

# Review of Environmental Factors

## Wando I Chip Hole – PEL I, Gunnedah Basin

---

Prepared by:

**RPS AUSTRALIA EAST PTY LTD**

Level 12  
92 Pitt Street  
Sydney NSW 2000

T: +61 8270 8300  
F: +61 8270 8399  
E: [sydney@rpsgroup.com.au](mailto:sydney@rpsgroup.com.au)

Report Number: PR108962  
Version / Date: Rev 1, 28 June 2011

Prepared for:

**SANTOS QNT PTY LTD**

Level 22 Santos Place  
32 Turbot Street  
BRISBANE, QLD, 4000

**IMPORTANT NOTE**

Apart from fair dealing for the purposes of private study, research, criticism, or review as permitted under the Copyright Act, no part of this report, its attachments or appendices may be reproduced by any process without the written consent of RPS Australia East Pty Ltd. All enquiries should be directed to RPS Australia East Pty Ltd.

We have prepared this report for the sole purposes of Santos QNT Pty Ltd (“**Client**”) for the specific purpose of only for which it is supplied (“**Purpose**”). This report is strictly limited to the purpose and the facts and matters stated in it and does not apply directly or indirectly and will not be used for any other application, purpose, use or matter.

In preparing this report we have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

This report is presented without the assumption of a duty of care to any other person (other than the Client) (“**Third Party**”). The report may not contain sufficient information for the purposes of a Third Party or for other uses. Without the prior written consent of RPS Australia East Pty Ltd:

- (a) this report may not be relied on by a Third Party; and
- (b) RPS Australia East Pty Ltd will not be liable to a Third Party for any loss, damage, liability or claim arising out of or incidental to a Third Party publishing, using or relying on the facts, content, opinions or subject matter contained in this report.


If a Third Party uses or relies on the facts, content, opinions or subject matter contained in this report with or without the consent of RPS Australia East Pty Ltd, RPS Australia East Pty Ltd disclaims all risk and the Third Party assumes all risk and releases and indemnifies and agrees to keep indemnified RPS Australia East Pty Ltd from any loss, damage, claim or liability arising directly or indirectly from the use of or reliance on this report.

In this note, a reference to loss and damage includes past and prospective economic loss, loss of profits, damage to property, injury to any person (including death) costs and expenses incurred in taking measures to prevent, mitigate or rectify any harm, loss of opportunity, legal costs, compensation, interest and any other direct, indirect, consequential or financial or other loss.

**Document Status**

Version	Purpose of Document	Orig	Review	Review Date	QA Review	Approval	Issue Date
Rev A	Draft for client Review	KH	BL	10/062011	BL	BL	10/06/2011
Rev 0	Final for submission	BL	Santos Legal	22/06/2011	BL	BL	17/06/2011
Rev 1	Final for Submission	BL				BL	28/06/2011

## Contact Information and Declaration

Applicant:	<p>Santos QNT Pty Ltd 32 Turbot Street Brisbane QLD 4000</p> <p>Contact Name: Jorge Pinedo</p> <p>Position: Gunnedah Project Execution Manager</p> <p>Signature:</p> <p>Date:</p>
REF Prepared by:	<p>Belinda Lewis RPS Level 12 92 Pitt Street Sydney NSW 2000</p> <p>Position: Senior Planner</p> <p>Qualifications: BEnvSci (Hons)</p> <p>Signature: </p> <p>Date: 17/06/2011</p>
Application Subject Land Address	<p>Wando 1 Chip Hole</p> <p>Land titles comprise the following: Lot 84 on DP755532</p>
Titleholder Declaration (Joint Titleholder)	<p>As joint titleholder I declare that the information contained in this Review of Environmental Factors is neither false nor misleading.</p> <p>Name: Santos QNT Pty Ltd (as joint title holder declaration)</p> <p>Signature:</p> <p>Date:</p>

## Executive Summary

RPS has prepared a Review of Environmental Factors (REF) on behalf of Santos QNT Pty Ltd (Santos) to assess the environmental impact of the proposed drilling of a chip hole and ancillary activities at the Wando 1 Chip Hole in the Gunnedah Basin. The purpose of the proposal is to investigate the potential coal seam gas resource within Petroleum Exploration Licence No. 1 (PEL 1). PEL 1 is located within a number of local government areas (LGAs), including the Gunnedah Shire Council LGA where the proposed activities are located.

The proposal includes the drilling of “Wando 1” chip hole to obtain information on coal depths, seam thickness, continuity and permeability.

The subject site forms part of the property “Tabbrawyndi”. This property is currently used for grazing and has been selectively cleared. The property is bounded to the north by Goscombe Road and to the south by Mount Knowles Road. The site itself is located within a grazing area and adjacent is a small stand of woodland vegetation.

The following technical investigations have been prepared to assist in the preparation of the REF:

- Ecological Assessment, prepared by RPS
- Cultural Heritage Assessment, prepared by Santos
- Santos Drill Rig Noise Assessment, prepared by Heggies (now SLR)

### Environmental Impacts

#### *Ecology*

The site is located within an area of disturbed grassland vegetation. No threatened flora species were identified as occurring in site, however the subject site provides potential marginal habitat for two grass species. One EEC / TEC was observed across the broader property, White Box - Yellow Box - Blakely's Red Gum Woodland. The chip hole lease is considered to be representative of the TSC Act EEC only, as it is lacking the native species diversity, canopy density, and regeneration to be classified as the TEC. The access track is located within an area that is considered to be the EEC under the EPBC Act, as well as the TSC Act EEC.

Disturbances to the site have arisen due to weed invasion, historical vegetation clearing and the presence of a small rubbish pit.

One threatened fauna species is known to occur adjacent to the chip hole lease, the Koala. It has been determined that the subject site does not comprise Potential or Core Koala Habitat as defined in SEPP 44 and therefore a Koala Plan of Management is not required.

No additional threatened fauna or flora species listed under the TSC Act and/or EPBC Act were recorded on site, however the site provides potential habitat for 10 additional threatened species.

One Class 5 noxious weed (Mexican Poppy) was recorded in the study area during the pre-clearance survey.

The proposed activity is located approximately 14km from Lake Goran, a nationally significant wetland, and 3km from Wondoba State Conservation Area. Given the poor connectivity, and considerable distance between the study area and these conservation areas, the proposal is considered to have a minimal impact on Wondoba State Conservation Area and Lake Goran.

An assessment of whether the proposed activities will have, or are likely to have a significant impact on listed threatened species, listed migratory species or threatened ecological communities under the EPBC Act has

been carried out in accordance with the EPBC Act and *EPBC Act Policy Statement 1.1 - Significant Impact Guidelines Matters of National Environmental Significance* (DEWHA, 2009). Where impacts on MNES are likely, then an assessment of the significance of those impacts must be performed. An Assessment of Significance has been undertaken for the White Box Yellow Box Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands, which concluded that the proposed activities are unlikely to have a significant impact on the EEC. As such, the proposal is not considered to constitute a 'controlled action' and approval from the Minister for Sustainability, Environment, Water, Population and Communities (under the EPBC Act) is not necessary.

The potential direct and indirect impacts that may be associated with the proposal are considered to be minimal. The area lacks important habitat features for significant native flora and fauna. A range of mitigation and management measures have been identified, targeted at minimising impacts on White Box - Yellow Box - Blakely's Red Gum Woodland, and Koala habitat. Implementation of these measures will ensure that the impacts on these ecological features are not significant. Key measures include the avoidance of all canopy vegetation, and the use of existing access tracks where practical. Vegetation clearing has been limited to the removal of disturbed ground covers only.

#### *Heritage*

A site visit was undertaken by Santos' cultural heritage officer and a search of the Aboriginal Heritage Information Management System (AHIMS) was undertaken. A Cultural Heritage Assessment was prepared which concluded Aboriginal objects are unlikely to occur in the subject area. There are no items of heritage significance listed as occurring on the subject site in either the Gunnedah LEP 1998 or on the NSW State Heritage Register. Potential impacts associated with any unknown Aboriginal sites or objects or any items of European cultural heritage significance can be appropriately managed with the mitigation measures specified in the REF.

#### *Ground Water*

Due to the type of drilling activity proposed, associated water from the targeted coal seams is not anticipated to be lifted.

There is some potential for groundwater contamination due to spills of fuels and chemicals, however this can be adequately managed through implementation of appropriate mitigation measures. Cross contamination of groundwater from drilling fluid will be avoided because the chip hole will be plugged and abandoned with permanent casing installed across the shallowest formations in accordance with regulatory requirements and specific well design.

#### *Air*

The air emissions associated with the proposal will be dust from drilling and the transportation of equipment and greenhouse gases from construction traffic, plant and site power generation.

To minimise impacts on air quality access tracks are to be maintained in a compacted state, land disturbance areas are to be minimised and slow speed restrictions will be enforced on internal site access tracks.

#### *Noise*

Temporary noise generation will occur as a result of the drilling of the chip hole. This is likely to occur over a 30 day period. The closest residence is approximately 1.4km from the proposed chip hole. Based on a generic noise assessment undertaken by Heggies (now SLR) for the relevant drill rig to be used in the proposal, noise levels at the residence are anticipated to be negligible and well within guideline levels.

Mitigation of impacts will be through appropriate community consultation and complaints handling.

#### *Surface water*

There are watercourses in the vicinity of the site with the closest being Collygra Creek to the north west. There is potential for chemicals and fuels to come into contact with watercourses and therefore mitigation

measures to minimise this risk are identified below. It is considered that the potential impacts associated with surface water can be appropriately managed if the mitigation measures identified in the REF are implemented. These include the handling and storage of fluids, fuels and waste water and the installation of sediment fences and traps.

#### *Soils*

The proposed activities will involve earthworks within a defined footprint for the installation of temporary infrastructure and the well lease and upgrading/ new areas of track. There is a potential risk for soil erosion to occur. The use of existing access tracks where possible and the selection of level or gently sloping sites will minimise the disturbance footprint of the exploration activities.

Any topsoil will be stripped and stockpiled and topsoil to be reinstated as part of the rehabilitation process. No soil is proposed to be removed from the site.

Once the drilling and testing activities are complete, the disturbed area will be rehabilitated with appropriate mitigation measures and environmental safeguards implemented to minimise potential impacts. Erosion and sediment control measures will be implemented. To reduce the risk of soil contamination measures to be implemented include the provision of spill kits; storage, handling, use and disposal of potential contaminants in accordance with the stipulations of the relevant Material Safety Data Sheet (MSDS) and containment of fluids. Any soil that becomes contaminated through contact with drilling fluids, fuels, or lubricants will be removed from the site and disposed of at an appropriate licensed disposal facility.

#### *Chemical and hazardous substances management*

The drilling operations would generally only use chemicals such as drilling fluids/agents, fuels, and lubricants. While these substances are not considered highly hazardous, there is still the potential risk of fire and pollution to land, water and air if an accidental spillage was to occur. The *Occupational Health and Safety Act 2000* and the *Protection of the Environment Operations Act 1997* are the acts that regulate dangerous goods. These Acts would be adhered with through all operations for the proposal. It is considered that the potential impacts associated with chemical and hazardous substances can be appropriately managed with the implementation of the mitigation measures presented in this REF.

#### *Contaminated Land*

Illegal dumping has occurred on the proposed well lease where various items of agricultural and domestic hard refuse (e.g. rubber, metal, plastic, wood) have been disposed of in an excavated pit. While no chemical testing of the dumped material has been undertaken, there is a possibility that localised soil contamination may be present. It is proposed to remove the waste from the site and dispose of it at a licensed facility. Prior to removal, waste will be classified in accordance with the OEH *Waste Classification Guidelines* by a suitably qualified person. While the waste is expected to be inert, if evidence of any contamination is identified validation testing of the soils will be undertaken to ensure all contaminated material is removed prior to the commencement of works. The stockpiled material excavated when the rubbish pit was formed will be backfilled into the pit to create a level drilling pad.

Contamination risk will be managed with the measures identified for surface water, soils and chemicals/hazardous substances. In addition, refuse removed from the rubbish pit will be managed in accordance with relevant guidelines and legislation.

#### *Waste Minimisation and management*

Drill cuttings and some general site operations waste will be produced as part of the proposed drilling operations. Any solvents, oils and other general waste would need to be managed in an appropriate manner to avoid health risks and contamination of land and waterways. As previously stated, following drilling and removal of excess drilling fluid from the sump, dried cuttings are removed and transported to an appropriate licensed waste facility.

A regular service of amenities will be conducted and waste is to be removed to a licensed facility.

Mitigation measures will include a general waste management strategy and a specific Site Waste Management Plan for drilling activities.

#### *Natural resource use*

The key natural resources that would be affected by the proposed drilling operations are agricultural land resources and fuels for the drilling equipment and transportation of staff. A relatively minor proportion of the overall area of the property would be taken from agricultural use during the duration of works, approximately 74 days. The disturbed areas will be rehabilitated by returning them to at least their pre-operational state or to a condition agreed by the landholder. Therefore, there would be a temporary loss of the use of this agricultural land in agreement with the landholder and, in the context of the total agricultural land holding and the wider agricultural uses of the region, is of minimal significance.

Fuels will be used for equipment and also for works and staff vehicles although this is not likely to be a significant quantity of fuel use. However the fuel should be used as efficiently as possible through appropriate work behaviour (e.g. switching off equipment when not in use).

#### *Local Community and Neighbouring Properties*

Santos is committed to providing ongoing information on activities with key stakeholders prior to work starting and for the duration of their presence in the region.

The nearest residential dwelling is approximately 1.4km to the east of the site. The closest community is Milroy, approximately 2.5km from the site and the township of Curlewis which is approximately 17km to the north east of the site.

The effect associated with the temporary loss of the agricultural use of the land is outlined above. Santos has secured access to the location and is finalising execution of a landowner agreement as required under the Petroleum (Onshore) Act 1991. This will address land access conditions, compensation and rehabilitation. The landholder will therefore experience the effects of the temporary loss of land and associated effects such as disturbance to current farming activities, stock and flora and fauna.

Drilling will be undertaken on a 24 hour basis and measures to mitigate noise are identified. There is not anticipated to be a significant visual impact because the activities are temporary.

In order to minimise impacts on landholders, mitigation measures include ongoing landholder and stakeholder consultation; responding promptly to any community concerns or complaints; informing the community promptly of any changes to timing or scheduling which will have an adverse impact on them.

#### *Visual Assessment*

The operations are temporary in nature, with a duration of approximately 74 days, and all equipment will be removed on completion of site activities. The closest residence is approximately 1.85km away to the north. Following completion of the works all sites will be rehabilitated and would not detract from the overall scenic qualities of the area.

No significant impacts on the visual amenity of the area are expected from the proposed drilling.

#### *Land Use*

There will be a temporary loss of use of approximately 5,504m<sup>2</sup> of agricultural land at the site. During the works, new fencing and a gate will be erected to allow for the movement of the landowners livestock and minimise disruption to the landholder.

The site is located within PEL 1, which has overlapping coal tenures. There are no known coal mining operations planned for this site, however the wells are designed such that they will pose no threat or hazard to future coal mining.

### *Cumulative Environmental Impacts*

There will be no cumulative impacts associated with the proposal. There are only 3 other wells in the general vicinity of the site, with the closest being approximately 5.35km away. All these wells have been plugged and abandoned.

### **Conclusion**

This REF has been prepared in accordance with Clause 228 of the Environmental Planning and Assessment Regulation 2000 and provides consideration of the environmental impact of the proposed works as required by Section 111 of the Environmental Planning and Assessment Act 1979. The proposal comprises temporary, small scale works of a short term duration. The REF has identified that the proposed chip hole and associated activities is not likely to significantly affect the environment or threatened species, populations or ecological communities or their habitats.

# Contents

<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
1.1	Background	1
1.2	Technical Investigations	1
1.3	Structure of REF	1
<b>2</b>	<b>SITE DESCRIPTION AND CONTEXT</b>	<b>2</b>
2.1	Location & description	2
2.2	Topography	8
2.3	Ecology	10
2.4	Water Resources	10
	2.4.1 Surface Water	10
	2.4.2 Groundwater	11
2.5	Heritage	11
	2.5.1 Aboriginal heritage	11
	2.5.2 Other heritage	11
2.6	Environmentally Sensitive Areas	13
2.7	Climate	13
2.8	Soils	15
2.9	Geology	16
	2.9.1 Regional Geology	16
<b>3</b>	<b>PROJECT DESCRIPTION</b>	<b>19</b>
3.1	Introduction	19
3.2	Site preparation & equipment	19
3.3	Drilling Activities	23
3.4	Abandonment and rehabilitation	24
3.5	Duration	24
3.6	Staff & Hours of Operation	25
3.7	Chemicals	25
3.8	Justification of activity	25
3.9	Alternatives	26
3.10	Stakeholder Consultation	27
<b>4</b>	<b>REGULATORY CONTEXT</b>	<b>29</b>
4.1	Petroleum (Onshore) Act	29
4.2	Environmental Planning & Assessment Act	30
	4.2.1 Overview	30
	4.2.2 Determining Authorities and the REF	30
	4.2.3 Gunnedah Shire Local Environmental Plan	31
	4.2.4 State Environmental Planning Policy No. 44 – Koala Habitat Protection	32
4.3	Environmental Protection and Biodiversity Conservation Act	32
4.4	Threatened Species Conservation Act	33

4.5	<b>National Parks and Wildlife Act</b>	<b>33</b>
4.6	<b>Heritage Act</b>	<b>34</b>
4.7	<b>Protection of the Environment Operations Act</b>	<b>34</b>
4.8	<b>Water Legislation</b>	<b>35</b>
5	<b>ENVIRONMENTAL IMPACTS AND MITIGATION</b>	<b>36</b>
5.1	<b>Introduction</b>	<b>36</b>
5.2	<b>Ecology</b>	<b>36</b>
5.2.1	Flora and Fauna	36
5.2.2	Key Threatening Processes Relevant to Proposed Activities	38
5.2.3	Matters of National Significance	39
5.3	<b>Heritage</b>	<b>40</b>
5.3.1	Aboriginal heritage	40
5.3.2	Other Cultural Heritage	41
5.4	<b>Ground water</b>	<b>42</b>
5.5	<b>Air</b>	<b>42</b>
5.6	<b>Noise</b>	<b>43</b>
5.7	<b>Surface water</b>	<b>44</b>
5.8	<b>Soils</b>	<b>45</b>
5.9	<b>Chemical and hazardous substances management</b>	<b>46</b>
5.10	<b>Contaminated land</b>	<b>46</b>
5.11	<b>Waste minimisation and management</b>	<b>47</b>
5.12	<b>Natural resource use</b>	<b>48</b>
5.13	<b>Local Community and Neighbouring Properties</b>	<b>48</b>
5.14	<b>Visual assessment</b>	<b>49</b>
5.15	<b>Land use</b>	<b>49</b>
5.16	<b>Cumulative Environmental Impacts</b>	<b>50</b>
5.17	<b>Summary of Mitigation Measures</b>	<b>50</b>
5.18	<b>Clause 228 Guidelines</b>	<b>53</b>
6	<b>CONCLUSIONS</b>	<b>55</b>

## Figures

Figure 2-1	Location of Wando 1 Chip Hole	3
Figure 2-2	Local Government Areas	4
Figure 2-3	Satellite Image	5
Figure 2-4	Coal Tenures	6
Figure 2-5	Aerial Photograph 1km Radius from Site	7
Figure 2-6	Contours	9
Figure 2-7	Drainage	12

Figure 2-8 Protected Areas	14
Figure 2-9 Stratigraphy of the Gunnedah Basin	17
Figure 3-1 Wando 1 Site Layout – Site Plan	20
Figure 3-2 Wando 1 Site Layout – Lease Detail	21
Figure 3-3 Erosion & Sediment Control	22

## Tables

Table 2-1 Environmentally Sensitive Areas	13
Table 2-2 Climate Statistics from Curlewis (Wongalee) (rainfall) & Gunnedah Resource Centre (temp) BoM Weather Stations	13
Table 3-1 Areas of disturbance & cut and fill for well leases	20
Table 3-2 Duration of drilling and site activities	24
Table 5-1 Key Threatening Processes Relevant to the Proposed Activities	38
Table 5-2 Matters of National Environmental Significance	39
Table 5-3 Summary of Mitigation Measures	50
Table 5-4 Clause 228 Guidelines	53

## Plates

Plate 2-1 View east from well lease towards White Cypress Woodland	8
Plate 2-2 View west across property from well lease	8
Plate 2-3 View north from well lease, on western side of fence	8
Plate 2-4 View south across well lease towards White Cypress Woodland	8
Plate 2-5 Rubbish pit located within the well lease	8
Plate 2-6 View east across property from well lease / canopy trees adjacent to well lease	8

## Appendices

APPENDIX A	Ecological Assessment, prepared by RPS
APPENDIX B	Cultural Heritage Assessment, prepared by Santos
APPENDIX C	Santos Drill Rig Noise Assessment, prepared by SLR
APPENDIX D	Chip Hole Design, prepared by Santos
APPENDIX E	Environmental Management Plan, prepared by RPS

# I Introduction

## 1.1 Background

RPS has prepared this Review of Environmental Factors (REF) on behalf of Santos QNT Pty Ltd (Santos) to assess the environmental impact of the proposed drilling of one chip hole and ancillary activities at the Wando 1 site in the Gunnedah Basin. The purpose of the chip hole is to obtain information about coal seam depths, seam thickness, continuity and permeability to assess the coal seam potential of the Gunnedah Basin in within Petroleum Exploration Licence No. 1 (PEL 1).

In accordance with the Petroleum Exploration Licence Conditions issued for PEL 1 under Part 3 of the Petroleum (Onshore) Act 1991, petroleum exploration holes are classified as a Category 3 activity. A Category 3 activity requires notification of the activity to an Environmental Officer of the Department of Primary Industries (DPI) – Mineral Resources (now the Department of Trade and Investment, Regional Infrastructure and Services) and in most circumstances, a specific determination of the proposal under Part 5 of the Environmental Planning and Assessment Act 1979.

This REF has been prepared in accordance with Clause 228 of the Environmental Planning and Assessment Regulation 2000 and provides consideration of the environmental impact of the proposed works as required by Section 111 of the Environmental Planning and Assessment Act 1979.

## 1.2 Technical Investigations

The following technical investigations have been prepared to assist in the preparation of this REF:

- Ecological Assessment, prepared by RPS
- Cultural Heritage Assessment, prepared by Santos
- Santos Drill Rig Noise Assessment, prepared by Heggies (now SLR)

## 1.3 Structure of REF

This REF comprises the following:

- Section 1 introduces the proposal and provides an overview of the REF.
- Section 2 provides an overview of the site, locality and key site features.
- Section 3 provides a detailed description of the activities to be undertaken as part of the proposal.
- Section 4 discusses the relevant planning legislation associated with the proposal.
- Section 5 considers the likely environmental impacts of the proposal and recommends mitigation measures to ensure these impacts are appropriately managed.
- Section 6 concludes the REF.

## 2 Site Description and Context

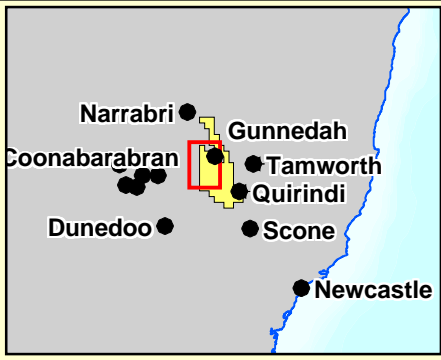
### 2.1 Location & description

The proposed chip hole site is located within Petroleum Exploration Licence (PEL) 1 as shown on Figure 2-1. PEL 1 is located within the Gunnedah region and covers a number of local government areas (LGAs), including the Gunnedah Shire Council LGA where the proposed activities are located (refer Figure 2-2).

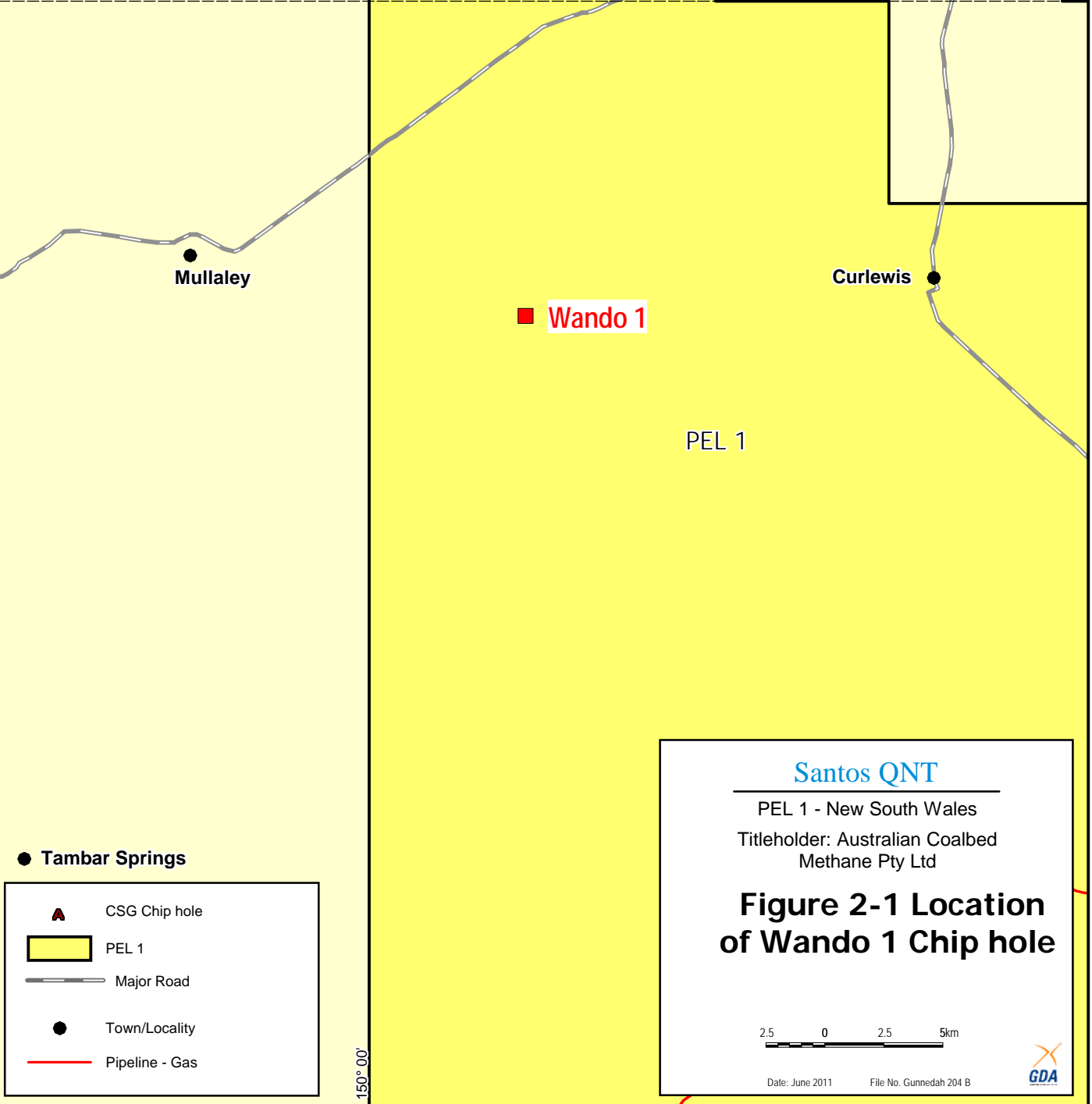
A satellite image showing the site and its vicinity is shown in Figure 2-3. The region has been used extensively for agricultural activities since the 1830s. Agricultural activities include mixed farming of sheep, cattle and grain crops with a gradually larger reliance on cattle. Coal mines are located in tenures that overlay PEL 1 (as shown on Figure 2-4), however these are not within the vicinity of the proposed chip hole.

The subject site forms part of a property called "Tabbrawyndi", which is bounded to the north by Goscombe Road and to the south by Mount Knowles Road (refer Figure 2-5). The property is currently used for cattle grazing, and is comprised of numerous fenced paddocks consisting of native and exotic grass species. Additional infrastructure on the property includes stock yards, sheds, and a residence. The majority of the property has been previously selectively cleared through historical land management practices, however a small stand of woodland vegetation and scattered canopy trees occur across the property.

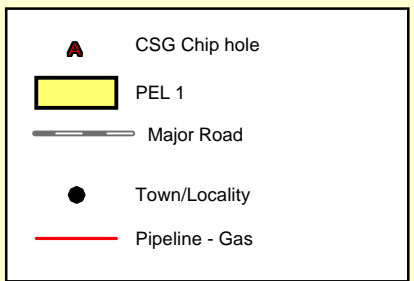
The proposed chip hole lease is located within a grazing area, adjacent to a small stand of woodland vegetation. A rubbish pit has been excavated within the proposed well lease and has been used for the dumping of agricultural and domestic hard refuse e.g. rubber, metal, plastic, wood. The pit is approximately 45m x 5m and 1.6m deep. The pile of excavated soil is located directly adjacent the pit and is approximately 1.8m high.



-31° 00'



● Tambar Springs



**Santos QNT**

---

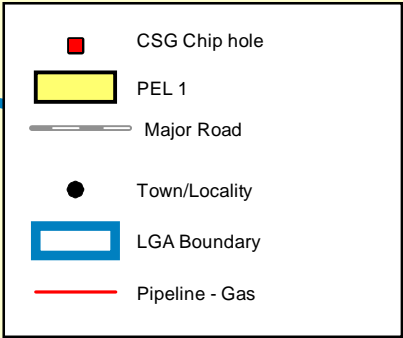
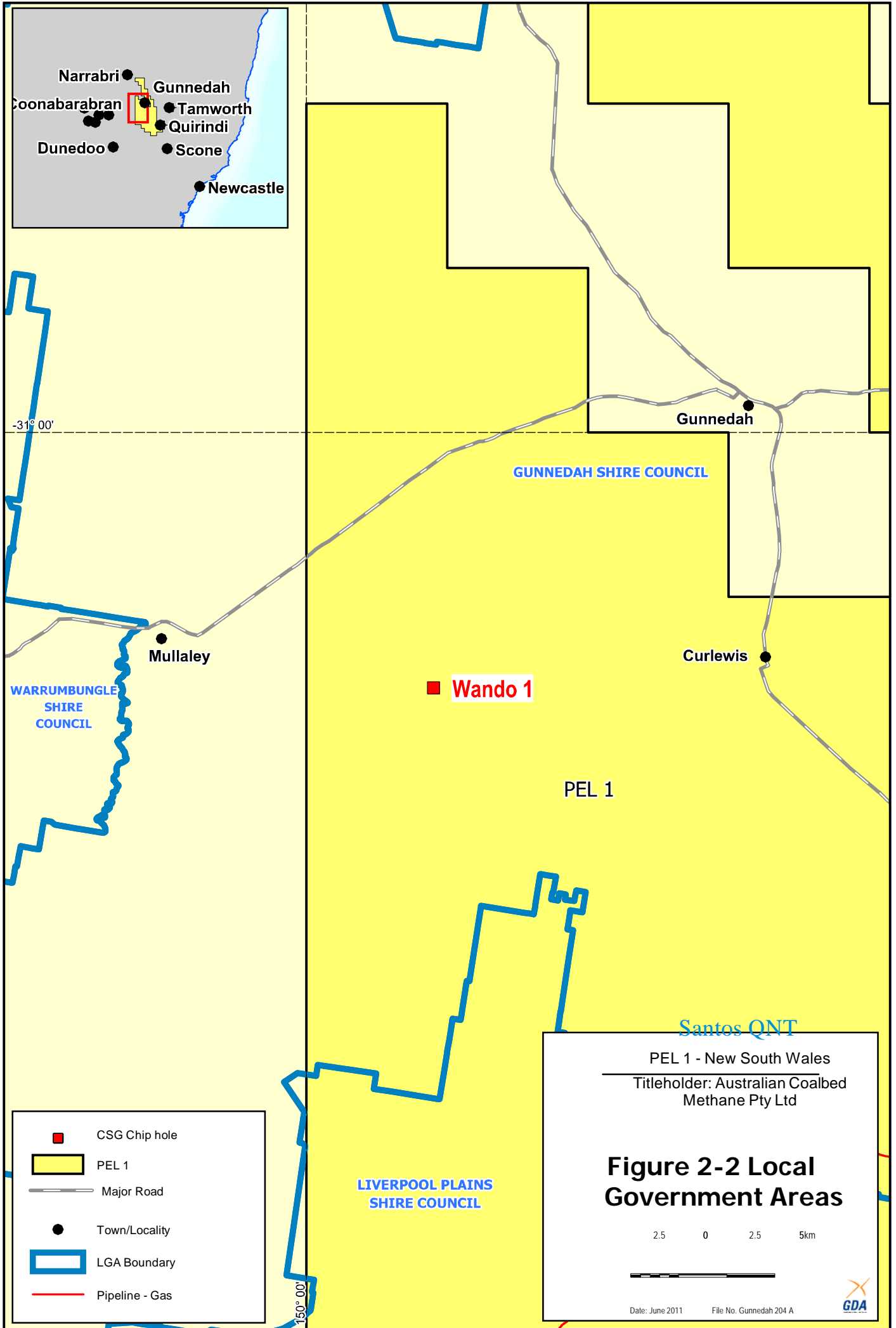
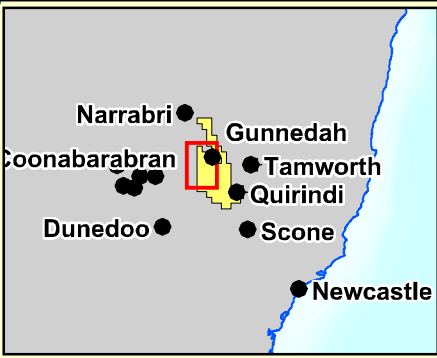
PEL 1 - New South Wales  
 Titleholder: Australian Coalbed Methane Pty Ltd

**Figure 2-1 Location of Wando 1 Chip hole**

2.5    0    2.5    5km

Date: June 2011    File No. Gunnedah 204 B

150° 00'



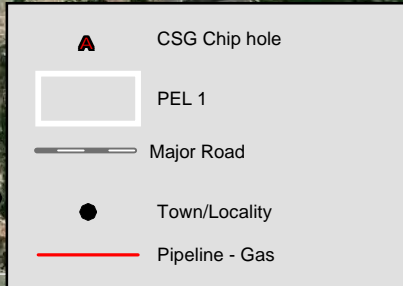
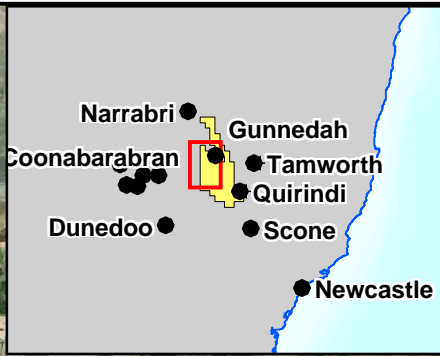
**Santos QNT**

PEL 1 - New South Wales  
Titleholder: Australian Coalbed Methane Pty Ltd

## Figure 2-2 Local Government Areas

2.5    0    2.5    5km

Date: June 2011    File No. Gunnedah 204 A



**Santos QNT**

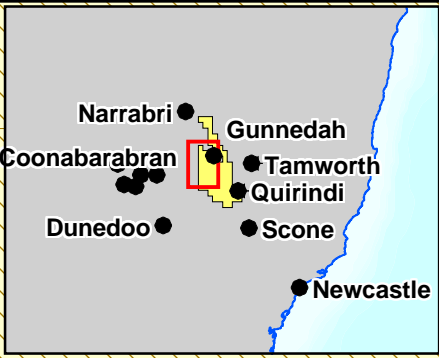
---

PEL 1 - New South Wales  
 Titleholder: Australian Coalbed Methane Pty Ltd

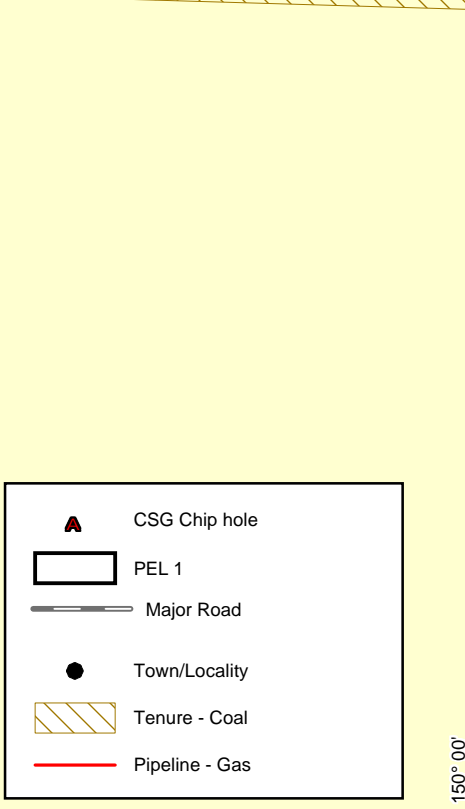
**Figure 2-3 Satellite Image**

2.5    0    2.5    5km

Date: June 2011    File No. Gunnedah 204 C



-31° 00'



150° 00'

**Wando 1**

PEL 1

**Santos QNT**

PEL 1 - New South Wales  
 Titleholder: Australian Coalbed Methane Pty Ltd

**Figure 2-4**

**Coal Tenures**

2.5 0 2.5 5km

Date: June 2011 File No. Gunnedah 204 F



**Santos**

**PEL 1**

**Wando 1 - Chiphole**



Figure 2-5 Aerial Photograph 1km Radius from Site

**Drawn by:**  
**Print date:** 01 Jun 2011 07:23 PM

The content on this map is provided for information purposes only. No undertakings, guarantees or warranties as to the accuracy, completeness, currency or suitability of the data for any purpose are provided. The user of these data should not rely on the data presented herein for any reason and should check for confirmation from the originating data owner or other body prior to the commencement of any works program.

The following photographs illustrate the subject site and proposed chip hole location.



**Plate 2-1 View east from well lease towards White Cypress Woodland**



**Plate 2-2 View west across property from well lease**



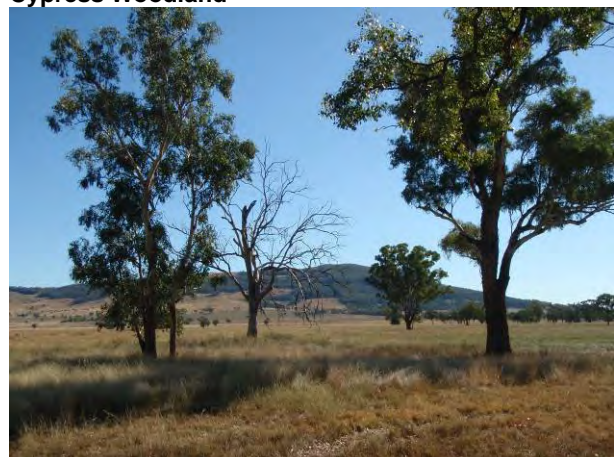
**Plate 2-3 View north from well lease, on western side of fence**



**Plate 2-4 View south across well lease towards White Cypress Woodland**



**Plate 2-5 Rubbish pit located within the well lease**

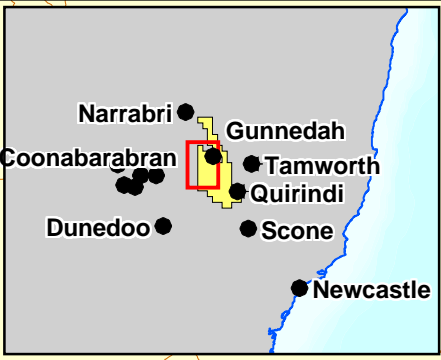


**Plate 2-6 View east across property from well lease / canopy trees adjacent to well lease**

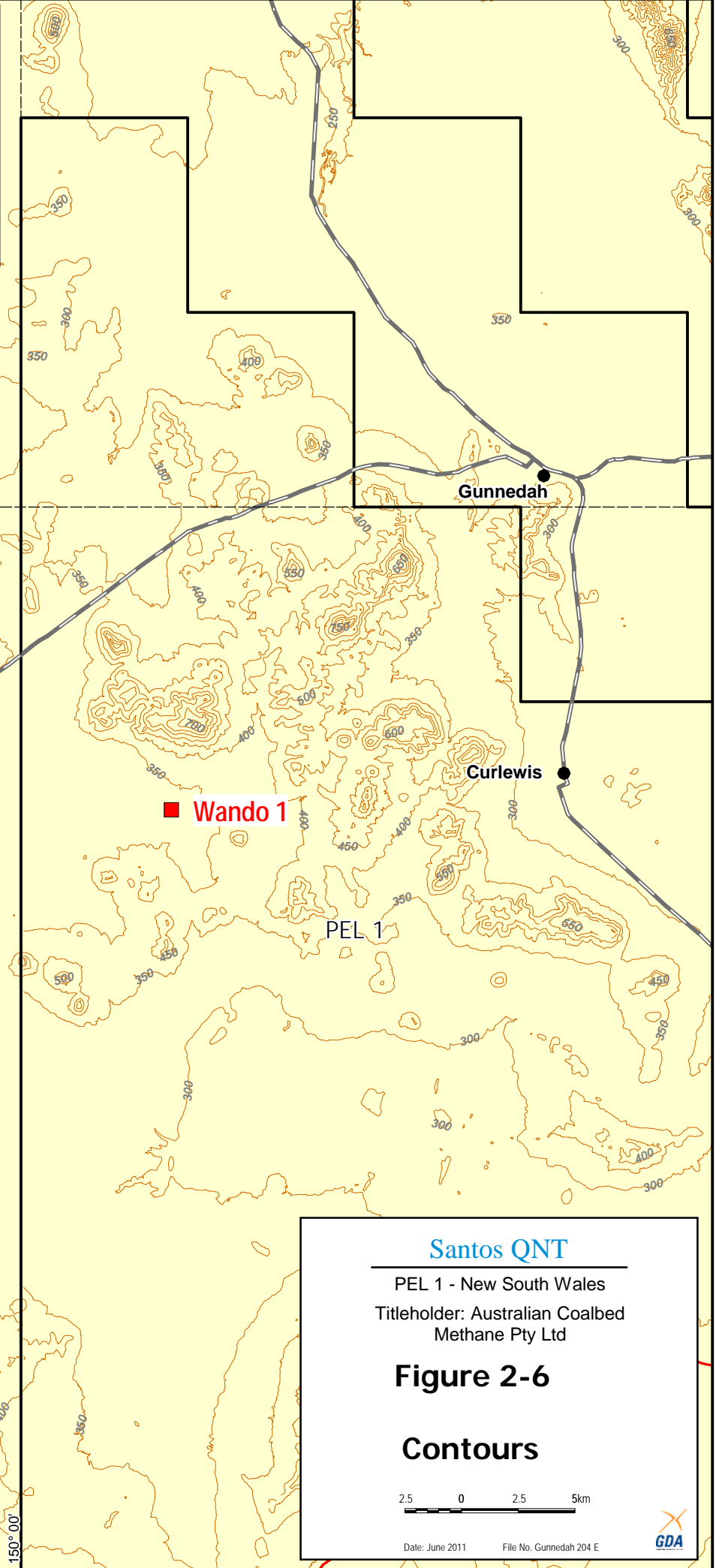
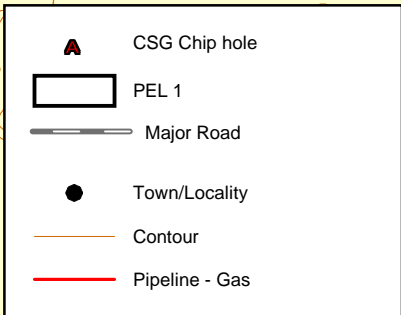
## 2.2 Topography

The topography of the subject site is flat to undulating. It is located at approximately 300m to 350m Australian Height Datum (AHD) and land rises to the north, east, south and west.

Refer to Figure 2-6 for further detail.



-31° 00'



**Santos QNT**

---

PEL 1 - New South Wales  
 Titleholder: Australian Coalbed Methane Pty Ltd

**Figure 2-6**

**Contours**

2.5    0    2.5    5km

Date: June 2011    File No. Gunnedah 204 E

## 2.3 Ecology

An Ecological Assessment (**Appendix A**) has been prepared for the subject site and surrounds.

The site is located within an area of disturbed grassland vegetation. The disturbed grassland is considered to be White Box – Yellow Box – Blakeleys Red Gum Woodland, an endangered ecological community (EEC) under the TSC Act. It is not considered to be a threatened ecological community (TEC) under the EPBC Act. No threatened flora species were identified on site.

Disturbances to the site have arisen due to weed invasion, historical vegetation clearing and the presence of a small rubbish pit. The site contains native and exotic grass, herb and forb species and is dominated by Plains Grass (*Austrostipa aristiglumis*) with Bathurst Burr (*Xanthium spinosum*) as a sub dominant species.

Commonly occurring weed species include Shepherds Purse (*Capsella bursa-pastoris*), Saffron Thistle (*Carthamus lanatus*), Mexican Poppy (*Argemone mexicana*), Tall Fleabane (*Conyza sumatrensis*), and Mint Weed (*Hyptis suaveolens*), with weed covers ranging from 30% to 50%. Common native species include Pitted Blue-grass (*Bothriochloa decipiens*), Slender Chloris (*Chloris divaricata*), Slender Rats Tail Grass (*Sporobolus creber*), Three-awn Speargrass (*Aristida vagans*), Yellow Buttons (*Chrysocephalum apiculatum*), Australian Bluebell (*Wahlenbergia gracillis*), and Small-leaved Cotton Bush (*Maireana microphylla*).

The site is located to the immediate north of an area of White Cypress (*Callitris glaucophylla*) Woodland. The woodland is dominated by White Cypress, with occasional emergent Yellow Box (*Eucalyptus melliodora*). No shrub layer occurs in this area, and the ground cover is generally consistent with the above. Scattered Yellow Box, Bimble Box (*Eucalyptus populnea*), and Blakley's Red Gum (*Eucalyptus blakelyi*) occur adjacent to the well lease.

