

Draft environmental management plan

# Noise management plan



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## Santos GLNG Upstream

# Noise Management Plan

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# Santos

## GLNG Project

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### Abbreviations and Units

Acronym	Description
AS	Australian Standard
CCA	Conduct and Compensation Agreement
CEO	Chief Executive Officer
CG	Coordinator General
CSG	Coal Seam Gas
dB	Decibels
dB(C)	C-weighted decibels
dB(Z)	Z-weighted decibels
dB(A)	A-weighted decibels
DEHP	Department of Environment and Heritage Protection
EA	Environmental Authority
EHS	Environment, Health and Safety
EHSMS	Environment, Health and Safety Management System
EIS	Environmental Impact Statement
EP Act	<i>Environmental Protection Act 1994 (QLD)</i>
EPP Noise	<i>Environmental Protection (Noise) Policy 2008 (QLD)</i>
EP Reg	<i>Environmental Protection Regulation 2008 (QLD)</i>
GLNG	Gladstone Liquefied Natural Gas
ISO	International Organisation for Standardisation
NMP	Noise Management Plan
NZS	Standards New Zealand
P&G Act	<i>Petroleum and Gas (Production and Safety) Act 2004 (QLD)</i>
QLD	Queensland
SDPWO Act	<i>State Development and Public Works Organisation Act 1971 (QLD)</i>
SRM System	Stakeholder Relationship Management System
SWL	Sound Power Level

## 1.0 Introduction

Santos GLNG 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 work over; and ancillary operations such as rig movements, water trucks and heavy construction and earth moving equipment. Noise emissions from these activities have the potential to impact upon environmental and social values.

Santos GLNG has developed a strategy to minimise the potential impacts of noise emissions from its project activities. This NMP provides an overview of the strategy and procedures developed by Santos GLNG to manage noise emissions in the Santos GLNG Upstream Project Area.

### 1.1 Purpose and Scope

#### 1.1.1 Purpose

Santos GLNG has both a legal and social responsibility to manage noise emissions from Santos GLNG assets and activities. This NMP has been prepared to satisfy these obligations for the Santos GLNG Upstream Project Area and complements the overarching Santos Environment, Health and Safety Management System (EHSMS).

The objectives of this NMP are to:

- Facilitate compliance with relevant State legislation, regulations and approvals;
- Facilitate compliance with Santos' Environmental Hazard Standard - *EHS12 Noise Emissions*;
- Provide a framework for Santos GLNG to:
  - Minimise noise emissions from Santos GLNG assets and activities;
  - Engage stakeholders including landholders and local communities in assisting Santos GLNG in the identification and management of noise emissions;
  - Identify, monitor and prioritise the management of noise emissions present on Santos GLNG assets and activities; and
  - Minimise nuisance noise emissions to sensitive receptors.

