.2 m for each container. Each container was assumed to be 6.0 m (20 feet) in length.

3 Noise Modelling Results

The following figures show the predicted external noise levels at Receptor 100 under neutral and adverse meteorological conditions, for each of the optimised modelled wall configurations.

Scenario 1 was modelled to assess the potential for attenuation by using a container wall along the west site boundary. This wall arrangement was predicted to not provide sufficient attenuation, but has been included for information purposes.

Figure 1 Scenario 1



It should be noted that the wall configurations in Scenario 2 and Scenario 3 required the main noise wall to be 17.5 m high, which exceeded the design constraint with regard to maximum wall height.

Figure 2 Scenario 2

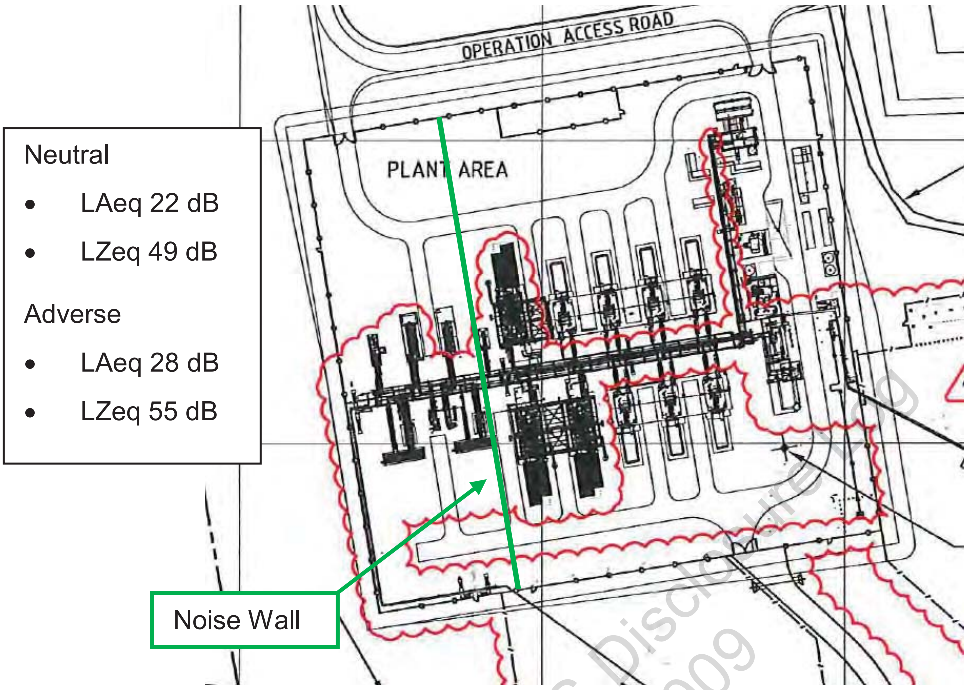
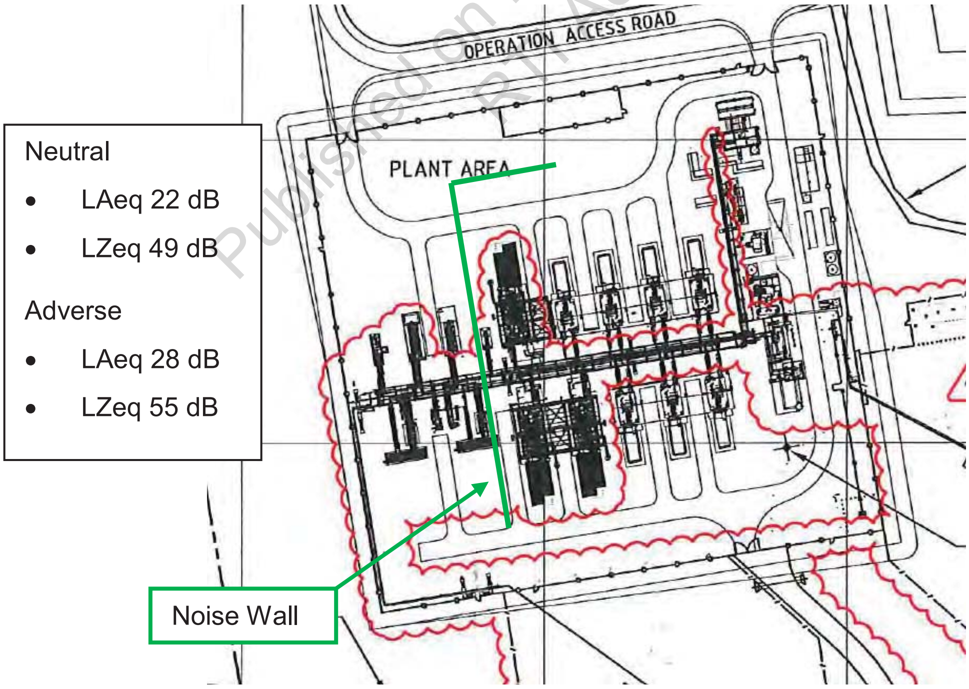
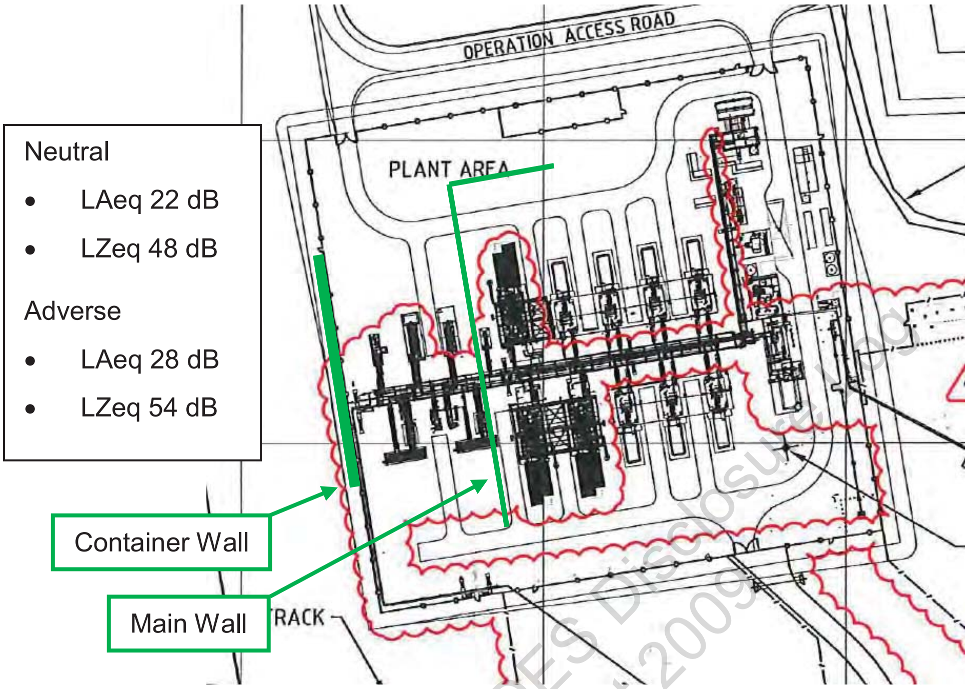