Mexican Poppy is a declared Class 5 noxious weed under the *Noxious Weed Act 1993*. There are no requirements to control existing plants of Class 5 weeds, however the weeds are notifiable, and a range of restrictions apply to their sale and movement. A range of environmental weeds were identified within the study area.

One threatened fauna species, the koala, was identified as occurring adjacent to the chip hole lease. No additional threatened and/or migratory fauna or flora species listed under the TSC Act and/or EPBC Act were recorded on site. Several generalist bird species were recorded opportunistically adjacent to the study area, including Australian Magpie (*Gymnorhina tibicen*), Crested Pigeon (*Ocyphaps lophotes*), and Apostlebird (*Struthidea cinerea*).

The site comprises understorey vegetation that is dominated by exotic species and a thinned canopy. Mature trees are either isolated individuals, or occur in small clumps. Due to historical land management practices, the pasture grasses do not provide significant habitat resources such as rocky outcrops or fallen woody debris. This area is considered to be of low value for fauna, although the ground cover may provide limited foraging resources and shelter for native birds and small reptiles and the scattered mature trees provide foraging and habitat resources for a range of generalist species, including mammals and birds.

## 2.4 Water Resources

### 2.4.1 Surface Water

PEL 1 is located in the Namoi catchment management area. In north west NSW, the catchment is bounded by the Great Dividing Range in the east, the Liverpool Ranges and Warrumbungle Ranges in the south and the Nandewar Ranges and Mt Kaputar to the north. Major tributaries of the Namoi River include Coxs Creek and the Mooki, Peel, Cockburn, Manilla and Macdonald Rivers all of which join the Namoi upstream of

Boggabri. The catchment is over 350km long and stretches from Woolbrook in the east to Walgett on the western boundary (NCMA, 2011).

The site is located within the Mullaley Sub-catchment which covers an area of 419km<sup>2</sup> and has elevations ranging from 720m to 300m ASL near Mullaley. Coxs Creek is the main drainage line and forms the western boundary of the sub-catchment (NCMA, 2011).

Issues identified by the Namoi Catchment Management Authority (NCMA, 2011) for this area include flood hazard, salinity and soil sodicity on the alluvial soils; and low soil organic matter, soil structure decline, erosion and salinity recharge on the medium and lighter soils.

Figure 2-7 shows the drainage in the vicinity. Collygra Creek, to the north of the site, is the nearest watercourse.

## 2.4.2 Groundwater

Groundwater in the Namoi catchment supports the irrigation industry and also provides the water supply for many towns and intensive industries and there are a total of 700 license holders in this catchment (NCMA, 2011). Groundwater sources include all water contained in the unconsolidated alluvial sediment aquifers associated with the Namoi and its tributaries.

The groundwater at the Wando chip hole site and surrounding areas consist of both alluvial and hard rock aquifers. Alluvial aquifers are generally those that are closer to the surface and associated with more porous soil and rock materials. The consolidated formations (e.g. hard rock aquifers) of the Gunnedah Basin comprise interbedded coals, sandstone and siltstones and are not considered major groundwater sources.

The Gunnedah Basin is divided into Groundwater Management Areas (GMAs), which each correspond to a different hydrogeological system. The Gunnedah Basin GMA (GMA604) and Oxley Basin GMA (GMA608) are those relevant to the subject site.

The target CSG bearing formations for this proposal are the Permian coals of the Black Jack Group (Hoskissons Coal). Other bores completed within the Black Jack Group have water levels between 10 and 16m below ground level. The aquifers of the Black Jack Group are low yielding with two bores indicating a yield of approximately 1 litre per second.

## 2.5 Heritage

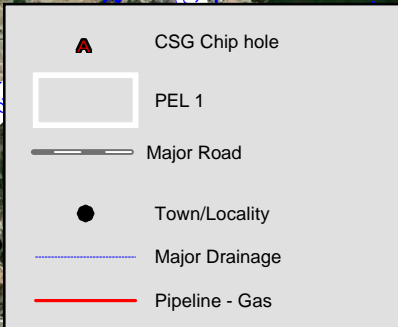
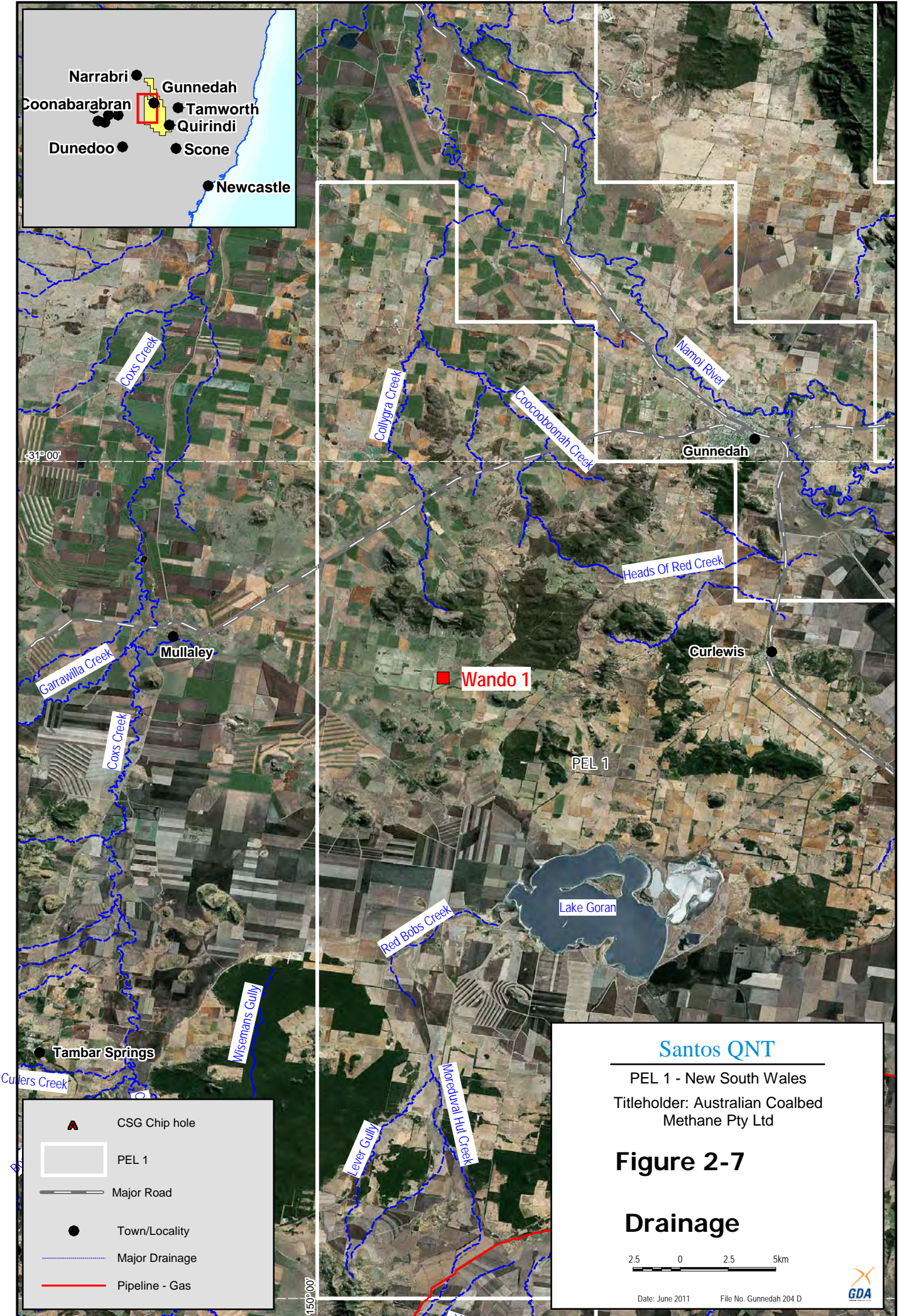
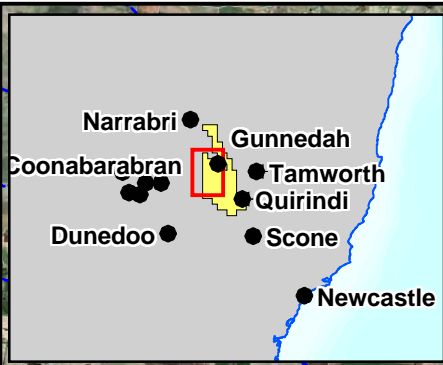
### 2.5.1 Aboriginal heritage

The site was inspected by Santos' cultural heritage officer in March 2011. No items of significance were identified, and no features likely to contain archaeological deposits were found. A Cultural Heritage Assessment was subsequently prepared (**Appendix B**) for the site, which concluded that Aboriginal objects are unlikely to occur in the subject area.

A search of the NSW OEH Aboriginal Heritage Information Management System (AHIMS) undertaken as part of the assessment was made on 17 June 2011 and found that there were no items of cultural heritage located on the site or in the vicinity of the site.

### 2.5.2 Other heritage

The NSW State Heritage Register and Gunnedah Local Environmental Plan 1998 identify a number of heritage items within the Gunnedah LGA area. The majority of these are located within Gunnedah and none are within proximity of the site.



**Santos QNT**

---

PEL 1 - New South Wales  
 Titleholder: Australian Coalbed Methane Pty Ltd

## Figure 2-7

### Drainage

2.5    0    2.5    5km

Date: June 2011    File No. Gunnedah 204 D

## 2.6 Environmentally Sensitive Areas

The subject site is not identified as occurring within an Environmentally Sensitive Area (refer Table 2-1) however there are protected areas located in the vicinity of the subject site (Figure 2-8). These include:

- Wondoba State Conservation Area – approximately 3km to the north east of the site.
- Goran State Forest – approximately 4km to the south east.
- Black Jack State Forest approximately 17km to the north east.
- Breeza state Forest – approximately 20km to the south east.
- Trinkey State Conservation Area – approximately 18km

Lake Goran is located approximately 14km south east of the subject site. It is listed as a nationally significant wetland in the '*Directory of important wetlands in Australia*', however it is not listed as a Ramsar wetland.

**Table 2-1 Environmentally Sensitive Areas**

Is the proposal located within any of the following:	Yes/No
An area reserved or dedicated under the <i>National Parks and Wildlife Act 1974</i> ?	No
Is the proposal located within land reserved or dedicated within the meaning of the <i>Crown Lands Act 1989</i> for preservation of other environmental protection purposes?	No
A World Heritage Area?	No
Environmental Protection Zones in environmental planning instruments?	No
Lands protected under SEPP 14 – Coastal Wetlands?	No
Lands protected under SEPP 26 – Littoral Rainforests?	No
Land identified as wilderness under the <i>Wilderness Act 1987</i> or declared as wilderness under the <i>National Parks and Wildlife Act 1974</i> ?	No
Aquatic reserves dedicated under the <i>Fisheries Management Act 1994</i> ?	No
Wetland areas dedicated under the Ramsar Wetlands Convention?	No
Land subject to a conservation agreement under the <i>National Parks and Wildlife Act 1974</i> ?	No
Land identified as <i>State Forest under the Forestry Act 1916</i> ?	No
Western Lands Lease	No
Freehold or Crown Land. If Crown Land, what type?	Freehold

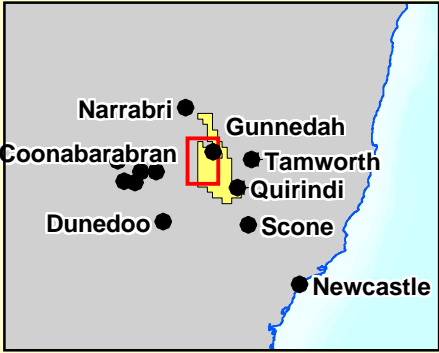
## 2.7 Climate

The Bureau of Meteorology (BoM) weather station closest to the site is Curlewis (Wongalee), which only provides rainfall and solar data. Gunnedah Resource Centre is the closest station with temperature statistics. The local climate is temperate with a slight dominance of summer rainfall. The average daily maximum temperature is around 24.5°C, while the average daily minimum temperature is around 12.1°C (BoM, 2011). Long-term mean annual rainfall for the locality is 640.8 mm.




As shown in Table 2-2, based on mean temperature records the warmest month is January and the coolest months are July and August. December receives the greatest rainfall and April the least.

**Table 2-2 Climate Statistics from Curlewis (Wongalee) (rainfall) & Gunnedah Resource Centre (temp) BoM Weather Stations**

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Max Temp (°C)	31.9	31.1	29.1	25.2	20.3	16.8	16.1	17.9	21.4	25.1	28.3	31.1
Mean Min Temp (°C)	18.9	18.7	16.6	12.8	8.7	6.1	4.7	5.8	8.6	12.2	15.0	17.5
Mean Rainfall (mm)	66.2	66.3	41.8	30.8	39.8	48.0	50.1	32.3	45.0	54.7	83.6	86.5

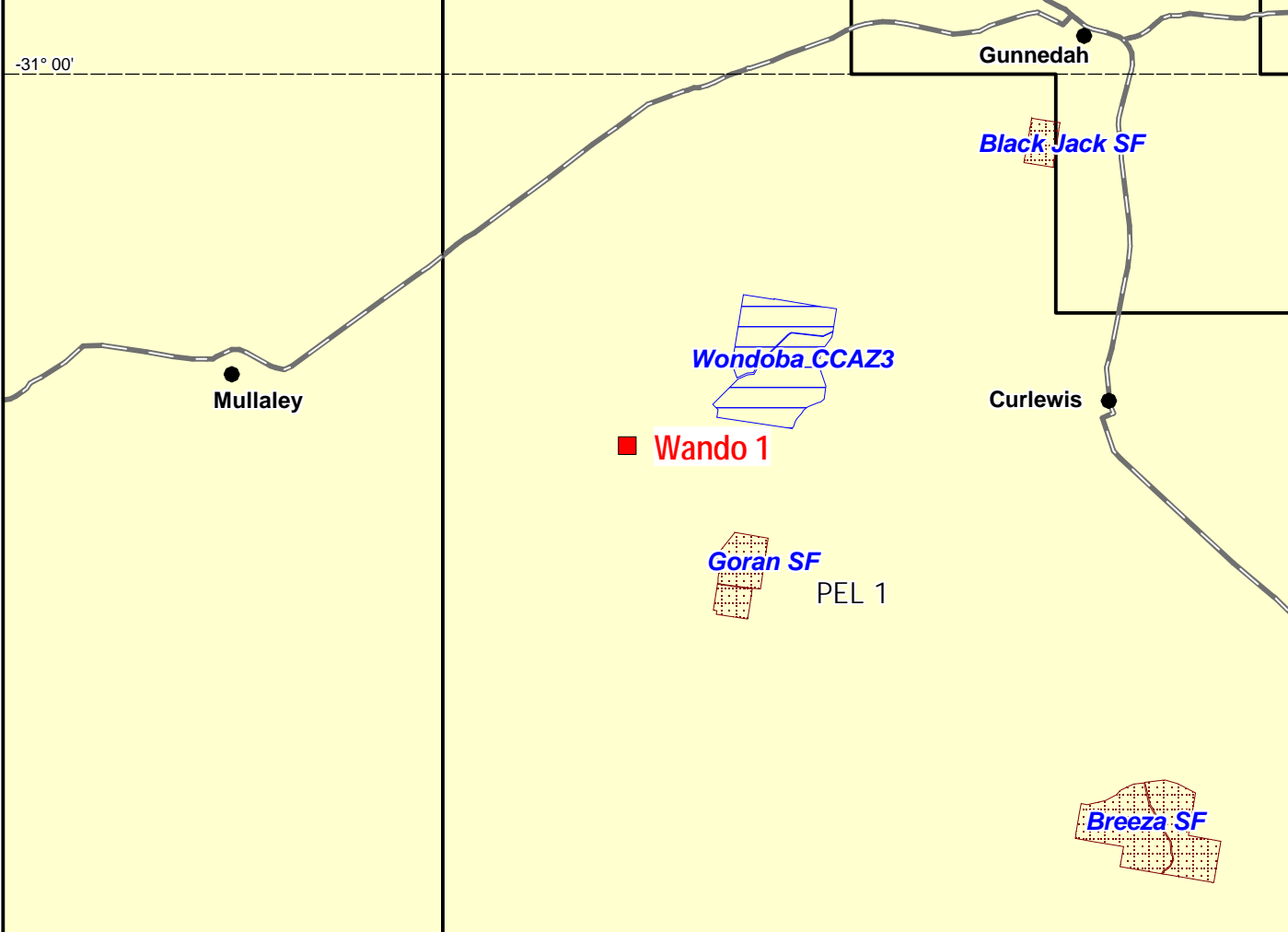


**Protected Areas**






-  CCA Zone 2 Aboriginal Area
-  CCA Zone 3 State Conservation Area
-  State Forest

*Kelvin CCAZ2*

-31° 00'



● Tambar Springs

-  CSG Chip hole
-  PEL 1
-  Major Road
-  Town/Locality
-  Pipeline - Gas

*Wando 1 CCAZ3*

150° 00'

**Santos QNT**


PEL 1 - New South Wales  
 Titleholder: Australian Coalbed Methane Pty Ltd

**Figure 2-8**

**Protected Areas**

2.5 0 2.5 5km

Date: June 2011 File No. Gunnedah 204 G



## 2.8 Soils

The soils across the region vary depending on the local sediment source. Gunnedah Shire Council have provided a description of the types of soils found within the Shire on their website, as follows (GSC, 2011):

### **Cracking Clay Soils**

*The dominate soils within the region are the black earths, largely formed from the basaltic alluvium and colluvium derived from Werrie Basalt which outcrops to the east of Porcupine Lookout Ridge, are found primarily along the Mooki River. They have a uniformly textured profile of well structured clay, and vary in colour from a very dark grey and very dark brown to black when moist.*

*The black earths have a clay content of between 50 and 80 per cent. One of the prominent characteristics of this soil type is its extensive cracking during dry periods. This is due to a high volume of montmorillonite, an expanding lattice clay mineral which causes swelling and shrinkage on wetting and drying respectively.*

*The pH of these soils is neutral at the surface and becomes increasingly alkaline (pH 8 - 9) with depth. Fertility is naturally high although responses to some applied nutrients, especially nitrogen and zinc, can be expected after cropping.*

*These have similar characteristics to the black earths but are not associated with gilgai formation.*

### **Clay and Loam Soils.**

*The loam textured soils are primarily associated with the Rangari Creek floodplain, while the clay soils have been formed along the Namoi River floodplain.*

*The clay soils appear to have a similar structure to the black earths and cracking clays, the difference being a thin band of recent alluvium on the surface which is subject to seasonal cracking. These soils graduate from black earths (heavy clays) next to the river, to brown medium to light clays along the perimeter of the floodplain.*

*These soils have a medium to high level of fertility responding under various conditions to applications of phosphorus, sulphur and nitrogen. The surface pH of both soils are neutral, increasing with depth.*

*Some of these clays have a shrink-swell capacity ranging from 16.8 to 21.2 per cent.*

### **Duplex and 'Gravelly' Soils**

*The gravelly red brown earths form the dominant soil type in and around Gunnedah and are associated with the mesozoic sedimentary and volcanic rocks of the ridge systems in the Wean, Kelvin and Tambar Springs areas of the Shire.*

*They are characterised by a dark grey to brown sandy loam to loam, graduating into a reddish brown clay, with gravel being present throughout the profile.*

*These soils are very poor in terms of fertility and are of lesser value due to their porosity and high leaching qualities. They are likely to be deficient in phosphorus, nitrogen, sulphur and some trace elements. The pH ranges from mildly acid at the surface (pH 6 to 6.5) to alkaline at depth (pH 8 to 8.5).*

*They have a low to medium shrink-swell capacity ranging from 10 per cent at the surface to 11.2 per cent at 50 centimetres, 13.6 per cent at 100 centimetres and 16.4 per cent at 200 centimetres.*

### **Clay Loams with Red Clay Subsoils**

*These soils are found around Gunnedah and to the west of the central ridge system with the major soil type being the Euchrozems.*

*Characteristically, the Euchrozem's colour graduates from red to reddish-brown and brown and grades from a clay loam or light clay into a medium to heavy textured clay soil at depth. The A1 horizon is self mulching*

with a depth of 15 centimetres. The structure of the A1 changes from a weak to strong crumb structure at the surface to a fine to medium blocky structure at depth. The boundary between the A1 and B1 horizons is gradual with no evidence of an A2 horizon. The B2 horizon is more blocky in structure with smooth faced, dense peds. When moist the soil is moderately friable but becomes hard when dry. The B2 horizon is much larger than the B1 and often consists of gravelly clay. Some calcium carbonate nodules are evident in the B horizon.

The pH ranges from 6.5 at the surface to 7.8 to 8 at depth while the shrink-swell capacity is low to moderate ranging from about 11 per cent at the surface to 16 per cent at a depth of 1 metre.

### **Highly Erodable - Hard Setting Soils**

These soils have been formed on Mandowa Mudstones, Lower Carboniferous, Baldwin and Caroda Formations North and West of the Keepit Catchment.

Their high degree of erodability is due to a slightly dispersible A2/B1 horizon. Where undisturbed, the A1 horizon is dark grey-brown to red-brown in colour varying from loamy sands to clay loams with a weak to blocky structure. These soils set hard when dry and become moderately friable when moist. However the A1 is often eroded away leaving an exposed A2 or B1 horizon as the surface.

In the Red-Brown earths the A2 horizon is only weakly developed. The B horizon consists of a reddish brown to red clay having a moderate to strong blocky structure, often with a shiny smooth-faced ped fabric.

### **Skeletal Soils**

These soils are primarily found along the ridge crests and the steeper slopes with the major soil type being Lithosols. They contain large amounts of parent rock material and are usually very stony with soil depth ranging from 2 to 20 centimetres.

## **2.9 Geology**

### **2.9.1 Regional Geology**

PEL 1 is located in the central portion of the Gunnedah Basin where Jurassic and Cretaceous Surat Basin sediments unconformably overlie Permo Triassic Gunnedah Basin sediments (Figure 2-9). The Gunnedah Basin covers an area of more than 15,000km<sup>2</sup> and is defined in structural terms as being bounded to the east by the Hunter Mooki Thrust Fault System and the New England Fold Belt, and to the west by the Lachlan Fold Belt onto which the Gunnedah Basin sediments gradually onlap.

Metavolcanics, meta-sediments and minor ignimbritic volcanics of the Lachlan Fold Belt form much of the basement under the western part of the Gunnedah Basin and the Rocky Glen Ridge. Widespread Late Carboniferous and Early Permian mafic lavas were succeeded by paralic-lacustrine environments with sediments of the Leard and Goonbri Formations deposited. This was followed by low energy fluvial conditions in which the coal measures of the Maules Creek Formation were deposited.

An Early Permian transgression then inundated the area and deposited shallow marine para-conglomerate, sandstone and siltstone of the Porcupine and lower Watermark Formations and culminating in the deposition of the upper Watermark Formation marine claystone.

The Black Jack Formation was deposited in a major delta system with a dominantly northeast sediment source from the New England region. A minor westerly provenance associated with the emergence of the Lachlan Fold Belt is also apparent. The New England provenance of the lower Black Jack Formation resulted in generally quartz lithic and arkosic sandstones with limited reservoir potential. The sandstones were deposited in a lower delta plain/marginal marine environment.

NEW STRATIGRAPHY (Tadros 1993a, e; 1995 & herein)							DEPOSITIONAL SYSTEMS (modified from Tadros 1986b, Tadros & Hamilton 1991, Hamilton 1993a & herein)	
PERIOD	PALYNOLOGY ZONE	GROUP	SUBGROUP	FORMATION	MEMBER	SEAM		
TRIASSIC	MIDDLE			GARRAWILLA VOLCANICS			GARRAWILLA VOLCANICS	
				DERIAH FORMATION				
	PT2.2-PT3				NAPPERBY FORMATION			
EARLY	PT1-PT2.1	BLACK JACK GROUP	NEA SUBGROUP	DIGBY FORMATION	ULINDA SANDSTONE		DIGBY ALLUVIAL SYSTEM	
					BOMERA CONG.			
PERMIAN	LATE			PP5	COOGAL SUBGROUP	TRINKEY FORMATION	SPRINGFIELD C.M.	DOONA
		WALLALA FORMATION	CLIFT C.M.					
		CLARE SANDSTONE	BREEZA C.M.			LACUSTRINE & WESTERN FLUVIAL SYSTEMS		
		HOEHLBIRRI FM	HOWES HILL C.M.					
		HOSKISSONS COAL	CAROONA C.M.					
	EARLY	PP4.3	MILLIE GROUP	BROTHERS SUBGROUP	BRIDGLOW FORMATION		BROWN	UPPER WATERMARK / LOWER BLACK JACK DELTA SYSTEMS
					ARKARULA FORMATION			
					PAMBOOLA FORMATION	MELVILLES C.M.		
					WATERMARK FORMATION			
					PORCUPINE FORMATION			
EARLY	PP3.2-PP3.3 PP3.1 PP2.2	BELLATA GROUP		MAULES CREEK FORMATION		BROWN	LEARD-MAULES CREEK ALLUVIAL / LACUSTRINE SYSTEMS	
				GOONBRI & LEARD FORMATIONS				
				BOGGABRI VOLCANICS, WERRIE BASALT, METAVOLCANICS & METASEDIMENTS				BOGGABRI VOLCANICS & WERRIE BASALT

September 2007, GUNDAH 002a

Figure 2-9 Stratigraphy of the Gunnedah Basin

Deposition of the lower Black Jack Formation sediments was followed by an episode when marine conditions affected the Gunnedah Basin, with the deposition of sandstones of poor to fair reservoir quality. Deposition of the western derived quartzose sandstones was followed by very widespread coal swamp conditions depositing the thick Hoskissons Coal seam that is readily correlated across the Basin. The thickness of the Hoskissons Coal ranges from less than 1m in the west to more than 12m in the north and to 18m in the south-east.

Late Permian volcanic activity and tectonism to the east resulted in renewed deposition of more lithic sediments with an easterly provenance and consequently the upper Black Jack Formation has only limited potential for reservoir development. A period of tectonism, uplift and erosion of variable intensity throughout the Basin followed Late Permian deposition. The end of the Permian is marked by a major regional unconformity.

The Digby Formation is marked by a basal conglomerate that has been derived from the New England Fold Belt. This unit thickens towards the east and onlaps onto the older sediments and basement to the west.

Reservoir quality is generally poor due to a tight sandstone matrix. Thick near-shore marine shales of the overlying Napperby Formation are considered a potential seal to any hydrocarbons reservoir in the Digby Formation.

A major period of uplift and erosion during the Late Triassic ended Gunnedah Basin deposition. Deposition of the Surat Basin sequence commenced during the Early Jurassic, preceded by lava flows, pyroclastics with intercalated claystones of the Garrawilla Volcanics (Nandewar Range). During the Tertiary period of tectonism, the Liverpool Ranges were formed by massive extrusions of basalts.

In the Triassic period, deposition of these alluvials continued forming beds of sandstones and mudstones. These outcrop in a belt which runs parallel to the Mooki and Goondiwindi fault regions, forming a non-marine wedge that was derived partly from the New England Tablelands.

Volcanic activity in the late Triassic or early Jurassic periods caused the eruption of basalts in the Mullaley district between Gunnedah and Coonabarabran. During the Tertiary period of tectonism, the Liverpool Ranges were formed by massive extrusions of basalts representing the last major depositional episode in PEL 1.

The present landscape is dominated by Quaternary sediments in the form of alluvial fans and outwash slopes that resemble the larger fans of the adjacent Darling Riverine Plains Bioregion to the west but are composed of coarser sediment and fan out at slightly steeper angles. The relative distribution of sediment from basalt or sandstone has a major impact on soil quality and vegetation.

## 3 Project Description

### 3.1 Introduction

Santos proposes to undertake drilling activities to assess the coal seam gas potential of the Gunnedah Basin in PEL 1, which are the subject of this REF.

The proposed appraisal program includes drilling at the Wando 1 location to obtain information on coal depths, seam thickness, continuity, gas composition (as required) and reservoir pressure and permeability. Drill stem testing (DST) or equivalent downhole evaluation is planned to be undertaken on target coal seams to collect information on reservoir pressure and gain an indication of permeability. Drill cuttings may also be collected and analysed for gas composition information. Wando 1 is planned as a 'chiphole' which means that no continuous core is planned to be collected from the well. Following drilling to the well total depth and conduct of required well logging and testing the well will be plugged and abandoned with cement plugs from total depth to surface.

In summary, the process involves:

- preparation of lease access tracks utilising existing access tracks as much as is practical;
- preparation of a level drill pad (also referred to as "well lease area");
- placement of a drilling rig and ancillary equipment at the well lease;
- drilling of the well;
- collection and analysis of drill cuttings (as required);
- conduct well testing and wireline logging (as required);
- plugging and abandonment of the well;
- removal of equipment and imported materials from the site; and
- full rehabilitation of the site in line with legislative and landholder requirements.

Santos has negotiated an access, compensation and rehabilitation agreement with the affected landowner in respect to land access, compensation and rehabilitation. A scouting survey has been undertaken in consultation with the relevant landholder prior to drilling taking place to locate the site with an emphasis on minimisation of impacts on the environment and property operations.

### 3.2 Site preparation & equipment

Various works will be required in order to prepare the site for the proposed drilling, including preparation of the well lease, access track improvements and construction as well as positioning the drill rig and associated temporary buildings and equipment on the site. The major equipment used on site will be a drilling rig and associated temporary buildings. These works are summarised further in this section. Figure 3-1 and Figure 3-2 illustrate the proposed site layout for the well lease and access tracks. Figure 3-3 illustrates the proposed erosion and sediment control measures for the well lease.

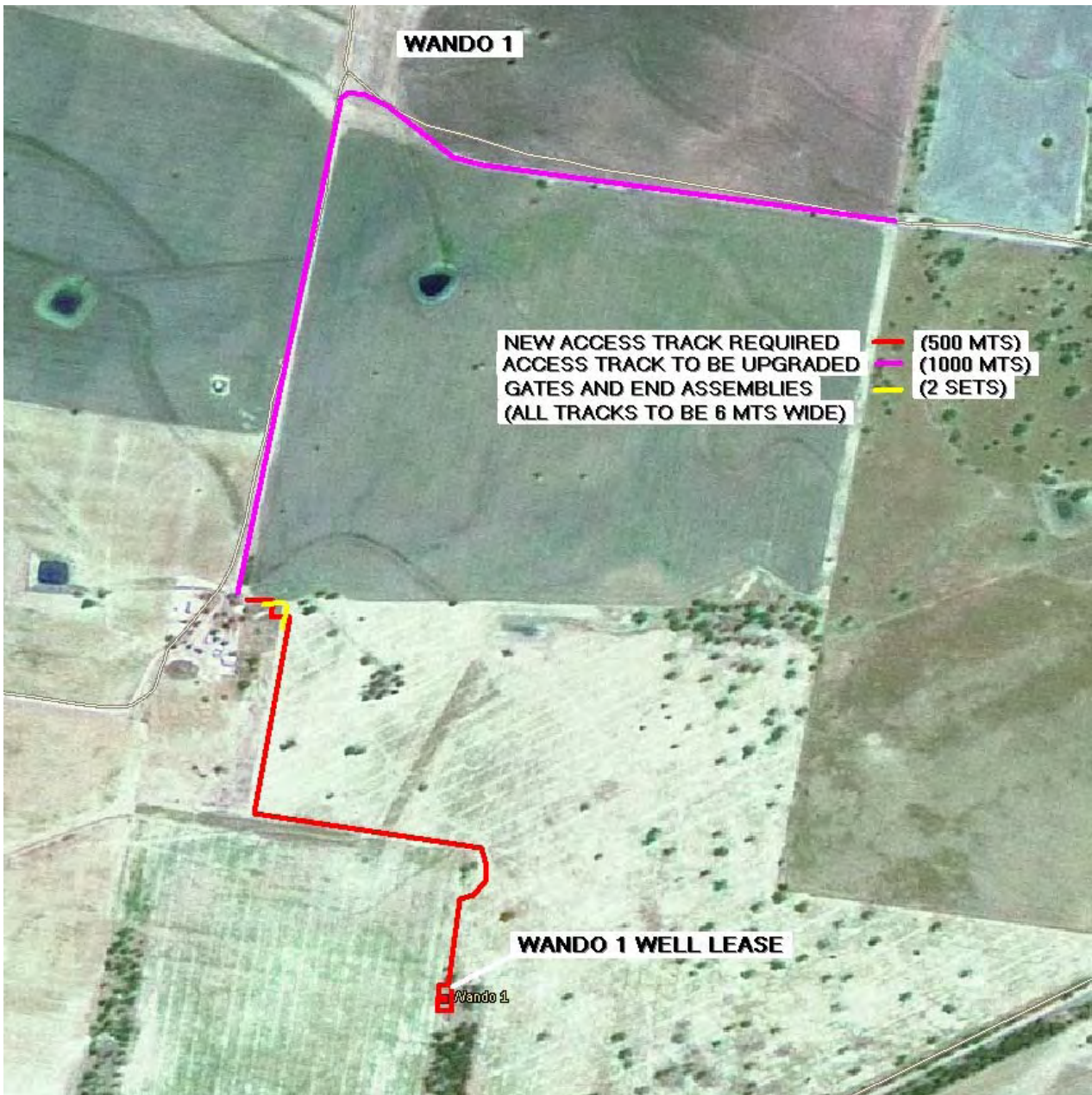
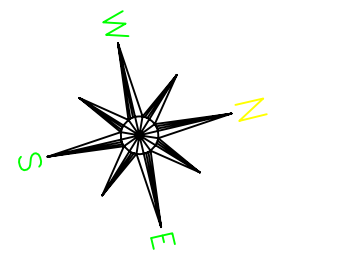


Figure 3-1 Wando 1 Site Layout – Site Plan

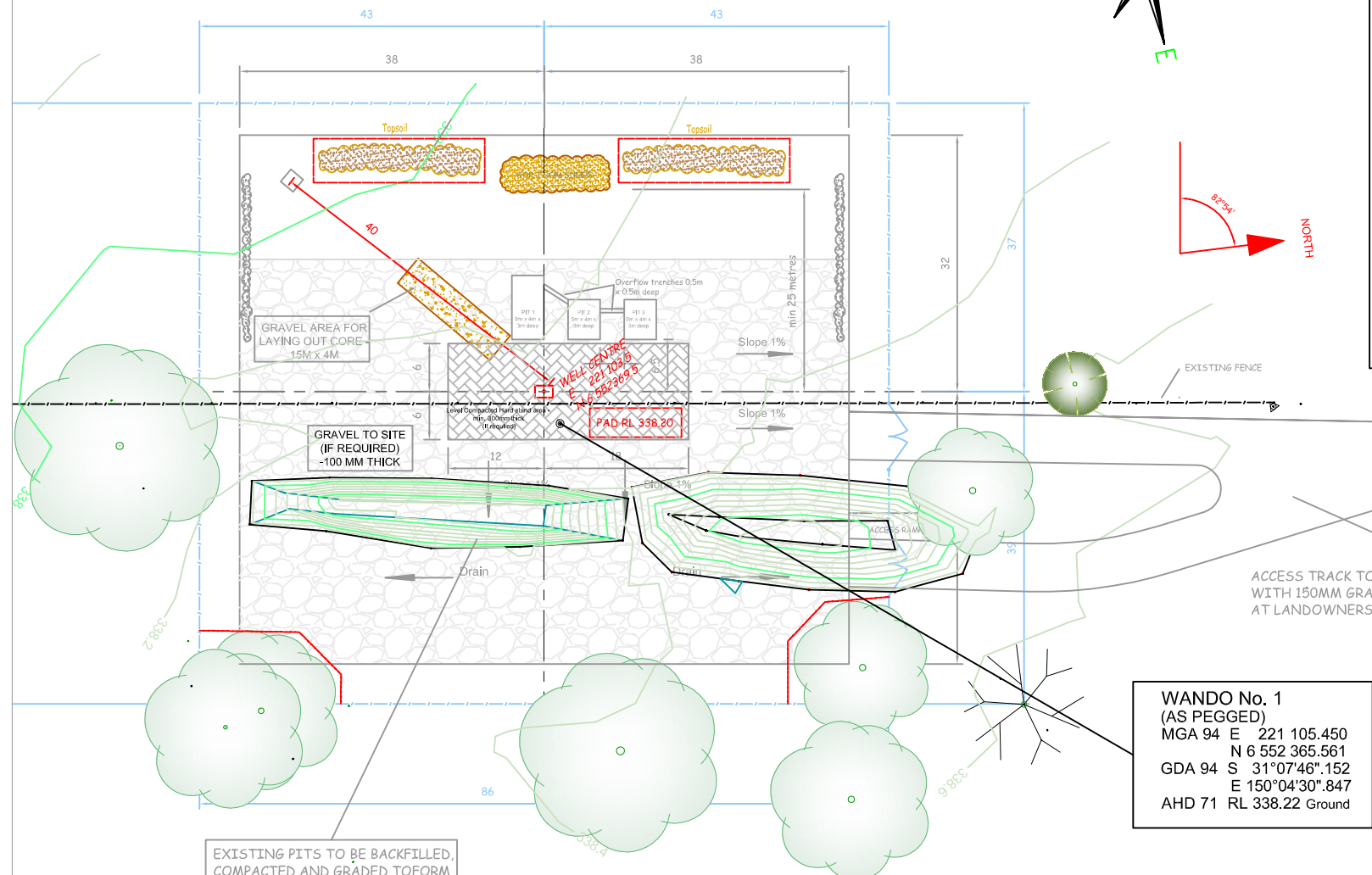
During site preparation, there will be some soil disturbance as a level drill pad will need to be constructed at the well lease. Associated lined drilling sumps and a flare pit will also be constructed on site for use during drilling operations. The area to be disturbed for drilling activity is outlined in Table 3.1.

Table 3-1 Areas of disturbance & cut and fill for well leases

	Area of Disturbance	Level
Wando 1	86m X 64m with an overall area of disturbance of 5,504m <sup>2</sup> .	Existing pit will be backfilled, compacted and graded to establish a pad level at approximately RL 338.20m AHD.
New access track	500 x 6m = 3,000m <sup>2</sup>	



- Notes:**
- Strip 150mm Topsoil of site and stockpile in area shown. Erect silt fence around topsoil to segregate soil from excavated material
  - All batters to be 1:1
  - Gravel to be placed at the direction of Santos Representative
  - All sites to be fenced and 1 x 8m double gates installed
  - All site over 1 metre slope to have benched site
  - Access tracks to be constructed as shown
  - Excavated material from Sump/ Pit to be placed behind pit and compacted as shown
  - Cellar and Conductor (6 metre x10 3/4") to be installed. Conductor to be set in centre of cellar with top of conductor at 1.6m below surface level. Cellar floor to be 1.8m below surface level. Covers to be placed on cellar after installation
  - Handstand area to be excavated (if required), backfilled and compact with suitable gravel Area to be graded on level
  - Area outside of handstand area to be graded at 1% away from pad and appropriate drainage, bunding and erosion control installed
  - Fence to be 6 line 70cm hingejoint fence, steel corner posts & droppers.



WANDO No. 1  
 (AS PEGGED)  
 MGA 94 E 221 105.450  
 N 6 552 365.561  
 GDA 94 S 31°07'46".152  
 E 150°04'30".847  
 AHD 71 RL 338.22 Ground

EXISTING PITS TO BE BACKFILLED, COMPACTED AND GRADED TO FORM LEASE PAD

NO TREES WILL BE REMOVED AND NO TREE ROOT SYSTEM WILL BE DAMAGED FOR THE PURPOSE OF LEASE CONSTRUCTION. IF ROOT SYSTEMS ARE FOUND TO INTRUDE ONTO LEASE AREA, THIS AREA WILL BE BYPASSED AND THE RELEVANT AREA FENCED OFF TO PREVENT ANY DAMAGE TO ROOT SYSTEMS. ECOLOGIST STUDY HAS IDENTIFIED KOALA HABITAT THEREFORE KOALA EXCLUSION FENCING WILL BE INSTALLED AROUND THE WELL LEASE TO PREVENT ACCESS TO THIS AREA

FIGURE 3-2

Rev	Date	Description
Rev 7	21st Mar 11	Lease Size Increased to accommodate Batters
Rev 6	1st Sept 10	Fencing moved 3m forward on hole centre
Rev 5	1st Sept 10	Lease size amended & drive thru access added
Rev 4	29th Jun 10	Handstand area added & gravel area defined
Rev 3	20th Jun 10	Flare Pit rotated, overflow trenches added

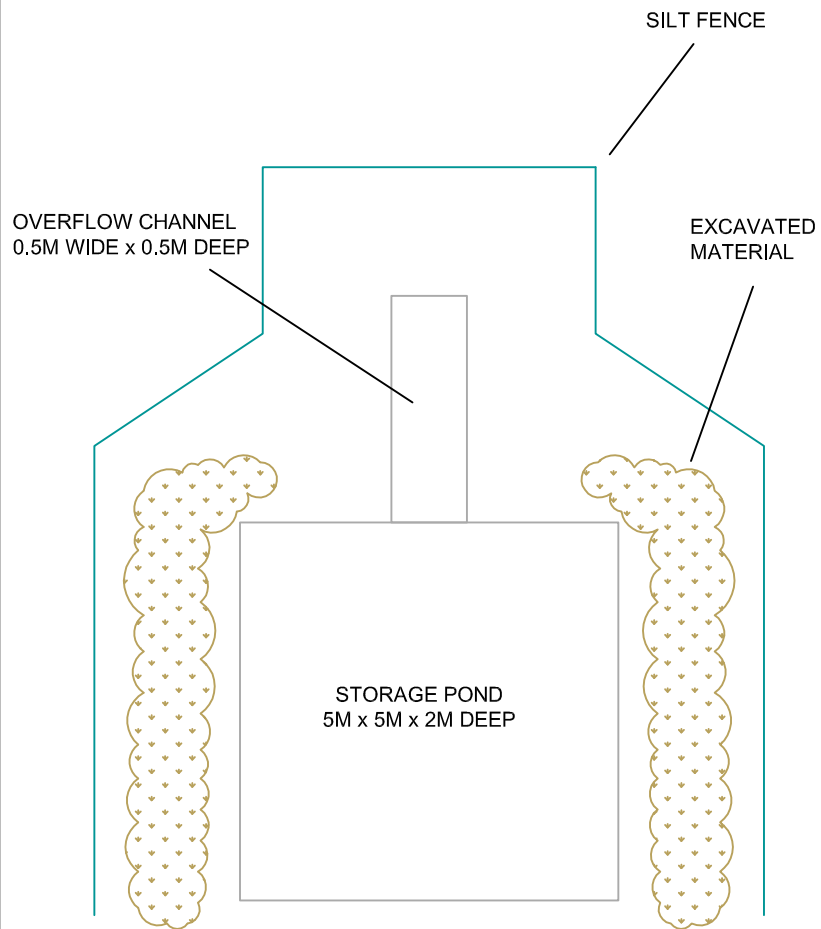
**WANDO 1 - FINAL**

**SANTOS LTD.**

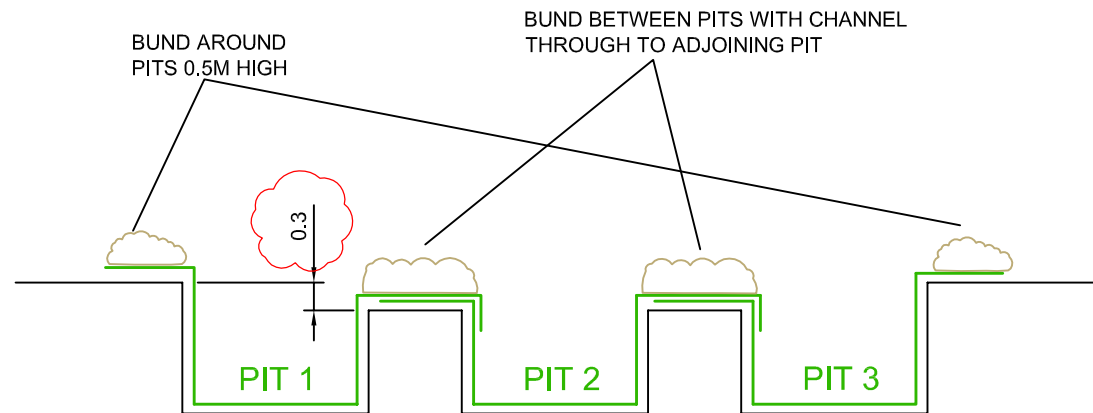
**RIG 13 - WELL PAD DRILLING**

**LEASE BUILD DETAILS**

Drawn: CSS	Date: 24th May 2011	Revision: 7
------------	---------------------	-------------



**EROSION CONTROL**



**LINER INSTALLATION SEQUENCE**

PITS TO BE LINED WITH 0.05  
LDPE FLAT SHEET LINER  
(SANTOS SUPPLIED)

FIGURE 3-3	
WANDO 1 - FINAL	
<b>SANTOS LTD.</b>	
1 WELL LEASE PAD	
SUMP & EROSION CONTROL	
Drawn: CSS	Date: 28th March 11
Rev No:	0

### Well Lease Construction

- Civil works equipment will be moved to site including bulldozer, excavator, grader, roller, water trucks, other trucks and support and light vehicles.
- Portable amenities will be located on site during construction.
- Any topsoil will be stripped and stockpiled.
- Required sumps will be excavated and lined with impermeable plastic sheeting.
- The lease area will be graded, rolled and otherwise constructed per Figure 3-2.
- A 10-3/4" steel conductor casing will be pre-installed at approximately 6m depth by the civil works crews ahead of the rig arriving on site.
- The well lease pad will be fenced in a conventional manner consistent with the fencing on the landholders property.

### Access track improvements and construction

There is an existing track which provides partial access to the location. Upgrading of this track with gravel will be required, however no widening is necessary.

Approximately 500m of new access track is required to be constructed to enable access to the well lease.

The following is a list of the detailed works involved.