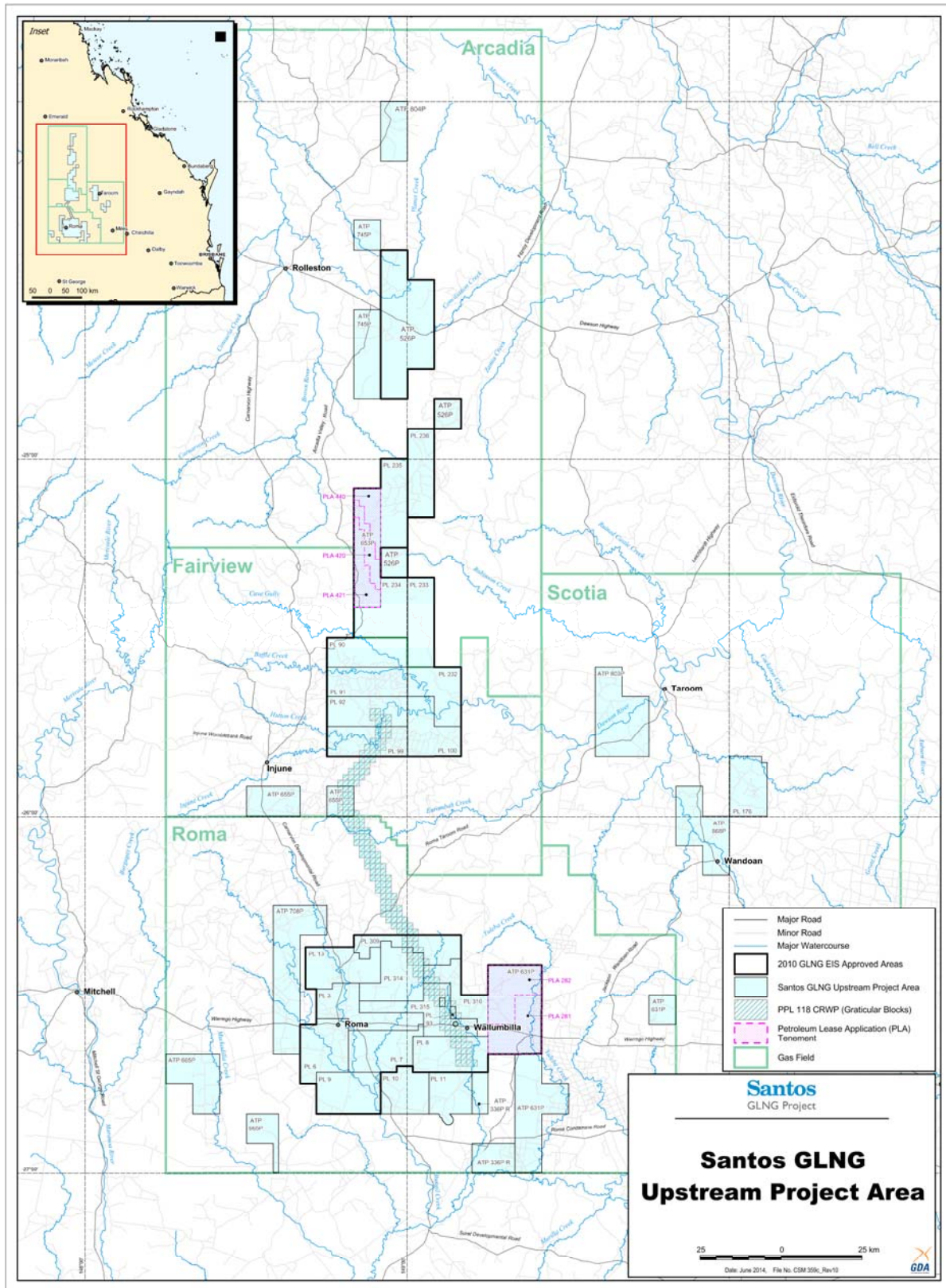
#### 1.1.2 Scope

This NMP identifies noise impacts from potential sources within the Santos GLNG Upstream Project Area and provides an overview of the strategy, methods and controls to be implemented by Santos GLNG to avoid, minimise and manage the impact of noise from Santos GLNG assets and activities to sensitive receptors.

The NMP is to be implemented by all Santos GLNG personnel and contractors conducting activities that have the potential to create noise nuisance throughout the exploration, construction, production, decommissioning and rehabilitation phases of the Project.

This NMP applies to activities carried out within the Santos GLNG Upstream Project Area. The Santos GLNG Upstream Project Area consists of Santos GLNG petroleum tenements comprising the Arcadia, Fairview, Roma and Scotia gas fields and as illustrated in Figure 1.

**Santos**  
GLNG Project



**Figure 1: The Santos GLNG Upstream Project Area**

## 2.0 Roles and Responsibilities

Santos GLNG 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. Santos GLNG 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, responsibilities and accountability under the NMP will be assigned in accordance with the Santos EHSMS05 – *Responsibility and Accountability*.



### 3.0 Legal and Other Requirements

Applicable legislation, regulations, guidance and strategies enacted by the State of Queensland regarding noise management in the Santos GLNG Upstream Project Area 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 NMP are presented in Table 1 below.

**Table 1: Summary of Key Applicable State Legislation, Strategies and Standards**

Act / Regulation / Code	Summary
<b>State Development and Public Works Organisation Act 1971 (SDPWO Act)</b>	<p>The SDPWO Act draws together a range of powers and functions used by the State Government to facilitate large projects. It provides a formal environmental impact statement (EIS) process for significant projects.</p> <p>Determined as a 'significant project' under the SDPWO Act, the Coordinator-General's evaluation report for the Santos GLNG Project's EIS imposes noise-related conditions on the project.</p>
<b>Environmental Protection Act 1994 (EP Act)</b>	<p>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 under the EP Act and implemented through the <i>Environmental Protection Regulation 2008</i> and <i>Environmental Protection (Noise) Policy 2008</i>.</p> <p>Santos GLNG holds a series of EAs issued under the EP Act which authorises the development of the Santos GLNG Upstream Project Area. These EAs include provisions for development and implementation of noise management procedures and prescribes noise limits that Santos GLNG must achieve at sensitive receptors (see Section 3.1.1).</p> <p>The EP Act also requires Santos GLNG to take all reasonable and practicable measures to prevent or minimise environmental harm.</p>
<b>Environmental Protection Regulation 2008 (EP Reg)</b>	<p>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 <i>AS1055-1997 Acoustics—Description and measurement of environmental noise</i> or the <i>Noise Measurement Manual 3rd edition (2000)</i> (DERM 2000).</p>
<b>Environmental Protection (Noise) Policy 2008 (EPP Noise)</b>	<p>The EPP Noise is subordinate legalisation developed to achieve the object of the EP Act in relation to the acoustic environment. The purpose of the EPP Noise is achieved by:</p> <ul style="list-style-type: none"> <li>identifying environmental values that are to be enhanced or protected;</li> <li>stating acoustic quality objectives for enhancing or protecting environmental values;</li> <li>providing a framework for making consistent, equitable and informed decisions about the acoustic environment.</li> </ul> <p>The EPP Noise prescribes a management hierarchy for noise: (1) avoid, (2) minimise, and (3) management, which is adopted into the Santos GLNG Noise Management Strategy.</p> <p>The EPP Noise also includes acoustic quality objectives based on the World Health Organization (WHO) guidelines with environmental noise criteria based on avoiding health and wellbeing impacts.</p>

Act / Regulation / Code	Summary
<b>Land Access Code</b>	The Land Access Code is provided for under the <i>Petroleum and Gas (Production and Safety) Act 2004</i> and 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.
<b>Guideline for Noise Assessment: Prescribing Noise Conditions for Environmental Authorities for Petroleum and Gas Activities</b>	This guideline prescribes best practice noise limits for petroleum and gas activities.

### 3.1.1 Prescribed Noise Limits

Noise limits are prescribed in the EA for short, medium and long-term noise events (as defined in Section 8.0). Santos GLNG is to operate within or below these noise limits at sensitive receptors as summarised in Table 2<sup>1</sup>. If the noise possesses tonal or impulsive characteristics, the noise measured / modelled is to include the adjustments detailed in Table 3. Prescribed noise limits must be considered when planning the location of noise generating activities (Section 5.1.1) and Santos GLNG must be able to demonstrate this in the event of a valid noise complaint.

Where alternative arrangements are in place at a sensitive receptor or where noise related agreements are made as part of Conduct and Compensation Agreements (CCAs) or equivalent, the noise limits in Table 2 and Table 3 do not apply for the duration that arrangements are in place. Alternative arrangements are discussed in further detail in Section 5.1.2.2.