Figure 3 Scenario 3



The wall configuration in Scenario 4 used a height of 15.0 m for the main wall, with the addition of a 9.6 m high container wall on the west site boundary. The container wall started just south of an access gate on the west site boundary and was arranged six (6) containers long by three (3) containers high.

Figure 4 Scenario 4



3.1 Reflected Noise

The introduction of a noise barrier has resulted in the reflection of noise from some of the Daandine CGPF noise source emissions. The barrier has been modelled as reflective on both sides and the resulting effect of reflected noise is shown in **Table 2**.

Table 2 Reflected Noise Impacts

Noise Sources	Orientation	Effects
TEG plant	West of Daandine CGPF	The reflected noise from plant associated with the TEG processes had a minor contribution to the overall noise levels predicted at Receptor 100. However, when the combined effect of reflected noise from each relevant plant item was summed, the overall contribution at Receptor 100 was insignificant.
CGPF	East of Daandine CGPF	The reflected noise from sources to the east of the noise walls (for Scenario 2 and Scenario 3) caused an increase of 1 dB in the overall noise level at Receptor 40, located to the east of the Daandine CGPF. The predicted noise level at Receptor 55, located east south east of the Daandine CGPF, was not affected by reflected noise.

It can be seen from **Table 2** that reflected noise to the east of the Daandine CGPF has the potential to marginally increase noise levels in that direction. An assessment of the absorptive properties of likely wall construction materials should be undertaken as part of the project detailed design, including the requirement for the application of absorptive material in key locations.

4 Receptor Treatments

The dwelling at Receptor 100 was observed from a distance during a noise survey undertaken by SLR in July 2017. Based on the observations, the assumed building construction is shown in **Table 3**.

Table 3 Building Construction Type - Receptor 100

Building Element	Construction Type
Walls	Brick veneer
Windows	Aluminium framed sliding windows (Single glazed)
Roof	Metal decking

The Department of Environment and Heritage Protection (DEHP) Planning for Noise Control Guideline (PNC) includes typical noise reductions for building facades in various states, as shown in **Table 4**.

Table 4 PNC Typical Noise Reduction through Facades

Typical Noise Reduction (dBA)	Window Type and Window Setting
5	Wide open
10	Partially closed
20	Single glazed. Closed
25	Thermal double glazing, closed

The DDEXP noise model predicts an external noise level of 42 dBA under adverse meteorological conditions at Receptor 100, without the inclusion of noise walls as detailed in **Table 1**. The predicted noise level correlates well with recent noise monitoring undertaken in the area surrounding the Daandine CGPF.

Based on observations of the dwelling, made from a distance during the recent noise survey, it is expected that, without the use of any noise walls, the dwelling windows would be required to be kept closed in order to ensure compliance with the EPP Noise internal noise limit of 30 dBA. It should be noted that if the windows were to be kept closed, a method to provide alternative ventilation to the dwelling would be required.

The modelling of the base situation without any noise walls predicted an LZeq external level at Receptor 100 of 68 dB. To ensure compliance with the internal low frequency EA noise limit a facade reduction of at least 18 dBZ would be necessary.

All three modelled noise wall scenarios predicted LZeq external levels that ranged from 54 to 55 dB under adverse meteorological conditions. To ensure compliance with the internal low frequency EA noise limit a facade reduction of at least 5 dBZ would be necessary.

The acoustical performance of the dwelling facades at Receptor 100 should be tested in order to accurately calculate the existing facade performance and enable recommendations about upgrades to any specific building elements.