- All access tracks will be constructed 6m in width.
- The new access track will have a topdress of 150 mm of road base.
- The existing track will have approximately 500m dressed with 100mm road base.
- Track is to be constructed to allow wet weather access .
- Two sets of double gates and end assemblies to be installed in two locations on the northern boundary of the well lease.

### Drill rig positioning & operation

- Equipment will enter/exit the site via the main access gate. Equipment will include generator units, lighting towers, site offices, stores and other various buildings and equipment required for the duration of drilling.
- Moving and rigging up/down of equipment (i.e. installation and dismantling of rig equipment) is expected to take up to 3 days per site (3 per rig up, 3 per rig down).
- Ancillary equipment will be required on site during the course of the drilling activities, including wireline trucks, cementing trucks and service company vehicles, these vehicles will exit and enter the site as required.

## 3.3 Drilling Activities

The well will have a specific design ensuring compliance with relevant legislation. A nominal 10-3/4" (273mm) cemented conductor is to be installed by the lease builder to approximately 6 m below ground level. Surface hole of 8 1/2" (216mm) will be rotary drilled to approximately 150mRT, where a 7" (178mm) steel surface casing will be landed and pressure cemented in place with cement to surface. The main hole of diameter 6-1/8" (156mm) will be drilled from the 7" (178mm) casing shoe to well total depth planned to be 20m into the Boggabri Volcanics at approximately 720mRT based on the pre-drill geological prognosis. DSTs

or equivalent downhole evaluations may be conducted on penetration over selected Late and Early Permian Coals with testing to be performed in accordance with legislative requirements.

The closest offset wells to the proposed activities are Wondobah Ddh 1 (5.35km), Millie Ddh 1 (10.13km) and Goran 1 (8.12km).

Once the well has reached its total depth, geophysical wire-line logs will be run over the entire length of the hole to identify major stratigraphic units, intersected coal seam depth and seam thickness. Further DST or equivalent downhole evaluation may follow after completion of logging. Following logging and any post TD activities, the well will be fully plugged and abandoned from bottom to top with cement plugs. A separate P&A program will be issued at a later date. Regulatory approval is required for the abandonment program prior to abandonment operations commencing.

It is worth noting that due to poor quantity of stratigraphic data in the vicinity of the planned well it is estimated that the pre-drill prognosed formation tops may be forecast in error of up to +/- 100m.

### 3.4 Abandonment and rehabilitation

The well will be cemented, plugged and abandoned in accordance with DTIRIS requirements and rehabilitated following completion of activities within the allowed regulatory timeframe, unless needed for further exploration testing. In the case of plug and abandonment, the intermediate casing would be removed above the top of cement (where required and practicable) and a steel identification plate installed near the top of the hole > 1 metres below the surface.

Once the drilling and testing activities are complete, the disturbed area is proposed to be rehabilitated with appropriate mitigation measures and environmental safeguards implemented to minimise potential impacts. All rehabilitation works will be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation in accordance with the relevant statutory requirements.

Revegetation & rehabilitation will be undertaken within the required regulatory timeframe. All private tracks used during operations are generally returned to their pre-operations state or to a condition agreed by the landholder.

### 3.5 Duration

Drilling activities are temporary and will not have any long-term impact on the visual amenity of the area. The drilling of the well is expected to occur over a 30 day period not including lease build, or site restoration. There will be 14 days of lease construction activities prior to drilling the well. Rehabilitation activities of 30 days following the drilling of the well will be additional to this period.

This equates to a total of approximately 44 days of construction and drilling and 30 days of rehabilitation, as outlined in the table below.

**Table 3-2 Duration of drilling and site activities**

Activity	Expected Duration
Lease Build	14 days
Drilling	30 days
Rehabilitation	30 days

### 3.6 Staff & Hours of Operation

The number of employees present on the site at any one time is expected to be up to 20 persons. It is not proposed to provide a workers camp on the site, with off-shift drilling crews to be located in nearby accommodation with travel to and from site to be provided.

The hours of operation during the drilling and work over will be on a 24-hour a day basis as negotiated with the landholder. Personnel movements to and from site will be minimised outside of a single shift change per day but may be necessary due to emergency situations or specific activities (e.g. crews and service companies entering and leaving site to conduct specific activities).

### 3.7 Chemicals

A number of chemicals are planned to be utilised to facilitate the efficient and safe drilling of the wells in line with best oilfield practice. These chemicals are typical of those generally used in oilfield activities. These chemicals will be used either to deliver the wells as planned or will be held in contingency to handle unplanned scenarios (e.g. stuck pipe, excessive mud losses etc.). The Material Safety Data Sheet (MSDS) information for all of these chemicals can be found on the Santos web site (<http://www.santos.com/exploration-acreage/gunnedah-basin-gas/fact-sheets-msds.aspx>). The fluids are water based (not synthetic or oil based) and recycled for reuse as much as possible during the drilling process. The following list summarises the list of relevant chemical MSDS for the proposed activities.

- |   |                                 |                                  |
|---|---------------------------------|----------------------------------|
| ▪ AMC Xtra-Sweep                        | ▪ Mud Flush III                 | ▪ AMC CR-650                     |
| ▪ AMC Lime                              | ▪ Guar gum, propoxylated        | ▪ Cement – Standard – Class A    |
| ▪ AMC Hammer Oil                        | ▪ Fly Ash – Eraring             | ▪ CFR-3                          |
| ▪ AMC Aus-Ben                           | ▪ Flocele 3/8"                  | ▪ CAL-Seal 60                    |
| ▪ AMC Aus-Gel                           | ▪ AMC EP Bit Lube               | ▪ Calcium Chloride – Flake       |
| ▪ AMC Aus-Plug                          | ▪ Econolite Additive            | ▪ Bentonite                      |
| ▪ Barite                                | ▪ Rheolube                      | ▪ AMC Superfoam                  |
| ▪ Caustic Soda (Rheochem)               | ▪ Idcide-20                     | ▪ Salt (Rheochem)                |
| ▪ Citric Acid (Rheochem)                | ▪ JK-261                        | ▪ AMC PAC R                      |
| ▪ Frascseal Fine, Medium                | ▪ Sodium Bicarbonate            | ▪ Baroid Quikmud                 |
| ▪ Drispac (Regular and Superlo) Polymer | ▪ Kwikseal (Fine/Medium/Coarse) | ▪ Quickseal (Fine/Medium/Coarse) |
| ▪ Soda Ash Dense                        | ▪ Xanthan Gum (XC)              | ▪ Defoam-A                       |
| ▪ SAPP                                  | ▪ Rheopac R/LV/UL/RD/LVD        | ▪ Trugel 13-A                    |
| ▪ Poly-Bore™                            | ▪ Pheno Seal                    | ▪ JK 161-LV                      |
| ▪ CSR Raw Sugar / Brown Sugar           | ▪ Potassium Chloride (Rheochem) |                                  |

### 3.8 Justification of activity

Drilling of the Wando 1 well is a necessary step in the ongoing exploration and evaluation of the hydrocarbon potential in PEL 1, which to date has undergone limited petroleum exploration. Discovery and appraisal of

coal seam gas resources in the area has the potential to increase the state's reserves and revenue from gas and underpin future exploration or production in the region.

The proposed program consists of preparing a lease site and access tracks, drilling a well, wireline geophysical logging, drill stem testing or equivalent downhole evaluation, casing and cementing using steel casing strings, plugging and abandoning of the well and rehabilitation of the site. These procedures are required to define and identify potentially commercially valuable reserves of coal seam gas. Santos is committed to undertake this work as part of its obligations under NSW petroleum legislation and its obligations contained in the Farm-in Agreement entered into with Australian Coalbed Methane Pty Ltd.

### 3.9 Alternatives

There is limited previous drilling in this area of the Gunnedah Basin that is sufficiently deep for the purposes of petroleum exploration. The proposed drilling operation is essential to gain detailed stratigraphical data and information on target coal seam pressures and permeabilities. Sampling of drill cuttings for gas composition may also be undertaken to gather data on gas composition heterogeneity throughout the target coal seams in PEL 1. Due to the highly specialised nature of the proposed works, drill cutting sampling and well testing are the only feasible method available to obtain reliable and accurate gas composition and pressure and permeability data for the local coal resource. Geophysical methods available (e.g. seismic), which could be applied to exploration would show the structure of the basin but would not provide the ability to sample and analyse the stratigraphy of the Gunnedah Basin to quantify coal seam gas potential.

The location of the appraisal hole is a substantial factor in the evaluation of the potential coal seam gas resource. The initial location of the appraisal hole was carefully considered by the project team, in consultation with specialist consultants and agricultural operators and taking into account the underlying geology, the existing environment and the current land use.

The selection of the proposed chip hole site located on privately owned land has been based upon the ecological protection principles of avoidance and harm minimisation. The site has been selected to avoid and/or minimise potential ecological impacts. The well lease site selection process identified areas where historical disturbances had modified the natural condition and where zero or minimal vegetation clearing, tree removal and earthworks would be required to establish the well lease and associated infrastructure, including the access track.

The site was located in consultation with the landholder and with the assistance of a scouting party comprised of Santos' Project Representatives, Cultural Heritage Officers and Lease Construction Experts. Third party surveyors and Ecologists were also consulted to assist in positioning of the well lease as part of the scouting process.

Once all known constraints were identified on the site, this information was used to delineate areas to be avoided in the initial appraisal hole location identification process. This included areas which would require unnecessary intrusion on sensitive ecological communities or significant cut and fill to accommodate level drilling pad and all weather vehicular access.

The final area identified for the appraisal hole operations have been determined to avoid existing constraints as much as is practical. By undertaking the site identification methodology outlined above, the evaluation of alternative sites for the drilling program were undertaken using an adaptive management approach, where constraints were identified, verified in the field and avoided. The resulting appraisal hole location area is considered the most appropriate location both from a resource investigation perspective and to minimise any potential environmental impacts.

### 3.10 Stakeholder Consultation

Santos has a commitment to open and transparent consultation with the communities that they work in. Since beginning their Gunnedah Basin coal seam gas exploration in 2008, the Gunnedah Project Execution Team has held more than 30 community information sessions within the Gunnedah Basin. Santos is committed to consultation with key stakeholders, including:

- Landholders
- Business
- Local, State and Federal government
- NSW Farmers Association
- Namoi Catchment Management Authority
- Utilities operators
- Local Aboriginal Land Councils
- Special interest and activist groups

Consultation aims to:

- Increase understanding of the coal seam gas industry in NSW
- Explain what is involved in coal seam gas exploration and appraisal activities
- Explain the differences between petroleum exploration legislation and mining legislation in NSW
- Identify issues that generate community interest and concern in the Gunnedah Basin

Santos provides information about their activities across the entire exploration area using the following consultation methods:

- Notification of neighbours (those sharing boundaries with properties where Santos is working) prior to commencement of activities.
- Community consultation sessions and presentations are held throughout the year at areas that are close to upcoming work. Community consultation sessions are attended by subject specialists (e.g. geologists, drilling engineers, hydrologists and hydrogeologists) to enable the community to speak directly to the people responsible for the work being undertaken in the area.
- AgQuip (every August) - Santos displays equipment and has up to eight subject specialists in attendance to answer questions from the public. The display at Agquip in August 2010 included a mock pilot well site with all of the kit that will be on site for a pilot test.
- 1800 number - attended during business hours, all calls returned within 48 business hours.
- Public email address – emails returned within 48 business hours.
- Newsletter (4 times per year, direct mailed to a database of over 5 000 stakeholders).
- Briefing of key Local, State and Federal government staff and elected representatives.
- Field trips to drill and seismic work sites (on request, year round).
- Presentations to community groups (on request, year round).
- Factsheets – a set of six factsheets (CSG Overview, CSG Regulation in NSW, Exploration Core Hole Drilling and Pilot Testing, Incidental Water Management, Seismic Testing) available in printed or electronic versions (<http://www.santos.com/exploration-acreage/gunnedah-basin-gas/factsheets-msds.aspx>).

- Website [www.santos.com/gunnedah](http://www.santos.com/gunnedah) – information includes factsheets, newsletters and presentations, frequently asked questions, photographs of sites and equipment, materials safety data sheets for chemicals used, upcoming events, industry terminology and a link to the Namoi Catchment Water Study website.
- Gunnedah regional office – 88 Marquis Street, Gunnedah.

To ensure that the community was aware of the proposed activities within the area, the following consultation activities were undertaken:

- Community consultation sessions (public meetings) were run at Spring Ridge on Tuesday 23 March and Gunnedah on Wednesday 24 March 2010. Both ran from 2-8pm. In the afternoon, team members (drilling engineer, geologist, hydrologist) engaged with landholders in one-on-one conversations. In the evening, pilot-focused presentations on geology, drilling and water handling were given in a facilitated session. The sessions were advertised in local papers (2 weeks prior to event), in the March edition of the newsletter (sent to 5,000 recipients) and by email. Approximately 70 people attended the session held in Spring Ridge.
- In addition to the sessions early last year, eight Ask Santos Community consultation sessions have been held late last year and early this year as outlined in the table below. The presentations used at each of these sessions are available on Santos' website at [www.santos.com/gunnedah](http://www.santos.com/gunnedah).

TOPIC	QUIRINDI	GUNNEDAH
Gunnedah Basin Geology	17 November 2010	18 November 2010
Pilot testing design principles	8 December 2010	9 December 2010
Pilot testing water handling principles	9 February 2011	10 February 2011
Beneficial water reuse	13 April 2011	14 April 2011

- Briefings provided to the local shire councils (Liverpool Plains and Gunnedah).
- The newsletters (direct mailed to over 5 000 property owners and stakeholders in the region) provided detailed information on various aspects of our pilot testing activities specifically:
  - » June 2010 - water handling during pilot testing;
  - » November 2010 - gave further information on pilot site logistics, water monitoring and coal geology;
  - » December 2010 - explains specific field operations and work plans for 2011.

## 4 Regulatory Context

There is a range of legislation applicable to the proposed activities which are addressed below.

### 4.1 Petroleum (Onshore) Act

The *Petroleum (Onshore) Act 1991* (NSW) (Petroleum Act) regulates the onshore exploration for and production of petroleum. Under the Petroleum Act, petroleum means:

- (a) any naturally occurring hydrocarbon, whether in a gaseous, liquid or solid state, or*
  - (b) any naturally occurring mixture of hydrocarbons, whether in a gaseous, liquid or solid state, or*
  - (c) any naturally occurring mixture of one or more hydrocarbons, whether in a gaseous, liquid or solid state, and one or more of the following, that is to say, hydrogen sulphide, nitrogen, helium, carbon dioxide and water,*
- and includes any substance referred to in paragraph (a), (b) or (c) that has been returned to a natural reservoir, but does not include coal or oil shale or any substance prescribed to be a mineral for the purposes of the Mining Act 1992.*

The holder of an exploration licence has the right to prospect for petroleum on the land comprised in the licence. The proposed activities will be undertaken within the area of PEL 1 granted under the Petroleum Act. PEL 1 indicates categories of works that are permissible as follows:

#### Category 1

- Geological mapping
- Rock sampling (by hand held equipment)
- All reconnaissance drilling other than petroleum exploration holes
- Geophysical surveys other than seismic
- Airborne surveys

#### Category 2

- Access tracks or line clearing involving formed construction or significant native vegetation disturbance

#### Category 3

- Petroleum exploration holes
- Seismic surveys

The proposed activities fall under Category 3. Under Condition 1 of PEL 1, Category 3 activities require notification to the Department of Primary Industries, submission of a Review of Environmental Factors (REF) under Part 5 of the EP&A Act and approval of the Assistant Director, Environment of the Department of Primary Industries. This REF is being submitted in accordance with Condition 1 of PEL 1.

## 4.2 Environmental Planning & Assessment Act

### 4.2.1 Overview

The *Environmental Planning and Assessment Act 1979* (NSW) (EP& A Act) regulates development carried out in New South Wales. The carrying out of development is regulated under either Part 3A, Part 4 or Part 5 of the EP&A Act.

Development is required to be assessed under Part 5 of the EP&A Act if the relevant environmental planning instruments provide that the development does not require consent or is not exempt development and the development is either carried out by a determining authority or requires the approval of a determining authority.

The proposed activities fall within the local government area (LGA) of Gunnedah Shire. The subject site is zoned 1(a) Rural (Agricultural Protection) under the *Gunnedah Local Environmental Plan 1998* (NSW) (Gunnedah LEP). The proposed activities are permissible with development consent under the Gunnedah LEP. However, *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (NSW) (Mining SEPP) applies to the activities. The Mining SEPP aims "to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of [New South Wales]". Clause 6 of the Mining SEPP provides that development for the purposes of petroleum exploration may be carried out without development consent. Clause 6 applies despite the provisions of the Gunnedah LEP. This has the effect that the proposed activities are required to be assessed under Part 5 of the EP&A Act.

A determining authority, for the purposes of this activity, is defined in Part 5 to include a public authority whose approval is required before an activity may be carried out. The Assistant Director, Environment of the Department of Primary Industries and the New South Wales Office of Water will be determining authorities for the purposes of Part 5 of the EP&A Act because their approval is required for the proposed development under the legislation administered by these determining authorities.

### 4.2.2 Determining Authorities and the REF

Under Part 5 of the EP&A Act, a determining authority is required to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

Additionally, clause 228 of the *Environmental Planning and Assessment Regulation 2000* (NSW) sets out the factors that must be taken into account concerning the impact of an activity on the environment.

The determining authorities are required to consider whether the proposed activity is likely to significantly affect the environment or threatened species, populations or ecological communities, or their habitats to determine whether an EIS or SIS is required. In deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities or their habitats, section 5A of the EP&A Act requires the following factors to be taken into account (the "seven part" test of significance)

- (a) *in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*
- (b) *in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*
- (c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

- (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*
- (d) in relation to the habitat of a threatened species, population or ecological community:*
  - (i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
  - (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
  - (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,*
- (e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*
- (f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*
- (g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

This REF has been prepared to assist the determining authorities in meeting their obligations under the EP&A Act. In particular, the "seven part" test has been applied to the proposed activities (refer Ecological Assessment in **Appendix A**). This REF concludes that the proposed activities are not likely to significantly affect the environment or threatened species, populations or ecological communities or their habitats.

#### **4.2.3 Gunnedah Shire Local Environmental Plan**

The site of the proposed chip hole is zoned 1(a) Rural (Agricultural Protection) under the Gunnedah LEP. As stated above, the effect of the Mining SEPP is to require the proposed development to be assessed under Part 5 of the EP&A Act. However, consideration has been given to the nature and objectives of the 1(a) Rural (Agricultural Protection) zone. The objectives of zone 1(a) Rural (Agricultural Protection) are:

- (a) to protect the use and efficiency of prime agricultural land while permitting appropriate development subject to suitable subdivision controls,*
- (b) to permit other forms of development which are ancillary to rural land uses or that, as a result of their nature, require siting outside the urban area,*
- (c) to avoid further fragmentation and alienation of useable rural land,*
- (d) to retain the low density nature of settlement within the rural areas and ensure that any future development does not create unreasonable demands on the existing infrastructure or available services,*
- (e) to provide for the requirements of the rural community,*
- (f) to maintain safety and convenience along main roads by discouraging uses that are likely to generate traffic volumes which disrupt traffic flow,*
- (g) to ensure that the existing level of scenic amenity is maintained by requiring development to have regard for significant ridgelines and hilltops.*

The proposed development of the chip hole is not expected to impact on the use and efficiency of prime agricultural land or fragment usable rural land and is considered generally consistent with the objectives of the zone.

#### 4.2.4 State Environmental Planning Policy No. 44 – Koala Habitat Protection

*State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44) aims "to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline".

Schedule 1 of SEPP 44, which lists the LGAs to which SEPP 44 applies, includes the Gunnedah LGA. SEPP 44 applies to local councils determining development applications under Part 4 of the EP&A Act. Although SEPP 44 does not apply in relation to the assessment of development under Part 5 of the EP&A Act, it has been considered in the preparation of this REF.

SEPP 44 requires that before granting development consent under Part 4 of the EP&A Act for development on land over 1 hectare in area, a consent authority must form a view as to whether the land is "potential" or "core" koala habitat. Potential koala habitat is defined as:

*areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.*

Core koala habitat is defined as:

*an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.*

Where core koala habitat is found to occur, SEPP 44 requires that a site-specific koala plan of management be prepared.

The Ecological Assessment in **Appendix A** reports that no canopy trees occur within the chip hole lease, however one species of listed Koala food tree is present on within the study area (Bimble Box). It does not constitute 15% of the total number of trees in the upper canopy of lower strata across the study area.

### 4.3 Environmental Protection and Biodiversity Conservation Act

The *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) provides that a person proposing to take an action that the person thinks may be a "controlled action" must refer the proposal to the Minister for Sustainability, Environment, Water, Population and Communities (Minister). A "controlled action" is an action that:

- will have or is likely to have a significant impact on
  - » World heritage areas
  - » National heritage places
  - » Ramsar wetlands of international importance
  - » Commonwealth listed threatened species and communities
  - » Commonwealth listed migratory species
  - » Commonwealth marine areas
  - » The environment on Commonwealth land
  - » Great Barrier Reef Marine Park;
- Is undertaken by the Commonwealth and will have or is likely to have a significant impact on the environment;
- Is undertaken by any person on Commonwealth land and will have or is likely to have a significant impact on the environment; or

- Is a nuclear action.

These are referred to as "matters of national environmental significance" (MNES). The EPBC Act sets out the process for identifying and listing the MNES including listed threatened species and listed migratory species.

If the Minister decides that the proposed action is a controlled action, then the approval of the Minister is required under the EPBC Act

A person proposing to take an action that the person thinks is not a controlled action may refer the proposal to the Minister for the Minister's decision whether or not the action is a controlled action. The proposed activities are not expected to have, or be likely to have, a significant impact on MNES including, in particular, listed threatened species or listed migratory species under the EPBC Act. A referral is therefore not considered necessary.

#### 4.4 Threatened Species Conservation Act

The objects of the *Threatened Species Conservation 1995* (NSW) (TSC Act) include:

- To conserve biological diversity and promote ecologically sustainable development;
- Prevent the extinction and promote the recovery of threatened species, populations and ecological communities;
- To protect the critical habitat of those threatened species, populations and ecological communities that are endangered; and
- To ensure that the impact of any action affecting threatened species, populations and ecological communities preventing the extinction and promoting the recovery of threatened species, populations and ecological communities is properly assessed.

The TSC Act provides the procedure for the listing of threatened species, populations and ecological communities and key threatening processes in New South Wales and the preparation and implementation of recovery plans and threat abatement plans.

The TSC Act also provides the mechanism for applying for and obtaining licences to take actions which will or is likely to result in harm to any animal that is a threatened species, population or ecological community, the picking of any plant which is part of a threatened species, population or ecological community, damage to critical habitat or damage to habitat of a threatened species, population or ecological community where such actions require a licence to be obtained.

#### 4.5 National Parks and Wildlife Act

##### Threatened Species

Part 8A of the *National Parks and Wildlife Act 1974* (NPW Act) regulates the undertaking of activities which may impact on threatened species, populations and ecological communities listed under the TSC Act and their habitats. The NPW Act provides that a person must not harm any animal that is a threatened species, population or ecological community, pick any plant which is part of a threatened species, population or ecological community, damage any critical habitat or damage any habitat of a threatened species, population or ecological community without a licence being obtained under the NPW Act or TSC Act or unless another exception applies.

The NPW Act provides that these requirements do not apply if the action was essential for the carrying out of an activity in accordance with an approval of a determining authority under Part 5 of the EP&A Act where the determining authority has complied with Part 5.

### Aboriginal Cultural Heritage

The NPW Act conserves places, objects and features of significance to Aboriginal people.

It is an offence under the NPW Act to:

- harm or desecrate an object that the person knows is an Aboriginal object except in accordance with an Aboriginal heritage impact permit;
- harm or desecrate Aboriginal objects and Aboriginal places except in accordance with an Aboriginal heritage impact permit or where the person can show they exercised due diligence to reasonably determine that no Aboriginal object would be harmed;

The proposed activities have been located in previously disturbed areas to reduce the risk of impacting upon areas of possible Aboriginal cultural heritage. A cultural heritage site inspection of the proposed disturbance areas has been undertaken. No Aboriginal places or objects were identified during the site inspection of the sites for the proposed activities. A cultural heritage assessment has been undertaken by Santos and is provided in **Appendix B**.

## 4.6 Heritage Act

The main objective of the *Heritage Act 1977* (NSW) (Heritage Act) is to encourage the conservation of the heritage of New South Wales. It prevents impacts on "relics", which are defined as:

*any deposit, artefact, object or material evidence that:*

- (a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and*
- (b) is of State or local heritage significance.*

Under the Heritage Act, it is an offence to disturb "disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit". The proposed activities have been located to reduce the risk of impacting upon relics. There are no items of heritage significance listed as occurring on the subject site in either the Gunnedah LEP 1998 or on the NSW State Heritage Register. A number of items of local and State heritage significance were recorded as occurring within the Gunnedah Local Government Area, however these are not located in close proximity to the subject site.

Four sites within the Gunnedah LGA are listed on the Commonwealth Register of National Estate, however none of these are on the subject site.

## 4.7 Protection of the Environment Operations Act

The primary objective of the *Protection of the Environment Operations Act 1997* (NSW) (POEO Act) is to "protect, restore and enhance the quality of the environment in New South Wales, having regard to the need to maintain ecologically sustainable development". The POEO Act requires entities intending on carrying out an activity declared to be a "scheduled activity" under Schedule 1 to hold an environmental protection licence (EPL) and comply with the conditions set out in the EPL.

The proposed activities are not a scheduled activity and an EPL is not required.

## 4.8 Water Legislation

### **Water Act 2007 (Cth)**

The *Water Act 1997* (Cth) (Commonwealth Water Act) regulates the management of water resources in the Murray-Darling Basin. One of the main objectives of the Commonwealth Water Act is to establish the powers for the Murray-Darling Basin Authority to prepare and implement the Murray-Darling Basin Plan.

The Murray Darling Basin Plan will establish limits on the quantities of surface water and groundwater which can be access from "Basin water resources" in each of 78 "sustainable diversion limit" (SDL) areas within the Murray Darling Basin. "Basin waster resources" includes all water resources within, or beneath the Murray Darling Basin but does not include groundwater that forms part of the Great Artesian Basin (GAB).

### **Water Act 1912 (NSW)**

The *Water Act 1912* (Water Act) was the principal legislation for regulating access to surface water and groundwater in NSW from 1912 to 2000. The Water Act is being phased out and replaced with the Water Management Act 2000 (NSW) (Water Management Act). However, the Water Act still applies to some activities in parts of NSW.

The Water Act currently applies to the drilling of, and pumping of water from wells. Under Part 5 of the Water Act, bore licences are required to be obtained from the NSW Office of Water for the drilling of, and pumping of water from, wells. This proposal does not seek to drill or pump water from a well and therefore in accordance with the Water Act, a bore licence is not required.

### **Water Management Act 2000 (NSW)**

The Water Management Act applies in respect of groundwater resources which are regulated by water sharing plans (WSPs). A WSP is a statutory water management instrument prepared under the Water Management Act.

There is currently one WSP in place in the location of the proposed chip hole. This is the Water Sharing Plan for the upper and Lower Namoi Groundwater Sources 2003 relating to the upper Namoi Alluvium GMA (GMA 004). This WSP applies to the unconsolidated alluvial deposits of the Narrabri and Gunnedah Formations which lie above the Hoskinsons Coal strata from which water is intended to be extracted.

A Draft Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2011 has been prepared but is not yet in force. The location of the proposed chip hole falls within the Gunnedah-Oxley Basin MDB Groundwater Source within the WSP. If the Draft Water Sharing Plan commences, then approvals will be required to be considered under the Water Management Act instead of the bore licences under the Water Act. Water licences, water use approvals and water supply work approvals under the Water Management Act will not be required because the *Water Management (General) Regulation 2004* (NSW) provides an exemption from the requirement to obtain these licences and approvals for prospecting for petroleum under the Petroleum (Onshore) Act 1991 in relation to water required for that purpose. However, an aquifer interference approval may be required under the Water Management Act.

## 5 Environmental Impacts and Mitigation

### 5.1 Introduction

This section of the REF addresses the potential environmental impacts associated with the proposal and any mitigation measures required to ensure that they are appropriately managed. A number of specialist investigations were prepared to assist in assessing these impacts, including:

- Ecological Assessment, prepared by RPS
- Cultural Heritage Assessment, prepared by Santos
- Santos Drill Rig Noise Assessment, prepared by Heggies (now SLR)

### 5.2 Ecology

#### 5.2.1 Flora and Fauna

##### Impacts

The potential impacts associated with the proposed activities are generally short-term and temporary. The physical ground disturbance will be limited to within the well lease area and along the proposed access tracks, which will result in the removal of ground cover vegetation only.

The proposed chip hole lease is located within an area of grassland that has been heavily invaded by exotic species. The grassland spans approximately 5ha and is highly disturbed by continued grazing, weed invasion, historical vegetation clearing, and the presence of a small rubbish pit. This area provides limited habitat for common, generalist species only. Approximately 5,504m<sup>2</sup> of grassland, including the rubbish pit, will be removed as part of the proposed activity.

The chip hole lease is classified as White Box-Yellow Box-Blakely's Red Gum woodland, listed under the TSC Act, as it may have previously supported White Box, and includes some native understorey species. It is not considered to be the EPBC Act Box-Gum Woodland and Derived Native Grassland. This area lacks important habitat features for significant native flora and fauna. As such the proposed chip hole lease has limited ecological value and impacts are expected to be negligible.

Approximately 500m of access track is required to be constructed to a width of 6m. This will result in the clearing of 0.3ha of ground cover vegetation. While the vegetation in this area is comprised of pasture grasses that have been heavily invaded by weed species, it is considered to be an EEC under the TSC Act, and a TEC under the EPBC Act. Given the current agricultural land use of this area, and the low habitat values associated with the disturbed ground covers, the removal of 0.3ha of vegetation is considered to have a minimal impact.

The proposed activity is located approximately 14km from Lake Goran, a nationally significant wetland, and 3km from Wondoba State Conservation Area. Given the poor connectivity, and considerable distance between the study area and these conservation areas, the proposal is considered to have a minimal impact on Wondoba State Conservation Area and Lake Goran.

An assessment of potential ecological impacts associated with the proposal has been undertaken, including:

- Potential short-term impacts;
- Vegetation removal;
- Disruption of breeding cycle, roosting and sheltering behaviour;

- Disruption of pollination cycle and seed dispersion;
- Introduction and spread of weeds and feral pest species;
- Noise; and
- Potential disturbance to nearby areas of ecological significance.

Each of the above listed potential impacts is discussed in greater detail below.

#### *Potential Ecological Impacts*

The proposed chip hole lease is located within a disturbed grassland and is void of canopy and shrub layer vegetation. While the chip hole lease is in poor condition, it is considered to be White Box-Yellow Box-Blakely's Red Gum grassy woodland, as listed under the TSC Act.

Evidence of Koala usage was observed in the study area adjacent to the chip hole lease. As no Koala habitat trees will be cleared, the impacts to Koala are considered minimal.

The proposed chip hole lease will result in clearing of native and introduced species, and is not considered to have a significant impact on the EEC. Slashing of grassland within areas of TEC / EEC will be required to widen the access track, however this will have a temporary impact upon this community only.

#### *Potential Short-term and Long-term Impacts*

Temporary short-term impacts will be associated with the establishment and operation of the chip hole lease site. The proposed rehabilitation and revegetation of the chip hole lease site will reinstate vegetation of similar structural diversity and habitat value over the long-term. Rehabilitation will be completed within 6 months of decommissioning. In consideration of site rehabilitation and revegetation activities that are to occur at the well site once decommissioning has occurred, it is unlikely that there will be any long-term impacts associated with the well lease. Furthermore the rehabilitation and revegetation of the activity site is likely to benefit the local ecology over the long-term, particularly given the current poor ecological condition of the study area.

The extension of the access track will result in permanent vegetation removal (0.3ha), as per landholders requests. Given the low ecological value of the vegetation to be removed, this is considered to be a minimal long-term impact.

#### *Vegetation Removal*

The chip hole lease has been selected to avoid the need to clear canopy vegetation. Vegetation disturbance will be limited to ground cover vegetation that is dominated by weed species, and native pasture grasses. While mature canopy species occur to the north and south of the proposed well lease, mitigation measures will be implemented to ensure these trees are not impacted throughout construction activities.

The new access track will result in the removal of ground cover vegetation that is dominated by weed species. The access track has been selected to ensure no canopy vegetation will be removed. Where canopy vegetation occurs in close vicinity to the access track, vegetation protection measures will be implemented, as per the site EMP (**Appendix E**).

#### *Disruption of Breeding Cycle, Roosting and Sheltering Behaviour*

The breeding cycle, roosting, sheltering and foraging behaviour for some species, particularly the Koala, may potentially be impacted by the proposed activities that utilise habitat resources adjacent to the chip hole lease due to additional noise, light, and vehicle traffic.

#### *Disruption of Pollination Cycle and Seed Dispersion*

Excessive dust from the proposed activities could potentially disrupt the pollination cycle and ability of native plants to regenerate (i.e. germination, revegetation and re-colonisation of existing plants).

### *Introduction of Weeds and Feral Pest Species*

The proposed activities have the potential to create favourable conditions for introduced weed species within the study area, which could potentially lead to an increase of existing weed populations. This is most likely to occur where soil disturbance is to occur.

All plant and machinery will be washed down and cleaned of any foreign soil and seed prior to being transported onsite to prevent the potential spread of introduced weeds and pathogens.

Disturbance of surface soils along access roads / tracks and where re-shaping / re-levelling earthworks are proposed to occur may encourage weed growth. Weed species, especially those listed as noxious, should be removed from site or controlled by means of herbicide applications to help prevent or minimise their re-occurrence within the proposed activities footprints. Where practical these weeds should be removed from site or controlled by means of herbicide applications to help prevent or minimise their re-occurrence.

### *Noise*

Short term noise pollution as a result of vehicles, machinery and drilling may deter native fauna, including Koalas, from utilising the study area and immediate surrounding areas as habitat. The proposed activities could affect the migration and dispersal ability of native fauna particularly in relation to noise and vehicular movements. The proposed activities may result in short term increased noise pollution which has the potential to disrupt the breeding cycle and the foraging and roosting behaviour of some native fauna species.

### *Potential Disturbance to Nearby Areas of Ecological Significance.*

The site is located approximately 3km to the south west of Wandoba State Conservation Area. While canopy vegetation within the study area provides a tenuous link to the conservation area via vegetated road reserve, it is considered unlikely that vegetation within the study area provides an extension of habitat, given the disturbed nature of the study area. Given the distance between the conservation area and the disturbance areas, as well as the temporary nature of the disturbance, it is considered unlikely that the proposed activity will result in disturbances to Wandoba State Conservation Area.

The study area is located approximately 14km to the north west of Lake Goran, a nationally significant wetland. Given the considerable distance, and the lack of connectivity between the study area and Lake Goran, it is considered highly unlikely that the proposal will impact upon Lake Goran.

The potential direct and indirect impacts on ecology that may be associated with the proposal are considered to be minimal.

## **5.2.2 Key Threatening Processes Relevant to Proposed Activities**

A threatening process is defined under the TSC Act as ‘a process that threatens, or that may threaten, the survival or evolutionary development of a species, population or ecological community’. Threatening processes that adversely affect threatened species, populations or ecological communities, or possibly cause others that are not currently threatened; to become threatened are listed as key threatening processes (KTPs) under the TSC, FM and EPBC Acts. KTPs relevant to the proposed activities are discussed below.

**Table 5-1 Key Threatening Processes Relevant to the Proposed Activities**

<b>Key Threatening Process</b>	<b>Relevance to Proposed Activities</b>
Invasion of native plant communities by exotic perennial grasses	The site has been heavily disturbed by exotic perennial grasses. There exists the potential for the invasion of additional weed species.
Clearing of native vegetation	Land clearing is to occur as a result of the proposed activities, however vegetation to be cleared comprises ground covers only.
Loss of hollow-bearing trees	No hollow bearing trees will be removed as part of this activity. Protection measures will be implemented to ensure hollow-bearing trees in the adjacent areas

Key Threatening Process	Relevance to Proposed Activities
	are not impacted by the proposed activity.
Infection of native plants by <i>Phytophthora cinnamomi</i>	There exists the potential for the importation of this pathogen on unclean vehicles and plant machinery. It is recommended that all vehicles be cleaned of foreign soil from other sites to ensure that this pathogen is not introduced.
Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands.	Lake Goran is located approximately 14km to the south-east of the site. Given the considerable distance between the lake and the proposed activity site, it is unlikely that the proposed activity will result in alteration of the natural flow regimes or quality of the lake.

### 5.2.3 Matters of National Significance

As part of the Ecological Assessment (**Appendix A**), an EPBC Act Protected Matters Search was undertaken within the SEWPaC on-line database to generate a list of those Matters of National Environmental Significance (MNES) from the area, which may have the potential to occur within the subject site. This data, combined with other local knowledge and records was utilised to assess whether the type of activity proposed on the site will have or is likely to have a significant impact upon a MNES, or on the environment of Commonwealth land. Two areas of Commonwealth land are identified from the EPBC Act Protected Matters Search. However the site is not land owned by the Commonwealth, and hence this portion of the Act is not applicable.

The matters of NES and site-specific responses are listed below.

**Table 5-2 Matters of National Environmental Significance**

Matter of National Environmental Significance	Overview
World Heritage Properties	The site is not a World Heritage area, and is not in close proximity to any such area.
Wetlands protected by international treaty (the RAMSAR convention)	The site is not part of any RAMSAR Wetland area. Goran Lake, located approximately 14 km south east of the site is not a RAMSAR wetland. However, it is listed on the Directory of Important Wetlands in Australia as a Seasonal/intermittent freshwater lake.
Nationally listed threatened species, migratory species and ecological communities:	Box-Gum Grassy Woodlands and Derived Native Grasslands occur across the property, however this community does not occur within the chip hole lease. Vegetation within the chip hole lease does not have the native species diversity, canopy density, or canopy regeneration to be representative of the EPBC Act Listed TEC. Goran Lake provides viable breeding and foraging habitat for listed migratory species. The proposed activities are unlikely to impact upon any migratory species and/or their habitats that occur at Goran Lake, due to the distance between the activity site and Goran Lake and the expected short timeframe of the proposed activities.
All nuclear actions	No type of nuclear activity is proposed for the site.
Commonwealth marine areas	The proposed activity on the site will not have a significantly adverse effect on any Commonwealth marine area.
Great Barrier Reef Marine Park	The proposed activity on the site will not have a significantly adverse effect on the Great Barrier Reef Marine Park.

One EEC listed under the EPBC Act was positively recorded within the broader property. No listed threatened species, migratory species or ecological communities were recorded within the study area. Pursuant to the EPBC Act, an assessment of potential impacts arising from the proposal on the White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland community was undertaken in accordance with the EPBC Act and *EPBC Act Policy Statement 1.1 - Significant Impact Guidelines Matters of National Environmental Significance* (DEWHA, 2009). The assessment concluded that the proposed activities are unlikely to have a significant impact on the EEC. As such, the proposal is not considered to

constitute a 'controlled action' and approval from the Minister for Sustainability, Environment, Water, Population and Communities (under the EPBC Act) is not necessary.

### Mitigation Measures

Mitigation comprises the following:

- The lease will be appropriately fenced to ensure machinery is limited to the designated disturbance area. Fencing will also ensure that all adjacent canopy trees are appropriately protected throughout construction works.
- Following construction of the chip hole, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Rehabilitation will include native grasses that are representative of the existing vegetation composition.
- Vehicle speeds will be limited to reduce the potential of fauna strike, and to reduce dust generation.
- Weed management procedures will be implemented to prevent the spread of weeds both on and off site. Weed monitoring will be undertaken throughout the construction phase, and weed removal carried out as necessary. Where vehicles and machinery are moving between the site and weed free areas, wash down procedures must be implemented. Mexican Poppy, a Class 5 declared noxious weed will be appropriately controlled within the proposal footprint and along the proposed access road and tracks prior to the construction stage.
- To minimise potential impacts on adjacent grazing lands, all liquids (fuel, oil, cleaning agents, drilling liquids etc) will be stored appropriately and disposed of at suitably licensed facilities.
- Spill management procedures will be implemented as required.
- Rubbish will be collected and removed from the site.
- Appropriate erosion and sediment control measures will be utilised as required.
- Following construction of the chip hole lease, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Rehabilitation will include native grasses that are representative of the existing vegetation composition.
- An Environmental Management Plan has been prepared for the proposed activity and will be adhered to by site personnel at all times.

## 5.3 Heritage

### 5.3.1 Aboriginal heritage

#### Impacts

The subject site, including the lease pad and access tracks was inspected by Santos' cultural heritage officer in March 2011. No items of significance were identified and no features likely to contain archaeological deposits were found. A Cultural Heritage Assessment was subsequently prepared (**Appendix B**) for the site, which concluded that Aboriginal objects are unlikely to occur in the subject area.

A search of the NSW OEH Aboriginal Heritage Information Management System (AHIMS) undertaken as part of the assessment was made on 17 June 2011 and found that there were no items of cultural heritage located on the site or in the vicinity of the site.

It is considered that the potential impacts associated with Aboriginal heritage can be appropriately managed if the mitigation measures presented below are proposed.

## Mitigation Measures

To limit any potential impact on any unknown Aboriginal sites or objects the following measures are proposed:

- Minimise impact to areas outside the area of operation through appropriate on-site induction of all employees and contractors attending site.
- Vehicle access is to remain within existing tracks where possible in order to minimise potential impacts on surrounding vegetation and reduce erosion.
- In the event that any vegetation clearing is required to allow large machinery access to a given area, soil disturbance shall be kept to a minimum. Subject to ecological constraints, it is preferable for vegetation to be cut with a chain saw rather than bulldozed, and trees and bushes shall be cut at their base just above ground level where possible.
- If works fall outside of the areas inspected for the purposes of the cultural heritage assessment or access routes are altered those areas must be further investigated by a qualified archaeologist.
- If an Aboriginal object or site is identified at any point during the proposed works, all works in the vicinity must cease immediately. That area shall be temporarily fenced with high visibility tape or barrier fencing in order to prevent further impact and a suitably qualified archaeologist contacted. Works in that location shall not proceed until the site has been registered with the OEH and an appropriate course of action determined by the archaeologist. In most instances this would involve applying for an Aboriginal Heritage Impact Permit (AHIP) from OEH in consultation with the Aboriginal Community.
- In the event that skeletal remains are uncovered, work must cease immediately in that area and the area fenced. Santos shall then contact the NSW Police and follow the advised procedure. If the skeletal remains are determined to be Aboriginal, Santos shall then contact the OEH and relevant Aboriginal Community Stakeholders in order to determine an action plan for the management of the skeletal remains prior to works commencing.

### 5.3.2 Other Cultural Heritage

#### Impacts

There are no items of heritage significance listed as occurring on the subject site in either the Gunnedah LEP 1998 or on the NSW State Heritage Register. A number of items of local and State heritage significance were recorded as occurring within the Gunnedah Local Government Area, however these are not located in close proximity to the subject site.

Four sites within the Gunnedah LGA are listed on the Commonwealth Register of National Estate, however none of these are on the subject site.

It is considered that the potential impacts associated with other cultural heritage can be appropriately managed if the mitigation measures presented below are implemented.

#### Mitigation Measures

It is considered highly unlikely that any items of European cultural heritage significance will be impacted by the proposed drilling. Nonetheless, heritage items are protected by legislation in NSW. If an object is found during drilling or other subsurface works that is considered to be of any heritage significance, all works shall cease, and a qualified archaeologist shall be contacted.

## 5.4 Ground water

### Impacts

Due to the type of activity proposed, water from the targeted coal seams is not anticipated to be lifted.

Potential impacts on groundwater may arise from the drilling process, where cross-contamination of groundwater from drilling fluids can occur. This will be prevented through the casing and cementing of the core hole in accordance with regulatory requirements.

There is potential for groundwater contamination due to spills of fuels and chemicals at the lease site and mitigation measures to minimise this risk are set out below.

A liner will be used for the drilling sump. It will be removed after drilling with the water re-used or taken to an appropriate site for disposal.

### Mitigation Measures

- The drilling and installation of the core hole will be undertaken in accordance with good industry practice.
- Monitoring of private groundwater bores in a 2km radius (where landowner is agreeable) will be undertaken on a regular basis during drilling activities. As a minimum, bores will be monitored for water level and water quality, including pH, temperature, dissolved oxygen, redox and electrical conductivity. Samples will be analysed by a National Association of Testing Authorities (NATA) accredited laboratory.
- Wells that are no longer required will be decommissioned.

The management measures to control the handling and storage of chemical and hazardous substances and for spill prevention and response are identified in Section 5.9 Hazardous and Chemical Substances Management.

Measures to minimise and manage waste are identified in 5.11 Waste Minimisation and Management.

## 5.5 Air

### Impacts

The existing air quality of the locality is typical of a rural area with the majority of air emissions and pollutants arising from existing agricultural activities including stock grazing, land clearing and soil preparation, sowing and harvesting of crops, vehicle and heavy machinery movements; bushfires and burn-offs.

The potential for the activity to introduce additional air emissions would arise from the following sources:

- vehicle movements to and from the sites;
- construction and rehabilitation of the proposed access tracks and well lease;
- drilling of the chip hole.

The air emissions associated with the proposal will be dust and greenhouse gases.

The dust generated by drilling and ancillary equipment travelling to and from a location would vary depending on road and weather conditions. Internal roads on the property will be gravelled and vehicle movement will be very slow. Minimal dust would be therefore be generated. In the context of the surrounding agricultural activities this will not be a significant issue.

Damage to any access roads would be repaired as soon as possible after occurrence to minimise any impact on the landholder or the public.

Santos will notify the Gunnedah Shire Council of the proposed start time of drilling prior to its commencement and will liaise with the appropriate Council representatives should any repairs to Council roads be necessary.

As the proposed activities are associated with exploration, potential contributions to greenhouse gases, for the duration of the activities, are confined to:

- the operation of diesel fuelled vehicular traffic;
- plant including the drilling rig;
- site power generation.