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<sup>1</sup> The noise limits presented in Table 4 are current at the time of development of the NMP. The noise limits prescribed in the current EA will always take precedence over those listed in the NMP.

**Table 2: Noise Limits at Sensitive Receptors**

Time Period	Metric	Short -Term Noise Event	Medium-Term Noise Event	Long-Term Noise Event
7:00 am – 6:00pm	L <sub>Aeq,adj,15min</sub>	45 dBA	43 dBA	40 dBA
6:00 pm – 10:00 pm	L <sub>Aeq,adj,15min</sub>	40 dBA	38 dBA	35 dBA
10:00 pm – 6:00am	L <sub>Aeq,adj,15min</sub>	28 dBA	28 dBA	28 dBA
	Max L <sub>pA,15min</sub>	55 dBA	55 dBA	55 dBA
6:00 am – 7:00 am	L <sub>Aeq,adj,15min</sub>	40 dBA	38 dBA	35 dBA

Note – The noise limits in this have been set based on the following deemed background noise levels (L<sub>ABG</sub>):

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

**Table 3: 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:

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

In addition to the above, the Coordinator General's (CG's) evaluation report for the Santos GLNG Project prescribes specific noise design objectives for Santos GLNG to achieve at longer-term workers accommodation as described Table 4.

**Table 4: Noise Design Objectives for Workers Accommodation**

Time of day	Noise Design Objectives for Indoors Measured at the Receptor in dB(A)		
	L <sub>Aeq,adj,1hr</sub>	L <sub>A10,adj,1hr</sub>	L <sub>A1,adj,1hr</sub>
Daytime and evening	35	40	45
Night time	35	40	45

### 3.2 Santos Environment, Health and Safety Management System

The Santos EHSMS provides a framework for environmental and safety practices across Santos operations worldwide. The framework is consistent with *AS 4801:2000 Occupational Health and Safety Management Systems* and *AS/NZS ISO 14001:2004 Environmental Management Systems*.

This NMP complements the requirements of the EHSMS, in particular, the Santos Environmental Hazard Standard *EHS12 Noise Emissions Waste Management*. This standard provides guidance to reduce the risk of noise impacts associated with Santos activities.

This NMP specifically addresses unique features and requirements relating to the Santos GLNG Project. Santos GLNG specific documentation is based on identified environmental and reputational risks and account for Santos GLNG's legal and other obligations, commitments made by the Santos GLNG Project and Santos GLNG's Social Licence to Operate. In this context, the NMP 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.

The '*Procedure for Noise Impact Assessment – Noise Planning Tool*' (3301-GLNG-4-1.3-0044) has been developed to assist with the implementation of this NMP.

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



Figure 2: The Santos Approach to Environmental Management

## 4.0 Noise Sources in the Santos GLNG Upstream Project Area

### 4.1 Existing Noise Environment

The Santos GLNG Upstream Project Area is predominantly rural farmland with land uses such as grazing, cropping, forestry and pre-existing gas field development. Existing infrastructure is minimal, however there are a number of rural secondary roads linking the major regional road network as well as numerous CSG field access roads. Existing noise sources are typical of rural areas and include fauna (birds and insects), traffic and local noises associated with rural based human occupation.

### 4.2 Exploration

Exploration activities undertaken in the Santos GLNG Upstream Project Area can potentially result in noise impacts. Noise generating exploration activities include exploration core drilling and seismic surveys. Site preparation may be required prior to exploration activities. The noise sources and representative sound levels associated with site preparation activities are discussed further in Section 4.3.1.

#### 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 studies 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 5.

#### 4.2.2 Exploration Core Drilling

Exploration 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 (refer Table 5 and Section 4.3.2.).

Exploration 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 5: Typical Sound Power Levels of Exploration Noise at the Source**

Operational Activity	Noise Source	Overall Sound Power Level (L <sub>Aeq</sub> )
Exploration core drilling	Core drilling rig	112 dBA
Seismic surveys	Seismic truck	107 dBA
	Mulcher	110 dBA

Source: SLR 2013

### 4.3 Construction

#### 4.3.1 General construction

General construction activities undertaken in the Santos GLNG Upstream Project Area 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 a 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 with the Santos GLNG Upstream Project Area is expected to be minimal, with the possible exception of blasting. The minimisation of construction noise sources is outlined in Section 5.2.1.

Representative sound power levels of typical general construction noise sources are presented in Table 6.

**Table 6: Typical Sound Power Levels of General Construction Noise at the Source**

Noise Source	Sound Power Level (L <sub>Aeq</sub> )
4WD vehicle	92 dBA
Air compressor (600CFM)	103 dBA
Backhoe	100 dBA
Bobcat	98 dBA
Compactor (CAT825)	106 dBA
Concrete Pump	110 dBA
Concrete Truck	109 dBA
Dozer (D6)	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

Noise Source	Sound Power Level (L <sub>Aeq</sub> )
Articulated Dump Truck	110 dBA
Padder	110 dBA
Reverse alarm	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

Source: SLR 2013

### 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 generally operate on a 24 hour basis and can last from anywhere between two days up to two weeks depending on the depth of the 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 engine 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 discernible in the context of other well lease construction noise at relatively short distances from the flare.

Indicative sound power levels for typical plant items associated with drilling are listed in Table 7.

**Table 7: Typical Sound Power Levels of Drilling Related Noise Sources**

Noise Source	Sound Power Level (L <sub>Aeq</sub> )
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 (DEHP 2012)	100-110 dBA (L <sub>Amax</sub> )
Flaring	110 dBA

Source: SLR 2013



### 4.4 Operations

Operational activities in the Santos GLNG Upstream Project Area 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 8 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 emergencies, maintenance and commissioning periods, as well as in the operation of appraisal wells to assess well characteristics.

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 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 the Santos GLNG Upstream Project Area. 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 8: Typical Sound Power Levels Associated with Operational Facilities at the Source**

Operational Activity	Noise Source	Overall Sound Power Level ( $L_{Aeq}$ )
Appraisal wells	Flaring	110 dBA
	Trucks (B-double)	106 dBA
	Generator (DG Set)	92 dBA
	Wellhead Motors	93 dBA
Production wells	Generator (DG Set)	92 dBA
	Wellhead Pumps	93 dBA



Operational Activity	Noise Source	Overall Sound Power Level (L <sub>Aeq</sub> )
Compressor stations	Field compressor station (screw drive engines) (DEHP 2012)	110-115 dBA
	Central compressor station (reciprocating engines) (DEHP 2012)	120-125 dBA
	Hub Compressor Station Flare Stack Package	126 dBA
Accommodation facilities	A/C Units (per 100 beds)	80 dBA
	Generator	99 dBA

Source: SLR 2013

### 4.5 Decommissioning and Rehabilitation

Decommissioning and rehabilitation will occur progressively throughout the life of the project as operational activities cease and exhausted facilities are decommissioned. However, final decommissioning and rehabilitation will occur at the end of 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 and hardstands is expected to generate the highest noise levels.

### 5.0 Noise Management Strategy

Figure 3 below illustrates the framework to manage noise emissions in the Santos GLNG Upstream Project Area. 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 Santos GLNG procedures.

The strategy for managing noise emissions also complies with the mandatory requirements within the Santos *EHS12 Noise Emissions*.

A more detailed step-wise implementation of the strategy to manage noise emissions is outlined in Figure 4 and discussed further in Sections 5.1- 5.3.