Collectively these represent minimal emissions when compared with the agricultural activities that take place throughout the region. It is considered that the potential impacts associated with air emissions can be appropriately managed if the mitigation measures presented below are implemented.

### **Mitigation Measures**

To minimise impacts on air quality the following actions will be undertaken:

- Access tracks are to be maintained with gravel throughout the duration of the project.
- Land disturbance areas are to be minimised.
- Slow speed restrictions will be enforced on internal site access tracks.

## **5.6 Noise**

The site is located in an agricultural area and the existing noise levels are relatively low. The nearest residential dwelling is approximately 1.4km to the north west of the site. There are also properties to the east, south and west within 2km from the site. The closest community is Milroy which is approximately 2.5km to the south west of the site and Curlewis is approximately 18km to the east of the site.

Drilling activities are temporary and noise will be generated by the construction of the lease and track infrastructure for a duration of approximately 14 days, drilling over approximately 30 days and rehabilitation for 30 days.

This equates to a total of approximately 44 days of construction and drilling and 30 days of rehabilitation. Drilling activities will be 24 hours per day with lease and track construction activities to be conducted over a 12 hour day shift. Mufflers are installed on the power plants and prime movers used for the powering and mobilisation of the drilling rig.

Drilling operations will be undertaken in accordance with landowner and State government requirements.

A generic, or 'flat earth', noise assessment was undertaken by Heggies (now SLR) in 2009 for a Santos Drill Rig 13 (the drill rig to be used for this proposal) and the results of this are useful in indicating potential impacts to the properties identified above. This noise assessment is presented in **Appendix C**.

The results of the study show the predicted noise levels at a range of distances from the equipment and considers both neutral and worst case weather conditions.

### *Noise Criterion*

Background noise for the location is assumed to be below 30dBA and therefore the Rating Background Level (RBL) is taken to be 30dBA, as per the NSW Industrial Noise Policy (INP).

The Noise Affected level for daytime according the NSW DECCW Interim Construction Noise Guideline is determined as RBL plus 10 dBA. The Noise Affected level for evening and night (ie outside recommended hours, which are defined as Monday to Friday 7am to 6pm and Saturday 8am to 1pm, with no work Sundays or public holidays) is determined as RBL plus 5 dBA. This equates to a daytime noise goal of 40 dBA and a night time goal of 35dBA.

According to the generic Drill Rig 13 assessment, at 1.4km noise levels from the Drill Rig 13 are likely to be less than 22 dBA during calm weather and 25 dBA during temperature inversion weather. These levels of noise are negligible and well below the specific noise criteria of 40 dBA and 35 dBA for daytime and night time activities respectively.

It is considered that the potential impacts associated with noise can be appropriately managed if the mitigation measures presented below are implemented.

### **Mitigation Measures**

To minimise the potential impacts on noise the following actions will be implemented:

- Santos will ensure that any community issues of concern will be met with a prompt response.
- Santos will undertake to refine on site noise mitigation measures and plant operating procedures where practical.
- Landholder notification will be given prior to commencement of drilling.
- Equipment will be maintained so that noise levels remain constant.

## **5.7 Surface water**

### **Impacts**

There are watercourses in the vicinity of the site with the closest being Collygra Creek to the north west. Water for drilling operations will be sourced from Council or another licensed provider and not from any watercourse or private dam.

There is the potential for the proposed activities to impact on the surface water quality of adjacent watercourses through sedimentation and site run-off. There is also potential for chemicals and fuels to come into contact with watercourses and therefore mitigation measures to minimise this risk are identified below.

It is considered that the potential impacts associated with surface water can be appropriately managed if the mitigation measures presented below are implemented.

### **Mitigation Measures**

General measures to protect surface waters include:

- Contaminated waters will be contained and where necessary disposed of at an appropriate facility.
- Drilling fluids will be contained on site and not discharged to surrounding watercourses. Over-balanced drill techniques to be utilised to prevent formation fluid from rising through the well to the surface.
- Excessive fluid losses will be cured by LCM (cellulose material such as sawdust) to ensure most fluids return to the surface.
- Sediment fences and traps will be installed so as to prevent soil loss or sedimentation.
- Fuel and lubricants will be stored on site only when necessary and maintained off site whenever possible.
- All areas storing or handling fuel, fuel using equipment, and chemicals will be bunded in accordance with Australian Standard 1940 – 2004; The Storage and Handling of Flammable and Combustible

Liquids.

- The maintenance and cleaning of vehicles and other equipment or plant will be carried out in areas from where the resultant contaminants cannot be released into any waters.
- Wastewater removed from site will be managed by a contractor licensed to carry and handle water.
- Where applicable maintenance of roads, drains, bund walls, contour and diversion banks to occur. All drainage structures will be maintained for the life of the development.
- Disturbed land will be rehabilitated to pre-operational quality or better, to minimise sediment erosion.
- During rehabilitation, diversion banks and ripping along the contour will be completed to prevent the concentration and momentum of water flow as required.

## 5.8 Soils

### Impacts

The proposed activities will involve earthworks within a defined footprint for the installation of temporary infrastructure and the well lease and upgrading and construction of track. There is still a potential risk for soil erosion to occur resulting in sediment transport to local waterways. The use of existing access tracks where possible, the gravelling of all access tracks used and the selection of a relatively level site will minimise the disturbance footprint of the exploration activities.

Any topsoil will be stripped and stockpiled and topsoil to be reinstated as part of the rehabilitation process. No soil is proposed to be removed from the site. The site layout plan (Figures 3.1 and 3.2) shows areas where soil will be stockpiled and the locations of erosion control facilities.

Once the drilling and associated activities are complete, the disturbed area will be rehabilitated with appropriate mitigation measures and environmental safeguards implemented to minimise potential impacts. All rehabilitation works will be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation in accordance with the relevant statutory requirements.

There is also a small potential risk of soil contamination occurring from the proposed activities (refer Section 5.10 for further information). The drilling activities require the use of chemicals (particularly drill fluid additives) and other hazardous substances (fuel). These goods will be transported and stored on site for use.

It is considered that the potential impacts associated with soils can be appropriately managed if the mitigation measures presented below are implemented.

### Mitigation Measures

The erosion and sediment control measures are proposed as follows:

- Any displaced soil gathered during operations will be stockpiled within the compound. This soil is to be used as backfill at the conclusion of drilling operations.
- Maintain existing ground cover where possible.
- Stabilise entry/exit points to the work area or any high traffic areas.
- Install sediment fence at downstream limit of disturbance area.
- Rehabilitate the disturbed area upon completion of required activities.

The following mitigation measures are proposed to reduce the risk of soil contamination:

- Provide a spill kit for clean up spills of diesel, lubricants, oil etc.

- Immediately clean up any spills or leaks.
- Daily pre-start inspection of plant and equipment to identify any maintenance requirements.
- Store, handle, use and dispose of all potential contaminants in accordance with the MSDS.
- Remove all wastes (other than drill cuttings and sump fluid) from the site as required.
- Containment of drilling fluids in sumps or above-ground tanks.
- Minimise on-site storage of fuel and lubricants.
- Adequate maintenance of tanks or sumps.
- Ensure tanks or sumps have overflow capacity in case of heavy rain.
- Any soil that becomes contaminated through contact with drilling fluids, fuels, or lubricants will be removed from the site and disposed of at an appropriate licensed disposal facility.

## 5.9 Chemical and hazardous substances management

### Impacts

The drilling operations would generally only use chemicals such as drilling fluids/agents, fuels, and lubricants. While these substances are not considered highly hazardous, there is still the potential risk of fire and pollution to land, water and air if an accidental spillage was to occur. The *Occupational Health and Safety Act 2000* and the *Protection of the Environment Operations Act 1997* are the acts that regulate dangerous goods. These Acts would be adhered with through all operations for the proposal.

It is considered that the potential impacts associated with chemical and hazardous substances can be appropriately managed if the mitigation measures presented below are implemented.

### Mitigation Measures

Any spills of chemicals used during drilling operations will be managed applying best practice principles, be in accordance with all legislation and standards for the safe handling and storage of hazardous substances and dangerous goods and comply with all occupational health and safety requirements. Any contaminated soil will be removed from the drill location. The drilling contractor is required to comply with their operations EMP and OHS requirements.

## 5.10 Contaminated land

### Impacts

Illegal dumping has occurred on the proposed well lease in the past where various items of agricultural and domestic hard refuse (e.g. rubber, metal, plastic, wood) have been dumped in an excavated pit. The pit is approximately 45m x 5m and 1.6m deep.

While no chemical testing of the dumped material has been undertaken, there is a possibility that localised soil contamination may be present. It is proposed to remove the waste from the site and dispose of it at a licensed facility. Prior to removal, waste will be classified in accordance with the OEH *Waste Classification Guidelines* by a suitably qualified person. While the waste is expected to be inert, if evidence of any contamination is identified validation testing of the soils will be undertaken to ensure all contaminated material is removed prior to the commencement of works. The stockpiled material excavated when the rubbish pit was formed will be backfilled into the pit to create a level drilling pad.

The proposed activities will pose minimal impact on the soils. No soil is proposed to be removed from the site. On completion of drilling all excavated material would be backfilled. Based upon the history of the

locations and the minimal impact to site soils during operations, land contamination issues are considered to be minimal for the proposed activity.

It is considered that the potential impacts associated with contamination can be appropriately managed if the mitigation measures presented below are implemented.

### **Mitigation Measures**

Those mitigation measures identified in Sections 5.7, 5.8 and 5.9 will ensure that any contamination risk is appropriately management. Specific mitigation measures are proposed in relation to the management of the rubbish pit on site, as follows:

- Prior to commencing earthworks on site, waste will be classified in accordance with the OEH *Waste Classification Guidelines* by a suitable qualified person and removed to an appropriate licensed facility.
- If evidence of any contamination is identified during removal, validation testing will be undertaken to ensure that all contaminated material is removed prior to the commencement of earthworks.

## **5.11 Waste minimisation and management**

### **Impacts**

Drill cuttings and some general site operations waste will be produced as part of the proposed drilling operations. Any solvents, oils and other general waste would need to be managed in an appropriate manner to avoid health risks and contamination of land and waterways. As previously stated, following drilling and removal of excess drilling fluid from the sump, dried cuttings are removed and transported to an appropriate licensed waste facility.

As outlined in Section 5.10, the rubbish to be removed from the site will be classified prior to removal and then transported to a licensed facility.

A regular service of amenities will be conducted and waste is to be removed to a licensed facility.

It is considered that the potential impacts associated with waste can be appropriately managed if the mitigation measures presented below are implemented.

### **Mitigation Measures**

- A general waste management strategy based upon the principles of reduce, reuse and recycling will be implemented.
- A specific Site Waste Management Plan for drilling activities will be prepared and implemented by the drilling contractor.
- All staff and contractors will be made aware of waste management procedures during induction.
- Appropriate waste containers will be provided on the site.
- Any waste generated is to be disposed of in an appropriate manner in accordance with relevant standards and guidelines.
- Spills of waste material shall be dealt with in a prompt and thorough manner, and reported to the appropriate authority if necessary.
- General refuse will be collected and transported to an approved recycling or disposal site.
- Onsite waste disposal is prohibited.
- Hazardous waste will be managed in accordance with existing guidelines and standards.

## 5.12 Natural resource use

### Impacts

The key natural resources that would be affected by the proposed drilling operations are agricultural land resources and fuels for the drilling equipment and transportation of staff. While there are coal mines situated in the area, the proposal will have no impact on their operation or production.

The subject site is part of a property comprising land used for agriculture. The location for the proposed chip hole has been selected taking into account the potential temporary loss of the land during this time. The total area of works and therefore the amount of agricultural land that would be temporarily taken out of agricultural use for the duration of the project is approximately 5,504m<sup>2</sup>. This represents a relatively minor proportion of the overall area of the property. A further 3,000m<sup>2</sup> of land will be utilised for the new access track, which is to remain following completion of works at the request of the landowner.

The lease build and drilling is anticipated to take a approximately 44 days and the rehabilitation approximately one month. The disturbed areas (excluding the access track, which is to remain) will be rehabilitated by returning them to at least their pre-operational state or to a condition agreed by the landholder. Therefore, there would be a temporary loss of the use of this agricultural land in agreement with the landholder and, in the context of the total agricultural land holding and the wider agricultural uses of the region, is of minimal significance.

Fuels will be used for equipment and also for works and staff vehicles although this is not likely to be a significant quantity of fuel use.

With regard to other impacts on the natural environment, impacts on ecology, surface and ground water and heritage are addressed in Sections 5.2, 5.7, 5.4 and 5.3 respectively.

It is considered that the potential impacts associated with natural resource use can be appropriately managed if the mitigation measures presented below are implemented.

### Mitigation Measures

The temporary loss of the use of the agricultural land will be mitigated through rehabilitation in the short to medium term.

The use of fuel is not considered to be significant however the fuel will be used as efficiently as possible through appropriate work behaviour (e.g. switching off equipment when not in use).

## 5.13 Local Community and Neighbouring Properties

As described in Section 3.10, Santos has a commitment to open and transparent consultation with the communities that they work in. Over 30 community information sessions have been held since beginning their Gunnedah Basin coal seam gas exploration in 2008. Therefore, the community are kept informed about the activities, stakeholders have the opportunity to speak directly with those undertaking the works and Santos are able to identify matters of concern to stakeholders.

The proposed works that are the subject of this REF are temporary (as described in Section 3.5). The nearest residential dwelling is approximately 1.4km to the north west of the site. There are also properties to the east, south and west within 2km from the site. The closest community is Milroy which is approximately 2.5km to the south west of the site and Curlewis is approximately 18km to the east of the site.

The effect associated with the temporary loss of the agricultural use of the land is described in Section 5.15.

Santos has negotiated an access, compensation and rehabilitation agreement with the affected landowner in respect to land access, compensation and rehabilitation as required under the Petroleum (Onshore) Act 1991. A scouting survey has been undertaken in consultation with the relevant landholder prior to drilling

taking place to locate the site with an emphasis on minimisation of impacts on the environment and property operations.

The landholder will experience the effects of the temporary loss of the use of this land and associated effects such as disturbance to current farming activities and flora and fauna.

Activities will be 24 hours per day in negotiation with the landholder and measures to mitigate noise are identified in Section 5.6 above.

There is not anticipated to be a significant visual impact because the activities are temporary and all infrastructure will be removed at the completion of works.

It is considered that the potential impacts associated with the local community and neighbouring properties can be appropriately managed if the mitigation measures presented below are implemented.

### **Mitigation Measures**

In order to minimise impacts on landholders the following measures are proposed:

- Undertake ongoing landholder and stakeholder consultation.
- Respond promptly to any community concerns or complaints.
- Inform the community promptly of any changes to timing or scheduling which will have an adverse impact on them.

## **5.14 Visual assessment**

### **Impacts**

The operations are temporary in nature, with a duration of approximately 74 days and all equipment will be removed on completion of site activities. The closest residence is approximately 1.4km away to the north west. Following completion of the works all sites will be rehabilitated and would not detract from the overall scenic qualities of the area.

No significant impacts on the visual amenity of the area are expected from the proposed drilling.

### **Mitigation Measures**

Visual impacts will be mitigated through rehabilitation in the short to medium term.

No other specific measures are recommended to mitigate against visual impacts, as any impacts would be negligible and short term.

## **5.15 Land use**

### **Impacts**

As described in Section 2.1 the site is within a property used for agriculture. Section 5.12 above addresses the temporary unavailability of agricultural land from the property. The land will be rehabilitated to its pre-operation state or to a condition agreed with the landholder.

The location of the site has taken into account the need to minimise impacts on landholder operations.

The site is located within PEL 1, which has overlapping coal tenures as identified on Figure 2-4. There are no known coal mining operations planned for this site, however the wells are designed such that they will pose no threat or hazard to future coal mining.

It is considered that the potential impacts associated with land use can be appropriately managed if the mitigation measures presented below are implemented.

### Mitigation Measures

The loss of the use of the agricultural land will be mitigated through rehabilitation following completion of the temporary activities.

## 5.16 Cumulative Environmental Impacts

The closest offset wells to the proposed activities are Wondobah Ddh 1 (5.35km), Millie Ddh 1 (10.13km) and Goran 1 (8.12km). These wells have been plugged and abandoned and there will therefore be no cumulative impacts associated with drilling or site activities associated with these wells. This includes impacts in relation to noise, traffic and ecology.

## 5.17 Summary of Mitigation Measures

The following table provides an overview of the mitigation measures recommended in Section 5. It is considered that all potential impacts identified in this section can be appropriately managed if these mitigation measures are implemented.

**Table 5-3 Summary of Mitigation Measures**

Potential Impact	Proposed Mitigation Measure
Ecology	<ul style="list-style-type: none"> <li>▪ The disturbance area will be appropriately fenced to ensure machinery is limited to the designated disturbance area. Fencing will also ensure that all adjacent canopy trees are appropriately protected throughout construction works.</li> <li>▪ Following construction of the chip hole, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Rehabilitation will include native grasses that are representative of the existing vegetation composition.</li> <li>▪ Vehicle speeds will be limited to reduce the potential of fauna strike, and to reduce dust generation.</li> <li>▪ Weed management procedures will be implemented to prevent the spread of weeds both on and off site. Where vehicles and machinery are moving between the site and weed free areas, wash down procedures must be implemented. Mexican Poppy, a Class 5 declared noxious weed will be appropriately controlled within the proposal footprint and along the proposed access road and tracks prior to the construction stage.</li> <li>▪ To minimise potential impacts on adjacent grazing lands, all liquids (fuel, oil, cleaning agents, drilling liquids etc) will be stored appropriately and disposed of at suitably licensed facilities.</li> <li>▪ Spill management procedures will be implemented as required.</li> <li>▪ Rubbish will be collected and removed from the site.</li> <li>▪ Appropriate erosion and sediment control measures will be utilised as required.</li> <li>▪ Following construction of the chip hole lease, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Rehabilitation will include native grasses that are representative of the existing vegetation composition.</li> <li>▪ An Environmental Management Plan has been prepared for the proposed activity and will be adhered to by site personnel at all times.</li> </ul>
Aboriginal Heritage	<ul style="list-style-type: none"> <li>▪ Minimise impact to areas outside the area of operation through appropriate on-site induction of all employees and contractors attending site.</li> <li>▪ Vehicle access is to remain within existing tracks where possible in order to minimise potential impacts on surrounding vegetation and reduce erosion.</li> <li>▪ In the event that any vegetation clearing is required to allow large machinery access to a given area, soil disturbance shall be kept to a minimum. Subject to ecological constraints, it is preferable for vegetation to be cut with a chain saw rather than bulldozed, and trees and bushes shall be cut at their base just above ground level where possible.</li> </ul>

Potential Impact	Proposed Mitigation Measure
	<ul style="list-style-type: none"> <li>▪ If works fall outside of the areas inspected for the purposes of the cultural heritage assessment or access routes are altered those areas must be further investigated by a qualified archaeologist.</li> <li>▪ If an Aboriginal object or site is identified at any point during the proposed works, all works in the vicinity must cease immediately. That area shall be temporarily fenced with high visibility tape or barrier fencing in order to prevent further impact and a suitably qualified archaeologist contacted. Works in that location shall not proceed until the site has been registered with the OEH and an appropriate course of action determined by the archaeologist. In most instances this would involve applying for an Aboriginal Heritage Impact Permit (AHIP) from OEH in consultation with the Aboriginal Community.</li> <li>▪ In the event that skeletal remains are uncovered, work must cease immediately in that area and the area fenced. Santos shall then contact the NSW Police and follow the advised procedure. If the skeletal remains are determined to be Aboriginal, Santos shall then contact the OEH and relevant Aboriginal Community Stakeholders in order to determine an action plan for the management of the skeletal remains prior to works commencing.</li> </ul>
Other Heritage	<ul style="list-style-type: none"> <li>▪ If an object is found during drilling or other subsurface works that is considered to be of any heritage significance, all works shall cease, and a qualified archaeologist shall be contacted.</li> </ul>
Groundwater	<ul style="list-style-type: none"> <li>▪ The drilling and installation of the core hole will be undertaken in accordance with good industry practice.</li> <li>▪ Monitoring of private groundwater bores in a 2km radius (where landowner is agreeable) will be undertaken on a regular basis during drilling activities. As a minimum, bores will be monitored for water level and water quality, including pH, temperature, dissolved oxygen, redox and electrical conductivity. Samples will be analysed by a National Association of Testing Authorities (NATA) accredited laboratory.</li> <li>▪ Wells that are no longer required will be decommissioned.</li> </ul>
Air	<ul style="list-style-type: none"> <li>▪ Access tracks are to be maintained with gravel throughout the duration of the project.</li> <li>▪ Land disturbance areas are to be minimised.</li> <li>▪ Slow speed restrictions will be enforced on internal site access tracks.</li> </ul>
Surface Water	<ul style="list-style-type: none"> <li>▪ Contaminated waters will be contained and where necessary disposed of at an appropriate facility.</li> <li>▪ Drilling fluids will be contained on site and not discharged to surrounding watercourses. Over-balanced drill techniques to be utilised to prevent formation fluid from rising through the well to the surface.</li> <li>▪ Excessive fluid losses will be cured by LCM (cellulose material such as sawdust) to ensure most fluids return to the surface.</li> <li>▪ Sediment fences and traps will be installed so as to prevent soil loss or sedimentation.</li> <li>▪ Fuel and lubricants will be stored on site only when necessary and maintained off site whenever possible.</li> <li>▪ All areas storing or handling fuel, fuel using equipment, and chemicals will be banded in accordance with Australian Standard 1940 – 2004; The Storage and Handling of Flammable and Combustible Liquids.</li> <li>▪ The maintenance and cleaning of vehicles and other equipment or plant will be carried out in areas from where the resultant contaminants cannot be released into any waters.</li> <li>▪ Wastewater removed from site will be managed by a contractor licensed to carry and handle water.</li> <li>▪ Where applicable maintenance of roads, drains, bund walls, contour and diversion banks to occur. All drainage structures will be maintained for the life of the development.</li> <li>▪ Disturbed land will be rehabilitated to pre-operational quality or better, to minimise sediment erosion.</li> <li>▪ During rehabilitation, diversion banks and ripping along the contour will be completed to prevent the concentration and momentum of water flow as required.</li> </ul>
Soils	<ul style="list-style-type: none"> <li>▪ Any displaced soil gathered during operations will be stockpiled within the compound. This soil is to be used as backfill at the conclusion of drilling operations.</li> <li>▪ Maintain existing ground cover where possible.</li> <li>▪ Stabilise entry/exit points to the work area or any high traffic areas.</li> </ul>

Potential Impact	Proposed Mitigation Measure
	<ul style="list-style-type: none"> <li>▪ Install sediment fence at downstream limit of disturbance area.</li> <li>▪ Rehabilitate the disturbed area upon completion of required activities.</li> <li>▪ Provide a spill kit for clean up spills of diesel, lubricants, oil etc.</li> <li>▪ Immediately clean up any spills or leaks.</li> <li>▪ Daily pre-start inspection of plant and equipment to identify any maintenance requirements.</li> <li>▪ Store, handle, use and dispose of all potential contaminants in accordance with the MSDS.</li> <li>▪ Remove all wastes (other than drill cuttings and sump fluid) from the site as required.</li> <li>▪ Containment of drilling fluids in sumps or above-ground tanks.</li> <li>▪ Minimise on-site storage of fuel and lubricants.</li> <li>▪ Adequate maintenance of tanks or sumps.</li> <li>▪ Ensure tanks or sumps have overflow capacity in case of heavy rain.</li> <li>▪ Any soil that becomes contaminated through contact with drilling fluids, fuels, or lubricants will be removed from the site and disposed of at an appropriate licensed disposal facility.</li> </ul>
Contaminated Land	<ul style="list-style-type: none"> <li>▪ Prior to commencing earthworks on site, waste will be classified in accordance with the OEH <i>Waste Classification Guidelines</i> by a suitable qualified person and removed to an appropriate licensed facility.</li> <li>▪ If evidence of any contamination is identified during removal, validation testing will be undertaken to ensure that all contaminated material is removed prior to the commencement of earthworks.</li> </ul>
Chemical and Hazardous Substances	<p>Any spills of chemicals used during drilling operations will be managed applying best practice principles, be in accordance with all legislation and standards for the safe handling and storage of hazardous substances and dangerous goods and comply with all occupational health and safety requirements. Any contaminated soil will be removed from the drill location. The drilling contractor is required to comply with their operations EMP and OHS requirements.</p>
Noise	<ul style="list-style-type: none"> <li>▪ Santos will ensure that any community issues of concern will be met with a prompt response.</li> <li>▪ Santos will undertake to refine on site noise mitigation measures and plant operating procedures where practical.</li> <li>▪ Landholder notification will be given prior to commencement of drilling.</li> <li>▪ Equipment will be maintained so that noise levels remain constant.</li> </ul>
Waste	<ul style="list-style-type: none"> <li>▪ A general waste management strategy based upon the principles of reduce, reuse and recycling will be implemented.</li> <li>▪ A specific Site Waste Management Plan for drilling activities will be prepared and implemented by the drilling contractor.</li> <li>▪ All staff and contractors will be made aware of waste management procedures during induction.</li> <li>▪ Appropriate waste containers will be provided on the site.</li> <li>▪ Any waste generated is to be disposed of in an appropriate manner in accordance with relevant standards and guidelines.</li> <li>▪ Spills of waste material shall be dealt with in a prompt and thorough manner, and reported to the appropriate authority if necessary.</li> <li>▪ General refuse will be collected and transported to an approved recycling or disposal site.</li> <li>▪ Onsite waste disposal is prohibited.</li> <li>▪ Hazardous waste will be managed in accordance with existing guidelines and standards.</li> </ul>
Natural Resource Use	<ul style="list-style-type: none"> <li>▪ The temporary loss of the use of the agricultural land will be mitigated through rehabilitation in the short to medium term.</li> <li>▪ The use of fuel is not considered to be significant however the fuel will be used as efficiently as possible through appropriate work behaviour (e.g. switching off equipment when not in use).</li> </ul>
Community	<ul style="list-style-type: none"> <li>▪ Undertake ongoing landholder and stakeholder consultation.</li> <li>▪ Respond promptly to any community concerns or complaints.</li> <li>▪ Inform the community promptly of any changes to timing or scheduling which will have an</li> </ul>

Potential Impact	Proposed Mitigation Measure
	adverse impact on them.
Visual Impacts	<ul style="list-style-type: none"> <li>Visual impacts will be mitigated through rehabilitation in the short to medium term.</li> </ul>
Land Use	<ul style="list-style-type: none"> <li>The loss of the use of the agricultural land will be mitigated through rehabilitation following completion of the temporary activities.</li> </ul>

## 5.18 Clause 228 Guidelines

Clause 228 of the EP&A Regulation states that for the purpose of Part 5 of the EP&A Act the following factors are to be taken into account concerning the impact of an activity on the environment. These factors are considered in Table 5-4.

**Table 5-4 Clause 228 Guidelines**

Factor	Impact
<i>Any environmental impact on the community</i>	<p>Short term negative.</p> <p>The proposed site lies approximately 2.5km from Milroy and 18 km east of the closest town, Curlewis. There are also residential properties within 2km of the site with the closest being 1.4km away. Minor short term impacts such as increased local traffic would be experienced. Receptors closer to the works would also have potential dust effects. Safeguards proposed in Section 5 and Table 5-2 would minimise these impacts.</p>
<i>Any transformation of a locality</i>	<p>Short term negative.</p> <p>There would be localised and non-permanent visual impact on the immediate vicinity of the hole for the duration of the programme. Safeguards proposed in Section 5 and Table 5-2 would minimise these impacts.</p>
<i>Any environmental impact on the ecosystems of the locality.</i>	<p>Minor negative.</p> <p>Some temporary disruption to the ecosystem will occur during site operations, however these are minor acceptable impacts and can be appropriately managed.</p>
<i>Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality</i>	<p>Nil.</p> <p>During drilling there may be a reduction in these values due to affecting visual amenity. Given the short-term nature of activities and the safeguards/mitigation detailed in Section 5 and Table 5-2 the potential for a reduction is considered negligible.</p>
<i>Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations</i>	<p>Nil.</p> <p>No locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations occur near the proposal area.</p>
<i>Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)</i>	<p>Short term negative.</p> <p>There will be minimal impacts on fauna habitat and mitigation measures are identified. Refer Section 5.2 for further details.</p>
<i>Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air</i>	<p>Nil.</p> <p>The proposal would not endanger any species of animal, plant or other form of life, whether living on land, in water or in the air.</p>
<i>Any long-term effects on the environment</i>	<p>Nil.</p> <p>The proposal would have no long-term effects on the environment. Rehabilitation of the well lease will occur.</p>
<i>Any degradation of the</i>	<p>Minor short term negative.</p>

Factor	Impact
<i>quality of the environment</i>	There is potential for minor short term environmental degradation due to visual, noise or dust impacts. Safeguards proposed in Section 5 and Table 5-2 would minimise these impacts.
<i>Any risk to the safety of the environment</i>	Minor short term negative. The proposal may result in short term potential risks to the safety of the environment due to incidents and spills. The likelihood and consequence of an incident occurring would be reduced through the application of Santos's EHSMS Standards and mitigation proposed in Section 5.
<i>Any reduction in the range of beneficial uses of the environment</i>	Nil. The footprint of activities for the proposal would not result in any reduction in the range of beneficial use of the environment.
<i>Any pollution of the environment</i>	Nil. The proposal may result in short term potential risk of pollution of the environment due to incidents and spills. The likelihood and consequence of an incident occurring would be reduced through the application of Santos's EHSMS Standards and mitigation proposed in Section 5.
<i>Any environmental problems associated with the disposal of waste</i>	Nil. Drill cuttings would be allowed to dry onsite and disposed of at an appropriate licensed facility. Rubbish removed from the illegal pit on site would be classified and disposed of in accordance with the relevant guidelines and legislation. Any other waste generated by the activities will be collected and removed from site for disposal at approved landfill sites. Given the short term of the propose activity waste production will be minimal.
<i>Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply</i>	Nil. Resources required for the proposal are not in limited supply in the area.

## 6 Conclusions

This Review of Environmental Factors has been prepared to assess the environmental impact of the proposed chip hole and ancillary facilities and activities at Wando 1 in the Gunnedah Basin. The purpose of the chip hole is to obtain information about coal seam depths, seam thickness, continuity and permeability to assess the coal seam potential of the Gunnedah Basin in within Petroleum Exploration Licence No. 1 (PEL 1).

The proposal includes drilling of a chip hole at the Wando 1 location to obtain information on coal depths, seam thickness, continuity, gas composition (as required) and reservoir pressure and permeability. Drill stem testing (DST) or equivalent downhole evaluation is planned to be undertaken on target coal seams to collect information on reservoir pressure and gain an indication of permeability. Drill cuttings may also be collected and analysed for gas composition information.

The proposal comprises temporary, small scale works of a short term duration. Following drilling to the well total depth and required well logging and testing, the well will be plugged and abandoned with cement plugs from total depth to surface.

Specialist assessments have been prepared for the proposal to assist in guiding the location of facilities assessing the potential impacts of the operations. Assessments were undertaken for:

- Ecology;
- Cultural Heritage; and
- Noise.

Consideration has also been given to a broader range of environmental impacts, including air, surface water, soils, chemical and hazardous substances management, contaminated land, waste minimisation and management, natural resources, local community and neighbouring properties, visual impacts, land use and cumulative environmental effects.

There are not anticipated to be any cumulative impacts associated with the proposed chip hole and associated activities.

This REF has been prepared in accordance with Clause 228 of the Environmental Planning and Assessment Regulation 2000 and provides consideration of the environmental impact of the proposed works as required by Section 111 of the Environmental Planning and Assessment Act 1979. The REF has identified that the proposed chip hole and associated activities are not likely to significantly affect the environment or threatened species, populations or ecological communities or their habitats.

---

## References

Bureau of Meteorology (BoM) (2011), *Curlewis (Wongalee) NSW Daily Weather Observations*, accessed on 1 June 2011 at: <http://www.bom.gov.au/climate>

Gunnedah Shire Council (GCS) (2011), Soil Descriptions. Website Accessed on 31 May 2011:  
<http://www.infogunnedah.com.au/index.php?pid=109>

Namoi Catchment Management Authority – website [www.namoi.cma.nsw.gov.au](http://www.namoi.cma.nsw.gov.au) – accessed in June 2011.

---

# Appendix A

Ecological Assessment

prepared by RPS



# Preliminary Ecological Assessment

## Wando I Chip Hole – PEL I, Gunnedah Basin

Prepared by:

**RPS AUSTRALIA EAST PTY LTD**

743 Ann Street  
PO Box 1559  
FORTITUDE VALLEY QLD 4006

T: 617 3237 8899  
F: 617 3237 8833  
E: Brad.Dreis@rpsgroup.com.au  
W: rpsgroup.com.au

Report Number: 106107-2-EA  
Version / Date: FR, Rev 0 / June 2011

Prepared for:

**SANTOS PTY LTD**

Level 22 Santos Place  
Turbot St  
BRISBANE QLD 4000

T: 07 3838 3676  
F: 07 3838 3700

### Important Note

Apart from fair dealing for the purposes of private study, research, criticism, or review as permitted under the Copyright Act, no part of this report, its attachments or appendices may be reproduced by any process without the written consent of RPS Australia East Pty Ltd. All enquiries should be directed to RPS Australia East Pty Ltd.

We have prepared this report for the sole purposes of Santos (“Client”) for the specific purpose only for which it is supplied. This report is strictly limited to the purpose and the facts and matters stated in it and does not apply directly or indirectly and will not be used for any other application, purpose, use or matter.

In preparing this report we have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

This report is presented without the assumption of a duty of care to any other person (other than the Client) (“Third Party”). The report may not contain sufficient information for the purposes of a Third Party or for other uses. Without the prior written consent of RPS Australia East Pty Ltd:

This report may not be relied on by a Third Party; and

RPS Australia East Pty Ltd will not be liable to a Third Party for any loss, damage, liability or claim arising out of or incidental to a Third Party publishing, using or relying on the facts, content, opinions or subject matter contained in this report.

If a Third Party uses or relies on the facts, content, opinions or subject matter contained in this report with or without the consent of RPS Australia East Pty Ltd, RPS Australia East Pty Ltd disclaims all risk and the Third Party assumes all risk and releases and indemnifies and agrees to keep indemnified RPS Australia East Pty Ltd from any loss, damage, claim or liability arising directly or indirectly from the use of or reliance on this report.

In this note, a reference to loss and damage includes past and prospective economic loss, loss of profits, damage to property, injury to any person (including death) costs and expenses incurred in taking measures to prevent, mitigate or rectify any harm, loss of opportunity, legal costs, compensation, interest and any other direct, indirect, consequential or financial or other loss.

### Document Status

<i>Version</i>	<i>Purpose of Document</i>	<i>Orig</i>	<i>Review</i>	<i>Review Date</i>	<i>QA Review</i>	<i>RPS Release Approval</i>	<i>Issue Date</i>
A	<i>Draft for Client Review</i>	HR KB	BD	7/6/2011	BD	BD	6/6/2011
0	<i>Final for Submission</i>	HR	Santos	15/6/2011	BD	BD	16/6/2011
1	<i>Final for Submission</i>	HR	Santos	22/6/2011	BD	BD	23/6/2011

# Contents

<b>TERMS &amp; ABBREVIATIONS .....</b>	<b>V</b>
<b>1.0 INTRODUCTION .....</b>	<b>1</b>
1.1 BACKGROUND .....	1
1.2 SITE PARTICULARS .....	1
1.2.1 Regional Location .....	1
1.2.2 Study Area Description .....	1
1.3 DESCRIPTION OF THE PROPOSED ACTIVITIES.....	2
1.3.1 Introduction.....	2
1.3.2 Site Preparation & Equipment.....	2
1.3.3 Drill Rig Positioning & Operation.....	3
1.3.4 Drilling Activities .....	4
1.3.5 Abandonment and Rehabilitation .....	4
1.3.6 Duration.....	5
1.3.7 Staff & Hours of Operation .....	5
1.3.8 Chemicals.....	5
1.3.9 Justification of Activity .....	6
1.3.10 Alternatives.....	7
1.4 SCOPE OF THE STUDY.....	8
1.5 LICENSING AND CERTIFICATION.....	8
<b>2.0 LEGISLATIVE CONTEXT.....</b>	<b>11</b>
2.1 COMMONWEALTH LEGISLATION .....	11
2.1.1 Environment Protection and Biodiversity Conservation Act 1999.....	11
2.2 NSW STATE LEGISLATION .....	12
2.2.1 Environmental Planning and Assessment Act 1979 .....	12
2.2.2 Threatened Species Conservation Act 1995 .....	14
2.2.3 National Parks and Wildlife Act.....	14
2.2.4 Key Threatening Processes .....	15
2.2.5 Noxious Weeds Act.....	15
2.2.6 Native Vegetation Act 2003.....	15

<b>3.0</b>	<b>METHODOLOGY .....</b>	<b>16</b>
3.1	DESKTOP ASSESSMENT .....	16
3.2	FIELD ASSESSMENT .....	16
3.3	SURVEY LIMITATIONS .....	17
<b>4.0</b>	<b>RESULTS .....</b>	<b>18</b>
4.1	LITERATURE REVIEW AND DATABASE SEARCH RESULTS .....	18
4.1.1	Environmental Protection and Biodiversity Conservation .....	18
4.1.2	Threatened Species Conservation Act .....	18
4.2	FLORA SURVEY RESULTS .....	19
4.2.1	Existing Condition .....	19
4.2.2	Weeds .....	23
4.2.3	Significant Flora Species.....	23
4.2.4	Threatened Ecological Communities Assessment.....	23
4.3	FAUNA SURVEY RESULTS .....	26
4.3.1	Habitat Values .....	26
4.3.2	Fauna Observations.....	26
4.3.3	Significant Species.....	26
<b>5.0</b>	<b>ENVIRONMENTAL IMPACT ASSESSMENT .....</b>	<b>28</b>
5.1	THREATENED FLORA AND FAUNA .....	28
5.2	IMPACT ASSESSMENT UNDER THE TSC ACT .....	49
5.3	IMPACT ASSESSMENT UNDER THE EPBC ACT .....	49
5.4	KEY THREATENING PROCESSES RELEVANT TO PROPOSED ACTIVITIES.....	49
5.5	KOALA SEPP 44 .....	50
5.6	DISCUSSION OF IMPACTS .....	51
5.6.1	Potential Impacts.....	51
5.6.2	Overview of Identifying Potential Impacts .....	52
<b>6.0</b>	<b>IMPACT MITIGATION AND MANAGEMENT .....</b>	<b>55</b>
6.1	INTRODUCTION .....	55
6.2	MITIGATION MEASURES .....	55
6.2.1	Avoid .....	55
6.2.2	Minimise .....	55
6.2.3	Mitigate.....	56
6.2.4	Offset.....	56

**7.0 CONCLUSION ..... 57**

**8.0 REFERENCES ..... 58**

## Tables

Table 1.1 Areas of disturbance & cut and fill for well leases ..... 3

Table 1.2 Duration of drilling and site activities ..... 5

Table 4.1: TSC Act Box Gum Woodland Listing Criteria ..... 24

Table 5.1: Likelihood of Significant Species Occurring in the Study Area..... 29

Table 5.2: Likelihood of Migratory Species Occurring within the study area ..... 46

Table 5.3: Key Threatening Processes Relevant to the Proposed Activities..... 50

## Plates

Plate 4.1: Disturbed Grassland ..... 20

Plate 4.2: White Cypress Woodland ..... 21

Plate 4.3: Eucalypt Open-woodland..... 22

## Figures

Figure 1.1: Site Location and Aerial Photograph ..... 9

Figure 1.2: Proposed Chip Hole Lease Layout..... 10

Figure 4.1: Vegetation Communities Within the Study Area..... 27

## Appendices

Appendix A: EPBC Act Protected Matters Search

Appendix B: Site Flora Species List

Appendix C: 7-Part Test / AOS

## Terms & Abbreviations

Abbreviation	Meaning
AoS	Assessment of Significance
BoM	Bureau of Meteorology
CEEC	Critically Endangered Ecological Community
CMA	Catchment Management Authority
DEWHA	Department of Water, Heritage and the Arts
EA	Ecological Assessment
EEC	Endangered Ecological Community
EMP	Environmental Management Plan
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
FM Act	NSW Fisheries Management Act 1994
ha	hectare
KTP	Key Threatening Process
LGA	Local Government Area
Locality	Lands within 10km of the study area
MNES	Matters of National Environmental Significance
NES	National Environmental Significance
NPWS	NSW National Parks and Wildlife Service
NSWG	NSW Government
NV Act	Native Vegetation Act 2003
NW Act	Noxious Weeds Act 1993
OEH	Office of Environment and Heritage
REF	Review of Environmental Factors
RPS	RPS Australia East Pty Ltd
SEPP 44	State Environmental Planning Policy 44 "Koala Habitat Protection"
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities
Sp	Singular Species
Spp	Multiple Species
Ssp. or subsp.	Subspecies
Activity Site	Area directly associated with the proposed activities
Study Area	Area indirectly associated with the proposed activities
TEC	Threatened Ecological Community
TSC Act	NSW Threatened Species Conservation Act 1995

---

## 1.0 Introduction

### 1.1 Background

Santos QNT Pty Ltd (Santos) is investigating opportunities for activities associated with Coal Seam Gas exploration currently underway in the Gunnedah Basin. RPS was engaged to undertake an ecological pre-clearance assessment of a portion Lot 84 on DP755532, to identify ecological constraints, potential impacts and mitigation measures associated with the development of an exploration gas well referred to as Wando 1, located within PEL 1.

This ecological assessment accompanies the review of environmental factors (REF) prepared in accordance with the *Environmental Planning and Assessment Act 1979* (NSW) in relation to the proposed activities.

### 1.2 Site Particulars

#### 1.2.1 Regional Location

The study area is located approximately 2.5km north east of Milroy, and 18km west of Curlewis, within the Gunnedah Shire Council Local Government Area (LGA) (**Figure 1.1**). The property is within the in the Brigalow Belt South IBRA Bioregion and Liverpool Plains IBRA Subregion. The property is located approximately 3km to the west of Wondoba State Conservation Area, and 14km north-west of Lake Goran, a wetland of national significance.

#### 1.2.2 Study Area Description

The property is approximately 155.3ha, however the study area is limited to a 16.8ha area surrounding the proposed chip hole lease (**Figure 1.1**). The topography of the study area is flat. The property is currently used for cattle grazing, and is comprised of numerous fenced paddocks consisting of native and exotic grass species. Additional infrastructure includes stock yards, sheds, and a residence.

The majority of the property has been previously selectively cleared through historical land management practices, however a small stand of woodland vegetation and scattered canopy trees occur across the property.

The property is bound to the north by Goscombe Road, and to the south by Mount Knowies Road. The property is surrounded by grazing lands. A vegetated road reserve and isolated stands of woodland vegetation providing a tenuous link to Wondoba State Conservation Area.

The proposed chip hole lease is located within a grazing area, adjacent to a small stand of woodland vegetation. A small rubbish pit occurs within the proposed chip hole lease (**Figure 1.1**).

---

## 1.3 Description of the Proposed Activities

### 1.3.1 Introduction

Santos proposes to undertake drilling activities to assess the coal seam gas potential of the Gunnedah Basin in PEL 1, which are the subject of the REF.

The proposed appraisal program includes drilling at the Wando 1 location to obtain information on coal depths, seam thickness, continuity, gas composition (as required) and reservoir pressure and permeability. Drill stem testing (DST) or equivalent downhole evaluation is planned to be undertaken on target coal seams to collect information on reservoir pressure and gain an indication of permeability. Drill cuttings may also be collected and analysed for gas composition information. Wando 1 is planned as a 'chiphole' which means that no continuous core is planned to be collected from the well. Following drilling to the well total depth and conduct of required well logging and testing the well will be plugged and abandoned with cement plugs from total depth to surface.

In summary, the process involves:

- preparation of lease access tracks utilising existing access tracks as much as is practical;
- preparation of a level drill pad (also referred to as "well lease area");
- placement of a drilling rig and ancillary equipment at the well lease;
- drilling of the well;
- collection and analysis of drill cuttings (as required);
- conduct well testing and wireline logging (as required);
- plugging and abandonment of the well;
- removal of equipment and imported materials from the site; and
- full rehabilitation of the site in line with legislative and landholder requirements.

Santos has negotiated an access, compensation and rehabilitation agreement with the affected landowner in respect to land access, compensation and rehabilitation. A scouting survey has been undertaken in consultation with the relevant landholder prior to drilling taking place to locate the site with an emphasis on minimisation of impacts on the environment and property operations.

### 1.3.2 Site Preparation & Equipment

Various works will be required in order to prepare the site for the proposed drilling, including preparation of the well lease, access track improvements and construction as well as positioning the drill rig and associated temporary buildings and equipment on the site. The major equipment used on site will be a drilling rig and associated temporary buildings. These works are summarised further in this section. Figure 3.1 and Figure 3.2 of the REF illustrate the proposed site layout for the well lease and access tracks. Figure 3.3 of the REF illustrates the proposed erosion and sediment control measures for the well lease.

During site preparation, there will be some soil disturbance as a level drill pad will need to be constructed at the well lease. Associated lined drilling sumps and a flare pit will also be constructed on site for use during drilling operations. The area to be disturbed for drilling activity is outlined in **Table 1.1**.

**Table 1.1 Areas of disturbance & cut and fill for well leases**

Well Lease	Area of Disturbance	Pad Level
Wando	86m X 64m with an overall area of disturbance of 5,504m <sup>2</sup> .	Existing pit will be backfilled, compacted and graded to establish a pad level at approximately RL 338.20m AHD.
Access Track	500 x 6m = 3,000m <sup>2</sup>	n/a

### Well Lease Construction

- Civil works equipment will be moved to site including bulldozer, excavator, grader, roller, water trucks, other trucks and support and light vehicles;
- Portable amenities will be located on site during construction.;
- Any topsoil will be stripped and stockpiled;
- Required sumps will be excavated and lined with impermeable plastic sheeting;
- The lease area will be graded, rolled and otherwise constructed per Figure 3.2 of the REF;
- A 10-3/4" steel conductor casing will be pre-installed at approximately 6m depth by the civil works crews ahead of the rig arriving on site; and
- The well lease pad will be fenced in a conventional manner consistent with the fencing on the landholders property.

### Access Track Improvements and Construction

There is an existing track which provides partial access to the location. Upgrading of this track with gravel will be required, however no widening is necessary. Approximately 500m of new access track is required to be constructed to enable access to the well lease. The following is a list of the detailed works involved.

- All access tracks will be constructed 6m in width;
- The new access track will have a topdress of 150 mm of road base;
- The existing track will have approximately 500m dressed with 100mm road base;
- Track is to be constructed to allow wet weather access; and
- Two sets of double gates and end assemblies to be installed in two locations on the northern boundary of the well lease.

### **I.3.3 Drill Rig Positioning & Operation**

- Equipment will enter/exit the site via the main access gate. Equipment will include generator units, lighting towers, site offices, stores and other various buildings and equipment required for the duration of drilling;

- Moving and rigging up/down of equipment (i.e. installation and dismantling of rig equipment) is expected to take up to 3 days per site (3 per rig up, 3 per rig down); and
- Ancillary equipment will be required on site during the course of the drilling activities, including wireline trucks, cementing trucks and service company vehicles, these vehicles will exit and enter the site as required.

### **1.3.4 Drilling Activities**

The well will have a specific design ensuring compliance with relevant legislation. A nominal 10-3/4" (273mm) cemented conductor is to be installed by the lease builder to approximately 6 m below ground level. Surface hole of 8 1/2" (216mm) will be rotary drilled to approximately 150mRT, where a 7" (178mm) steel surface casing will be landed and pressure cemented in place with cement to surface. The main hole of diameter 6-1/8" (156mm) will be drilled from the 7" (178mm) casing shoe to well total depth planned to be 20m into the Boggabri Volcanics at approximately 720mRT based on the pre-drill geological prognosis. DSTs or equivalent downhole evaluations may be conducted on penetration over selected Late and Early Permian Coals with testing to be performed in accordance with legislative requirements.

The closest offset wells to the proposed activities are Wondobah Ddh 1 (5.35km), Millie Ddh 1 (10.13km) and Goran 1 (8.12km).

Once the well has reached its total depth, geophysical wire-line logs will be run over the entire length of the hole to identify major stratigraphic units, intersected coal seam depth and seam thickness. Further DST or equivalent downhole evaluation may follow after completion of logging. Following logging and any post TD activities, the well will be fully plugged and abandoned from bottom to top with cement plugs. A separate P&A program will be issued at a later date. Regulatory approval is required for the abandonment program prior to abandonment operations commencing.

It is worth noting that due to poor quantity of stratigraphic data in the vicinity of the planned well it is estimated that the pre-drill prognosed formation tops may be forecast in error of up to +/- 100m.

### **1.3.5 Abandonment and Rehabilitation**

The well will be cemented, plugged and abandoned in accordance with DTIRIS requirements and rehabilitated following completion of activities within the allowed regulatory timeframe, unless needed for further exploration testing. In the case of plug and abandonment, the intermediate casing would be removed above the top of cement (where required and practicable) and a steel identification plate installed near the top of the hole > 1 metres below the surface.

Once the drilling and testing activities are complete, the disturbed area is proposed to be rehabilitated with appropriate mitigation measures and environmental safeguards implemented to minimise potential impacts. All rehabilitation works will be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation in accordance with the relevant statutory requirements.

Revegetation & rehabilitation will be undertaken within the required regulatory timeframe. All private tracks used during operations are generally returned to their pre-operations state or to a condition agreed by the landholder.

### 1.3.6 Duration

Drilling activities are temporary and will not have any long-term impact on the visual amenity of the area. The drilling of the well is expected to occur over a 30 day period not including lease build, or site restoration. There will be 14 days of lease construction activities prior to drilling the well. Rehabilitation activities of 30 days following the drilling of the well will be additional to this period.

This equates to a total of approximately 44 days of construction and drilling and 30 days of rehabilitation, as outlined in the table below.

**Table 1.2 Duration of drilling and site activities**

Activity	Expected Duration
Lease Build	14 days
Drilling	30 days
Rehabilitation	30 days

### 1.3.7 Staff & Hours of Operation

The number of employees present on the site at any one time is expected to be up to 20 persons. It is not proposed to provide a workers camp on the site, with off-shift drilling crews to be located in nearby accommodation with travel to and from site to be provided.

The hours of operation during the drilling and work over will be on a 24-hour a day basis as negotiated with the landholder. Personnel movements to and from site will be minimised outside of a single shift change per day but may be necessary due to emergency situations or specific activities (e.g. crews and service companies entering and leaving site to conduct specific activities).

### 1.3.8 Chemicals

A number of chemicals are planned to be utilised to facilitate the efficient and safe drilling of the wells in line with best oilfield practice. These chemicals are typical of those generally used in oilfield activities. These chemicals will be used either to deliver the wells as planned or will be held in contingency to handle unplanned scenarios (e.g. stuck pipe, excessive mud losses etc.). The Material Safety Data Sheet (MSDS) information for all of these chemicals can be found on the Santos web site (<http://www.santos.com/exploration-acreage/gunnedah-basin-gas/fact-sheets-msds.aspx>). The fluids are water based (not synthetic or oil based) and recycled for reuse as much as possible during the drilling process. The following list summarises the list of relevant chemical MSDS for the proposed activities.

- AMC Xtra-Sweep
- AMC Lime
- AMC Hammer Oil
- AMC Aus-Ben
- AMC Aus-Gel
- AMC Aus-Plug
- Barite
- Caustic Soda (Rheochem)
- Citric Acid (Rheochem)
- Frascseal Fine, Medium
- Drispac (Regular and Superlo) Polymer
- Soda Ash Dense
- SAPP
- Poly-Bore™
- CSR Raw Sugar / Brown Sugar
- Mud Flush III
- Guar gum, propoxylated
- Fly Ash – Eraring
- Flocele 3/8"
- AMC EP Bit Lube
- Econolite Additive
- Rheolube
- Idcide-20
- JK-261
- Sodium Bicarbonate
- Kwikseal (Fine/Medium/Coarse)
- Xanthan Gum (XC)
- Rheopac R/LV/UL/RD/LVD
- Pheno Seal
- Potassium Chloride (Rheochem)
- AMC CR-650
- Cement – Standard – Class A
- CFR-3
- CAL-Seal 60
- Calcium Chloride – Flake
- Bentonite
- AMC Superfoam
- Salt (Rheochem)
- AMC PAC R
- Baroid Quikmud
- Quickseal (Fine/Medium/Coarse)
- Defoam-A
- Trugel 13-A
- JK 161-LV

### 1.3.9 Justification of Activity

Drilling of the Wando 1 well is a necessary step in the ongoing exploration and evaluation of the hydrocarbon potential in PEL 1, which to date has undergone limited petroleum exploration. Discovery and appraisal of coal seam gas resources in the area has the potential to increase the state's reserves and revenue from gas and underpin future exploration or production in the region.

The proposed program consists of preparing a lease site and access tracks, drilling a well, wireline geophysical logging, drill stem testing or equivalent downhole evaluation, casing and cementing using steel casing strings, plugging and abandoning of the well and rehabilitation of the site. These procedures are required to define and identify potentially commercially valuable reserves of coal seam gas. Santos is committed to undertake this work as part of its obligations under NSW petroleum legislation and its obligations contained in the Farm-in Agreement entered into with Australian Coalbed Methane Pty Ltd.

---

### 1.3.10 Alternatives

There is limited previous drilling in this area of the Gunnedah Basin that is sufficiently deep for the purposes of petroleum exploration. The proposed drilling operation is essential to gain detailed stratigraphical data and information on target coal seam pressures and permeabilities. Sampling of drill cuttings for gas composition may also be undertaken to gather data on gas composition heterogeneity throughout the target coal seams in PEL 1. Due to the highly specialised nature of the proposed works, drill cutting sampling and well testing are the only feasible method available to obtain reliable and accurate gas composition and pressure and permeability data for the local coal resource. Geophysical methods available (e.g. seismic), which could be applied to exploration would show the structure of the basin but would not provide the ability to sample and analyse the stratigraphy of the Gunnedah Basin to quantify coal seam gas potential.

The location of the appraisal hole is a substantial factor in the evaluation of the potential coal seam gas resource. The initial location of the appraisal hole was carefully considered by the project team, in consultation with specialist consultants and agricultural operators and taking into account the underlying geology, the existing environment and the current land use.

The selection of the proposed chip hole site located on privately owned land has been based upon the ecological protection principles of avoidance and harm minimisation. The site has been selected to avoid and/or minimise potential ecological impacts. The well lease site selection process identified areas where historical disturbances had modified the natural condition and where zero or minimal vegetation clearing, tree removal and earthworks would be required to establish the well lease and associated infrastructure, including the access track.

The site was located in consultation with the landholder and with the assistance of a scouting party comprised of Santos' Project Representatives, Cultural Heritage Officers and Lease Construction Experts. Third party surveyors and Ecologists were also consulted to assist in positioning of the well lease as part of the scouting process.

Once all known constraints were identified on the site, this information was used to delineate areas to be avoided in the initial appraisal hole location identification process. This included areas which would require unnecessary intrusion on sensitive ecological communities or significant cut and fill to accommodate level drilling pad and all weather vehicular access.

The final area identified for the appraisal hole operations have been determined to avoid existing constraints as much as is practical. By undertaking the site identification methodology outlined above, the evaluation of alternative sites for the drilling program were undertaken using an adaptive management approach, where constraints were identified, verified in the field and avoided. The resulting appraisal hole location area is considered the most appropriate location both from a resource investigation perspective and to minimise any potential environmental impacts.

---

## 1.4 Scope of the Study

The objective of this assessment was to undertake an ecological assessment of the proposed exploration chip hole lease and access roads to identify ecological impacts of the proposed activities, and recommend appropriate mitigation measures. The specific scope of the assessment was to:

- Conduct a background review of relevant environmental databases, maps and policies;
- Verify the vegetation communities and ecosystems occurring in the study area;
- Identify threatened species habitat values of the study area;
- Identify significant weed species;
- Identify constraints associated with the ecological features of the site in a legislative and planning context;
- Identify potential ecological impacts associated with the chip hole; and
- Recommend appropriate mitigation measures to minimise potential ecological impacts.


A desktop assessment of the proposed chip hole lease and surrounds was conducted prior to completing a site assessment on 31 March, 2011. This assessment details the findings of the background review and pre-clearance survey. Additionally, Commonwealth, state and local legislation relevant to the proposal have been addressed in this assessment.

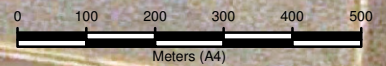
## 1.5 Licensing and Certification

Research was conducted under the NSW National Parks and Wildlife Service Scientific Investigation Licence S10300 (Valid 30 November 2011).



### Legend

 Study Area



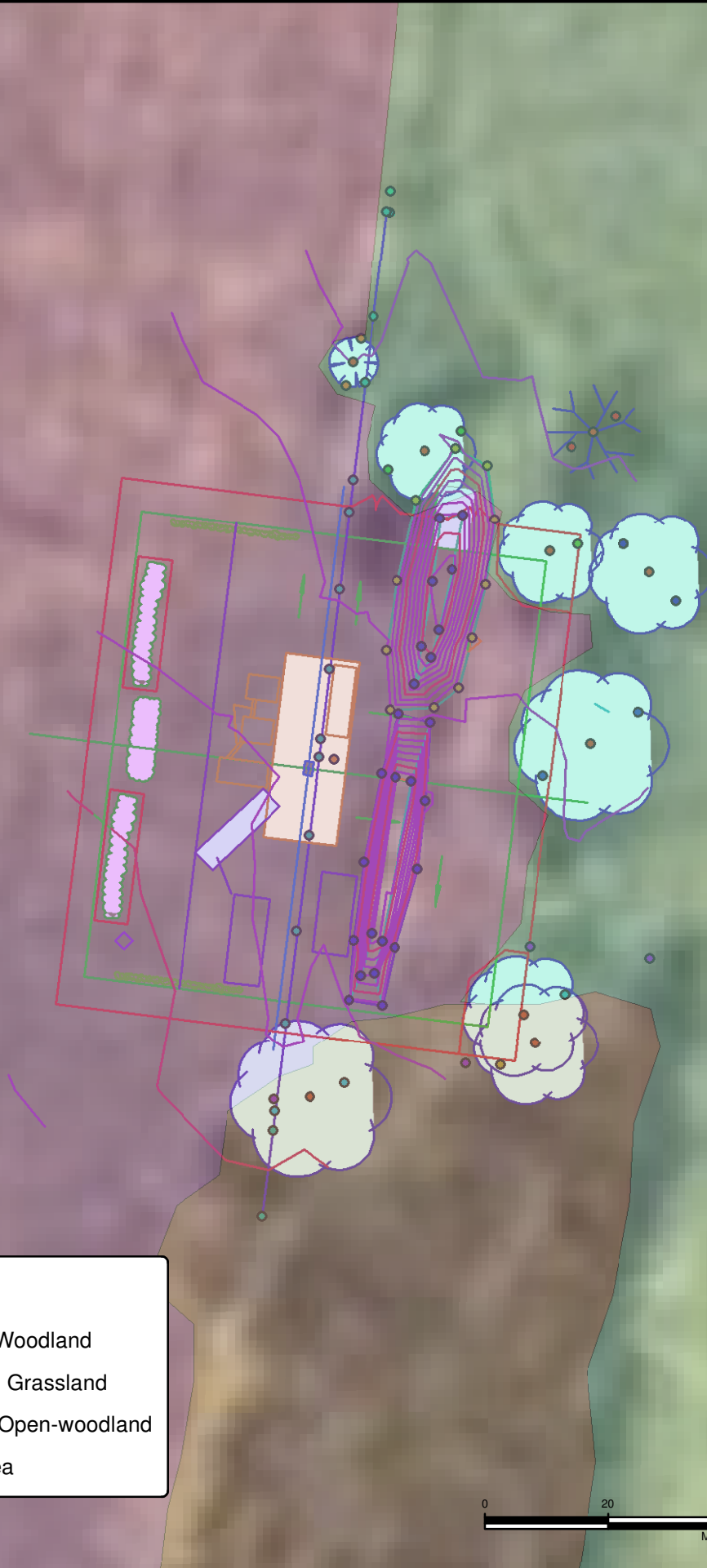
AERIAL PHOTOGRAPHY.  
The aerial photography used in this plan has not been rectified.  
The image has been overlaid on a grid fit on the boundaries  
shown and position is approximate only.

Project Manager	BD
Compiled by	HR
Map Projection	MGAz56
Map Datum	GDA94
File Reference	PR107106-2.mxd
Sheet Number	1 of 1

Client	Santos QNT Pty Ltd
Title	Figure 1.1 Aerial Photograph and Site Locality Wando 1

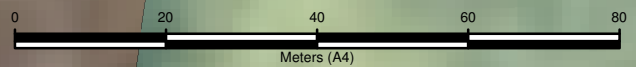
# RPS

SCALE (A4) 1:11,000	DATE 9/6/2011	DRAWING NO. PR107106-1	ISSUE A
------------------------	------------------	---------------------------	------------



### Legend

- Cypress Woodland
- Disturbed Grassland
- Eucalypt Open-woodland
- Study Area



AERIAL PHOTOGRAPHY:  
The aerial photography used in this plan has not been rectified.  
The image has been overlaid at a best fit on the boundaries shown  
and position is approximate only.

Project Manager	BD
Compiled by	HR
Map Projection	MGAz56
Map Datum	GDA94
File Reference	107106-2
Sheet Number	1 of 1

Client	Santos QNT Pty Ltd
Title	Figure 1.2 Well Lease Layout Wando 1

<h1>RPS</h1>			
SCALE (A4)	DATE	FIGURE	ISSUE
1:1,000	14/6/2011	107106-2	A

---

## 2.0 Legislative Context

### 2.1 Commonwealth Legislation

#### 2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) provides that a person proposing to take an action that the person thinks may be a "controlled action" must refer the proposal to the Minister for Sustainability, Environment, Water, Population and Communities (Minister). A "controlled action" is an action that:

- will have or is likely to have a significant impact on
  - » World heritage areas
  - » National heritage places
  - » Ramsar wetlands of international importance
  - » Commonwealth listed threatened species and communities
  - » Commonwealth listed migratory species
  - » Commonwealth marine areas
  - » The environment on Commonwealth land
  - » Great Barrier Reef Marine Park;
- Is undertaken by the Commonwealth and will have or is likely to have a significant impact on the environment;
- Is undertaken by any person on Commonwealth land and will have or is likely to have a significant impact on the environment; or
- Is a nuclear action.

These are referred to as "matters of national environmental significance" (MNES). The EPBC Act sets out the process for identifying and listing the MNES including listed threatened species and listed migratory species.

If the Minister decides that the proposed action is a controlled action, then the approval of the Minister is required under the EPBC Act

A person proposing to take an action that the person thinks is not a controlled action may refer the proposal to the Minister for the Minister's decision whether or not the action is a controlled action. The proposed chip hole and associated activities are not expected to have, or be likely to have, a significant impact on MNES including, in particular, listed threatened species or listed migratory species under the EPBC Act.

---

## 2.2 NSW State Legislation

### 2.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) regulates development carried out in New South Wales. The carrying out of development is regulated under either Part 3A, Part 4 or Part 5 of the EP&A Act.

Development is required to be assessed under Part 5 of the EP&A Act if the relevant environmental planning instruments provide that the development does not require consent or is not exempt development and the development is either carried out by a determining authority or requires the approval of a determining authority.

The proposed activities fall within the local government area (LGA) of Gunnedah Shire. The subject site is zoned 1(a) Rural (Agricultural Protection) under the *Gunnedah Local Environmental Plan 1998* (NSW) (Gunnedah LEP). The proposed activities are permissible with development consent under the Gunnedah LEP. However, *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (NSW) (Mining SEPP) applies to the activities. The Mining SEPP aims "to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of [New South Wales]". Clause 6 of the Mining SEPP provides that development for the purposes of petroleum exploration may be carried out without development consent. Clause 6 applies despite the provisions of the Gunnedah LEP. This has the effect that the proposed activities are required to be assessed under Part 5 of the EP&A Act.

A determining authority, for the purposes of this activity, is defined in Part 5 to include a public authority whose approval is required before an activity may be carried out. The Assistant Director, Environment of the Department of Primary Industries and the New South Wales Office of Water will be determining authorities for the purposes of Part 5 of the EP&A Act because their approval is required for the proposed development under the legislation administered by these determining authorities.

#### Determining Authorities

Under Part 5 of the EP&A Act, a determining authority is required to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

Additionally, clause 228 of the *Environmental Planning and Assessment Regulation 2000* (NSW) sets out the factors that must be taken into account concerning the impact of an activity on the environment.

The determining authorities are required to consider whether the proposed activity is likely to significantly affect the environment or threatened species, populations or ecological communities, or their habitats to determine whether an EIS or SIS is required. In deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities or their habitats, section 5A of the EP&A Act requires the following factors to be taken into account (the "seven part" test of significance):

*In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction;*

*In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction;*

*In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

- (i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- (ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

*In relation to the habitat of a threatened species, population or ecological community:*

- (i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and*
- (ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed activities, and*
- (iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*

*Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);*

*Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan; and*

*Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

This ecological assessment has been prepared to assist the determining authorities in meeting their obligations under the EP&A Act. In particular, the "seven part" test has been applied to the proposed chip hole activities in **Appendix C**.

#### State Environmental Planning Policy No. 44 – Koala Habitat Protection

*State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) aims "to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline".*

Schedule 1 of SEPP 44, which lists the LGAs to which SEPP 44 applies, includes the Gunnedah LGA. SEPP 44 applies to local councils determining development applications under Part 4 of the EP&A Act. Although SEPP 44 does not apply in relation to the assessment of development under Part 5 of the EP&A Act, it has been considered in the preparation of this REF.

SEPP 44 requires that before granting development consent under Part 4 of the EP&A Act for development on land over 1 hectare in area, a consent authority must form a view as to whether the land is "potential" or "core" Koala habitat. Potential Koala habitat is defined as:

*areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.*

Core Koala habitat is defined as:

*an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.*

Where core Koala habitat is found to occur, SEPP 44 requires that a site-specific Koala plan of management be prepared.

### **2.2.2 Threatened Species Conservation Act 1995**

The objects of the *Threatened Species Conservation 1995* (NSW) (TSC Act) include:

- To conserve biological diversity and promote ecologically sustainable development;
- Prevent the extinction and promote the recovery of threatened species, populations and ecological communities;
- To protect the critical habitat of those threatened species, populations and ecological communities that are endangered; and
- To ensure that the impact of any action affecting threatened species, populations and ecological preventing the extinction and promoting the recovery of threatened species, populations and ecological communities is properly assessed.

The TSC Act provides the procedure for the listing of threatened species, populations and ecological communities and key threatening processes in New South Wales and the preparation and implementation of recovery plans and threat abatement plans.

The TSC Act also provides the mechanism for applying for and obtaining licences to take actions which will or is likely to result in harm to any animal that is a threatened species, population or ecological community, the picking of any plant which is part of a threatened species, population or ecological community, damage to critical habitat or damage to habitat of a threatened species, population or ecological community where such actions require a license to be obtained.

### **2.2.3 National Parks and Wildlife Act**

Part 8A of the *National Parks and Wildlife Act 1974* (NPW Act) regulates the undertaking of activities which may impact on threatened species, populations and ecological communities listed under the TSC Act and their habitats. The NPW Act provides that a person must not harm any animal that is a threatened species, population or ecological community, pick any plant which is part of a threatened species, population or ecological community, damage any critical habitat or damage any habitat of a

---

threatened species, population or ecological community without a licence being obtained under the NPW Act or TSC Act or unless another exception applies.

The NPW Act provides that these requirements do not apply if the action was essential for the carrying out of an activity in accordance with an approval of a determining authority under Part 5 of the EP&A Act where the determining authority has complied with Part 5.

#### **2.2.4 Key Threatening Processes**

A key threatening process is defined under the TSC Act as ‘a process that threatens, or that may threaten, the survival or evolutionary development of a species, population or ecological community. Threatening processes that adversely affect threatened species, populations or ecological communities, or possibly cause others that are not currently threatened; to become threatened may be eligible for listing as a key threatening process (KTP).

#### **2.2.5 Noxious Weeds Act**

The *Noxious Weeds Act 1993* relates to the management of declared weed species. This act allows for classification of weed species according to severity or ‘invasiveness’ and dictates the control requirements of weed species occurring on a site according to its classification.

#### **2.2.6 Native Vegetation Act 2003**

The *Native Vegetation Act 2003* regulates the clearing of native vegetation on all land in NSW, except for excluded land in Schedule 1 of the Act. The Act outlines what landowners can and cannot do in clearing native vegetation.

---

## 3.0 Methodology

### 3.1 Desktop Assessment

A desktop assessment was undertaken to identify potential development constraints as well as significant ecosystems and species that may potentially occur on within the proposed chip hole lease. The following databases and maps were reviewed:

- EPBC Act Protected Matters Search Tool (Department of Sustainability, Environment, Water, Population and Community (DSEWPaC), 2010) (**Appendix A**);
- Review of threatened fauna and flora records contained in the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife for the Curlewis Map Sheet, as well as the Liverpool Plains sub-catchment listing;
- National Vegetation Information Systems mapping; and
- Aerial photography.

### 3.2 Field Assessment

A site inspection was carried out on the 31 March 2011 to:

- Verify the results of the desktop assessment;
- Ground-truth vegetation communities;
- Undertake a fauna habitat assessment and incidental fauna observations;
- Undertake targeted searches for evidence of Koala (*Phascolarctos cinereus*);
- Identify potential habitat for potentially occurring significant species as listed under the EPBC and *Threatened Species Conservation Act 1995* (TSC); and
- Search for weed species.

Surveys of the proposed chip hole lease consisted of a threatened flora species search, a vegetation survey and a flora and fauna habitat assessment.

Habitat assessments included identifying and describing the commonly occurring and listed terrestrial species and communities known or likely to be present in the study area, and assess which species or communities may be affected by the proposed activities. Targeted searches for evidence of Koala were also undertaken on the majority of trees in the study area.

The threatened flora species search targeted those threatened flora species listed within the EPBC Protected Matters search and those species listed within the NSW Wildlife Atlas database for the Curlewis Map Sheet and Liverpool Plains Catchment Management Area (CMA) sub-region.

The flora survey consisted of a random meander and general threatened flora searches. This method generated a flora species list for and a description of the dominant flora species for the site.

---

### 3.3 Survey Limitations

It should be noted that the detectability of plants and the ability to accurately identify plants to species level may vary greatly with the time of year, prevailing climatic conditions and the presence of reproductive material (e.g. flowers, fruit, and seed capsules). Consequently, the survey conducted for the study area should not be regarded as conclusive evidence that certain protected plants do not occur within the study area; however every effort has been made to detect these species in habitats that were considered suitable.

In response to the abovementioned limitations the precautionary approach has been adopted; as such 'assumed presence' of known and expected threatened species, populations and ecological communities has been made where relevant to ensure a holistic assessment.

---

## 4.0 Results

### 4.1 Literature Review and Database Search Results

#### 4.1.1 Environmental Protection and Biodiversity Conservation

A search using the EPBC Act protected matters search tool revealed 46 threatened fauna species, comprising 22 birds, one frog, one fish, three reptiles and 19 mammals (including five bats), and nine threatened flora species listed under the EPBC Act that are predicted to occur within the locality of the study area.

In addition, nine migratory bird species were revealed as predicted to occur within the locality of the study area.

Four Critically Endangered Ecological Communities (CEEC) listed under the EPBC Act are also identified as potentially occurring within the locality of the study area:

- Fine-textured alluvial plains of northern New South Wales and southern Queensland;
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box-Gum Grassy Woodland and Derived Grassland);
- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia; and
- Weeping Myall Woodlands.

The results of the database search are shown in **Appendix A**.

No World Heritage properties, National Heritage properties, Commonwealth marine environments or Ramsar wetlands occur in the study area or would be affected by the activity.

A full list of threatened and migratory species obtained from the protected matters search tool is available in **Table 5.1** for flora and fauna species, and **Table 5.2** for migratory species. Each table describes the conservation status, habitat requirements and likelihood of occurrence of each listing. A review of the specific habitat requirements of these species, and the habitat present within the study area and its surrounds allowed a number of these species and/or EECs to be eliminated as having nil, or low likelihood of occurrence in the study area.

#### 4.1.2 Threatened Species Conservation Act

The results of the wildlife atlas database search revealed seven threatened flora species and 38 threatened fauna species, previously recorded within the Curlewis map sheet area, and Liverpool Plains CMA.

In addition there are nine Endangered Ecological Communities (EEC) listed within the TSC Act that are known or predicted to occur in the Liverpool Plains Management Area Sub-region. Those from the locality that are predicted to occur within the study area include:

- 
- Artesian Springs Ecological Community;
  - Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions;
  - Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions;
  - Native Vegetation on Cracking Clay Soils of the Liverpool Plains;
  - White Box-Yellow Box-Blakely's Red Gum Woodland.

A full list of threatened and migratory species obtained from the protected matters search tool is available in **Table 5.1** for flora and fauna species, and **Table 5.2** for migratory species. Each table describes the conservation status, habitat requirements and likelihood of occurrence of each listing. A review of the specific habitat requirements of these species, and the habitat present within the study area and its surrounds allowed a number of these species and/or EECs to be eliminated as having nil, or low likelihood of occurrence in the study area.

## 4.2 Flora Survey Results

### 4.2.1 Existing Condition

Three vegetation communities were observed within the study area. These communities were:

- Disturbed Grassland;
- White Cypress (*Callitris glaucophylla*) Woodland; and
- Eucalypt Open-woodland.

A detailed description of these vegetation communities is provided below, while the location and extent of these communities is shown in **Figure 4.1**. A detailed flora species list is included in **Appendix B**.

## Disturbed Grassland



**Plate 4.1: Disturbed Grassland**

**Description:** This vegetation community occurs across the proposed chip hole lease. It is characterised by a dense grassy ground layer, with no shrub or canopy vegetation.

**Ground Layer:** 0.2 m to 1.5 m. Variable 70-90% cover. Dominated by Plains Grass (*Austrostipa aristiglumis*), with Bathurst Burr (*Xanthium spinosum*) as a sub-dominant species. Commonly occurring weed species include Shepherds Purse (*Capsella bursa-pastoris*), Saffron Thistle (*Carthamus lanatus*), Mexican Poppy (*Argemone mexicana*), Tall Fleabane (*Conyza sumatrensis*), and Mint Weed (*Hyptis suaveolens*), with weed covers ranging from 30% to 50%.

Common native species include Pitted Blue-grass (*Bothriochloa decipiens*), Slender Chloris (*Chloris divaricata*), Slender Rats Tail Grass (*Sporobolus creber*), Three-awn Speargrass (*Aristida vagans*), Yellow Buttons (*Chrysocephalum apiculatum*), Australian Bluebell (*Wahlenbergia gracillis*), and Small-leaved Cotton Bush (*Maireana microphylla*).

**Condition:** This vegetation community occupies the chip hole lease. It is highly disturbed, due to grazing, historical vegetation clearing, and the presence of a small rubbish pit, which has resulted in weed invasion and poor native species diversity. This community is in a poor condition.

**Classification:** This vegetation community does not constitute any community that is listed within the schedules of the EPBC Act. This vegetation community is consistent with the White Box - Yellow Box - Blakely's Red Gum Woodland which is listed within the schedules of the TSC Act, despite the poor condition of vegetation within this community. Further justification for the classification of this community is provided in **Section 4.3.3** and **Section 4.3.4**.

White Cypress (*Callitris glaucophylla*) Woodland

**Plate 4.2: White Cypress Woodland**

**Description:** This vegetation community occurs to the immediate north of the proposed chip hole lease. It is characterised by a dense canopy of White Cypress, with occasional emergent Yellow Box. This community include a dense grassy ground layer, with no shrub layer.

**Canopy:** 10m to 15m. Variable 45-60% cover. Dominated by White Cypress, with emergent Yellow Box.

**Ground Layer:** 0.2 m to 1.5 m. Variable 70-90% PFC. Dominated by Plains Grass, with Pitted Bluegrass, Three-awn Speargrass, and Australian Bluebell. Weed species occurring include Shepherds Purse, Saffron Thistle (*Carthamus lanatus*), and Tall Fleabane (*Conyza sumatrensis*).

**Condition:** The ground cover and shrub layer of this community have been disturbed due to historical vegetation clearing and grazing. This has resulted in the presence of weed species in the ground cover. Generally, this community is in moderate condition.

**Classification:** This vegetation community does not constitute any community that is listed within the schedules of the EPBC Act. This vegetation community is consistent with the White Box - Yellow Box - Blakely's Red Gum Woodland which is listed within the schedules of the TSC Act. Further justification for the classification of this community is provided in **Section 4.3.3** and **Section 4.3.4**.

### Eucalypt Open-woodland



**Plate 4.3: Eucalypt Open-woodland**

**Description:** This vegetation community occurs across the majority of the study area, and to the immediate north and east of the proposed chip hole lease. It is characterised by scattered canopy species, with a grassy understorey.

**Canopy:** 15m to 22m. 5-15% PFC. Comprised of scattered Yellow Box, Bimble Box (*E. populnea*), and Blakeley's Red Gum (*E. blakelyi*).

**Ground Layer:** 0.2 m to 1.5 m. Variable 65-90% cover. Dominated by Plains Grass, with Bathurst Burr (*Xanthium spinosum*) as a sub-dominant species. Species are similar to the Disturbed Grassland community, and include Shepherds Purse, Saffron Thistle, Tall Fleabane, Pitted Blue-grass, Slender Chloris, Slender Rats Tail Grass, and Three-awn Speargrass.

**Condition:** The ground cover and shrub layer of this community have been disturbed due to historical vegetation clearing and continued grazing. This has resulted in the presence of weed species in the ground cover, and a sparse canopy cover. This vegetation community is in moderate condition.

**Classification:** Despite the disturbed condition of this community, the floristic structure and character corresponds with the (EEC known as White Box - Yellow Box - Blakely's Red Gum Woodland which is listed within the schedules of the TSC Act. This vegetation community is also commensurate with the federally listed (EPBC Act) threatened community known as White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Grasslands. This community is listed as Critically Endangered within the schedules of the EPBC Act.

#### 4.2.2 Weeds

Mexican Poppy is a declared Class 5 noxious weed under the *Noxious Weed Act 1993*. There are no requirements to control existing plants of Class 5 weeds, however the weeds are notifiable, and a range of restrictions apply to their sale and movement.

#### 4.2.3 Significant Flora Species

Using the EPBC Act Protected Matters Search Tool (**Appendix A**), nine threatened flora species listed under the EPBC Act were identified as potentially occurring in the site locale (10km buffer). Eight of these species were also identified as occurring in the study locale, based on the Curlewis Atlas of NSW Wildlife records. The likelihood of occurrence of these flora species was assessed based on broad habitat type and species distribution and is outlined in **Table 5.1**.

The chip hole lease contains marginal habitat for two grass species, however extensive searches failed to identify either species. No threatened flora species were identified on site.

#### 4.2.4 Threatened Ecological Communities Assessment

An assessment of the chip hole lease against the EPBC Act Policy Statement for Box-Gum Grassy Woodland and Derived Grassland, and Identification guidelines have been provided for the White Box - Yellow Box - Blakely's Red Gum Woodland EEC listed under the TSC Act (NPWS NPWS 2002) was conducted, given the presence of key indicator species adjacent to the proposed chip hole lease.

The disturbed grassland occurring across the chip hole lease is considered to be an EEC under the TSC Act, as outlined below. It is not considered to be a TEC under the EPBC Act.

It is noted that large tracts of the study area are considered to be a TEC under the EPBC Act.

##### TSC Act Assessment

Under the TSC Act, White Box - Yellow Box - Blakely's Red Gum Woodland EEC can exist in a number of states. Intact stands that contain diverse upper and mid-storeys and ground layers are rare. Modified states include the following:

- Areas where the main tree species are present ranging from an open woodland formation to a forest structure, and the ground layer is predominantly composed of exotic species; and
- Subject sites where the trees have been removed and only the grassy groundlayer and some herbs remain.

Identification guidelines have been provided for this community (NPWS 2002). The vegetation in the subject site has been assessed against these guidelines in **Table 4.2**.

Table 4.1: TSC Act Box Gum Woodland Listing Criteria

Box Gum Woodland	NPWS Comment	Response
1. The subject site is in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands or NSW South Western Slopes Bioregions. Proceed to 2.		The subject site is located within the Nandewar Bioregion.
1*. The site is outside of the above bioregions.	The site is not Box-Gum Woodland.	N/A
2. There are no native species in the understorey, and the subject site is unlikely to respond to assisted natural regeneration	The subject site is not Box Gum Woodland.	N/A
2* The subject site is otherwise. Proceed to 3.		The understorey, whilst comprising up to 50% weed species, includes large tracts of Plains Grass.
3. The subject site has trees. Proceed to 4.		The canopy is dominated by White Cypress, with occasional Bimble Box, Blakely's Red Gum and Yellow Box.
3* The subject site is treeless, but is likely to have supported White Box, Yellow Box or Blakely's Red Gum prior to clearing.		N/A
4. White Box, Yellow Box or Blakely's Red Gum, or a combination of these species, are or were present. Proceed to 5.		The canopy comprises occasional Blakely's Red Gum and Yellow Box.
4* White Box, Yellow Box or Blakely's Red Gum have never been present.	The subject site is not Box Gum Woodland.	N/A
5. The subject site is predominantly grassy.	The subject site is Box Gum Woodland.	The site comprises a weedy understorey, however native grasses are present.
5* The understorey of the subject site is dominated by shrubs excluding pioneer species.	The subject site is not Box Gum Woodland.	N/A

The results of the field survey determined that the chip hole lease and adjacent areas of the study area do fit the NSW Scientific Committee Final Determination of this EEC. This is due to the canopy comprising of either Blakely' Red Gum or Yellow Box with an understorey comprised of some of the native species listed in the determination. The chip hole lease is considered to be White Box – Yellow Box – Blakely's Red Gum Woodland.

#### EPBC Assessment

The following outlines the listing criteria to determine if a site is the Box-Gum Grassy Woodland and Derived Grassland under the EPBC Act Policy Statement:

*'Is, or was previously, at least one of the most common overstorey species White Box, Yellow Box, or Blakely's Red Gum (or Western Grey Box or Coastal Grey Box in the Nandewar region)?'*

While there are no canopy trees within the chip hole lease, surrounding trees include Yellow Box and Blakeley's Red Gum. It is likely that these species previously occurred within the proposed chip hole lease.

*Does the patch have a predominantly native understorey?*

A patch is defined as a continuous area containing the ecological community (areas of other ecological communities such as woodlands dominated by other species are not included in a patch). The patch is the larger of:

- An area that contains five or more trees in which no tree is greater than 75m from another tree; or
- The area over which the understorey is predominantly native.

For the purposes of this assessment, the patch that includes the proposed chip hole lease has been delineated as the disturbed grassland vegetation community. Whilst this area has been highly disturbed, as a predominantly native ground layer is one where at least 50% of the perennial vegetation cover in the ground layer is made up of native species, this area is considered to meet this criteria.

*Is the patch 0.1ha or greater in size?*

The defined patch is approximately 5.03ha, so is considered to meet this criteria.

*Are there 12 or more native understorey species present (excluding grasses), with at least one important species?*

Within the defined patch, there are not 12 or more native understorey species present, excluding grasses. A total of six herb and forb species were recoded within this patch. The patch does not meet this criteria.

*Is the patch 2ha or greater in size?*

The patch has been delimited at approximately 5ha.

*Does the patch have an average of 20 or more mature trees per hectare, or is there natural regeneration of the dominant overstorey eucalypts?*

The patch does not comprise an average of 20 or more mature trees per hectare. Furthermore, there is no evidence of natural regeneration of eucalypt species within this patch. The patch does not meet this criteria, and is therefore not considered to be the EPBC Act Box-Gum Grassy Woodland and Derived Grassland.

#### *Outcomes*

The results of the field survey determined that the chip hole lease does not fit the EPBC Act Box-Gum Grassy Woodland and Derived Native Grassland criteria, as the patch does not comprise the native species diversity, canopy tree density, or canopy species regeneration required under the Policy Statement.

It is noted that adjacent areas are considered to be the EPBC Act Box-Gum Grassy Woodland and Derived Native Grassland, including areas adjacent to the proposed access track.

---

## 4.3 Fauna Survey Results

### 4.3.1 Habitat Values

The proposed chip hole lease is comprised of understory vegetation that is dominated by exotic species, and a thinned canopy. This area has been highly disturbed due to weed invasion and a rubbish pit. Mature trees are either isolated individuals, or occur in small clumps, adjacent to the well lease. Due to historical land management practices, the pasture grasses do not provide significant habitat resources, such as rocky outcrops or fallen woody debris. This area is considered to be of low value for fauna, although the ground cover may provide limited foraging resources and shelter for native birds and small reptiles.

The scattered mature trees provide foraging and habitat resources for a range of generalist species, including mammals and birds. Additionally, many scattered trees are Koala food tree species. Evidence of Koala usage was identified at several Eucalypt trees surrounding the proposed lease.

### 4.3.2 Fauna Observations

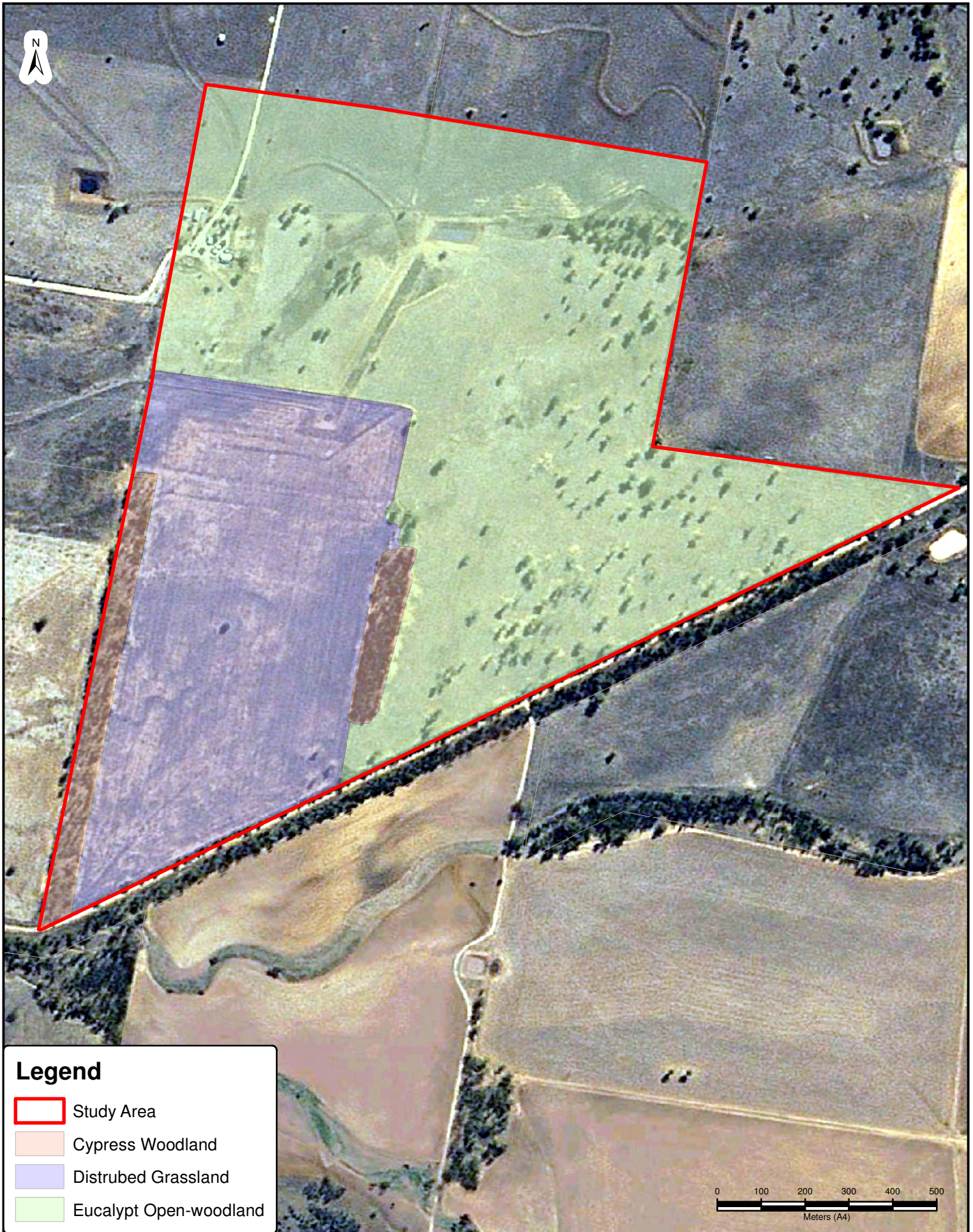
Several generalist bird species were recorded opportunistically adjacent to the study area, including Australian Magpie (*Gymnorhina tibicen*), Crested Pigeon (*Ocyphaps lophotes*), and Apostlebird (*Struthidea cinerea*). None of the above bird species are listed as threatened and/or migratory under the TSC Act and/or EPBC Act.

Macropod and rabbit scat were observed across the site. Additionally, Koala scat was observed under several Eucalypt species, however no Koalas were identified on site. Koala is listed as Vulnerable under the TSC Act.

### 4.3.3 Significant Species

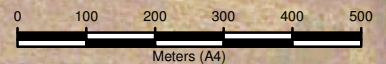
Fourteen threatened fauna species listed under the EPBC Act were identified as potentially occurring in the site locale (10km buffer) using the EPBC Protected Matters Search Tool (**Appendix 1**). Forty-five threatened species were identified as potentially occurring in the study area, based on the Curlewis Atlas of NSW Wildlife records. The likelihood of occurrence of these species was assessed, based on broad habitat type and species distribution, outlined in **Table 5.1**. The assessment identified that the site provides potential habitat for eight ave species, as well as three bat species. Additionally, Koala scats were observed on site.

An additional nine migratory species were identified as potentially occurring in the site locale using the EPBC Protected Matters Search Tool. The site provides suitable potential habitat for four of the listed migratory species, as identified in **Table 5.2**.



### Legend

- Study Area
- Cypress Woodland
- Disturbed Grassland
- Eucalypt Open-woodland



AERIAL PHOTOGRAPHY:  
The aerial photography used in this plan has not been rectified.  
The image has been overlaid as a best fit on the boundaries shown  
and position is approximate only.

Note that this figure shows clearly defined boundaries between  
vegetation communities that are the product of individual  
interpretation and are not distinguished by clearly defined  
boundaries on the ground. No account for intergrading areas  
between delineated vegetation communities has been made.

Project Manager	BD
Compiled by	HR
Map Projection	MGAz56
Map Datum	GDA94
File Reference	PR107106-2.mxd
Sheet Number	1 of 1

Client	Santos QNT Pty Ltd
Title	Figure 4.1 Vegetation Communities Wando 1

# RPS

SCALE (A4)	DATE	DRAWING NO.	ISSUE
1:11,000	9/6/2011	PR107106-1	A

---

## 5.0 Environmental Impact Assessment

### 5.1 Threatened Flora and Fauna

Those threatened flora and fauna species (listed under the *TSC Act* and the *EPBC Act*) that have been gazetted / recorded from within the locality have been considered in this ecological assessment. EEC's and Endangered Populations known from the broader area have also been addressed. Each species / community / population is considered for its potential to occur within the study area and the likely level of impact as a result of the proposed activities. This ecological assessment deals with each species / community / population separately and identifies the ecological parameters of significance associated with the proposed activities.

Those species / communities that have been identified as potentially being impacted have been assessed in **Appendix C**.