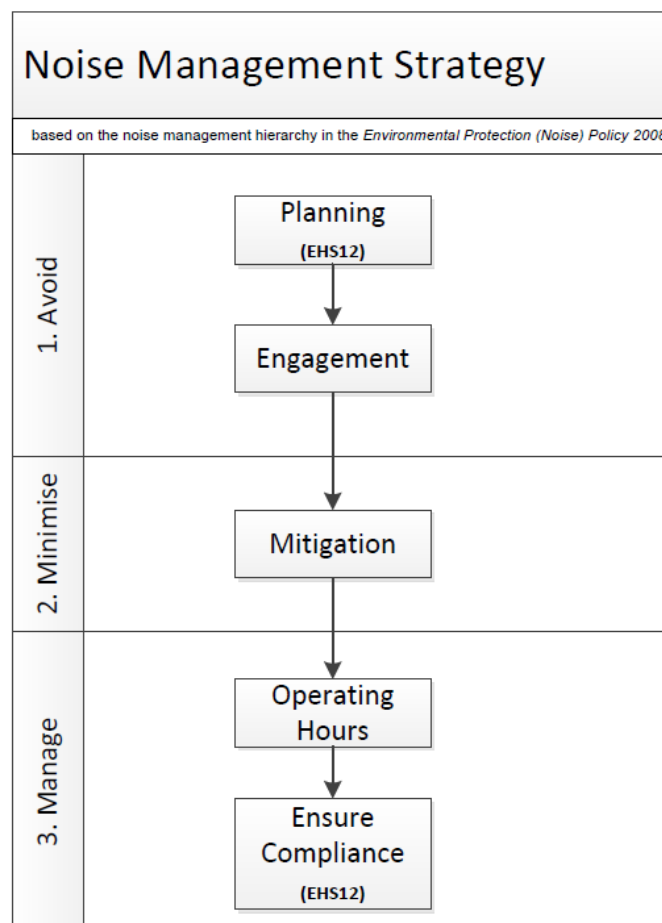


Figure 3: Strategy to Manage Noise Emissions

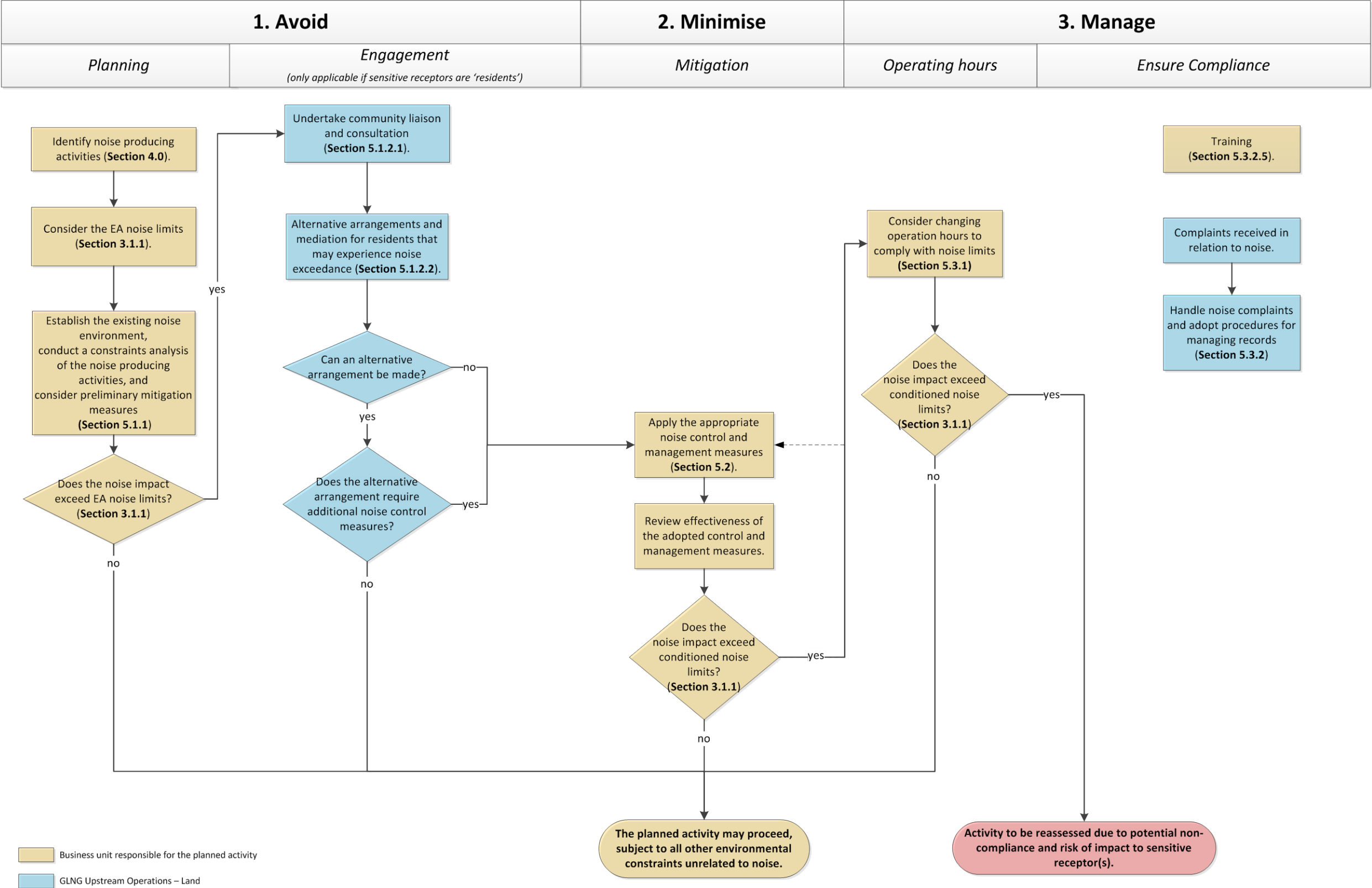


Figure 4: Process to Manage Noise Emissions

## 5.1 Avoid

### 5.1.1 Planning

#### 5.1.1.1 Constraint Analysis

A constraint analysis is to be undertaken 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 the EA noise limits at sensitive receptors.

Noise constraint analysis primarily involves identifying sensitive receptors and predicting the likely impacts of potential noise generating activities on the sensitive receptors via modelling and/or site-specific noise measurements. 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 levels. The detailed site-specific noise assessment should ensure the accuracy of predicted noise levels at the sensitive receptor(s) and, where required, will adequately assess the cumulative impact of multiple noise sources 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). Findings are to be communicated to internal stakeholders where applicable.

### 5.1.2 Engagement

#### 5.1.2.1 Community Liaison and Consultation

Community consultation prior to proceeding with noise generating activities is an important step in forging mutually beneficial relationships between all involved parties. Involving the public establishes a channel of communication between the community and Santos GLNG through which Santos GLNG may obtain local information useful in project planning while the public may have an avenue to voice concerns and raise questions.

Based on the outcomes 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 *EHSMS07 Consultation and Communication*, Santos GLNG has also developed a strategy for community liaison and consultation, the *GLNG Upstream Community Relations Strategy (0020-GLNG-3-1.3-0004)*. This strategy is designed to:

- Inform community members and stakeholders of the gas field 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 gas field activities;
- Provide an avenue for complaints regarding noise emissions and thus enable strategies to minimise disturbance; and
- Provide Santos GLNG with feedback from the community for incorporation into future activities where appropriate.

### 5.1.2.2 Alternative Arrangements

Residents that may experience noise levels in excess of the limits specified in the relevant EAs (identified during 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 within the EA.

As per respective EA conditions, where alternative arrangements are made and written to the satisfaction of 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 upon which Santos GLNG activities are to be held will have CCAs. Alternative arrangements may need to be negotiated with potential impacted landholders without CCAs.

## 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 into 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 9 below suggests typical noise mitigation principles and their associated potential approaches that could be utilised to avoid noise nuisance, to reduce source noise emissions and impede the propagation of noise to the nearest sensitive receptor. To reduce total noise emissions and achieve a desired objective of compliance to the noise limits, a combination of noise mitigation measures may be required. It must be noted that the degree to which the suggested mitigation measures are reasonable and/or feasible are specific to the various activities and noise sources under consideration.

**Table 9: Potential Noise Mitigation Principles and Measures**

Noise Mitigation Principles	Potential Mitigation Measures
Avoidance of noise limit exceedances	<ul style="list-style-type: none"> <li>• Locate activities at suitable buffer distances from nearest sensitive receptors through field planning and alternative arrangements.</li> <li>• Switch off all noise generating plant and equipment not in use.</li> </ul>
Alter the orientation of an activity to minimise noise	<ul style="list-style-type: none"> <li>• Alter the orientation of noise emitting facades of plant and equipment away from nearest sensitive receptors.</li> <li>• Utilise natural shielding (e.g. local topography from hills and other earth mounds).</li> </ul>
Utilisation of best available technology – substitution with quieter equipment or process	<ul style="list-style-type: none"> <li>• Select plant with the lowest noise source emission levels and limit the simultaneous operation of noise generating plant.</li> <li>• Where possible, manage operation of noisy events such as relief valves and flares to occur in the daytime period (noting difference in noise limit between day time and night-time period is 12 dBA or more).</li> </ul>

Noise Mitigation Principles	Potential Mitigation Measures
Engineering noise controls at the noise source	<ul style="list-style-type: none"> <li>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 all wall panels, shelters and roofs which are used to cover the facility.</li> <li>Provide vibration isolation to equipment to avoid structure borne noise being reradiated from enclosures and buildings such as acoustic lagging of pipe work.</li> </ul>
Treatment of the noise propagation path	<ul style="list-style-type: none"> <li>Install temporary noise barriers within close proximity of the noise sources to impede the propagation path between the noise source and the nearest receptor.</li> </ul>
Treatment of the noise at the receptor	<ul style="list-style-type: none"> <li>Community liaison controls as described in relevant Santos GLNG procedures and management plans.</li> </ul>

Source: SLR 2013

### 5.2.1 Construction

Noise from short-term and medium-term construction activities are to be managed adequately by appropriately trained staff using the procedures in this NMP. The following outline of noise control measures are applicable to construction works, and are largely derived 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 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 problems 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 will therefore 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 at a low volume, where feasible.