**'Species'** or **'EEC / Population'** – Lists each threatened species / EEC / population known from the vicinity of the site. The status of each threatened species under the *TSC Act* and *EPBC Act* is also provided.

**'Habitat'** – Provides a brief account of the species / community / population and the preferred habitat attributes required for the existence / survival of each species / community / population.

**'Likelihood of Occurrence'** – Assesses the likelihood of each species / community / population to occur within the site in terms of the aforementioned habitat description and taking into account local habitat preferences, results of recent field investigations, data gained from various sources and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

**'Potential for Impact'** – Through consideration of the likely level / significance of impacts to each species / community / population that would result from the proposed activities, taking into account both short and long-term impacts, a decision has been made whether further assessment is required. This assessment is largely based on the chance of occurrence of each species / community with due recognition to other parameters such as home range, habitat use, connectivity etc. It also considers the scope of the proposed activities.

Table 5.1: Likelihood of Significant Species Occurring in the Study Area

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
<b>Flora</b>						
<i>Cadellia pentastylis</i>	Ooline	V	V	Forms a closed or open canopy mixing with Eucalypt and Cypress Pine species with a typical soil profile of sandy loam surface layer, grading from a light clay to medium clay with depth.	Unlikely. Marginal habitat occurs within the study area, however the species was not observed within the study area.	Marginal habitat is present in the study area, however the species was not observed within the study area and thus is unlikely to be affected by the proposed activities. Therefore AoS for this species is not required.
<i>Dichanthium setosum</i>	Bluegrass	V	V	Found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture on heavy basaltic black soils and stony red-brown hard setting loam with clay subsoil.	Possible. Marginal habitat occurs within the study area, however the species was not observed within the study area.	Marginal habitat is present in the study area and although it is possible the species may occur within the study area. It is unlikely to be affected by the proposed activities, given the temporary disturbances associated with the proposal. Therefore AoS for this species is not required.
<i>Digitaria porrecta</i>	Finger Panic Grass	E	E	Occurs in grasslands and in undulating woodlands and open forests with an underlying basaltic geology.	Possible. Suitable habitat occurs within the study area, however the species was not observed within the study area.	Marginal habitat is present in the study area and although it is possible the species may occur within the study area, it is unlikely to be affected by the proposed activities, given the temporary disturbances associated with the proposal. Therefore AoS for this species is not required.
<i>Philothea ericifolia</i>	-	V	V	Grows mostly in dry sclerophyll forest and heath on damp sandy flats and gullies.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
<i>Prasophyllum sp. Wybong</i>	A Leek-orchid	-	CE	Generally found in shrubby and grassy habitats in dry to wet soil. It is known to occur in open Eucalypt woodland and grassland.	Possible. Suitable habitat occurs within the study area.	Considered unlikely to be adversely affected by the proposed activities, therefore AoS for this species is not required.
<i>Pterostylis cobarensis</i>	Cobar Greenhood Orchid	V	V	Found in Eucalypt woodlands, open mallee or <i>Callitris</i> shrublands on low or stony ridges and slopes in skeletal sandy-loam soils.	Unlikely due to highly modified nature of the study area.	Considered unlikely to be adversely affected by the proposed activities, therefore AoS for this species is not required.
<i>Swainsona murrayana</i>	Slender Darling-pea	V	V	Known to occur on clay-based soils in a variety of vegetation types, including Bladder Saltbush, Black Box and grassland communities on level plains, floodplains and depressions. It is often found with <i>Maireana</i> species.	Possible. Suitable habitat occurs within the study area.	Considered unlikely to be adversely affected by the proposed activities, therefore AoS for this species is not required.
<i>Thesium australe</i>	Austral Toadflax	V	V	Occurs in grasslands or grassy woodlands and is often found in damp subject sites in association with Kangaroo Grass.	Possible. Suitable habitat occurs within the study area.	Considered unlikely to be adversely affected by the proposed activities, therefore AoS for this species is not required.
<i>Tylophora linearis</i>	-	V	E	Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry Eucalypt and/or <i>Callitris</i> woodlands.	Possible. Suitable habitat occurs within the study area.	Considered unlikely to be adversely affected by the proposed activities, therefore AoS for this species is not required.
<b>TSC Act and/or EPBC Act - Threatened Ecological Communities</b>						
EPBC Act – Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland		-	CE	Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland commonly occur in the Darling Downs of southern Queensland and the Liverpool Plains and Moree Plains of northern NSW.  Species composition can change yearly and seasonally in response to rainfall, temperature, fire, grazing pressure and management. This community is typically	While species from the listed generas occur within the chip hole lease, this community was not identified within the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				<p>dominated by tussock grasses in the genera <i>Austrodanthonia</i>, <i>Austrostipa</i>, <i>Bothriochloa</i>, <i>Chloris</i>, <i>Enteropogon</i>, or <i>Themeda</i>, with occurrences of other herbaceous plants such as native daisies, orchids, lilies and other wildflowers. The shrub cover is typically a very minor component of the grassland. A tree canopy is typically absent.</p> <p>The ecological community generally occurs on flat to low slopes, of no more than 5 percent (or less than 1 degree) inclination. The community is mainly associated with fine textured, often cracking clay soils derived from either basalt or alluvium.</p>		
<p><b>EPBC Act - White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland</b></p> <p><b>TSC Act - White Box Yellow Box Blakely's Red Gum Woodland</b></p>		EEC	CE	<p><b>White Box Yellow Box Blakely's Red Gum Woodland (commonly referred to as Box-Gum Woodland) is an open woodland community (sometimes occurring as a forest formation) , in which the most obvious species are one or more of the following: White Box (<i>Eucalyptus albens</i>), Yellow Box (<i>E. melliodora</i>) and Blakely's Red Gum (<i>E. blakelyi</i>). Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs.</b></p> <p><b>Box-Gum Woodland is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the tablelands and western slopes of NSW.</b></p>	<p><b>TSC Act – Known to occur within the chip hole lease.</b></p> <p><b>The community is not considered to be a TEC under the EPBC Act.</b></p>	<p><b>The proposed chip hole lease is considered to be the TSC Act White Box Yellow Box Blakely's Red Gum Woodland. The study area comprises a weedy understorey, however native grasses are present. The condition of the chip hole lease is poor due to previous disturbances.</b></p> <p><b>A 7-part test of significance(TSC Act) has been applied to this community in Appendix C</b></p> <p><b>The chip hole lease is not considered to be the EPBC listed community, as it is lacking the native species diversity, canopy tree density, and canopy regeneration required to meet the</b></p>

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
						<p><b>policy statement. However, adjacent vegetation communities are considered to be the EPBC listed community.</b></p> <p><b>Given that this community occurs within the study area, an AOS has been undertaken in Appendix C.</b></p> <p>.</p>
EPBC Act - Grey Box ( <i>Eucalyptus microcarpa</i> ) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia; and		-	E	<p>The Grey Box (<i>Eucalyptus microcarpa</i>) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia predominantly occurs on the drier edge of the temperate grassy eucalypt woodland belt. It ranges from the Narrabri district in central NSW through northern Victoria into South Australia.</p> <p>The community typically occurs in landscapes of low-relief on productive soils derived from alluvial or colluvial materials but may occur on a range of substrates. The canopy is typically dominated by Grey Box and the understorey is generally a sparse shrub layer and a species-rich ground layer of grasses and herbs. The ecological community includes patches of derived grassland.</p>	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.
EPBC Act - Weeping Myall Woodlands.		-	E	The Weeping Myall Woodlands range from open woodlands to woodlands, generally 4 – 12m high. The overstorey is dominated by Weeping Myall ( <i>Acacia pendula</i> ). The understorey often includes an open layer of shrubs over a ground layer which includes a	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				<p>diversity of grasses and forbs. There are more than 80 species of plants that could be part of the community.</p> <p>The ecological community generally occurs on flat areas, shallow depressions or gilgais on raised alluvial plains. Occurs on black, brown, red-brown or grey clay or clay loam soils.</p>		
TSC Act - Artesian Springs Ecological Community;		EEC	-	<p>The vegetation within the community frequently consists of sedges or similar vegetation. Trees and shrubs may be adjacent to, or nearby, the springs.</p> <p>Unique aquatic invertebrate, vertebrate and plant communities occupy the springs. Where artesian water emerges at the surface through fault lines in the overlying rock, mounds form from salts and sediments as the water evaporates. These occur at the edges of the Great Artesian Basin. Most occur in Queensland and South Australia and a few occur in the Mulga Lands, Darling Riverine Plains and Cobar Peneplain Bioregions of New South Wales.</p>	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.
TSC Act - <i>Cadellia pentastylis</i> (Ooline) community in the Nandewar and Brigalow Belt South bioregion;		EEC	-	<p>The canopy of this community is dominated by Ooline (<i>Cadellia pentastylis</i>). Other canopy species include <i>Eucalyptus albens</i>, <i>Eucalyptus beyeriana</i>, <i>E. chloroclada</i>, <i>E. melanophloia</i>, <i>E. pilligaensis</i>, <i>E. viridis</i> and <i>Callitris glaucophylla</i>. The understorey is made up of a range of shrubs such as Wattles and grasses.</p> <p>The community is known on the North West</p>	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				Slopes in NSW, between Narrabri and the Queensland border, and also in Queensland. It usually occurs on undulating terrain on a variety of soil types, between 300 – 450m altitude.		
TSC Act - Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions;		EEC	-	<p>Characteristic tree species of this community are Carbeen (<i>Corymbia tessellaris</i>) and White Cypress-pine (<i>Callitris glaucophylla</i>). Associated trees include <i>Corymbia dolichocarpa</i>, <i>Eucalyptus populnea</i>, <i>E. camaldulensis</i>, <i>Casuarina cristata</i> and <i>Allocasuarina leuhmannii</i>.</p> <p>This community occurs on siliceous sands, earthy sands and clayey sands. It is found on riverine plains of the Meehi, Gwydir, MacIntyre and Barwon Rivers and in small remnants farther south.</p>	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.
TSC Act - Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions		EEC	-	<p>This community is a tall woodland dominated by Fuzzy Box (<i>Eucalyptus conica</i>), often with inland Grey Box (<i>E. microcarpa</i>), Yellow Box (<i>E. melliodora</i>), Bulloak (<i>Allocasuarina leuhmannii</i>) or Kurrajong (<i>Brachychiton populneus</i>). Shrubs are generally sparse, with the groundcover dominated by grasses and low forbs.</p> <p>It is found on alluvial soils of Southern Western Slopes, Brigalow Belt South and Darling Riverine Plains Bioregions, mainly in the Dubbo-Narromine-Parkes-Forbes area.</p>	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.
TSC Act - Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions		EEC	-	Inland Grey Box Woodland is dominated by <i>Eucalyptus microcarpa</i> (Inland Grey Box), often found in association with <i>E. populnea</i> subsp. <i>bimbil</i> (Bimble or Poplar Box),	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				<p><i>Callitris glaucophylla</i> (White Cypress Pine), <i>Brachychiton populneus</i> (Kurrajong), <i>Allocasuarina luehmannii</i> (Bulloak) or <i>E. melliodora</i> (Yellow Box), and sometimes with <i>E. albens</i> (White Box).</p> <p>Shrubs are typically sparse or absent and a variable ground layer of grass and herbaceous species is present at most sites.</p> <p>The community generally occurs as an open woodland 15–25 m tall and occurs on fertile soils predominantly within the Riverina and South West Slopes regions of NSW down to the Victorian border, including Albury. This community also extends across the slopes and plains in Central and Northern NSW up to the Queensland Border. This includes Yetman and Inverell in the North, Molong to the east of the Central Slopes and plains and out towards Nymagee to the west.</p>		AoS for this community is not required.
TSC Act - Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions		EEC	-	<p>This ecological community is scattered across the eastern parts of the alluvial plains of the Murray-Darling river system. Typically, it occurs on red-brown earths and heavy textured grey and brown alluvial soils.</p> <p>The structure of the community varies from low woodland and low open woodland to low sparse woodland or open shrubland, depending on site quality and disturbance history. The tree layer grows up to a height of about 10 metres and invariably includes <i>Acacia pendula</i> (Weeping Myall or Boree) as one of the dominant species or the only tree species present. The understorey includes</p>	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				an open layer of chenopod shrubs and other woody plant species and an open to continuous groundcover of grasses and herbs.		
TSC Act - Native Vegetation on Cracking Clay Soils of the Liverpool Plains		EEC	-	<p>Native Vegetation on Cracking Clay Soils of the Liverpool Plains is mainly a native grassland community which includes a range of small forb and herb species. The main grass species include Plains Grass (<i>Austrostipa aristiglumis</i>), Queensland Bluegrass (<i>Dichanthium sericeum</i>) and Coolibah Grass (<i>Panicum queenslandicum</i>). It also contains scattered and patchy shrubs and trees, including Boree (<i>Acacia pendula</i>), Rough-barked Apple (<i>Angophora floribunda</i>), Fuzzy Box (<i>Eucalyptus conica</i>), Bimble Box (<i>E. populnea</i>) and Yellow Box (<i>E. melliodora</i>). In wetter locations rushes and sedges are common.</p> <p>This community is located around Coonabarabran, Gunnedah, Murrurundi, Narrabri, Tamworth and Quirindi, on the North West Slopes and Plains of NSW.</p> <p>Occurs on the highly fertile cracking clay soils of the Liverpool Plains.</p>	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.
TSC Act - Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions		EEC	E	<p>In New South Wales, this ecological community occurs mainly on hills and flattish footslopes, on deep, loamy, high nutrient basaltic soils and sandy loams.</p> <p>The vegetation is floristically rich in shrubs, small trees and vines. Characteristic canopy species include <i>Elaeodendron australe</i> var. <i>integrifolium</i> (Red Olive Plum), <i>Ehretia membranifolia</i> (Peach Bush), <i>Geijera</i></p>	This ecological community was not identified in the study area.	Considered unlikely to be adversely affected by the proposed activities, as this ecological community is not known to occur in the study area. An AoS for this community is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				<p><i>parviflora</i> (Wilga), <i>Notelaea microcarpa</i> (Native Olive), <i>Pouteria cotinifolia</i> var. <i>pubescens</i> (Yellow Lemon) and <i>Pittosporum spinescens</i> (Wallaby Apple). The trees and tall shrubs are usually 2–10 m tall. Emergent trees often associated with the vine thickets include <i>Eucalyptus</i> spp., <i>Callitris glaucophylla</i> (White Cypress Pine), <i>Casuarina cristata</i> (Belah) and <i>Brachychiton populneus</i> (Kurrajong).</p> <p>These communities are located on the North West Slopes east of Moree and north from the Liverpool Plains, with major occurrences in the vicinity of Gunnedah, Bingara and Narrabri and the region between Yetman, Graman and Crooble.</p>		
<b>Fish</b>						
<i>Maccullochella peelii peelii</i>	Murray Cod	-	V	Found in clear rocky streams to slow flowing, turbid rivers and billabongs. Usually found near large rocks, snags, overhanging vegetation and other woody structures.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.
<b>Amphibians</b>						
<i>Litoria booroolongensis</i>	Booroolong Frog	E	E	Found along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.
<b>Reptiles</b>						
<i>Aprasia parapulchella</i>	Pink-tailed Legless Lizard	V	V	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass ( <i>Themeda australis</i> ). Sites are	Unlikely due to lack of suitable habitat and fragmented	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat and fragmented nature of the study area,

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				typically well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks;	nature of the study area.	therefore AoS for this species is not required.
<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake	V	-	Found mainly in dry Eucalypt forests and woodlands, Cypress woodland and occasionally in rainforest or moist Eucalypt forest. Favours streamside areas, particularly in drier habitats.	Unlikely due to lack of suitable habitat and fragmented nature of the study area.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat and fragmented nature of the study area, therefore AoS for this species is not required.
<i>Underwoodisaurus sphyrurus</i>	Border Thick-tailed Gecko	V	V	Favours forest and woodland areas on steep rocky or scree slopes, with boulders, rock slabs, fallen timber and deep leaf litter.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.
<b>Aves</b>						
<i>Anthochaera phrygia</i>	Regent Honeyeater	E	E	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland and open riparian forests of River She-oak.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.
<i>Calyptorhynchus lathami</i>	Glossy-Black Cockatoo	V	-	She-oaks, in forests, woodlands, timbered watercourses, in eucalypt and native cypress, brigalow scrub.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat and fragmented nature of the study area, therefore AoS for this species is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
<i>Circus assimilis</i>	Spotted Harrier	V	-	Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Possible. Suitable habitat occurs within the study area.	Although suitable habitat exists, this species was not observed utilising the study area and thus is unlikely to be affected by the proposed activities. Therefore, AoS for this species is not required.
<i>Climacteris picumnus</i>	Brown Treecreeper	V	-	Found in Eucalypt woodlands and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked Eucalypts, usually with a grassy understorey.	Unlikely due to lack of suitable habitat and fragmented nature of the study area.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat and fragmented nature of the study area, therefore AoS for this species is not required.
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Unlikely due to lack of suitable habitat and fragmented nature of the study area.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat and fragmented nature of the study area, therefore AoS for this species is not required.
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	Forages primarily in the canopy of open Eucalypt forest and woodland. Riparian habitats are particularly used, due to higher soil fertility. Also found in isolated flowering trees in open country, e.g. paddocks and roadside remnants.	Possible. Suitable foraging trees occur within the study area.	Although suitable foraging trees occur adjacent to the study area, this species was not observed within the study area and thus is unlikely to be affected by the proposed activities. Therefore, AoS for this species is not required.
<i>Grantiella picta</i>	Painted Honeyeater	V	-	Inhabits Boree, Brigalow and Box-Gum woodlands and Box-Ironbark forests, feeding on the fruits of mistletoes growing on woodland Eucalypts and Acacias.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat and fragmented nature of the study area, therefore AoS for this species is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard	V	-	Lives in a range of habitats, especially along timbered watercourses which is the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands.	Possible. Suitable foraging habitat occurs within the study area.	Although suitable foraging habitat exists, this species was not observed utilising the study area and thus is unlikely to be affected by the proposed activities. Therefore, AoS for this species is not required.
<i>Hieraaetus morphnoides</i>	Little Eagle	V	-	Occupies open eucalypt forest, woodland or open woodland. She oak or acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.
<i>Lathamus discolor</i>	Swift Parrot	E	E	Migrates to south-east Australia between March and October. Occurs in areas where Eucalypts are flowering profusely or where there are abundant lerp infestations.	Possible. Suitable habitat occurs within the study area.	Although suitable habitat occurs adjacent to the study area, this species was not observed within the study area and thus is unlikely to be affected by the proposed activities. Therefore, AoS for this species is not required.
<i>Lophoictinia isura</i>	Square-tailed Kite	V	-	Found in a variety of habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	Possible. Suitable foraging habitat occurs within the study area.	Although suitable foraging habitat exists, this species was not observed utilising the study area and thus is unlikely to be affected by the proposed activities. Therefore, AoS for this species is not required.
<i>Melanodryas cucullata</i>	Hooded Robin	V	-	Prefers lightly wooded country and structurally diverse habitats, usually open Eucalypt woodland, Acacia scrub and mallee, often in or near clearings or open areas.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater	V	-	Occupies mostly upper levels of drier open forests or woodlands dominated by Box or ironbark Eucalypts. Also inhabits open forests of smooth-barked Gums, stringy barks, ironbarks and tea-trees.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	Lives on edges of Eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	Possible. Suitable habitat occurs within the study area.	Although suitable habitat exists, this species was not observed utilising the study area and thus is unlikely to be affected by the proposed activities. Therefore, AoS for this species is not required.
<i>Ninox connivens</i>	Barking Owl	V	-	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. Roosts in shaded portions of tree canopies, with tall midstorey species, such as Acacia and Casuarina species.	Possible. Suitable roost trees occur within the study area.	Although suitable roost trees exist, this species was not observed utilising the study area and thus is unlikely to be affected by the proposed activities. Therefore, AoS for this species is not required.
<i>Polytelis swainsonii</i>	Superb Parrot	V	V	Found in Box-Gum, Box-Cypress-pine and Boree woodlands and River Red Gum forest. Nests in small colonies in the hollows of large trees, mainly in tall riparian River Red Gum forest or woodland.	Possible. Suitable habitat occurs within the study area.	Although suitable habitat occurs adjacent to the study area, this species was not observed within the study area and thus is unlikely to be affected by the proposed activities. Therefore, AoS for this species is not required.
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	V	-	Inhabits open Box-Gum woodlands on the slopes, Box-Cypress pine and open Box woodlands on alluvial plains.	Possible. Suitable habitat occurs within the study area.	Although suitable habitat occurs adjacent to the study area, this species was not observed within the study area and thus is unlikely to be affected by the proposed activities. Therefore, AoS for this species is not required.
<i>Pyrrholaemus sagittatus</i>	Speckled Warbler	V	-	Lives in a wide range of Eucalypt dominated communities that have a grassy understorey and often on rocky ridges or in gullies.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.
<i>Rostratula australis</i>	Australian Painted Snipe	E	V	Inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
						species is not required.
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	Found in grassy eucalypt woodlands, including Box-Gum woodlands and Snow Gum woodlands. Often found in riparian areas and sometimes in lightly wooded farmland.	Possible. Suitable habitat occurs within the study area.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.
<i>Stictonetta naevosa</i>	Freckled Duck	V		Primarily occurs in south-eastern and south-western, however the species occasionally occurs in coastal NSW and Victoria, particularly during drought. Breeds in large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system. Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. May also utilise lakes, reservoirs, farm dams and sewage ponds. During drier times, the Freckled Duck moves to more permanent waters such as lakes, reservoirs, farm dams and sewerage ponds.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.
<i>Tyto novaehollandiae</i>	Masked Owl	V	-	Roosts and breeds in moist Eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Lives in dry Eucalypt forests and woodlands.	Unlikely due to lack of suitable roost trees.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable roost trees within the study area, therefore AoS for this species is not required.
<b>Mammals</b>						
<i>Bettongia penicillata penicillata</i>	Brush-tailed Bettong (South-East Mainland)	EX	-	The Brush-tailed Bettong (south-east mainland) was associated with grassland, heath and sclerophyll woodland. Other accounts record the subspecies from open eucalypt forest with low woody scrub, tussock grass and occasional bare patches.	Extinct.	N/A

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Roosts in caves, crevices in cliffs, old mine workings and disused Fairy Martin ( <i>Hirundo ariel</i> ) nests, frequenting dry open forest and woodland close to these features.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.
<i>Chalinolobus picatus</i>	Little Pied Bat	V	-	Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee and Bimbil box. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings.	Possible. Suitable roost trees occur within the study area.	Considered unlikely to be adversely affected by the proposed activities, as not habitat trees will be removed as part of this proposal. Therefore, AoS for this species is not required.
<i>Conilurus albipes</i>	White-footed Tree Rat	E	-	The White-footed Rabbit-rat was known to inhabit open forest woodlands and grassy ecosystems in Victoria. Habitat information is not known for other states in which the species occurred. Gould observed the species sleeping in the hollow limbs of prostrate trees, or in hollow branches of large <i>Eucalypts</i> near the ground.	Extinct.	N/A
<i>Dasyurus geoffroii</i>	Western Quoll	E	V	Most kinds of wooded habitat including eucalypt forest, dry woodland and mallee shrubland.	Unlikely due to lack of suitable habitat and known range.	Considered unlikely to be adversely affected by the proposed activities, due to the lack of suitable habitat and the study area is located outside of the known distribution. Therefore AoS for this species is not required.
<i>Dasyurus maculatus maculatus</i>	Spotted-tail Quoll	V	E	Recorded in a wide range of habitat types including dry and moist sclerophyll forests and woodlands, rainforest, coastal heathland, and riparian forest. Found in shelters and dens in small caves, fallen logs with large hollows and tree hollows.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.
<i>Lagorchestes leporides</i>	Eastern Hare-wallaby	PE	EX	Little is known about this species, but it appears to have inhabited open grassland plains.	Extinct.	N/A

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
<i>Macropus dorsalis</i>	Black-striped Wallaby	E	-	Preferred habitat is characterised by dense woody or shrubby vegetation that must occur near a more open, grassy area to provide suitable habitat.	Unlikely due to lack of suitable habitat and fragmented nature of the study area.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat and fragmented nature of the study area, therefore AoS for this species is not required.
<i>Nyctophilus timoriensis</i>	Greater Long-eared Bat	V	V	Commonly roosts in crevices, hollows and under loose bark in Box / Ironbark / Cypress Pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland.	Possible. Suitable roost trees occur within the study area.	Although suitable roost trees exist, this species was not observed utilising the study area and thus is unlikely to be affected by the proposed activities. Therefore, AoS for this species is not required.
<i>Onychogalea fraenata</i>	Bridled Nailtail Wallaby	E	-	Preferred habitat is a narrow band of transitional vegetation that separates dense Acacia scrub from open grassy Eucalypt woodland.	Unlikely. Outside of known distribution.	Considered unlikely to be adversely affected by the proposed activities, as the study area is outside on the known distribution. Therefore AoS for this species is not required.
<i>Perameles bougainville fasciata</i>	Western Barred Bandicoot	PE	EX	Inhabited a variety of landscapes and vegetation types, including Saltbush covered Nullarbor Plain, woodlands on sand ridges, Bluebush plains, Desert Acacia, shrublands and heath.	Extinct.	N/A
<i>Petaurus norfolcensis</i>	Squirrel Glider	V	-	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat and thus this species is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
<i>Phascolarctos cinereus</i>	Koala	V	-	Inhabits Eucalypt woodlands and forests, spending most of their time in trees. Feeds on the foliage of more than 70 Eucalypt and 30 non-Eucalypt species.	Known. Koala scat observed under several Eucalypt trees.	Bimble Box occurs adjacent to the chip hole lease, and is a known Koala food tree. Evidence of Koala usage within the study area was observed in the form of scats under several Eucalypt trees within the study area, but not within the chip hole lease.  While no canopy tree species will be cleared as a result of proposed activities, given the proximity of Koala habitat trees to the chip hole lease, an AoS has been prepared for this species (Appendix C).
<i>Pseudomys australis</i>	Plains Rat	E	V	Primarily found in stone-covered plains and mod slopes with boulders, small stones and gilgais. Associated vegetation is predominantly chenopod as well as ephemeral plants.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.
<i>Pseudomys gouldii</i>	Gould's Mouse	E	-	It is a poorly known species. Animals are reported to have preferred sandhills and plains, and to make burrows under bushes in loose soil.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.
<i>Rattus villosissimus</i>	Long-haired Rat	V	-	Sustained in mesic, densely vegetated sites. During plagues can be found in virtually all inland habitats. Following extended periods of above average rainfall or flood this species can breed rapidly. Resulting populations disperse widely, then die away abruptly as food is depleted and water evaporates. Predators rely on these rat plagues for their own rapid reproduction.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V	-	Roosts in tree hollows and buildings. If there are no trees, they are known to occupy mammal burrows.	Possible. Suitable roost trees occur within the study area.	Although suitable roost trees exist, this species was not observed utilising the study area and thus is unlikely to be affected by the proposed activities. Therefore, AoS for this species is not required.
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V	-	Generally distributed among a broad band associated within both sides of the Great Dividing Range from Cape York to Kempsey. Some records further south including within the Great Lakes, Lake Macquarie and Cessnock LGA's.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.

**Sources:** EPBC Act Protected Matters Search Tool (Department of Sustainability, Environment, Water, Population, and Community, 2011)  
Atlas of Wildlife, Map Sheet 8935 – Curlewis ((Department of Environment, Climate Change and Water, 2011)

**Key:** CE: Critically Endangered, E: Endangered, V: Vulnerable, PE/EX: Presumed Extinct, **Bold:** known to occur

**Table 5.2: Likelihood of Migratory Species Occurring within the study area**

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
<i>Anthochaera phrygia</i>	Regent Honeyeater	E	E, M	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland and open riparian forests of River She-oak.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.
<i>Apus pacificus</i>	Fork-tailed Swift	-	M	Aerial over open country, from semi-deserts to coasts, islands and sometimes over forests and cities.	Possible flyover species.	Although this species is considered to possibly flyover the study area, it unlikely to be affected by the proposed activities. Therefore, AoS for this species is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
<i>Ardea alba</i>	Great Egret	-	M	Prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.
<i>Ardea ibis</i>	Cattle Egret	-	M	Found in grasslands, woodlands, wetlands, pastures and croplands, especially where drainage is poor.	Possible. Suitable habitat occurs within the study area.	Although suitable habitat exists, this species is unlikely to be affected by the proposed activities, given the limited habitat that will be temporarily impacted. Therefore, AoS for this species is not required.
<i>Gallinago hardwickii</i>	Latham's Snipe	-	M	soft wet ground or shallow water with tussocks with other green or dead growth, wet parts of paddocks, seepage below dams, irrigated areas, scrub or open woodland from sea level to alpine bogs over 2000m, samphire on salt marshes, mangrove fringes	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	-	M	Habitat characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest (including rainforest) and even urban areas.	Possible flyover species.	Although suitable habitat exists, this species is unlikely to be affected by the proposed activities, given the limited habitat that will be temporarily impacted. Therefore, AoS for this species is not required
<i>Hirundapus caudacutus</i>	White-throated Needletail	-	M	Almost exclusively aerial most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy.	Possible. Suitable habitat occurs within the study area.	Although suitable habitat exists, this species is unlikely to be affected by the proposed activities, given the limited habitat that will be temporarily impacted. Therefore, AoS for this species is not required
<i>Merops ornatus</i>	Rainbow Bee-eater	-	M	Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human	Possible. Suitable habitat occurs within the study area.	Although suitable habitat exists, this species is unlikely to be affected by the proposed activities, given the limited habitat that will be

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				habitation.		temporarily impacted. Therefore, AoS for this species is not required
<i>Rostratula benghalensis</i>	Painted Snipe	-	M	Inhabits inland and coastal shallow freshwater wetlands, occurring in both ephemeral and permanent wetlands, particularly where there is grass. Individuals have been spotted in artificial dams, sewage ponds and waterlogged grasslands.	Unlikely due to lack of suitable habitat.	Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat within the study area, therefore AoS for this species is not required.

**Sources:** EPBC Act Protected Matters Search Tool (Department of Sustainability, Environment, Water, Population, and Community, 2011)

Atlas of Wildlife, Map Sheet 8935 – Curlewis (Department of Environment, Climate Change and Water, 2011)

**Key:** CE: Critically Endangered, E: Endangered, V: Vulnerable, PE/EX: Presumed Extinct, M: Migratory, **Bold:** known to occur

## 5.2 Impact Assessment under the TSC Act

Section 5A of the EP&A Act lists seven factors that must be taken into account in the determination of the significance of potential impacts proposed activities on ‘threatened species, populations or ecological communities (or their habitats)’ listed under the TSC Act. The Assessment of Significance (7-part test) is used to determine whether activities are ‘likely’ to cause ‘a significant impact’ on threatened biota and thus whether a Species Impact Statement (SIS) is required.

On this basis, a 7-part test of significance is required for the White Box-Yellow Box-Blakely’s Red Gum grassy woodland (**Appendix C**). The application of the 7-part test concluded that there is not likely to be a significant effect on this community arising from the proposed activities.

## 5.3 Impact Assessment under the EPBC Act

An EPBC Act Protected Matters Search was undertaken using the on-line database to generate a list of those MNES on potentially occurring within the study area and surrounds. This data, combined with other local knowledge and records, was utilised to assess whether the proposed activities will have, or are likely to have a significant impact on MNES

### World Heritage areas:

The proposed activities are not in a World Heritage area, and are not in close proximity to any such area.

### Wetlands protected by international treaty (the Ramsar convention):

There are no Ramsar wetlands identified near the site. The site is approximately 100km upstream of a Ramsar site, the Hunter Estuary wetlands.

### Nationally listed threatened species, migratory species and ecological communities:

Box-Gum Grassy Woodlands and Derived Native Grasslands occur across the property, however this community does not occur within the chip hole lease. Vegetation within the chip hole lease does not have the native species diversity, canopy density, or canopy regeneration to be representative of the EPBC Act Listed TEC.

As this community does occur on the property, and adjacent to the proposed access tracks, an Assessment of Significance has been conducted in **Appendix C**.

## 5.4 Key Threatening Processes Relevant to Proposed Activities

A threatening process is defined under the TSC Act as ‘a process that threatens, or that may threaten, the survival or evolutionary development of a species, population or ecological community’. Threatening processes that adversely affect threatened species, populations or ecological communities, or possibly cause others that are not currently threatened; to become threatened are listed as key threatening processes (KTPs) under the TSC, FM and EPBC Acts. KTPs relevant to the proposed activities are discussed below in **Table 5.3**.

**Table 5.3: Key Threatening Processes Relevant to the Proposed Activities**

Key Threatening Process	Relevance to Proposed Activities
Invasion of native plant communities by exotic perennial grasses	The site has been heavily disturbed by exotic perennial grasses. There exists the potential for the invasion of additional weed species.
Clearing of native vegetation	Land clearing is to occur as a result of the proposed activities, however vegetation to be cleared comprises ground covers only.
Loss of hollow-bearing trees	No hollow bearing trees will be removed as part of this activity. Protection measures will be implemented to ensure hollow-bearing trees in the adjacent areas are not impacted by the proposed activity.
Infection of native plants by <i>Phytophthora cinnamomi</i>	There exists the potential for the importation of this pathogen on unclean vehicles and plant machinery. It is recommended that all vehicles be cleaned of foreign soil from other sites to ensure that this pathogen is not introduced.
Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands.	Lake Goran is located approximately 14km to the south-east of the site. Given the considerable distance between the lake and the proposed activity site, it is unlikely that the proposed activity will result in alteration of the natural flow regimes or quality of the lake.

## 5.5 Koala SEPP 44

Gunnedah LGA is listed in the *State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44), Schedule 1 as an LGA where this policy applies. Schedule 2 of SEPP 44 lists ten tree species that are considered indicators of ‘Potential Koala Habitat’. The presence of any of the species listed on a site proposed for development triggers the requirement for an assessment for ‘Potential Koala Habitat’. SEPP 44 defines potential Koala Habitat as:

“areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component”.

No canopy trees occur within the chip hole lease, however one species of listed Koala food tree is present on within the study area (Bimble Box). It does not constitute 15% of the total number of trees in the upper canopy of lower strata across the study area.

Core Koala habitat is defined as:

‘an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

A thorough search of all canopy trees within the study area, and adjacent to the study area was undertaken. While Koala scats were observed under several trees, no recent scats were identified. Furthermore, no Koalas were observed in the site. While it is likely that a transient population utilise the property, it is considered unlikely that a resident Koala population reside within the study area.

---

## 5.6 Discussion of Impacts

The potential impacts associated with the proposed activities are generally short-term and temporary. The physical ground disturbance will be limited to within the well lease area and along the proposed access tracks, which will result in the removal of ground cover vegetation only.

The proposed chip hole lease is located within an area of grassland that has been heavily invaded by exotic species. The grassland spans approximately 5ha, and is highly disturbed by continued grazing, weed invasion, historical vegetation clearing, and the presence of a small rubbish pit. This area provides limited habitat for common, generalist species only. Approximately 5,504m<sup>2</sup> ha of grassland, including the rubbish pit will be removed as part of the proposed activity.

The chip hole lease is classified as White Box-Yellow Box-Blakely's Red Gum woodland, listed under the TSC Act, as it may have previously supported White Box, and includes some native understorey species. It is not considered to be the EPBC Act Box-Gum Woodland and Derived Native Grassland. This area lacks important habitat features for significant native flora and fauna. As such the proposed chip hole lease has limited ecological value and impacts are expected to be negligible.

Approximately 500m of access track is required to be constructed to a width of 6m. This will result in the clearing of 0.3ha of ground cover vegetation. While the vegetation in this area is comprised of pasture grasses that have been heavily invaded by weed species, it is considered to be an EEC under the TSC Act, and a TEC under the EPBC Act. Given the current agricultural land use of this area, and the low habitat values associated with the disturbed ground covers, the removal of 0.3ha of vegetation is considered to have a minimal impact.

The proposed activity is located approximately 14km from Lake Goran, a nationally significant wetland, and 3km from Wondoba State Conservation Area. Given the poor connectivity, and considerable distance between the study area and these conservation areas, the proposal is considered to have a minimal impact on Wondoba State Conservation Area and Lake Goran.

### 5.6.1 Potential Impacts

Direct impacts associated with the proposal include the clearing of limited ground cover vegetation within the chip hole lease, which is considered to be the TSC Act White Box - Yellow Box - Blakely's Red Gum Woodland EEC, despite being dominated by weed species. The proposed chip hole lease is located within a pasture, with scattered Eucalypts and a stand of White Cypress occurring adjacent to the lease. Vegetation clearing within the lease will result in the removal of pasture grasses and weed species only, no mature canopy species are required to be cleared.

Additional removal of ground cover vegetation is required to extend the access track, within areas considered to be EEC / TEC. This will result in the removal of pasture grasses and weed species only.

The proposed activity is considered to have minimal impacts on fauna habitat, as no canopy trees, and limited ground cover will be cleared as part of construction. However, construction activities have the potential to impact upon fauna populations, such as reptiles and Koala, through vehicle strike, noise and dust pollution.

Potential indirect ecological impacts associated with the proposed activity include dust generation, noise, soil erosion, weed invasion, and transportation of weeds off site.

### 5.6.2 Overview of Identifying Potential Impacts

The assessment of potential ecological impacts revealed the following:

- Potential short-term and long-term impacts;
- Vegetation removal;
- Disruption of breeding cycle, roosting and sheltering behaviour;
- Disruption of pollination cycle and seed dispersion;
- Introduction and spread of weeds and feral pest species;
- Noise; and
- Potential disturbance to nearby areas of ecological significance.

Each of the above listed potential impacts is discussed in greater detail within the following relevant sections.

#### Potential Ecological Impacts

The proposed chip hole lease is located within a disturbed grassland, and is void of canopy and shrub layer vegetation. While the chip hole lease is in poor condition, it is considered to be White Box-Yellow Box-Blakely's Red Gum grassy woodland, as listed under the TSC Act.

Evidence of Koala usage was observed in the study area adjacent to the chip hole lease. As no Koala habitat trees will be cleared, the impacts to Koala are considered minimal.

The proposed chip hole lease and extension of the access tracks will result in clearing of native and introduced species, and is not considered to have a significant impact on the EEC. The access track will remain in place, as per landholder requests.

#### Potential Short-term and Long-term Impacts

Temporary short-term impacts will be associated with the establishment and operation of the chip hole lease site. The proposed rehabilitation and revegetation of the chip hole lease site will reinstate vegetation of similar structural diversity and habitat value over the long-term. Rehabilitation will be completed within 6 months of decommissioning. In consideration of site rehabilitation and revegetation activities that are to occur at the well site once decommissioning has occurred, it is unlikely that there will be any long-term impacts associated with the well lease. Furthermore the rehabilitation and revegetation of the activity site is likely to benefit the local ecology over the long-term, particularly given the current poor ecological condition of the study area.

The extension of the access track will result in permanent vegetation removal (.3ha), as per landholders requests. Given the low ecological value of the vegetation to be removed, this is considered to be a minimal long-term impact.

#### Vegetation Removal

The chip hole lease has been selected to avoid the need to clear canopy vegetation. Vegetation disturbance will be limited to ground cover vegetation that is dominated by weed species, and native pasture grasses. While mature canopy species occur to the north and south of the proposed well lease, mitigation measures will be implemented to ensure these trees are not impacted throughout construction activities.

The access track extension will result in the removal of ground cover vegetation that is dominated by weed species. The access track has been selected to ensure no canopy vegetation will be removed. Where canopy vegetation occurs in close vicinity to the access track, vegetation protection measures will be implemented, as per the site EMP.

#### Disruption of Breeding Cycle, Roosting and Sheltering Behaviour

The breeding cycle, roosting, sheltering and foraging behaviour for some species, particularly the Koala, may potentially be impacted by the proposed activities that utilise habitat resources adjacent to the chip hole lease due to additional noise, light, and vehicle traffic.

#### Disruption of Pollination Cycle and Seed Dispersion

Excessive dust from the proposed activities could potentially disrupt the pollination cycle and ability of native plants to regenerate (i.e. germination, revegetation and re-colonisation of existing plants).

#### Introduction of Weeds and Feral Pest Species

The proposed activities have the potential to create favourable conditions for introduced weed species within the study area, which could potentially lead to an increase of existing weed populations. This is most likely to occur where soil disturbance is to occur.

All plant and machinery will be washed down and cleaned of any foreign soil and seed prior to being transported onsite to prevent the potential spread of introduced weeds and pathogens.

Disturbance of surface soils along access roads / tracks and where re-shaping / re-levelling earthworks are proposed to occur may encourage weed growth. Weed species, especially those listed as noxious, should be removed from site or controlled by means of herbicide applications to help prevent or minimise their re-occurrence within the proposed activities footprints. Where practical these weeds should be removed from site or controlled by means of herbicide applications to help prevent or minimise their re-occurrence.

---

### Noise

Short term noise pollution as a result of vehicles, machinery and drilling may deter native fauna, including Koalas, from utilising the study area and immediate surrounding areas as habitat. The proposed activities could affect the migration and dispersal ability of native fauna particularly in relation to noise and vehicular movements. The proposed activities may result in short term increased noise pollution which has the potential to disrupt the breeding cycle and the foraging and roosting behaviour of some native fauna species.

### Potential Disturbance to Nearby Areas of Ecological Significance.

The study area is located approximately 3km to the south west of Wandoba State Conservation Area. While canopy vegetation within the study area provides a tenuous link to the conservation area via vegetated road reserve, it is considered unlikely that vegetation within the study area provides an extension of habitat, given the disturbed nature of the study area. Given the distance between the conservation area and the disturbance areas, as well as the temporary nature of the disturbance, it is considered unlikely that the proposed activity will result in disturbances to Wandoba State Conservation Area.

The study area is located approximately 14km to the north west of Lake Goran, a nationally significant wetland. Given the considerable distance, and the lack of connectivity between the study area and Lake Goran, it is considered highly unlikely that the proposal will impact upon Lake Goran.

---

## 6.0 Impact Mitigation and Management

### 6.1 Introduction

In order to minimise potential ecological impacts resulting from the proposed activity, the location and design of the chip hole and associated infrastructure, and identification of appropriate mitigation measures has been undertaken in accordance with the 'avoid – minimise – mitigate – offset' hierarchy:

- Avoiding the impact altogether by relocating the proposed activity, or parts of an activity;
- Minimising impacts by restricting the magnitude of the proposed activity and its implementation; and
- Mitigating the impact of the activity by appropriately managing the proposed activity, and rehabilitating, or restoring the affected environment; and
- Offsetting any residual impacts where appropriate.

### 6.2 Mitigation Measures

#### 6.2.1 Avoid

The chip hole lease has been located within a disturbed grazing paddock that incorporates a small rubbish pit to avoid areas of intact vegetation, native grasses and ground covers, as well as areas of intact White Box - Yellow Box - Blakely's Red Gum Woodland. This area has been selected to avoid nearby canopy trees, and stands of White Cypress, and is considered to be of low ecological value.

The access track will be predominantly located along existing tracks to avoid unnecessary additional disturbances. Where new access tracks are required, it has been located to avoid all canopy trees.

#### 6.2.2 Minimise

The disturbance area will be minimised to reduce unnecessary clearing and earthworks. Disturbances associated with the chip hole lease have been minimised, as the location has been selected to encompass highly disturbed areas, including a rubbish pit.

Where access tracks are required, they will be predominantly located along existing tracks to minimise the need for additional vegetation clearing. Where additional clearing is required for access tracks, it will result in the disturbance of pasture grasses only.

The chip hole lease will be appropriately fenced to ensure machinery is limited to the designated disturbance area. Fencing will also ensure that all adjacent canopy trees are appropriately protected throughout construction works.

---

### 6.2.3 Mitigate

Weed monitoring will occur throughout the construction phase, and weed removal will be carried out as necessary.

Following construction of the chip hole, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Rehabilitation will include native grasses that are representative of the existing vegetation composition.

Vehicle speeds will be limited to reduce the potential of fauna strike, and to reduce dust generation.

Weed management procedures will be implemented to prevent the spread of weeds both on and off site. Where vehicles and machinery are moving between the site and weed free areas, wash down procedures must be implemented. Mexican Poppy, a Class 5 declared noxious weed should be appropriately controlled within the proposal footprint and along the proposed access road and tracks prior to the construction stage.

To minimise potential impacts on adjacent grazing lands, all liquids (fuel, oil, cleaning agents, drilling liquids etc) will be stored appropriately and disposed of at suitably licensed facilities. Spill management procedures will be implemented as required. Rubbish will be collected and removed from the site. Appropriate erosion and sediment control measures will be utilised as required.

An Environmental Management Plan has been prepared for the proposed activity and provides further detail regarding specific management measures to be implemented.

### 6.2.4 Offset

Due to the proposed activities being short-term and the level of impacts being temporary and minimal in extent, as well as the recommended mitigation measures to rehabilitate the activity site, offsets are not required.

---

## 7.0 Conclusion

Santos propose to drill a chip hole known as Wando 1 to obtain information of coal seam depths, seam thickness, continuity and permeability to assess coal seam gas potential within the Gunnedah Basin. A pre-clearing assessment has been conducted, and verified that the site has been highly modified, and is considered to be in very poor ecological condition. The site has been located to avoid and minimise impacts on key ecological features occurring on the wider property.

One threatened fauna species is known to occur adjacent to the chip hole lease, the Koala. No additional threatened fauna or flora species listed under the TSC Act and/or EPBC Act were recorded on site, however the site provides potential habitat for 10 additional threatened species.

No threatened flora species were identified as occurring in site, however the site provides potential marginal habitat for two grass species. One EEC / TEC was observed across the property, White Box - Yellow Box - Blakely's Red Gum Woodland. The chip hole lease is considered to be representative of the TSC Act EEC only, as it is lacking the native species diversity, canopy density, and regeneration to be classified as the TEC. The access track is located within an area that is considered to be the EEC under the EPBC Act, as well as the TSC Act EEC.

One Class 5 noxious weed (Mexican Poppy) was recorded in the study area during the pre-clearance survey.

The potential direct and indirect impacts that may be associated with the proposal are considered to be minimal. A range of mitigation and management measures have been identified, targeted at minimising impacts on White Box - Yellow Box - Blakely's Red Gum Woodland, and Koala habitat. Implementation of these measures will ensure that the impacts on these ecological features are not significant. Key measures include the avoidance of all canopy vegetation, and the use of existing access tracks where practical. Vegetation clearing has been limited to the removal of disturbed ground covers only.

---

## 8.0 References

Department of Environment and Climate Change (2008). *Recovery Plan for the Koala (Phascolarctos cinereus)*. The State of NSW and DECC.

Department of Sustainability, Environment, Water, Population and Community (2011). *EPBC Act Protected Matters Search Tool (online)*. Accessed 7/4/2011.

Department of Sustainability, Environment, Water, Population and Community (2006). *White Box – Yellow Box – Blakely’s Red Gum Grassy Woodlands and Derived Native Grasslands Policy Statement*. Australian Government.

Office of Environment and Heritage (2011). *Atlas of NSW Wildlife, Curlew Map Sheet*.

Office of Environment and Heritage (2011). *White box yellow box Blakely's red gum woodland - endangered ecological community listing - NSW Scientific Committee - final determination*. NSW Government.

Office of Environment and Heritage (2011). *Threatened Species, Populations, and Ecological Communities of NSW. White Box Yellow Box Blakely's Red Gum Woodland – profile*. Accessed 7/4/2011.

Office of Environment and Heritage (2011). *Threatened Species, Populations, and Ecological Communities of NSW. Liverpool Plains Catchment Management Area Sub-region Threatened Species List (online)*. Accessed 7/4/2011.

NSW National Parks and Wildlife Service (1999). *Threatened Species Information – Koala*. NPWS, Sydney.

# Appendix A

## EPBC Act Protected Matters Search



# EPBC Act Protected Matters Report: Coordinates

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

Information about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

**Report created: 07/04/11 17:04:21**

## [Summary](#)

## [Details](#)

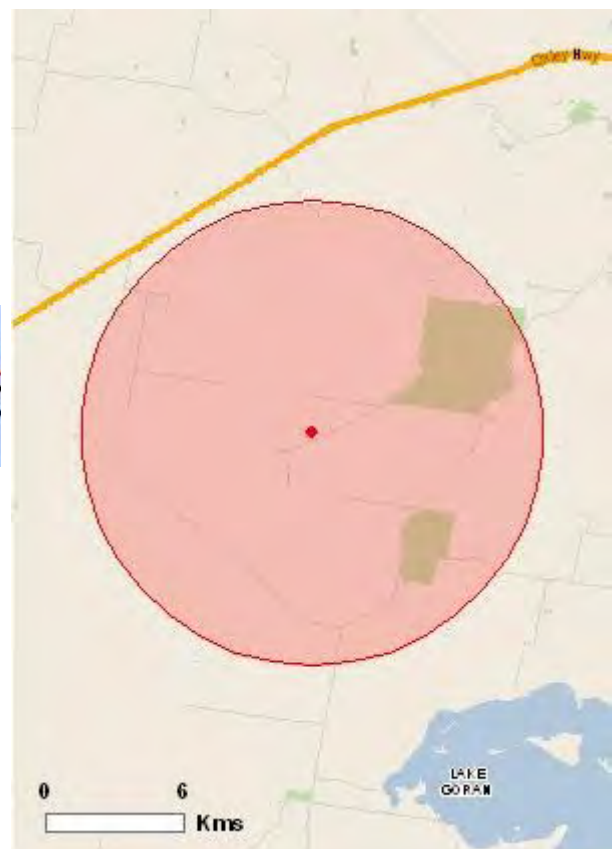
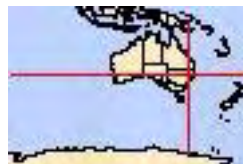
[Matters of NES](#)

[Other matters protected by the EPBC Act](#)

[Extra Information](#)

## [Caveat](#)

## [Acknowledgements](#)



This map may contain data which are  
©Commonwealth of Australia (Geoscience  
Australia), ©PSMA 2010

[Coordinates](#)

Buffer: 10Km

# Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see <http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>.

<a href="#">World Heritage Properties:</a>	None
<a href="#">National Heritage Places:</a>	None
<a href="#">Wetlands of International Significance (Ramsar Wetlands):</a>	None
<a href="#">Great Barrier Reef Marine Park:</a>	None
<a href="#">Commonwealth Marine Areas:</a>	None
<a href="#">Threatened Ecological Communities:</a>	4
<a href="#">Threatened Species:</a>	17
<a href="#">Migratory Species:</a>	11

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage/index.html>

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov.au/epbc/permits/index.html>.

<a href="#">Commonwealth Lands:</a>	1
<a href="#">Commonwealth Heritage Places:</a>	None
<a href="#">Listed Marine Species:</a>	9

<a href="#">Whales and Other Cetaceans:</a>	None
<a href="#">Critical Habitats:</a>	None
<a href="#">Commonwealth Reserves:</a>	None

## Report Summary for Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

<a href="#">Place on the RNE:</a>	None
<a href="#">State and Territory Reserves:</a>	1
<a href="#">Regional Forest Agreements:</a>	None
<a href="#">Invasive Species:</a>	10
<a href="#">Nationally Important Wetlands:</a>	None

## Details

### Matters of National Environmental Significance

#### Threatened Ecological Communities

[\[ Resource Information \]](#)

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
<a href="#">Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland</a>	Critically Endangered	Community likely to occur within area
<a href="#">White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland</a>	Critically Endangered	Community may occur within area
<a href="#">Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia</a>	Endangered	Community may occur within area
<a href="#">Weeping Myall Woodlands</a>	Endangered	Community may occur within area

#### Threatened Species

[\[ Resource Information \]](#)

Name	Status	Type of Presence
<b>BIRDS</b>		
<a href="#">Anthochaera phrygia</a> Regent Honeyeater [82338]	Endangered	Species or species habitat may occur within area
<a href="#">Lathamus discolor</a> Swift Parrot [744]	Endangered	Species or species habitat may occur within area
<a href="#">Polytelis swainsonii</a> Superb Parrot [738]	Vulnerable	Species or species habitat may occur within area
<a href="#">Rostratula australis</a> Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area

## FISH

### [Maccullochella peelii peelii](#)

Murray Cod, Cod, Goodoo [68443]      Vulnerable      Species or species habitat may occur within area

## FROGS

### [Litoria booroolongensis](#)

Booroolong Frog [1844]      Endangered      Species or species habitat may occur within area

## MAMMALS

### [Chalinolobus dwyeri](#)

Large-eared Pied Bat, Large Pied Bat [183]      Vulnerable      Species or species habitat may occur within area

### [Dasyurus maculatus maculatus \(SE mainland population\)](#)

Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]      Endangered      Species or species habitat may occur within area

### [Nyctophilus timoriensis \(South-eastern form\)](#)

Greater Long-eared Bat, South-eastern Long-eared Bat [66888]      Vulnerable      Species or species habitat may occur within area

## PLANTS

### [Digitaria porrecta](#)

Finger Panic Grass [12768]      Endangered      Species or species habitat likely to occur within area

### [Philothea ericifolia](#)

[64942]      Vulnerable      Species or species habitat likely to occur within area

### [Prasophyllum sp. Wybong \(C.Phelps ORG 5269\)](#)

a leek-orchid [81964]      Critically Endangered      Species or species habitat may occur within area

### [Pterostylis cobarensis](#)

Cobar Greenhood Orchid [12993]      Vulnerable      Species or species habitat likely to occur within area

### [Swainsona murrayana](#)

Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]      Vulnerable      Species or species habitat likely to occur within area

### [Thesium australe](#)

Austral Toadflax, Toadflax [15202]      Vulnerable      Species or species habitat likely to occur within area

### [Tylophora linearis](#)

[55231]      Endangered      Species or species habitat likely to occur within area

## REPTILES

### [Underwoodisaurus sphyrurus](#)

Border Thick-tailed Gecko [1660]      Vulnerable      Species or species habitat likely to occur within area

## Migratory Species

## [ [Resource Information](#) ]

Name	Status	Type of Presence
------	--------	------------------

## Migratory Marine Birds

### [Apus pacificus](#)

Fork-tailed Swift [678] <a href="#">Ardea alba</a>	Species or species habitat may occur within area
Great Egret, White Egret [59541] <a href="#">Ardea ibis</a>	Species or species habitat may occur within area
Cattle Egret [59542]	Species or species habitat may occur within area

### **Migratory Terrestrial Species**

<a href="#">Haliaeetus leucogaster</a> White-bellied Sea-Eagle [943]	Species or species habitat likely to occur within area
<a href="#">Hirundapus caudacutus</a> White-throated Needletail [682]	Species or species habitat may occur within area
<a href="#">Merops ornatus</a> Rainbow Bee-eater [670]	Species or species habitat may occur within area
<a href="#">Xanthomyza phrygia</a> Regent Honeyeater [430]	Species or species habitat may occur within area

### **Migratory Wetlands Species**

<a href="#">Ardea alba</a> Great Egret, White Egret [59541] <a href="#">Ardea ibis</a>	Species or species habitat may occur within area
Cattle Egret [59542] <a href="#">Gallinago hardwickii</a>	Species or species habitat may occur within area
Latham's Snipe, Japanese Snipe [863] <a href="#">Rostratula benghalensis s. lat.</a>	Species or species habitat may occur within area
Painted Snipe [889]	Species or species habitat may occur within area

## **Other Matters Protected by the EPBC Act**

### **Commonwealth Lands**

**[ Resource Information ]**

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land - Australian Telecommunications Commission

### **Listed Marine Species**

**[ Resource Information ]**

Name	Status	Type of Presence
<b>Birds</b>		
<a href="#">Apus pacificus</a> Fork-tailed Swift [678]		Species or species habitat may occur within area
<a href="#">Ardea alba</a> Great Egret, White Egret [59541] <a href="#">Ardea ibis</a>		Species or species habitat may occur within area
Cattle Egret [59542] <a href="#">Gallinago hardwickii</a>		Species or species habitat may occur within area
Latham's Snipe, Japanese Snipe [863] <a href="#">Haliaeetus leucogaster</a>		Species or species habitat may occur within area
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
<a href="#">Hirundapus caudacutus</a>		

White-throated Needletail [682] <a href="#">Lathamus discolor</a>		Species or species habitat may occur within area
Swift Parrot [744] <a href="#">Merops ornatus</a>	Endangered	Species or species habitat may occur within area
Rainbow Bee-eater [670] <a href="#">Rostratula benghalensis s. lat.</a>		Species or species habitat may occur within area
Painted Snipe [889]		Species or species habitat may occur within area

## Extra Information

### State and Territory Reserves [ [Resource Information](#) ]

Wondoba, NSW

### Invasive Species [ [Resource Information](#) ]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit, 2001.

Name	Status	Type of Presence
------	--------	------------------

#### Frogs

[Bufo marinus](#)

Cane Toad [1772]		Species or species habitat likely to occur within area
------------------	--	--

#### Mammals

[Capra hircus](#)

Goat [2]		Species or species habitat may occur within area
----------	--	--

[Felis catus](#)

Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
-----------------------------------	--	--

[Oryctolagus cuniculus](#)

Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
-------------------------------	--	--

[Sus scrofa](#)

Pig [6]		Species or species habitat likely to occur within area
---------	--	--

[Vulpes vulpes](#)

Red Fox, Fox [18]		Species or species habitat likely to occur within area
-------------------	--	--

#### Plants

[Lycium ferocissimum](#)

African Boxthorn, Boxthorn [19235]		Species or species habitat may occur within area
------------------------------------	--	--

[Nassella trichotoma](#)

Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat may occur within area
---	--	--

[Pinus radiata](#)

Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
---	--	--

[Rubus fruticosus aggregate](#)

Blackberry, European Blackberry [68406]		Species or species habitat may occur within area
---	--	--

# Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

## Coordinates

150.07667 -31.13028

## Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Department of Environment, Climate Change and Water, New South Wales](#)
- [-Department of Sustainability and Environment, Victoria](#)

- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment and Natural Resources, South Australia](#)
- [-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [-Environmental and Resource Management, Queensland](#)
- [-Department of Environment and Conservation, Western Australia](#)
- [-Department of the Environment, Climate Change, Energy and Water](#)
- [-Birds Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-SA Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [-State Forests of NSW](#)
- Other groups and individuals

Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

[Accessibility](#) | [Disclaimer](#) | [Privacy](#) | [© Commonwealth of Australia](#) | [Help](#)

Last updated: Thursday, 16-Sep-2010 09:13:25 EST

[Department of Sustainability, Environment, Water, Population and Communities](#)

GPO Box 787

Canberra ACT 2601 Australia

+61 2 6274 1111 [ABN](#)

| [Australian Government](#) |

## Appendix B

### Site Flora Species List

Family Name	Scientific Name	Common Name
ASCLEPIADACEAE	<i>Maireana microphylla</i>	Small-leaved Cotton Bush
ASTERACEAE	<i>Bidens pilosa</i> *	Cobblers Pegs
ASTERACEAE	<i>Carthamus lanatus</i> *	Saffron Thistle
ASTERACEAE	<i>Chrysocephalum apiculatum</i>	Yellow Buttons
ASTERACEAE	<i>Conyza sumatrensis</i> *	Tall Fleabane
ASTERACEAE	<i>Conyza sumatrensis</i> *	Tall Fleabane
ASTERACEAE	<i>Vittadinia</i> sp.	-
ASTERACEAE	<i>Xanthium spinosum</i> *	Bathurst Burr
BRASSICACEAE	<i>Capsella bursa-pastoris</i> *	Shepherds purse
CAMPANULACEAE	<i>Wahlenbergia gracillis</i>	Australian Bluebell
CHENOPODIACEAE	<i>Einadia</i> sp.	-
CUPRESSACEAE	<i>Callitris glaucophylla</i>	White Cypress
LAMIACEAE	<i>Salvia reflexa</i> *	Mint Weed
MYRTACEAE	<i>Eucalyptus blakelyi</i>	Blakely's Red Gum
MYRTACEAE	<i>Eucalyptus melliodora</i>	Yellow Box
MYRTACEAE	<i>Eucalyptus populnea</i>	Bimble Box
PAPAVERACEAE	<i>Argemone ochroleuca</i> *	Mexican Poppy
POACEAE	<i>Aristida vagans</i>	Threeawn Speargrass
POACEAE	<i>Austrostipa aristiglumis</i>	Plains Grass
POACEAE	<i>Bothriochloa decipiens</i>	Pitted Blue-grass
POACEAE	<i>Chloris divaricata</i>	Slender Chloris
POACEAE	<i>Eragrostis</i> sp.	-
POACEAE	<i>Sporobolus creber</i>	Slender Rat's Tail Grass

\* denotes introduced species.

## Appendix C

### 7-Part Test / Assessment of Significance

---

## 7-Part Test

### Approach

Section 5A of the EP&A Act lists seven factors that must be taken into account in the determination of the significance of potential impacts of proposed activities on 'threatened species, populations or ecological communities or their habitats' (threatened biota) listed under the TSC Act. The '7-part test' is used to determine whether proposed activities are 'likely' to impose 'a significant effect' on threatened biota and thus whether a Species Impact Statement (SIS) is required to be produced.

The significance of the impacts on White Box Yellow Box Blakely's Red Gum Woodland and the Koala has been assessed in the sections below.

### **White Box Yellow Box Blakely's Red Gum Woodland**

White Box Yellow Box Blakely's Red Gum Woodland is found on relatively fertile soils on the tablelands and western slopes of NSW and generally occurs between the 400 and 800 mm isohyets extending from the western slopes, at an altitude of c. 170m to c. 1200 m, on the northern tablelands. The community occurs within the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions.

### *7-Part Test Criteria*

***a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.***

Not applicable.

***b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.***

Not applicable.

***c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

***(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or***

Approximately .0.5ha of this EEC is likely to be temporarily removed to construct the chip hole lease. An additional 0.3ha will be permanently removed to construct the access tracks. The proposed activity will not significantly reduce the extent of this EEC in the wider study area as there are more extensive areas of this EEC within the local area, that are considered to be a better representation of the EEC. The local occurrence is not likely to be placed at risk of extinction. Furthermore, the portion of EEC to be removed is in poor ecological condition as it is void of canopy and shrub vegetation with weed species occurring,

while adjacent areas containing mature canopy vegetation and are considered to be of higher ecological value have been avoided.

***(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.***

The proposed activities will cause the temporary removal of a relatively small portion of this EEC in the study area, however vegetation removal will be limited to ground cover species only. Additionally, approximately 0.3ha of the EEC will be permanently removed to facilitate the extension of the access tracks. The proposed activities are unlikely to adversely impact the EEC in areas adjacent to the chip hole lease and access tracks, through the implementation of mitigation measures.

***d) In relation to the habitat of a threatened species, population or ecological community:***

***(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and***

The proposed activity will temporarily remove 0.5ha of Box Gum Woodland EEC, and permanently remove 0.3ha to facilitate the construction and extension of the access tracks. Vegetation to be removed is disturbed ground covers only, all canopy vegetation will remain intact. Areas adjacent to disturbance areas are unlikely to be modified as a result of the proposed activity.

***(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and***

The proposed chip hole lease and access tracks are currently void of native canopy vegetation, and are dominated by weed species. These areas are not considered to be contributing to a movement corridor. No areas of adjacent EEC habitat will become fragmented or isolated as a result of the proposed activity.

***(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.***

The area of this EEC to be removed is limited in extent and subject to ongoing disturbances associated with weed invasion. This area is relatively small, and highly disturbed, in contrast to similar habitats across the property that are also the EEC, where the native species composition may have greater diversity and structurally intact, and as such maybe a better representation of this EEC.

Additionally, the patch of EEC within the well lease is likely to be improved in contrast to its current condition, species composition and structural diversity as part of the decommissioning rehabilitation. The habitat to be removed or modified is not likely to be important for the long-term survival of the community.

***e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)***

No critical habitat is registered for this EEC.

***f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.***

The OEH (2010) has prepared a (draft) national recovery plan for this EEC. The primary objective of the recovery plan is to minimise the risk of extinction of this EEC through:

- Achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;
- Increasing protection of sites in good condition;
- Increasing landscape functionality of the ecological community through management and restoration of degraded sites;
- Increasing transitional areas around remnants and linkages between remnants; and
- Bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.

Only a very small proportion of this EEC would be temporarily disturbed, and a small portion permanently removed, comprising of ground cover vegetation only. These areas are already in a highly disturbed state, as they are void of canopy vegetation, include a rubbish pit, and comprised a high density of weed species. The un-impacted EEC adjacent to disturbance areas will be protected and some weed control will occur where vegetation clearing is likely to take place.

***g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process***

There are currently 35 key threatening processes (KTP's) listed under the TSC Act. The most relevant ones to this proposed activities and White Box Yellow Box Blakely's Red Gum Woodland are the invasion of native plant communities by exotic perennial grasses and the clearing of native vegetation, which are listed as KTPs under TSC and EPBC Acts.

*Invasion of native plant communities by exotic perennial grasses* - Based on the above considerations, the proposed activity would not result in a significant increase in the operation of this KTP to White Box Yellow Box Blakely's Red Gum Woodland.

*Clearing of native vegetation* - The proposed activities will temporarily remove approximately 0.5ha of this EEC within the chip hole lease. Additionally, 0.3ha will be permanently removed to extend the access track. The loss of this relatively small amount of structurally modified EEC is unavoidable in light of the objectives of the proposed activities and is unlikely to result the decline of this EEC in the locality, particularly given that no canopy vegetation is to be removed. The proposed activity should not result in the operation of, or increase the impact of the invasion of exotic perennial weeds into those areas not impacted by the proposed activities in adjacent areas.

***Conclusion***

Based on the consideration of the above factors, the proposed activities are not likely to significantly affect the listed threatened ecological community White Box Yellow Box Blakely's Red Gum Woodland or its habitats.

**Koala (*Phascolarctos cinereus*)**

The Koala is widespread, found in sclerophyll forest and woodland on foothills and plains on both sides of the Great Dividing Range from about Chillagoe in northern Queensland to Mount Lofty Ranges in South Australia. The distribution extends inland to Desert Uplands of central Queensland and along riverine forests in central NSW and north-central Victoria. Koalas are arboreal, agile climbers and spend most of their time in trees. They are inactive for 20 hours per day. Koalas feed on the foliage of more than 70 Eucalypt and 30 non-Eucalypt species.

**7-Part Test Criteria**

***a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.***

The proposed activities are unlikely to have an adverse effect on the life cycle of the Koala. While evidence of Koala usage was observed within the study area, no canopy trees occur within the chip hole lease and subsequently will not be affected by the proposed activities.

***b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.***

Not applicable.

***c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:***

***(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or***

***(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.***

Not applicable.

***d) In relation to the habitat of a threatened species, population or ecological community:***

***(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and***

The proposed activity will result in the temporary disturbance of 5,504m<sup>2</sup> of grassland, including a rubbish pit. No canopy trees will be removed. Adjacent areas considered suitable habitat for Koalas are unlikely to be modified as a result of the proposed activity.

***(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and***

The proposed chip hole lease is currently void of native canopy vegetation, and is dominated by weed species. It is not considered to be contributing to a movement corridor. No areas of adjacent Koala habitat are likely to become fragmented or isolated as a result of the proposed activity.

***(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.***

Evidence of Koala usage was observed under several Eucalypt trees in the study area, however no canopy trees occur within the chip hole lease. Therefore the grassland to be removed or modified is not likely to be important for the long-term survival of the Koala, as it does not provide an important habitat resource for the Koala.

***e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)***

The vegetation within the chip hole lease is not considered to provide critical habitat for the Koala, as it is lacking mature canopy vegetation. While mature eucalypts, including known Koala food trees occur adjacent to the chip hole lease, this Koala habitat will not be impacted by the proposed activities.

***f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.***

The OEH (2008) has prepared an Approved Recovery Plan for the Koala. The primary objective of the recovery plan is to minimise the risk of extinction of this species. Specific objectives include:

- To conserve Koalas in their existing habitat;
- To rehabilitate and restore Koala habitat and populations;
- To develop a better understanding of the conservation biology of Koalas;
- To ensure that the community has access to factual information about the distribution, conservation and management of Koalas at a national, state and local scale;
- To manage captive, sick or injured Koalas and orphaned wild Koalas to ensure consistent and high standards of care;
- To manage overbrowsing to prevent both Koala starvation and ecosystem damage in discrete patches of habitat; and
- To coordinate, promote the implementation, and monitor the effectiveness of the NSW Koala Recovery Plan across NSW.

The proposed activities will result in the temporary disturbance of 5,504m<sup>2</sup> of grassland habitat, including a rubbish pit. No canopy trees will be cleared within the chip hole lease. Areas adjacent to the chip hole lease, including mature canopy trees will not be directly impacted upon. Furthermore, mitigation measures such as fencing will be implemented as part of construction works. Koalas are unlikely to be affected by the proposed activities.

***g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process***

---

There are currently 35 key threatening processes (KTP's) listed under the TSC Act. The most relevant KTP to this activity is the clearing of native vegetation, which is listed as a KTP under TSC and EPBC Acts.

*Clearing of native vegetation* - The proposed activities will result in the temporary disturbance of approximately 5,504m<sup>2</sup> of grassland, including an existing rubbish pit. The loss of grassland is unavoidable in light of the objectives of the proposed activities, however is unlikely to result in impacts upon Koalas, particularly given that no canopy vegetation is to be removed. No mature canopy vegetation in areas adjacent to the chip hole lease will be removed.

### *Conclusion*

Based on the consideration of the above factors, the proposed activities are not likely to significantly affect the listed Vulnerable Koala or its habitats.

---

## Assessment of Significance

### Approach

An assessment of whether the proposed activities will have, or are likely to have a significant impact on listed threatened species, listed migratory species or threatened ecological communities under the EPBC Act has been carried out in accordance with the EPBC Act and *EPBC Act Policy Statement 1.1 - Significant Impact Guidelines Matters of National Environmental Significance* (DEWHA, 2009). The DEWHA (2009) guidelines require proponents to self-assess as to whether or the action is likely to have a significant impact on MNES. Where impacts on MNES are likely, then an assessment of the significance of those impacts must be performed.

There is one EEC listed under the EPBC Act that were positively recorded occurring within the study area, White Box Yellow Box Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands. An Assessment of Significance has been conducted below.

### White Box Yellow Box Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands

White Box Yellow Box Blakely's Red Gum Woodland Grassy Woodland and derived Native Grasslands (Box Gum Woodland) is found on relatively fertile soils on the tablelands and western slopes of NSW and generally occurs between the 400 and 800 mm isohyets extending from the western slopes, at an altitude of c. 170m to c. 1200 m, on the northern tablelands. The community occurs within the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions. Less than 5% of this community remains in good condition, and much of this occurs in small, isolated patches.

### Significant Impact Criteria

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

#### **a) Reduce the extent of an ecological community;**

This community is not present within the proposed chip hole lease, however it does occur adjacent to the lease. Minimal areas of this community will be disturbed, as removal of approximately 0.3ha of ground cover vegetation is required to extend the proposed access tracks. No canopy trees within the TEC are to be removed. The proposed activities will not result in a reduction of the extent of an ecological community.

#### **b) Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;**

Some extension of the existing track that leads to the chip hole lease will be required to enable access. This would require construction of an additional 500m of 6m wide access through the Box Gum Woodland and Derived Native Grassland community. This widening of the existing track will not segregate any part of this community, given that no canopy trees are to be cleared, and disturbed ground covers are to be

removed only. Therefore, the proposed activity will not result in increased fragmentation of the ecological community.

**c) Adversely affect habitat critical to the survival of an ecological community;**

Past disturbances associated with land clearing for agriculture have already significantly impacted the extent of this community in the study area. The proposed activities are unlikely to further affect habitats critical to this community in the study area, given that slashing will be conducted in this community only.

**d) Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;**

The proposed activities will not impact abiotic factors necessary for the survival of this community.

**e) Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;**

The impacts to the community will be limited to clearing of disturbed ground cover vegetation only, and continued vehicle movement through the community. These areas do not contain species that are unique to the community within the same patch, and temporarily suppressing these species will not affect the diversity or overall functionality of the community.

**f) Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:**

**-- assisting invasive species, that are harmful to the listed ecological community, to become established, or**

The proposed chip hole lease, and wider study area areas have been heavily invaded by weed species. However, guidelines will be put in place prevent the spread and invasion of additional weed species into this community.

**-- causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or**

The proposed activities will not cause regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community.

**g) Interfere with the recovery of an ecological community.**

The OEH (2010) has prepared a (draft) national recovery plan for this CEEC. The primary objective of the recovery plan is to minimise the risk of extinction of this TEC through:

- Achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;
- Increasing protection of sites in good condition;

- 
- Increasing landscape functionality of the ecological community through management and restoration of degraded sites;
  - Increasing transitional areas around remnants and linkages between remnants; and
  - Bringing about enduring changes in participating land manager attitudes and behaviors towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.

Only a very small proportion of the TEC in the locality will be disturbed due to limited vegetation clearing, within areas that are in poor ecological condition. The clearing will not result in a reduction of landscape functionality, or reduction in size of vegetation remnants.

#### Conclusion

Based on consideration of the above factors it is concluded that the proposed activities are unlikely to have a significant impact on the White Box Yellow Box Blakely's Red Gum Woodland.

---

# Appendix B

Cultural Heritage Assessment

prepared by Santos

# Gunnedah Basin – Cultural Heritage Assessment

## Request Details

Asset Type:	Well and access road
Asset Name:	Wando 1
Description of activity, including location and machinery involved:	Excavator, grader and Dozer to construct lease and access track
Activity start date:	1/6/2011
Activity end date:	30/6/2012
Tenement:	Petroleum Exploration Licence No. 1

<b>Request Contact Details</b>	<b>Requestor Contact Detail Type</b>
0738383754	Telephone

## The Investigation Area

The **Investigation Area** means the land described below.

Please input the latitude and longitude for the location of the Investigation Area, which may involve multiple points, for example if the site is a large evaporation pond or excavation area. You can also put in the sequence for a set of points or points in a line, and a description for each of them. Please use degrees, minutes and seconds.

Seq	Latitude			Longitude			Description
	Deg	Min	Sec	Deg	Min	Sec	
							The area was searched by using the Lot and deposited plan number of the landholding (see below)

Please also provide the GPS Datum from the GPS, which will usually be GDA94.

<b>GPS Datum:</b>	MGA94
-------------------	-------

<b>Property details</b>	<b>Landholder details</b>
Lots _22,25,34,83,84 on 755532 known as Tabbrawyndi	Martin Michael and Anthea Rae Wainberg

Action taken to comply with the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales published by DECCW in September 2010.

<b>Action taken</b>	<b>Results</b>
---------------------	----------------

Action taken	Results
<b>1. Records Search</b>	
<p>A search of the Aboriginal Heritage Information Management System was undertaken on _28 day of March_ 2011.</p>	<p>Evidence found of:</p> <p><input type="checkbox"/> Cultural heritage objects <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p><input type="checkbox"/> Cultural heritage sites <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Search results are attached.</p>
<p>Are there other readily available resources for the Investigation Area? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>If Yes, a search of other readily available resources (eg Santos GSI) was undertaken on _____ day of _____ 20____.</p> <p>(These sources can include previous studies, surveys or reports of which you may be aware.)</p>	<p>Evidence found of:</p> <p><input type="checkbox"/> Prior cultural heritage investigations <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p><input type="checkbox"/> Cultural heritage objects <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p><input type="checkbox"/> Cultural heritage sites <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>If Yes, the search results are attached.</p>
<p>A search of Aboriginal Places was undertaken on __14__ day of __June 20__11</p> <p>[see list of Aboriginal Places on <a href="http://www.environment.nsw.gov.au/conservation/AboriginalPlacesNSW.htm">http://www.environment.nsw.gov.au/conservation/AboriginalPlacesNSW.htm</a> ]</p>	<p>Is the Investigation Area an "Aboriginal Place"?</p> <p><input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
<p>The landholder was consulted as to whether they are aware of any sites or reports of Aboriginal objects in the area on:</p> <p>_31__ day of __March_ 20__11.</p>	<p>The landholder is aware of any sites or reports of Aboriginal objects in the area <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p>
<b>2. Status of Investigation Area</b>	
<p>Consideration of whether the Investigation Area is "disturbed land".</p> <p>'Disturbed land' is defined in the Due Diligence Code as:</p> <p><i>Land is disturbed land if it has been the subject of human activity that has changed the land's surface, being changes that remain clear and observable. Examples include ploughing, construction of rural infrastructure (such as dams and fences), construction of roads, trails and tracks (including fire trails and tracks and walking tracks), clearing vegetation, construction of buildings and the erection of other structures, construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure), substantial grazing involving the construction of rural infrastructure, and</i></p>	<p>[Insert description of disturbances within Investigation Area, e.g. evidence of cultivation, ploughing, grazing, infrastructure, construction or utility developments]</p> <p>Attached is a map which is an overhead photograph of the project area. The map displays the surface area and the disturbance to the land from agricultural activities.</p>

Action taken	Results
<i>construction of earthworks associated with anything referred to above.</i>	
<b>3. Landscape features</b>	
<p>Consideration of whether there are any landscape features within the Investigation Area or nearby which suggest the presence of Aboriginal sites, objects or places.</p> <p>The Due Diligence Code provides examples of landscape features including rock shelters, sand dunes, waterways, waterholes and wetlands.</p> <p>Is Investigation Area:</p> <ul style="list-style-type: none"> <li>• within 200m of waters;</li> <li>• within a sand dune system;</li> <li>• on a ridgetop, ridge line or headland;</li> <li>• within 200m below or above a cliff face; or</li> <li>• within 20m of or in a cave, rock shelter or cave mouth?</li> </ul>	<p>Visual inspection / photographs / environmental studies / etc [refer to source of conclusions] reveal that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> landscape features <b>were</b> identified within the Investigation Area <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</li> <li><input type="checkbox"/> landscape features were identified <b>nearby</b> the Investigation Area <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</li> <li><input type="checkbox"/> waterways were identified within 200 metres of the Investigation Area <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</li> <li><input type="checkbox"/> sand dune systems were identified within/nearby the Investigation Area <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</li> <li><input type="checkbox"/> ridgetops, ridge lines or headlands were identified within/nearby the Investigation Area <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</li> <li><input type="checkbox"/> cliff faces were identified within 200m above or below the Investigation Area <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</li> <li><input type="checkbox"/> caves, rock shelters or cave mouths were identified within 20 metres of the Investigation Area <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</li> </ul>
<b>4. Results of visual inspection of Investigation Area</b>	
<p>On ___31 day of __March 2011 a visual inspection of the Investigation Area was undertaken by</p> <p>Name of assessor: Steven Coghill</p> <p>The purpose of the visual inspection was to:</p> <p>(a) Confirm the extent of land disturbance (if any);</p> <p>(b) Confirm the extent of landscape features (if any).</p> <p>If:</p> <ul style="list-style-type: none"> <li>• any of the Investigation Area is undisturbed land (see Section 2 above); <b>and</b></li> <li>• the Investigation Area contains landscape features or is near landscape features (see Section 3 above),</li> </ul>	<p>[Insert reasons for concluding that the visual inspection indicates that Aboriginal objects <b>are/ are not</b> likely to exist within the Investigation Area].</p> <p>The proposed lease site and access road are contained within an area that has been significantly disturbed from agricultural activities. Further, the area does not contain any of the above features.</p>

Action taken	Results
<p>then the purpose of the visual inspection is also to determine whether Aboriginal objects can be identified or are likely to be present below the surface of the Investigation Area.</p> <p>Did an archaeologist inspect <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Name of archaeologist: _____</p>	
5. Conclusion	
<p>Consider what the likely impact of the activity will be on the Aboriginal objects.</p>	<p>Based on my inspection of the Investigation Area, the extent of land disturbance, the extent of landscape features (if any) and the various search results:</p> <ul style="list-style-type: none"> <li>• Further detailed investigation and impact assessment: <ul style="list-style-type: none"> <li><input type="checkbox"/> Is <input checked="" type="checkbox"/> Is not necessary</li> </ul> </li> <li>• An AHIP application: <ul style="list-style-type: none"> <li><input type="checkbox"/> Is <input checked="" type="checkbox"/> Is not necessary</li> </ul> </li> <li>• Can work proceed with caution? <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Yes, work can proceed with caution</li> <li><input type="checkbox"/> Not, work cannot proceed.</li> </ul> </li> </ul>

### Assessor's Certification

---

Assessed by:	Santos assessor: Steven Coghill Archaeologist <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes name of archaeologist _____
Assessment date:	31 day of March_2011

Santos Limited  
Level 22 32 Turbot Street  
Brisbane Queensland 4000

Date: 17 June 2011

Attention: Ann Stewart

Email: [ann.stewart@santos.com](mailto:ann.stewart@santos.com)

Dear Sir or Madam:

**AHIMS Web Service search for the following area at Lot : 22, DP:DP755532 with a Buffer of 200 meters.  
conducted by Ann Stewart on 17 June 2011**

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

**If your search shows Aboriginal sites or places what should you do?**

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the [NSW Government Gazette \(http://www.nsw.gov.au/gazette\)](http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

**Important information about your AHIMS search**

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

Santos Limited  
Level 22 32 Turbot Street  
Brisbane Queensland 4000

Date: 17 June 2011

Attention: Ann Stewart

Email: [ann.stewart@santos.com](mailto:ann.stewart@santos.com)

Dear Sir or Madam:

**AHIMS Web Service search for the following area at Lot : 25, DP:DP755532 with a Buffer of 200 meters.  
conducted by Ann Stewart on 17 June 2011**

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

**If your search shows Aboriginal sites or places what should you do?**

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the [NSW Government Gazette \(http://www.nsw.gov.au/gazette\)](http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

**Important information about your AHIMS search**

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

Santos Limited  
Level 22 32 Turbot Street  
Brisbane Queensland 4000

Date: 17 June 2011

Attention: Ann Stewart

Email: [ann.stewart@santos.com](mailto:ann.stewart@santos.com)

Dear Sir or Madam:

**AHIMS Web Service search for the following area at Lot : 34, DP:DP755532 with a Buffer of 200 meters.  
conducted by Ann Stewart on 17 June 2011**

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

**If your search shows Aboriginal sites or places what should you do?**

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the [NSW Government Gazette \(http://www.nsw.gov.au/gazette\)](http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

**Important information about your AHIMS search**

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

Santos Limited  
Level 22 32 Turbot Street  
Brisbane Queensland 4000

Date: 17 June 2011

Attention: Ann Stewart

Email: ann.stewart@santos.com

Dear Sir or Madam:

**AHIMS Web Service search for the following area at Lot : 83, DP:DP755532 with a Buffer of 200 meters.  
conducted by Ann Stewart on 17 June 2011**

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

**If your search shows Aboriginal sites or places what should you do?**

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the [NSW Government Gazette \(http://www.nsw.gov.au/gazette\)](http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

**Important information about your AHIMS search**

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

Santos Limited  
Level 22 32 Turbot Street  
Brisbane Queensland 4000

Date: 17 June 2011

Attention: Ann Stewart

Email: [ann.stewart@santos.com](mailto:ann.stewart@santos.com)

Dear Sir or Madam:

**AHIMS Web Service search for the following area at Lot : 84, DP:DP755532 with a Buffer of 50 meters. conducted by Ann Stewart on 17 June 2011**

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

**If your search shows Aboriginal sites or places what should you do?**

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the [NSW Government Gazette \(http://www.nsw.gov.au/gazette\)](http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

**Important information about your AHIMS search**

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

---

## Appendix C

Santos Drill Rig Noise Assessment

prepared by Heggies (now SLR)



**HEGGIES**

REPORT 20-2014-R3

Revision 2

**Santos Drill Rig  
Noise Assessment**

PREPARED FOR

**URS**

**Level 14, 240 Queen Street  
Brisbane Qld 4000**

29 APRIL 2009

**HEGGIES PTY LTD**  
ABN 29 001 584 612

*Incorporating*

New Environment

Graeme E. Harding & Associates

Eric Taylor Acoustics



# Santos Drill Rig

## Noise Assessment

### PREPARED BY:

Heggies Pty Ltd  
 Ground Floor, Suite 7, 240 Waterworks Road Ashgrove QLD 4060 Australia  
 Telephone 61 7 3858 4800 Facsimile 61 7 3858 4801  
 Email brisbane@heggies.com Web www.heggies.com

### DISCLAIMER

Reports produced by Heggies Pty Ltd are prepared for a particular Client's objective and are based on a specific scope, conditions and limitations, as agreed between Heggies and the Client. Information and/or report(s) prepared by Heggies may not be suitable for uses other than the original intended objective. No parties other than the Client should use any information and/or report(s) without first conferring with Heggies.

The information and/or report(s) prepared by Heggies should not be reproduced, presented or reviewed except in full. Before passing on to a third party any information and/or report(s) prepared by Heggies, the Client is to fully inform the third party of the objective and scope and any limitations and conditions, including any other relevant information which applies to the material prepared by Heggies. It is the responsibility of any third party to confirm whether information and/or report(s) prepared for others by Heggies are suitable for their specific objectives.



Heggies Pty Ltd is a Member Firm of the Association of Australian Acoustical Consultants.



Heggies Pty Ltd operates under a Quality System which has been certified by SAI Global Pty Limited to comply with all the requirements of ISO 9001:2000 "Quality management systems - Requirements" (Licence No 3236).

This document has been prepared in accordance with the requirements of that System.

### DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
20-2014-R3	Revision 2	29 April 2009	Henrik Malker	Mark Caslin	Mark Caslin
20-2014-R3	Revision 1	28 April 2009	Henrik Malker	Mark Caslin	Mark Caslin
20-2014-R3	Revision 0	27 April 2009	Henrik Malker	Mark Caslin	Mark Caslin



## TABLE OF CONTENTS

1	INTRODUCTION	5
2	DETERMINING EXISTING AMBIENT NOISE LEVELS	7
2.1	Instrumentation	9
2.2	Noise Monitoring Results	9
2.2.1	Unattended Noise Monitoring	9
2.2.2	Attended Ambient Noise Measurements	10
2.3	Predicted Ambient Noise Levels for the Winter Period	11
3	NOISE CRITERIA	11
3.1	Intrusive Criterion	11
3.2	Amenity Criteria	12
3.3	Accounting for Annoying Noise Characteristics	12
4	ATTENDED SOURCE NOISE MEASUREMENTS	12
4.1	Drill Rig McD 33	13
4.2	Drill Rig McD 29	14
4.3	Drill Rig MDC 105	14
4.4	Drill Rig Atlas 1	14
5	NOISE PREDICTIONS/ ASSESSMENT	15
5.1	Drill Rig McD 29 and McD 33	15
5.2	Drill Rig MDC 105 and Atlas 1	17
5.3	Noise Attenuation due to Meteorology, Topography and Vegetation	20
5.3.1	Meteorological Effects	20
5.3.2	Topographical Effects	20
5.3.3	Vegetation and Forest Effects	20
6	CONCLUSION	21
6.1	Noise Emissions for McD 29, McD 33 and MDC 105	21
6.2	Noise Emissions Atlas Rig 1	22
6.3	Noise Attenuation due to Meteorology, Topography and Vegetation	22
Table 1	Ambient Noise Monitoring Locations	8
Table 2	Measured Ratings Background Levels	9
Table 3	Attended Measurement Results – Day, Evening and Night-Time Periods	10
Table 4	Predicted Rating Background Level for the Winter Season	11
Table 5	Location and Time Specific Intrusive Criteria – Summer Season	11
Table 6	Summary of Relevant Amenity Criteria <sup>1</sup>	12
Table 7	Determined SWL for Plant Items at Drill Rig McD 33	13
Table 8	Determined SWL for Plant Items at Drill Rig McD 29	14
Table 9	Determined SWL for Plant Items at Drill Rig MDC 105	14
Table 10	Determined SWL for Plant Items at Drill Rig Atlas 1	15



## TABLE OF CONTENTS

Table 11	Weather Conditions – Neutral and “Worst Case”	15
Table 12	Predicted Noise Levels at Various Offset Distances – Drill Rig McD 29 and McD 33	16
Table 13	Predicted Offset Distances to Achieve the Noise Criteria – Drill Rig McD 29 and McD 33	17
Table 14	Predicted Noise Levels at Various Offset Distances – Drill Rig MDC 105 and Atlas 1	17
Table 15	Predicted Offset Distances to Achieve the Noise Criteria – Drill Rig MDC 105 and Atlas 1	19
Table 16	Increase in Noise Levels due to “Worst Case” Weather Conditions	20
Table 13	Predicted Offset Distances to Achieve the Noise Criteria – Drill Rig McD 29, McD 33 and MDC 105	22
Figure 1	Ambient Noise Monitoring Locations on the Gunnedah Basin	7
Figure 2	Typical Drill Site Plan	13
Appendix A	Unattended Noise Monitoring at Wisemans 1 – Statistical Noise Plots	
Appendix B	Unattended Noise Monitoring at Stoney Creek 1 – Statistical Noise Plots	
Appendix C	Noise Contour Plots – Drilling Operations McD 29 and McD 33	
Appendix D	Noise Contour Plots – Drilling Operations MDC 105 and Atlas Rig 1	



## 1 INTRODUCTION

Heggies Pty Ltd (Heggies) has been engaged by URS Australia Pty Ltd (URS) on behalf of Santos Ltd (Santos) to undertake noise and lighting assessments for the drill rigs operating in the Gunnedah Basin.

This report presents the results from:

- Ambient noise monitoring conducted at Wisemans 1 and Stoney Creek 1 which are located on the Gunnedah Basin, New South Wales. The two (2) monitoring locations are representative of flat/ open plains (Wisemans 1) and woodlands (Stoney Creek 1). Both attended and unattended noise measurements have been performed in order to accurately document the existing background noise environment.
- Based on the existing background noise environment the appropriate noise criteria have been determined.
- Attended noise measurements have been performed to determine sound power levels (SWL) for the dominant noise sources during operation of drill rigs McD 29, McD 33, MDC 105 and Atlas Rig 1.
- Noise emission predictions including noise contour plots and offset distances at which the noise criteria is predicted to be achieved using the calculated SWLs for the drill rigs.

## 2 TECHNICAL NOISE INFORMATION

### 2.1 Standard Noise Indices

This report makes reference to certain noise level descriptors, in particular the LA90, LAeq, LA10 and L<sub>Amax</sub> noise levels.

The LAeq is essentially the average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound over the same measurement period.

The LA90 noise level is the A-weighted sound pressure level exceeded 90% of a given measurement period and is representative of the average minimum background sound level (in the absence of the source under consideration), or simply the “background” level.

The LA10 is the A-weighted sound pressure level exceeded 10% of a given measurement period.

The L<sub>Amax</sub> noise level is the maximum A-weighted noise level associated with site activity.

The L<sub>Amax,adj T</sub> noise level is the average of the maximum noise levels during time period T adjusted for tonality and impulsiveness.

The relationship between the LAeq and the LA90 is in general less than 1 dBA for steady state noise sources (ie generators and normal drilling operation).



## 2.2 Typical Noise Levels

Table 1 presents examples of typical noise levels

Table 1 Typical Noise Levels

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

## 2.3 A-Weighting or dBA Noise Levels

The overall level of a sound is usually expressed in terms of dBA, as is the case in Australian Standard AS 1055 Acoustics – *Description and measurement of environmental noise*, which is measured using the “A-weighting” filter incorporated in sound level meters. These filters have 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 as loud, although the perceived loudness can also be affected by the character of the sound (eg the loudness of human speech and a distant motorbike may be perceived differently, although they are of the same dBA level).

## 2.4 Sensitivity of People to Noise Level Changes

A change of up to 3 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.