When blasting is required, a Blast Management Plan is to be developed before each individual blast, and include predictions of vibration levels and mitigation where necessary. Noise from blasting operations must not exceed an airblast overpressure level of 120 dB (linear peak) at any time, when measured at or extrapolated to any sensitive receptor, as required in respective EA conditions.

### 5.2.2 Drilling

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

### 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 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 a detailed design process. For general facilities, the orientation of various infrastructure to reduce noise nuisance is assessed and a noise compliant buffer to be applied around the activity is determined through noise impact assessment previously described.

## 5.3 Manage

### 5.3.1 Operating Hours

Where possible, construction activities will be carried out 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

When a complaint is first received (inclusive of noise complaints), a record is to be entered into the GLNG Stakeholder Relationship Management (SRM) System which manages stakeholder interactions including complaints management through systematic workflows. This process supports the Santos GLNG Social Licence to Operate key principles, the Community Charter and dispute resolution guidelines suggested in the *GLNG Social Impact Management Plan (3301-GLNG-3-8.6-0014)*. Steps for managing complaints are outlined in the latest version of the *GLNG SRM Business Process 03 Complaints (3301-GLNG-3-2.1-0110)*. This procedure provides guidance for the receiving, handling, investigating, reporting and closing out of complaints.

Through the GLNG SRM System, all **valid** environmental complaints (inclusive of noise complaints) will be referred to an appropriate Environmental Advisor as soon as practicable. An Environmental Advisor will undertake the appropriate compliance monitoring investigation.

Where an exceedance of the prescribed noise limits has been confirmed, appropriate mitigation measures will be applied to ensure compliance in the future. Results of the noise compliance monitoring are reported back in the GLNG SRM System. The complaints management process is then continued with the aim of closing out the complaint to the satisfaction of both parties.

Adherence to this process will ensure:

- All noise complaints are taken seriously;
- Noise complaints are appropriately investigated and addressed through implementing appropriate attenuation or mitigation measures, or alternative dispute resolution process;
- Compliance with regulatory requirements for performance and for reporting; and



- Complaint causes and actions taken to resolve complaints are accurately recorded for internal use and for when a complaint is escalated / involves the regulator.

### 5.3.2.2 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 still cannot reach agreement within a 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 of the 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.

### 5.3.2.3 Complaint Records Management

The management of records associated with all aspects of the NMP are in accordance with Santos standards, in particular *EHS12 Noise Emissions* and *EHSMS08 Document and Records Management*.

When a noise complaint is first received, it is registered into the GLNG SRM System. Actions and correspondence associated with the complaint, including the outcomes of any noise monitoring undertaken are stored and tracked in both the GLNG SRM system and EHS Toolbox. A record of all valid complaints and actions taken in response to the valid complaint is to be kept for a minimum period as prescribed in the EA.

All valid complaints received require the recording of details that are not limited to:

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



# Santos

## GLNG Project

### 5.3.2.4 Compliance Monitoring

Monitoring is to be conducted to determine compliance with the conditioned noise limits and is triggered by a noise complaint. Noise monitoring undertaken by a suitably qualified person will include the following parameters:

- a)  $L_{AN,T}$  (where N equals the statistical levels of 1, 10 and 90 and  $T=15$  mins);
- b)  $L_{Aeq\ adj, 15\ mins}$ ;
- c) background noise level as  $L_{A\ 90, 15\ mins}$ ;
- d)  $Max\ L_{pA, 15\ mins}$ ;
- e) the level and frequency of occurrence of impulsive or tonal noise and any adjustment and penalties to measured noise levels;
- f) atmospheric conditions including temperature, relative humidity and wind speed and directions;
- g) effects due to any extraneous factors such as traffic noise;
- h) location, date and time of monitoring;
- i) if the complaint concerns low frequency noise,  $Max\ L_{pZ, 15\ mins}$ ; and
- j) 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.

Noise monitoring will be undertaken in accordance with the requirements outlined in the DEHP's *Noise Measurement Manual 2000* or *AS 1055-1997 Acoustics - Description and Measurement of Environmental Noise*. Noise compliance monitoring must be undertaken as soon as practicable when requested by the regulator. If the complaint is made via DEHP, the results of noise compliance monitoring must be reported back to DEHP within the timeframe required by the EA conditions.

The noise compliance monitoring procedure is to be supported by Santos' *EHSMS14 Monitoring, Measurement and Reporting*.

### 5.3.2.5 Training

All employees and subcontractors working in the Santos GLNG Upstream Project Area are required to undergo a basic site-specific induction which includes an outline of the environmental conditions and controls on-site. To maintain competency, applicable training suited to the different roles and responsibilities (Section 2.0) is to be undertaken in accordance with appropriate Santos Standards such as *EHSMS06 Training and Competency*, *EHS12 Noise Emissions* and *EHSMS14 Monitoring, Measuring and Reporting*.

Regular toolbox meetings are also conducted which may include key noise management principles and reinforce any noise-related issues that arise during the course of exploration, construction, operations, decommissioning and rehabilitation.

### 6.0 Commitment by the CEO

The current Santos Environmental Policy statement signed by David Knox, Chief Executive Officer and Managing Director, stands as the environmental commitment to *'ensure that we have the resources and skills necessary to achieve our environmental commitments'*; in this case, the development and implementation of the NMP. Figure 5 presents the current Santos Environmental Policy.

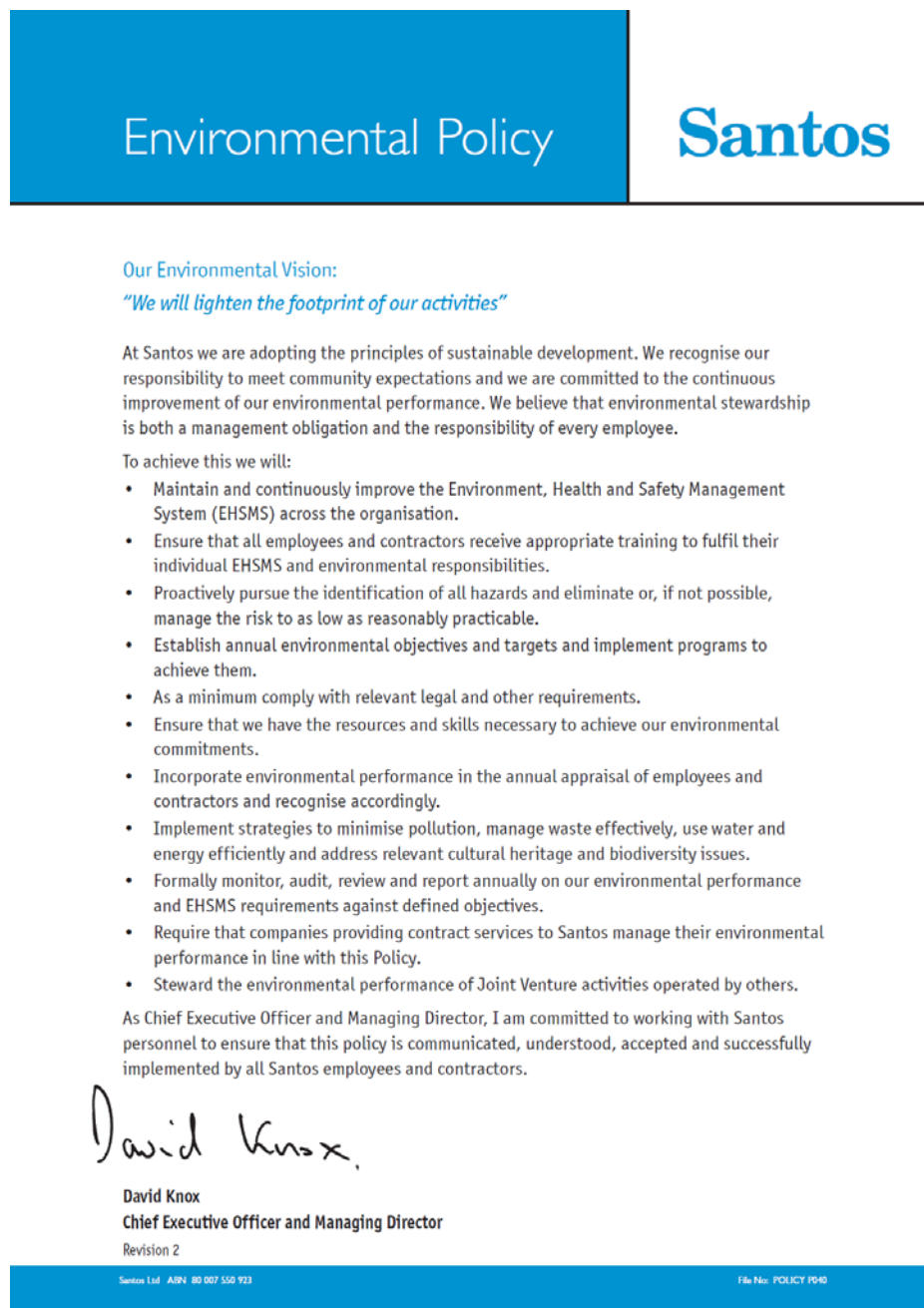


Figure 5: Santos Environmental Policy

## 7.0 Evaluation and Review

### 7.1 Evaluation

The implementation and effectiveness of this management plan and any associated procedures will be regularly assessed to ensure:

- Santos GLNG is demonstrating compliance with legal and landholder obligations;
- The overall management strategy remains relevant and up to date; and
- The plan and procedures adequately manage the environmental issue.

Effectiveness can be assessed by a number of methods as shown in Table 10.

**Table 10: Methods to Assess Legal and Procedural Effectiveness**

Assessment Tool	Description
<b>Checklists – Santos GLNG Compliance Management System</b>	<ul style="list-style-type: none"> <li>• Checklists, developed to reflect legal and procedural requirements / outcomes will be used by individual Santos GLNG Departments to assess and manage compliance. The results of the checklists will be evaluated for common non-compliances that may be resolved through procedural change or by implementing another measure or process.</li> </ul>
<b>Audits</b>	<ul style="list-style-type: none"> <li>• Conduct internal and third party audits to formally assess the level of compliance with both regulatory requirements and with Santos GLNG procedures.</li> <li>• Audit outcomes are used to develop corrective actions which may include changes to procedures.</li> </ul>
<b>Review of Incidents</b>	<ul style="list-style-type: none"> <li>• A review of internal incidents, near misses or hazards will be undertaken to identify recurrences of similar incident types. This may highlight a requirement for a change in an existing procedure, require the development of a new procedure or by implementation of another measure or process to address the recurring issue.</li> </ul>
<b>Review of Data</b>	<ul style="list-style-type: none"> <li>• Analyse all relevant data collected for negative and/or common trends that may be prevented by procedural changes or by implementing another measure or process.</li> </ul>

### 7.2 Review

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

- The plan is not adequately managing the issue (refer Section 7.1);
- Legislative requirements change;
- The area of activity changes; and/or
- A previously unidentified declared pest or weed species is found within an area of activity.

Reviews and changes to the NMP are to be communicated to relevant Santos GLNG Project personnel.

### 8.0 Definitions

Term	Definition
<b>Alternative arrangement</b>	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.
<b>A-weighted sound pressure level</b>	A measure of sound adjusted to the 'A' frequency weighting network
<b>Background noise level</b>	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.
<b>Checklist</b>	Checklists assist in assessing the implementation of a Procedure. Checklists contain a list of key items required, things to be done, or points to be considered and are a tool to assess compliance with a Procedure.
<b>Daytime</b>	The period after 7am on a day to 6pm on the day
<b>dB(A)</b>	Decibels measured on the 'A' frequency weighting network
<b>dB(LIN)</b>	unweighted decibels
<b>dB(Z)</b>	Decibels measured on the 'Z' frequency weighting network
<b>EHS</b>	Environmental Hazard Standard
<b>Evening</b>	The period after 6pm on a day to 10pm on the day
<b>GLNG Stakeholder Relationship Management System (SRM)</b>	The GLNG internal register that manages stakeholder engagement including complaints management through systematic workflows.
<b>Infrastructure</b>	<p>Plant or works including for example, communication systems, compressors, powerlines, pumping stations, reservoirs, roads and tracks, water storage dams, evaporation or storage ponds and tanks, equipment, buildings and other structures built for the purpose and duration of the conduct of the petroleum activity(ies) including temporary structures or structures of an industrial or technical nature, including, for example, mobile and temporary camps.</p> <p>Infrastructure does not include other facilities required for the long-term management of the impact of those petroleum activity(ies) or the protection of potential resources. Such other facilities include dams other than water storage dams (e.g., evaporation dams), pipelines and assets, that have been decommissioned, rehabilitated, and lawfully recognised as being subject to subsequent transfer with ownership of the land.</p>
<b>L<sub>A1, adj, 1hr</sub></b>	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'.
<b>L<sub>A10, adj, 1hr</sub></b>	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 the time-weighting 'F'

Term	Definition
<b>L<sub>A90</sub></b>	Noise level (in decibels – A-weighted) exceeded for 90 per cent of the measurement period
<b>L<sub>A90, adj, 15 mins</sub></b>	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.
<b>L<sub>Aeq</sub></b>	Equivalent continuous (or ‘average’) noise level (in decibels – A-weighted) over a measurement period
<b>L<sub>Aeq, adj, 1hr</sub></b>	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.
<b>L<sub>Aeq, adj, 15 mins</sub></b>	The A-weighted sound pressure level of a continuous steady sound, adjusted for tonal character, that within any 15 minute period has the same square sound pressure as a sound level that varies with time.
<b>L<sub>Amax</sub></b>	Maximum noise level measured in A-weighted sound pressure
<b>Long-term noise event</b>	Noise exposure, when perceived at a sensitive receptor, persists for a period of greater than five (5) days, even when there are respite periods when the noise is inaudible within those five (5) days.
<b>L<sub>pZ</sub></b>	Low frequency sound pressure level
<b>LWA</b>	Sound Power Level
<b>Max L<sub>pA</sub></b>	Absolute maximum instantaneous level
<b>Max L<sub>pA, 15 min</sub></b>	The absolute maximum instantaneous A-weighted sound pressure level, measured over 15 minutes.
<b>Medium-term noise event</b>	Noise exposure, when perceived at a sensitive receptor, persists for an aggregate period not greater than five (5) days and does not re-occur for a period of at least four (4) weeks. Re-occurrence is deemed to apply when 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.
<b>Night-time</b>	The period after 10pm on a day to 7am on the next day
<b>Noise</b>	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.
<b>Management Plan</b>	Management Plans are specific to an environmental issue and/or topic. They primarily serve to provide a high level overview of the legislative and approval requirements and the Santos GLNG management strategy in place for the relevant environmental issue. Management Plans are also suitable for providing environmental regulators an overview of Santos GLNG environmental management, and in many cases, may be a direct requirements of an environmental approval.
<b>Procedure</b>	Procedures are designed to assist in the implementation of the Management Plan, by prescribing a series of processes and actions for a specific topic.
<b>Santos GLNG Upstream Project Area</b>	Comprises all Santos GLNG exploration and production tenements of the Arcadia, Fairview, Roma and Scotia gas fields.
<b>Sensitive receptor</b>	An area or place where noise (including low frequency, vibration and blasting) is

Term	Definition
	<p>measured investigate whether nuisance impacts are occurring and includes:</p> <ul style="list-style-type: none"> <li>• a dwelling (including residential allotment, mobile home or caravan park, residential marina or other residential premises, motel, hotel or hostel; or</li> <li>• a library, childcare centre, kindergarten, school, university or other educational institution;</li> <li>• a medical centre, surgery or hospital; or</li> <li>• a protected area; or</li> <li>• 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</li> <li>• 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.</li> </ul>
<b>Short-term noise event</b>	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 when 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.
<b>Suitably qualified person</b>	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.

### 9.0 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 edn, Queensland.
- Santos Limited (2013) Environment, Health and Safety Management System Library  
<http://teams.santos.com/sites/ehsmsadministration-00401-c/sitepages/home.aspx>
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- Santos Ltd (2012) *SRM Business Process 03 Complaints*, Doc No: 3301-GLNG-3-2.1-0110
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- SLR Ltd. (2013) *Santos Noise Planning Tool*, Doc No: 620.10587
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