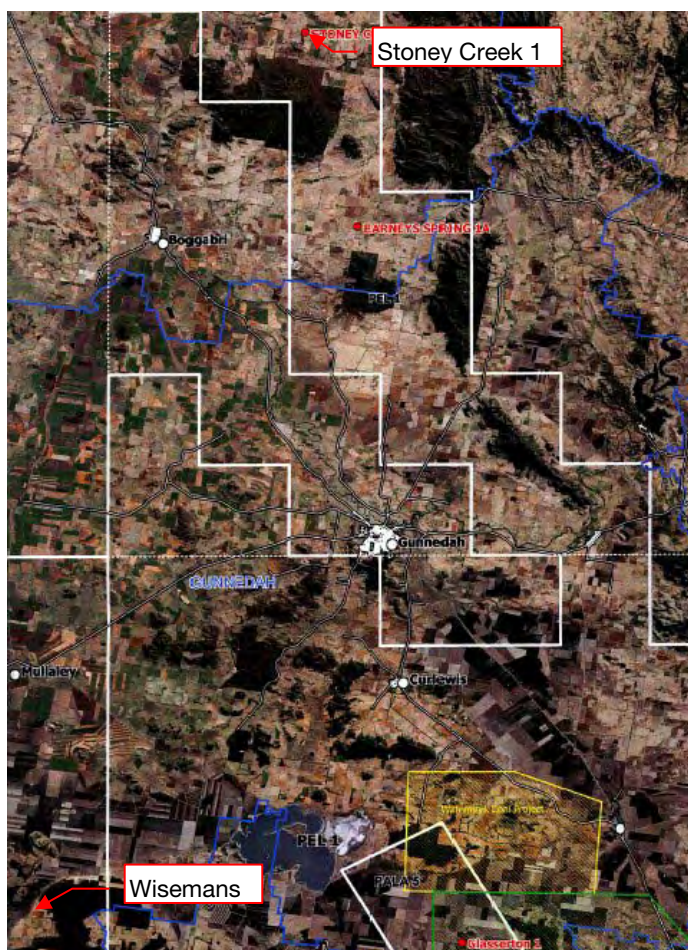
### 3 DETERMINING EXISTING AMBIENT NOISE LEVELS

In order to characterise the existing noise environment, long-term unattended ambient noise monitoring was undertaken from 9 March to 23 March at two (2) locations typical of the terrain in the Murrurundi/Gunnedah of NSW. These noise monitoring locations were located in areas with the following type of terrain:

- Wisemans 1 – flat/ open plains; and
- Stoney Creek 1 – woodlands.

The noise monitoring locations are shown in **Figure 1**.

**Figure 1 Ambient Noise Monitoring Locations on the Gunnedah Basin**



**Table 2** summarises the noise monitoring location details.



**Table 2 Ambient Noise Monitoring Locations**

Noise monitoring Location	Comments	Photo
Wisemans 1	Logger located next to a sorghum field and a paddock with cattle to the side.	
Stoney Creek 1	Logger located in an unused paddock. With cattle paddock to the side.	

Attended noise measurements were also conducted at the site to confirm background noise levels and to observe typical noise sources associated with the ambient noise environment during the daytime, evening and night-time periods. The attended noise measurements were conducted for one 15 minute period during each of the day (7.00 am to 6.00 pm), evening (6.00 pm to 10.00 pm) and night (10.00 pm to 7.00 am) time periods at both Wisemans 1 and Stoney Creek 1 (ie six 15 minute attended noise measurements were undertaken). The attended noise measurements were conducted on the 9, 10 and 23 March 2009.

15-minute weather data over the noise monitoring period was sourced via a remote weather station setup near the unattended logger at Wisemans 1. The weather conditions on 9 to 11 March were windy (above 5 m/s) and these days have been excluded from the measurements results. For the monitoring period 12 to 21 March the weather conditions were generally fine, with temperatures ranging from 15°C to 30°C, with calm to moderate breezes (below 5 m/s) blowing generally from the south, east and west. Some minor rainfall was recorded during the monitoring period these periods have been excluded from the measurement results. The weather conditions during the remainder of the monitoring period are considered to be suitable for background noise measurements.



Graphs showing the statistical noise levels and weather data measured at Wisemans 1 and Stoney Creek 1 over the whole monitoring period are presented in **Appendix A** and **Appendix B** for each 24-hour period. The graphs show various statistical noise levels, including the background (LA90) noise level.

### 3.1 Instrumentation

The long term unattended monitoring was undertaken using two (2) Acoustic Research Laboratories (ARL) EL-316 Environmental Noise Loggers programmed to record various statistical noise levels including the background (LA90) noise level. The logger was checked for calibration before and after the survey with a Rion NC-73 Sound Level Calibrator and no significant drift (greater than 0.5 dBA) in calibration was detected.

ARL EL-316 Noise Loggers are NATA certified Type 1 meters. It is common practice to use Type 1 (or 2) noise loggers for measuring background noise levels. The noise floor of EL-316 loggers is around 19 dBA.

Attended measurements were undertaken using a SVAN 948 Sound Level Meter. This unit is a Type 1 Sound Level Meter. The SVAN was checked for calibration before and after each set of noise measurements using a Rion NC-73 Sound Level Calibrator and no significant drift in calibration signal level was observed.

All items of acoustic instrumentation employed during the noise monitoring were set to 'Fast' response in accordance with the relevant Australian Standards. All items of acoustic instrumentation employed during the noise measurement surveys were designed to comply with AS 1259.2 *Sound Level Meters* and carry current calibration certificates.

### 3.2 Noise Monitoring Results

#### 3.2.1 Unattended Noise Monitoring

The unattended ambient noise measurements were used to determine the "Rating Background Level" (RBL) for the daytime (7.00 am to 6.00 pm), evening (6.00 pm to 10.00 pm) and night-time (10.00 pm to 7.00 am) periods at Wisemans 1 and Stoney Creek 1. The RBL is the median of the 90<sup>th</sup> percentile of the background (LA90) noise levels in each assessment period (day, evening and night) over the duration of the monitoring period.

For the purpose of determining the applicable noise criteria the New South Wales (NSW) 'Industrial Noise Policy' (INP) states that where a rating background noise level of less than 30 dBA is measured, the rating background noise level is set to the threshold level of 30 dBA. **Table 3** summarises the measured RBLs for Wisemans 1 and Stoney Creek 1.

**Table 3 Measured Ratings Background Levels**

Monitoring Location	Rating Background Level (dBA)		
	Day <sup>1</sup>	Evening <sup>1</sup>	Night <sup>1</sup>
Wisemans 1	(27) 30 <sup>2</sup>	32	33
Stoney Creek 1	(26) 30 <sup>2</sup>	34	(23) 30 <sup>2</sup>

Note 1: Daytime: 0700 to 1800 hours (Monday to Saturday), or 0800 to 1800 hours (Sundays and public holidays). Evening: 1800 to 2200 hours. Night-time: the remaining periods

Note 2: Numbers within brackets are the actual measured RBL's. Where the rating background level is less than 30 dBA, it is set to 30 dBA.

The elevated ambient noise levels in the evening and night-time at Wisemans 1 and in the evening at Stoney Creek 1 are due to noise from insects which are typical of the ambient noise environment during the summer season.



### 3.2.2 Attended Ambient Noise Measurements

Attended measurements were undertaken in order to confirm background noise levels and to observe typical noise sources associated with the ambient noise environment. The results of these measurements are summarised in **Table 4**.

**Table 4 Attended Measurement Results – Day, Evening and Night-Time Periods**

Monitoring Location	Date	Time (end of 15 min period)	Measured Noise Level (dBA)			Comments
			LA90 <sup>1</sup>	LAeq <sup>2</sup>	LA10 <sup>3</sup>	
Wisemans 1	9/03/09	5:25pm	42	46	49	Wind speed above 5 m/s. Wind generated noise in grass, trees and sorghum dominant. Noise from insects present, but lower than wind generated noise.
	10/03/09	2:45pm	37	44	46	Wind speed approximately 5 m/s. Wind generated noise in grass and sorghum dominant. Some occasional bird noise.
	10/03/09	7:05pm	43	48	51	Windy and gusty above 5 m/s. Wind generated noise in grass, trees and sorghum dominant. Noise from insects present, but lower than wind generated noise.
	10/03/09	11:20pm	33	37	38	Light breeze, wind speed less than 5 m/s. Insect noise dominant.
Stoney Creek 1	9/03/09	8:25pm	38	44	46	Wind speed approximately 5 m/s (wind gusts of above 5 m/s). Wind generated noise in grass and trees dominant. Some occasional insect noise.
	23/03/09	4:30pm	26	38	41	In general wind speed of much less than 5 m/s (wind gust of approximately 5 m/s). Bird chipping and occasional insect dominant noise source. 2 car passbys generated less than 35 dBA.
	24/03/09	0:45am	23	36	30	No wind. Distant Insect noise dominant. Car passby.

- 1 The LA90 is the noise level exceeded for 90% of the sample period. This noise level is described as the background level.
  - 2 The LAeq is the A-weighted equivalent noise level. It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.
  - 3 The LA10 is the noise level exceed for 10% of the sample period. This is commonly referred to as the average maximum noise level.
- Note: Daytime: 7.00am to 6.00pm (Monday to Saturday), or 8.00am to 6.00pm (Sundays and public holidays). Evening: 6.00pm to 10.00pm. Night-time: 10.00pm to 7.00am.

The attended measurements and observations summarised in **Table 4** shows that, in the absence of wind noise, insects and birds noise dominates the ambient noise environment at both Wisemans 1 and Stoney Creek 1.



### 3.3 Predicted Ambient Noise Levels for the Winter Period

The most significant seasonal influence on noise levels is due to the presence (or otherwise) of insect noise (usually most prevalent during the summer months) and from the prevailing weather conditions. On review of the measured RBLs in **Table 3**, the statistical noise plots (**Appendix A** and **Appendix B**), the 1/3 octave attended measurements and operator notes in **Table 4**, the measured RBLs have been adjusted to predict the likely ambient noise level for the winter period (excluding insect noise). The predicted RBLs for the winter season are shown in **Table 5**.

**Table 5 Predicted Rating Background Level for the Winter Season**

Monitoring Location	Rating Background Level (dBA)		
	Day <sup>1</sup>	Evening <sup>1</sup>	Night <sup>1</sup>
Wisemans 1	(27) 30 <sup>2</sup>	(27) 30 <sup>2</sup>	(28) 30 <sup>2</sup>
Stoney Creek 1	(26) 30 <sup>2</sup>	(26) 30 <sup>2</sup>	(23) 30 <sup>2</sup>

Note 1: Daytime: 0700 to 1800 hours (Monday to Saturday), or 0800 to 1800 hours (Sundays and public holidays).  
Evening: 1800 to 2200 hours. Night-time: the remaining periods

Note 2: Where the rating background level is less than 30 dBA, it is set to 30 dBA.

## 4 NOISE CRITERIA

The New South Wales (NSW) 'Industrial Noise Policy' (INP) outlines industrial noise criteria in two categories, an intrusive criterion and an amenity criterion. These criteria will be used in assessing the noise impacts associated with the operating drill rigs and are summarised below.

### 4.1 Intrusive Criterion

L<sub>Aeq</sub>(15 minute) should not exceed the RBL by more than 5 dBA. **Table 6** presents a summary of the time specific intrusive criteria, based on the RBL's in **Table 3**.

**Table 6 Location and Time Specific Intrusive Criteria – Summer Season**

Background Noise Monitoring Location	Day <sup>1</sup> L <sub>Aeq</sub> (15minute) (dBA)	Evening <sup>1</sup> L <sub>Aeq</sub> (15minute) (dBA)	Night <sup>1</sup> L <sub>Aeq</sub> (15minute) (dBA)
Wisemans 1	35	37	38
Stoney Creek 1	35	39	35

Note 1: Daytime: 0700 to 1800 hours (Monday to Saturday), or 0800 to 1800 hours (Sundays and public holidays).  
Evening: 1800 to 2200 hours. Night-time: the remaining periods



## 4.2 Amenity Criteria

Table 7 Summary of Relevant Amenity Criteria<sup>1</sup>

Type of Receiver	Indicative Noise Amenity Area	Time of Day <sup>2</sup>	Recommended LAeq Noise Level, dBA	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45

Note 1: Sourced from Table 2.1 in the NSW INP

Note 2: Daytime: 0700 to 1800 hours (Monday to Saturday), or 0800 to 1800 hours (Sundays and public holidays).  
Evening: 1800 to 2200 hours. Night-time: the remaining periods.

The noise criteria in **Table 6** and **Table 7**, shows that the intrusive noise criterion is the limiting criterion and will represent the operational noise criterion for this project. The limiting intrusive noise criterion for the project is 35 dBA LAeq(15 minute) for both open/flat plains and woodland terrain areas.

## 4.3 Accounting for Annoying Noise Characteristics

The INP refers to 'Modifying factor' adjustments. 'Modifying factor' adjustments should be applied if the noise characteristics include:

- Tonal noise
- Low-frequency noise
- Impulsive noise
- Intermittent noise

Low frequency noise was observed during the site visits to the investigated drill rigs. The noise emission from these drill rigs has therefore been assessed against the relevant noise criterion, applying the low frequency 'modifying factor' adjustments where appropriate.

'Modifying factor' adjustments are applied for low frequency noise when the difference between the C-weighted level and the A-weighted level is more than 15 dB. If the noise is of low frequency character (ie dBC-dBA >15 dB) a penalty of 5 dB is to be added to the measured/predicted noise level before comparison with the applicable intrusive or amenity criteria. This is equivalent to reducing the noise criteria (which has been done for this assessment to allow for a simple presentation of the measured/predicted noise levels).

## 5 ATTENDED SOURCE NOISE MEASUREMENTS

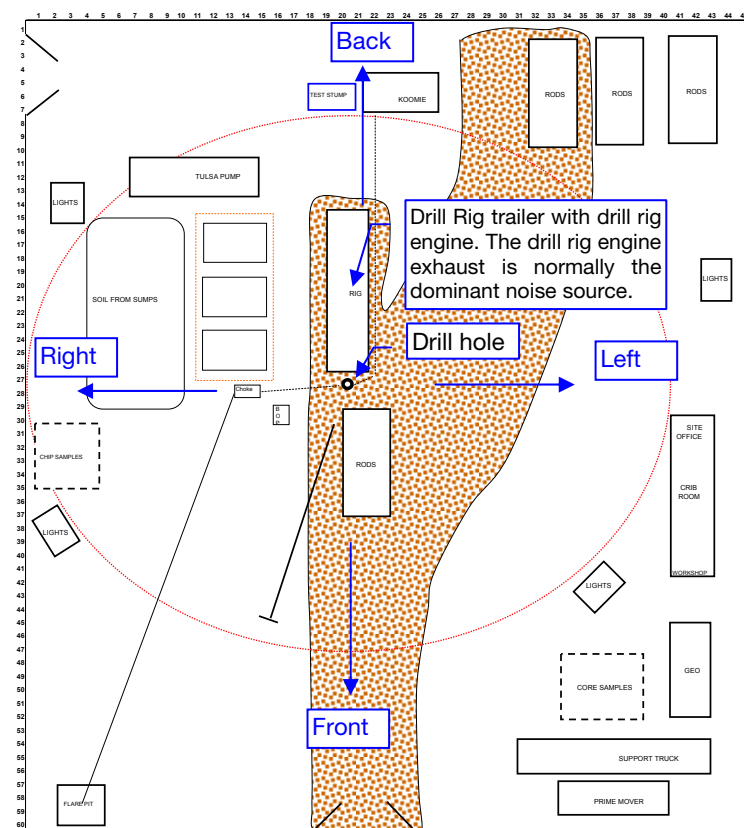
Attended near-field source noise measurements at two (2) drill rigs operating in the Gunnedah Basin and two (2) drill rigs operating in the Roma/Fairview area have been performed to determine sound power levels (SWL) for noise prediction purposes. Where possible individual noise sources (ie drill rig, drill rig engine exhaust, generators, pumps) have been identified and the noise emission from these individual plant items were measured.



The attended noise measurements were carried out with a SVAN 948 Type 1 Sound Level Meter (S/N 8895) that was checked for calibration before the measurement using a Rion NC 73 Calibrator. The Sound Level Meter was designed to comply with the requirements of AS IEC 61672.1 2004 *Electroacoustics - Sound Level Meters* and carried a current manufacturer calibration certificate.

A nominal site plan for the drill rigs is shown in **Figure 2**. The orientation and indicated directions shown on **Figure 2** have been used for presentation of the determined SWLs and predicted noise emission levels.

**Figure 2 Typical Drill Site Plan**



## 5.1 Drill Rig McD 33

Attended near-field source noise measurements were performed for the drill rig McD 33 at Drill Site Maroo 1 on 10 March 2009 and Drill Site Slacksmith 1 on 24 March 2009. The determined SWLs are presented in **Table 8**.

**Table 8 Determined SWL for Plant Items at Drill Rig McD 33**

Plant Item	Operation	SWL dBA	Direction of Noise Emission
Drill engine exhaust dominant source (RPM 750)	Drillstring testing operation	105	Main source emission to the sides of the drill rig trailer with engine
Drill engine exhaust dominant source (RPM 1700)	High RPM with no load	110	Main source emission to the sides of the drill rig trailer with engine



Plant Item	Operation	SWL dBA	Direction of Noise Emission
Trailer KOOMIE, compressor, genset	Both the “white generator” and the green hydraulic pump in operation	93	
Generator QAS20	Normal operation	85	
Generator Allight P14E25	Normal operation	85	
Light Tower Diesel generator	Normal operation	94	Main source emission from exhaust in direction of light (towards centre of drill site)
Tulsa pump, Diesel motor and charge pump	Pumping water from and back to the sump	105	

## 5.2 Drill Rig McD 29

Attended near-field source noise measurements were performed for the drill rig McD 29 at Drill Site Glasserton 1 on 24 March 2009. The determined SWLs are presented in **Table 9**.

**Table 9 Determined SWL for Plant Items at Drill Rig McD 29**

Plant Item	Operation	SWL dBA	Direction of Noise Emission
Drill engine exhaust dominant source (RPM 800)	Core drilling operation	111	Main source emission to the front of the drill hole
Generator QAS20	Normal operation	85	
Generator Genelite P14E25	Normal operation	84	

## 5.3 Drill Rig MDC 105

Attended near-field source noise measurements were performed for the drill rig MDC 105 at Drill Site Blythe Down 1 in Roma on 6 April 2009. The determined SWLs are presented in **Table 10**.

**Table 10 Determined SWL for Plant Items at Drill Rig MDC 105**

Plant Item	Operation	SWL dBA	Direction of Noise Emission
Drill engine exhaust dominant source	Core drilling operation	108	Main source emission to the sides of the drill rig trailer with engine
Mud Pump PEQ 179	Normal operation	111	
Generator Allight P14E2S	Normal operation	87	
Generator Allight P11E2S	Normal operation	82	
Light Tower Diesel generator	Normal operation	104	Main source emission from engine exhaust, normally perpendicularly to the direction of light.

## 5.4 Drill Rig Atlas 1

Attended near-field source noise measurements were performed for the drill rig Atlas 1 at Drill Site Fairview 83\_OB3 on 7 April 2009. The determined SWLs are presented in **Table 11**.



**Table 11 Determined SWL for Plant Items at Drill Rig Atlas 1**

Plant Item	Operation	SWL dBA	Direction of Noise Emission
Drill engine exhaust dominant source	Core drilling operation	111	Main source emission to the sides and back of the drill rig trailer with engine
Mud Pump (pump PZ7 and motor Caterpillar 3408)	Normal operation	113	
Rig Generator Allight P275HE2	Normal operation	94	
Generator Allight P30E1	Normal operation	87	
Sykes Pump	Normal operation	101	
Light Tower Diesel generator	Normal operation	98	Main source emission from engine exhaust, normally perpendicularly to the direction of light.

## 6 NOISE PREDICTIONS/ ASSESSMENT

All noise predictions for this project have been carried out utilising the CONCAWE prediction methodology within SoundPLAN. The CONCAWE prediction method is specially designed for large industrial facilities and incorporates the influence of distance attenuation, ground absorption, air absorption and shielding attenuation, as well as meteorological conditions, including wind effects.

Noise levels have been calculated for both neutral and “worst case” weather conditions. The “worst case” weather conditions used to assess the effect of adverse meteorological conditions on noise propagation is shown in **Table 12** below. The parameters in **Table 12** are considered typical of neutral and “worst case” weather in regards to noise propagation.

**Table 12 Weather Conditions – Neutral and “Worst Case”**

Parameter	Neutral Weather	“Worst Case” Weather
Temperature	10°C	10°C
Humidity	70%	90%
Pasquill Stability Category	D	F (simulates temperature inversion conditions)
Wind Speed	0 m/s	2 m/s (source to receiver)

The determined SWLs, location of noise sources and the directivities (noise emission in different directions) in **Section 5** have been used to predict noise emission levels at various offset distances for each of the operational drill rigs. The predictions include noise emissions from the diesel generators in the light towers which would be operating if night works were being undertaken.

### 6.1 Drill Rig McD 29 and McD 33

Noise contour plots for the different drill rig operations, modelled for neutral and “worst case” weather conditions, are presented in **Appendix C** for the 2 existing drill rigs (ie McD 29 and McD 33) operating in the Gunnedah area. The predicted noise emissions in **Table 13** and the offset distances at which the noise criteria are predicted to be achieved (shown in **Table 14**) assume propagation over flat, soft ground (ie open grassland) to a typical receiver.



**Table 13 Predicted Noise Levels at Various Offset Distances – Drill Rig McD 29 and McD 33**

Drill Rig and Operation	Weather Condition	Direction	Predicted Noise Level at Buffer Distance (LAeq dBA)						
			50m	100m	250m	500m	1,000 m	2,000 m	5,000 m
Drillstring testing operation McD 33	Neutral	Front	57	49	39	30	20	10	<10
		Left	57	50	39	31	22	12	<10
		Back	61	53	41	32	22	12	<10
		Right	60	53	42	33	23	13	<10
Drillstring testing operation McD 33	Worst Case	Front	57	50	42	33	24	14	<10
		Left	57	51	42	34	26	16	<10
		Back	61	54	44	36	27	16	<10
		Right	60	54	45	37	27	17	<10
Core drilling operation McD 29	Neutral	Front	65	59	48	39	30	19	<10
		Left	58	56	45	37	27	17	<10
		Back	62	55	44	35	25	15	<10
		Right	62	55	44	35	26	16	<10
Core drilling operation McD 29	Worst Case	Front	66	59	51	43	33	23	<10
		Left	58	56	48	40	31	20	<10
		Back	63	56	47	39	29	19	<10
		Right	62	55	47	39	29	19	<10
Open hole drilling operation McD 33	Neutral	Front	60	54	43	34	25	16	<10
		Left	59	55	43	35	26	17	<10
		Back	66	58	46	36	27	18	<10
		Right	64	57	45	36	26	16	<10
Open hole drilling operation McD 33	Worst Case	Front	61	55	47	39	31	22	<10
		Left	60	56	47	39	31	23	<10
		Back	67	59	49	41	32	23	<10
		Right	65	58	49	40	31	21	<10

It is noted that the predicted noise levels at distances greater than 1,000m would be similar to, or below, background noise levels observed in rural areas of the Gunnedah Basin.

The character of the noise source has been considered when assessing the relevant intrusive noise criteria. A penalty of 5 dB has been applied to the noise criteria to account for the low frequency character of the noise source (ie the difference between C-weighted and A-weighted is more than 15 dB as outlined in **Section 4.3**). A column showing the result of the low frequency assessment is shown in **Table 14**, the relevant intrusive noise criteria (reduced by 5 dB where necessary) shows.

**Table 14** shows the predicted offset distances in each direction for the different drilling operations. The highlighted distances are the predicted offset distance required to achieve the noise criteria for all drilling operations at drill rigs McD 29 and McD 33.



**Table 14 Predicted Offset Distances to Achieve the Noise Criteria – Drill Rig McD 29 and McD 33**

Drill Rig and Operation	Noise Contour Map in Appendix C	Weather Condition	Low Frequency Assessment Difference (dBC – dBA)	Relevant Intrusive Criterion (LAeq dBA)	Offset Buffer Distance (m)			
					Front	Left	Back	Right
Drillstring testing operation McD 33	Map 1	Neutral	22 $\geq 15$	30 <sup>1</sup>	475	580	565	630
Core drilling operation McD 29	Map 2	Neutral	22 $\geq 15$	30 <sup>1</sup>	975	790	690	800
Open hole drilling operation McD 33	Map 3	Neutral	22 $\geq 15$	30 <sup>1</sup>	730	780	820	780
Drillstring testing operation McD 33	Map 4	Worst Case	21 $\geq 15$	30 <sup>1</sup>	650	775	760	830
Core drilling operation McD 29	Map 5	Worst Case	21 $\geq 15$	30 <sup>1</sup>	1250 <sup>2</sup>	1015	915	1050
Open hole drilling operation McD 33	Map 6	Worst Case	19 $\geq 15$	30 <sup>1</sup>	1100	1160 <sup>2</sup>	1220 <sup>2</sup>	1110 <sup>2</sup>

Note 1: If the difference between the C-weighted and A-weighted noise level is more than 15 dB, the intrusive noise criterion is reduced by 5 dB to account for noise of low frequency character (as outlined in **Section 4.3**).

Note 2: Highlighted shows the predicted distance in each direction required to achieve the noise criteria for all drilling operations at drill rigs McD 29 and McD 33 (currently operating in the Gunnedah Basin).

## 6.2 Drill Rig MDC 105 and Atlas 1

Noise contour plots for the different drill rig operations, modelled for neutral and “worst case” weather conditions, are presented in **Appendix D** for the two drill rigs, MDC 105 and Atlas 1, operating in the Roma/Fairview area. The predicted noise emissions in **Table 15** and the offset distances at which the noise criteria are predicted to be achieved (shown in **Table 16**) assume propagation over flat, soft ground (ie open grassland) to a typical receiver.

**Table 15 Predicted Noise Levels at Various Offset Distances – Drill Rig MDC 105 and Atlas 1**

Drill Rig and Operation	Weather Condition	Direction	Predicted Noise Level at Buffer Distance (LAeq dBA)						
			50m	100m	250m	500m	1,000 m	2,000 m	5,000 m
Core drilling operation MDC 105	Neutral	Front	65	58	46	36	26	16	<10
		Left	67	60	49	38	28	18	<10
		Back	64	57	45	36	26	16	<10
		Right	63	58	47	37	27	17	<10



Drill Rig and Operation	Weather Condition	Direction	Predicted Noise Level at Buffer Distance (LAeq dBA)						
			50m	100m	250m	500m	1,000 m	2,000 m	5,000 m
Core drilling operation MDC 105	Worst Case	Front	66	58	49	40	31	21	<10
		Left	68	61	52	42	33	23	<10
		Back	64	58	48	40	31	21	<10
		Right	63	59	50	41	32	22	<10
Drilling operation including the mud pump MDC 105	Neutral	Front	67	60	48	39	29	19	<10
		Left	67	62	51	41	32	21	<10
		Back	68	60	48	39	29	19	<10
		Right	66	60	49	39	30	19	<10
Drilling operation including the mud pump MDC 105	Worst Case	Front	68	61	52	43	34	24	<10
		Left	68	62	55	46	37	27	<10
		Back	69	61	52	43	34	24	<10
		Right	67	61	52	44	35	25	<10
Core drilling operation Atlas Rig 1	Neutral	Front	67	50	48	38	29	18	<10
		Left	69	63	51	42	32	21	<10
		Back	69	63	51	42	32	21	<10
		Right	72	63	51	42	32	21	<10
Core drilling operation Atlas Rig 1	Worst Case	Front	68	50	50	42	33	23	<10
		Left	70	63	54	46	37	26	<10
		Back	69	63	54	46	37	26	<10
		Right	72	63	54	46	37	26	<10
Drilling operation including the mud pump Atlas Rig 1	Neutral	Front	71	55	53	44	34	23	<10
		Left	72	66	55	45	35	25	<10
		Back	73	66	55	45	35	25	<10
		Right	75	67	55	45	35	25	<10
Drilling operation including the mud pump Atlas Rig 1	Worst Case	Front	73	56	55	48	39	29	11
		Left	73	67	57	49	40	30	12
		Back	74	67	57	49	40	30	12
		Right	75	67	57	49	40	30	12

It is noted that the predicted noise levels at distances greater than 1,000m to 2,000m would be similar to, or below, background noise levels observed in rural areas of the Gunnedah Basin.

The character of the noise source has been considered when assessing the relevant intrusive noise criteria. A penalty of 5 dB has been applied to the noise criteria to account for the low frequency character of the noise source (ie the difference between C-weighted and A-weighted is more than 15 dB as outlined in **Section 4.3**). A column showing the result of the low frequency assessment is shown in **Table 16**, the relevant intrusive noise criteria (reduced by 5 dB where necessary) shows.



**Table 16** shows the predicted offset distances and directivities for the different drilling operations. The highlighted distances are the predicted offset distance required to achieve the noise criteria for all drilling operations at the two drill rigs, MCD 105 and Atlas Rig 1, currently operating in the Roma/Fairview area. **Table 16** shows that Atlas Rig 1 is the noisiest of all measured drill rigs. It is also the drill rig that requires the largest drill site (in terms of area).

**Table 16 Predicted Offset Distances to Achieve the Noise Criteria – Drill Rig MDC 105 and Atlas 1**

Drill Rig and Operation	Noise Contour Map in Appendix D	Weather Condition	Low Frequency Assessment Difference (dBC – dBA)	Relevant Intrusive Criterion (LAeq dBA)	Offset Buffer Distance (m)			
					Front	Left	Back	Right
Core drilling operation MDC 105	Map 1	Neutral	16 <u>&gt;15</u>	30'	755	860	745	850
Drilling operation including the mud pump MDC 105	Map 2	Neutral	14 < 15	35	660	760	640	680
Core drilling operation Atlas Rig 1	Map 3	Neutral	10 < 15	35	620	810	815	800
Drilling operation including the mud pump Atlas Rig 1	Map 4	Neutral	9 < 15	35	900	1010	1010	1025
Core drilling operation MDC 105	Map 5	Worst Case	15 <u>&gt;15</u>	30'	1055	1215	1055	1210
Drilling operation including the mud pump MDC 105	Map 6	Worst Case	13 < 15	35	950	1140	930	980
Core drilling operation Atlas Rig 1	Map 7	Worst Case	9 < 15	35	840	1100	1110	1100
Drilling operation including the mud pump Atlas Rig 1	Map 8	Worst Case	7 < 15	35	<b>1280<sup>2</sup></b>	<b>1410<sup>2</sup></b>	<b>1410<sup>2</sup></b>	<b>1400<sup>2</sup></b>

Note 1: If the difference between the C-weighted and A-weighted noise level is more than 15 dB, the intrusive noise criterion is reduced by 5 dB to account for noise of low frequency character (as outlined in **Section 4.3**).

Note 2: Highlighted shows predicted distance in each direction required to achieve the noise criteria for all drilling operations at drill rigs MDC 105 and Atlas Rig 1 (currently operating in the Roma/Fairview area).



## 6.3 Noise Attenuation due to Meteorology, Topography and Vegetation

### 6.3.1 Meteorological Effects

As previously noted, the predicted noise level emissions in **Table 13** and **Table 15** are based on neutral weather and “worst case” weather conditions as presented in **Table 12**. The resulting change in predicted levels due to “worst case” weather is summarised in **Table 17**.

**Table 17 Increase in Noise Levels due to “Worst Case” Weather Conditions**

	Increase in Predicted Noise Level at Offset Distance (dBA)					
	50m	100m	250m	500m	1,000m	2,000m
Change due to adverse weather	0	1	3	4	4	5

Note: Increase above predicted noise level for neutral weather conditions.

Appendix D of the NSW’s INP provides guidance on estimating the increase in noise levels due to temperature inversion conditions. The increase in noise levels was estimated using similar modelling parameters as those nominated above for “worst case” weather conditions. The increase in noise levels (nominated in NSW INP) due to temperature inversion conditions is estimated to be between 1 dBA and 6.5 dBA depending on the distance from the noise source and the change in temperature (increase for temperature inversions) with respect to height above ground. The increase in noise level due to temperature inversion conditions, nominated in the NSW INP (1 dBA to 6.5 dBA) is consistent with the increase in noise levels from the “worst case” weather condition (0 dBA to 5 dBA) shown in **Table 17**.

**Table 17** shows that sensitive receivers located at 250m or more from a drill rig operation would experience a noticeable change in noise levels as a result of adverse weather conditions (up to distances where noise is no longer audible).

### 6.3.2 Topographical Effects

As previously stated, the predictions in **Table 13** to **Table 16** assume propagation over flat, soft ground (ie open grassland) to a typical receiver.

Local topography can dramatically affect the propagation of noise, especially if the drilling operation is conducted in an area with steep terrain. The extent of change in noise levels due to topographical effects would be dependant 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 receiver location is just obscured, and up to approximately 15 dBA where the topography provides optimal sheilding of the sound transmission path.

It is noted that during “worst case” weather conditions, noise attenuation due to topographical shielding would be less than that expected during “neutral” weather conditions.

### 6.3.3 Vegetation and Forest Effects

Dense forest vegetation increases the amount of sound absorption along the noise propagation path. For the vegetation to have an effect on the noise propagation the height of vegetation must be above 2 metres (low scrub/bush would not attenuate the noise more than normal absorbing soft ground ie grass) and dense (unable to see through the vegetation even a short distances). The increased sound absorption of typical forest vegetation is estimated to be between 0.05 to 0.1 dBA per metre of propagation distance (ie approximately 5 to 10 dBA over 100 metres in dense forest).



## 7 CONCLUSION

Background noise monitoring has been performed for two (2) locations representative of open/flat plains (Wisemans 1) and woodland (Stoney Creek 1) terrain areas respectively. The results show presence of bird and insect noise as well as wind noise in grass, sorghum and trees (low breeze less than 5 m/s).

For the purpose of determining the applicable noise criteria the NSW INP states that where a rating background noise level of less than 30 dBA is measured, the rating background noise level is set to the threshold level of 30 dBA. The limiting rating background noise level for both open/flat plains and woodland terrain areas were set to the threshold level of 30 dBA.

The noise emissions from drill rigs McD 29, McD 33 and to some extent MDC 105 were identified as having low frequency noise characteristics. The NSW INP specifies a penalty of 5 dB if the noise is of low frequency character (ie dBC – dBA > 15 dB).

Therefore the limiting intrusive noise criterion has been reduced to **30 dBA LAeq(15 minute)** for drill rigs McD 29, McD 33 and to some extent MDC 105 for where the noise emission has been identified as having low frequency character.

The limiting intrusive noise criterion for the Atlas Rig 1 is **35 dBA LAeq(15 minute)**

Noise emission levels and offset distances at which the intrusive noise criterion is predicted to be achieved for the different drill rigs and drilling operations are presented in **Table 13** to **Table 16**. A summary of the offset distances required to achieve the relevant intrusive noise criteria is summarised in **Section 7.1** and **Section 7.2**.

### 7.1 Noise Emissions for McD 29, McD 33 and MDC 105

It was found that for the 2 drill rigs currently operating in the Gunnedah Basin, the noisiest drilling operation was the core drilling. For the core drilling the direction in front of the drill hole is emitting more noise than to the sides and backwards. For worst case weather conditions and core drilling operations, offset distances of up to **1250 metres** were found to be required to achieve the relevant intrusive noise criterion.

For the current drill site layout the open hole drilling operation (including the Tulsa mud pump) radiates more noise backwards and to the sides. For worst case weather conditions and open hole drilling operations, offset distances of up to **1220 metres** were found to be required to achieve the relevant intrusive noise criterion.

The MDC 105 drill rig has very similar noise emission levels to the McD 29 and McD 33. The noise emission from MDC 105 was also identified as having low frequency characteristics. However, when the mud pump was added to the noise sources the overall noise emission from MDC 105 was not identified as having low frequency characteristics. For worst case weather conditions a maximum offset distance of **1215 metres** was found to be required to achieve the relevant intrusive noise criterion. The maximum noise emission was measured to the left of the drilling operations almost 200 metres more offset distance required in comparison to the other three directions.

The offset distance required in each direction to achieve the relevant intrusive noise criteria for all drilling operations at drill rig McD 29, McD 33 and MDC 105 is summarised in **Table 18**.



**Table 18 Predicted Offset Distances to Achieve the Noise Criteria for All Drilling Operations – Drill Rig McD 29, McD 33 and MDC 105**

Drill Rig	Weather Condition <sup>1</sup>	Offset Buffer Distance (m)			
		Front	Left	Back	Right
McD 29 and McD 33	Neutral	975	790	820	800
	Worst Case	1250	1160	1220	1110
MDC 105	Neutral	755	860	745	850
	Worst Case	1055	1215	1055	1210

Note 1: See discussion in **Section 6.3.1**. Neutral and “Worst Case” weather conditions defined in **Table 12**.

For the drill rigs McD 29, McD 33 and MDC 105, an optimally placed drill site in the woodland with significant (if not dense) forest vegetation and topography obscuring line-of-sight between noise sources and the noise sensitive receiver, would result in an offset distance of approximately **600 metres** being required to achieve the relevant intrusive noise criterion (as detailed discussed below in **Section 7.3**).

## 7.2 Noise Emissions Atlas Rig 1

Atlas Rig 1 is the loudest of all measured drill rigs, but does not have low frequency characteristics. The maximum noise emission was measured to the sides and back of the drill rig. For worst case weather conditions and drilling operations including the mud pump, an offset distance of up to **1410 metres** was found to be required to achieve the relevant intrusive noise criterion.

The offset distance required in each direction to achieve the relevant intrusive noise criteria for all drilling operations at drill rig Mcd 29, McD 33 and MDC 105 is summarised in **Table 19**.

**Table 19 Predicted Offset Distances to Achieve the Noise Criteria for All Drilling Operations – Atlas Rig 1**

Drill Rig	Weather Condition <sup>1</sup>	Offset Buffer Distance (m)			
		Front	Left	Back	Right
Atlas Rig 1	Neutral	900	1010	1010	1025
	Worst Case	1280	1410	1410	1400

Note 1: See discussion in **Section 6.3.1**. Neutral and “Worst Case” weather conditions defined in **Table 12**.

For the Atlas Rig 1, an optimally placed drill site in the woodland with significant (if not dense) forest vegetation and topography obscuring line-of-sight between noise sources and the noise sensitive receiver, would result in an offset distance of approximately **700 metres** being required to achieve the relevant intrusive noise criterion (as detailed discussed below in **Section 7.3**).

## 7.3 Noise Attenuation due to Meteorology, Topography and Vegetation

There are several mitigation measures that can be applied to screen and direct the noise emission away from noise sensitive receivers as well as using the natural topography and vegetation to reduce the noise impacts.

With dense forest vegetation between the drill rig and the nearest noise sensitive receiver there will be increased noise propagation attenuation as outlined in **Section 6.3.3**. The dense forest vegetation will not only increase the attenuation, but also disrupt the steady down wind (wind from source to receiver) that is a characteristic of the adverse weather conditions. Typical dense forest vegetation in the woodlands thus has the potential to halve the required offset distances presented in **Table 13** to **Table 16** for worst case weather.



Furthermore using natural topographical shielding (or man-made earth mounds from the mud sumps etc) to shield the drill rigs from the nearest noise sensitive receivers has the potential to attenuate the noise emission by 5 dBA if line-of-sight between the noise source (drill rig engine exhaust typically at 3.5m height) and receiver location is just obscured, and by up to 15 dBA where the topography provides optimal blocking of the sound transmission path.

For the drill rigs McD 29, McD 33 and MDC 105, an optimally placed drill site in the woodland with significant (if not dense) forest vegetation and topography obscuring line-of-sight between noise sources and the noise sensitive receiver, would result in an offset distance of approximately **600 metres** being required to achieve the relevant intrusive noise criterion.

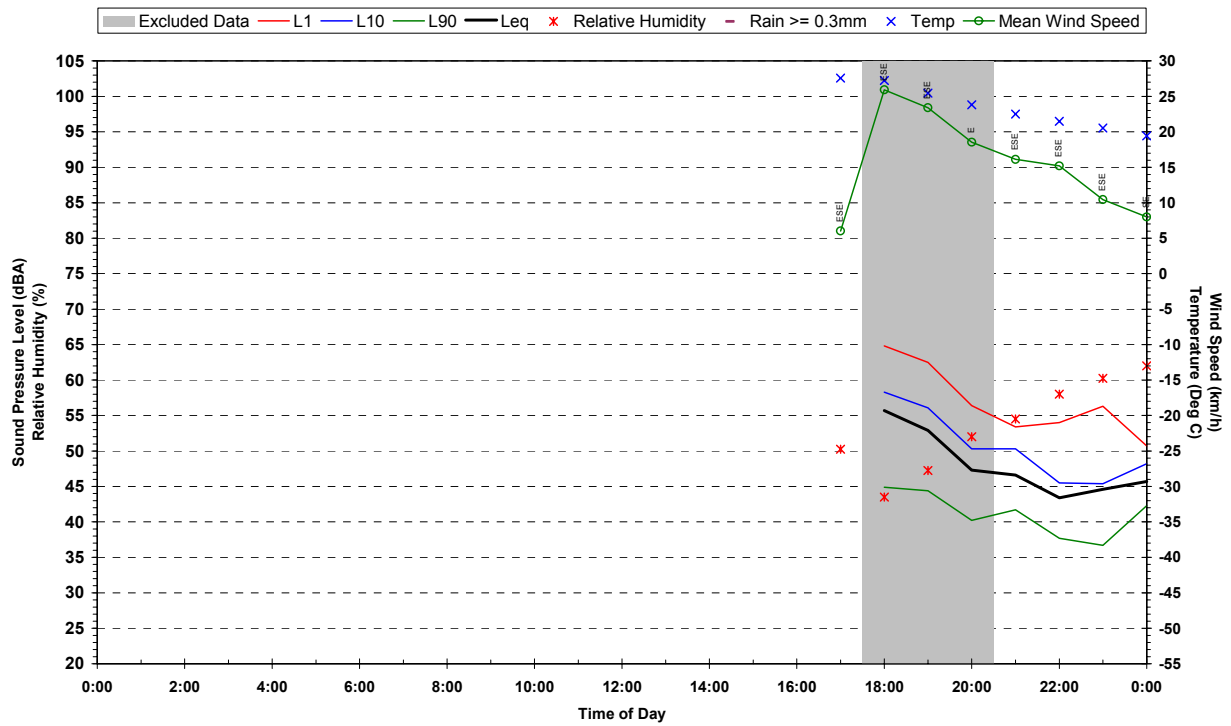
Atlas Rig 1 is louder and has the dominant noise source (ie the drill rig engine exhaust) located approximately 1m higher than the other three drill rigs (ie 4.5m height). Atlas Rig 1 optimally placed in the woodland with significant (if not dense) forest vegetation and topography obscuring line-of-sight between noise sources and the noise sensitive receiver would result in an offset distance of approximately **700 metres** being required to achieve the relevant intrusive noise criterion. Since the noise source is located higher than the other three drill rigs, obscuring line-of-sight between noise source and receiver will require significantly more elevation from the topography.

There are also other mitigation measures which could be incorporated closer to the noise sources (ie drill rig engine exhaust and mud pump) that would enable additional noise attenuation to be provided to the noise sensitive receiver. These noise mitigation measures may include:

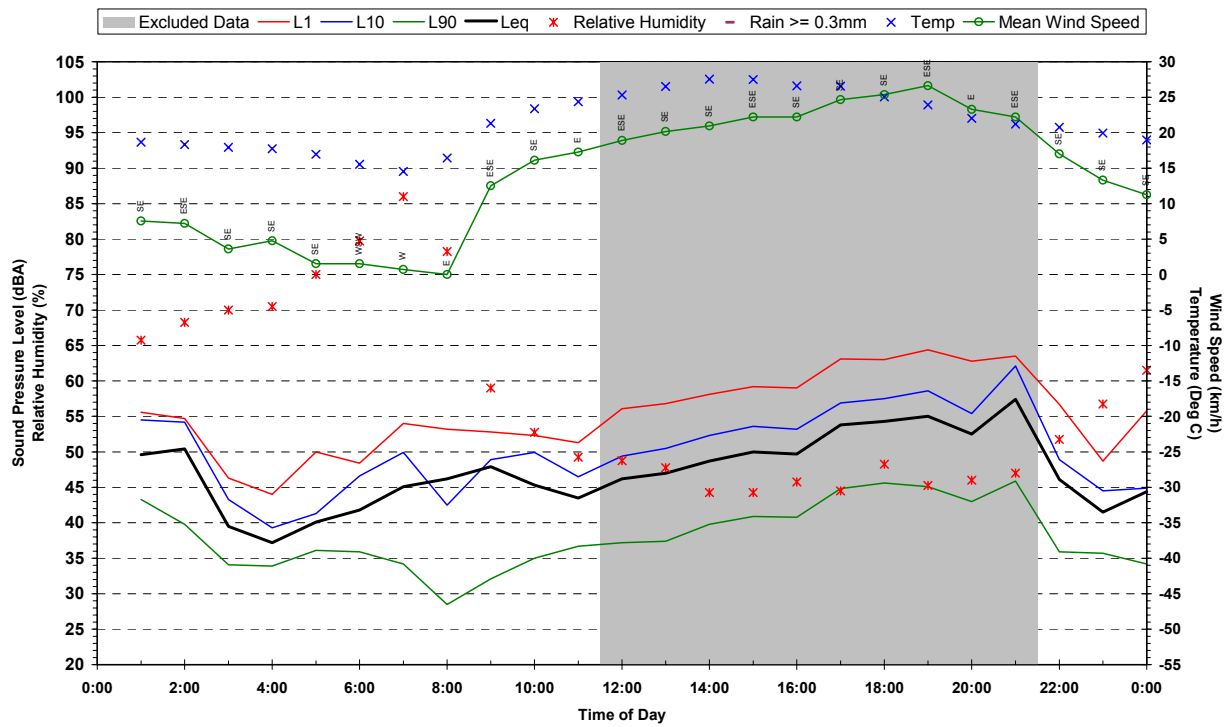
- Engine exhaust silencers
- Screening of engine exhausts

## UNATTENDED NOISE MONITORING AT WISEMANS – STATISTICAL NOISE PLOTS

**Statistical Ambient Noise Levels**  
20-2014 - GLNG - Wisemans - Monday 9 March 2009

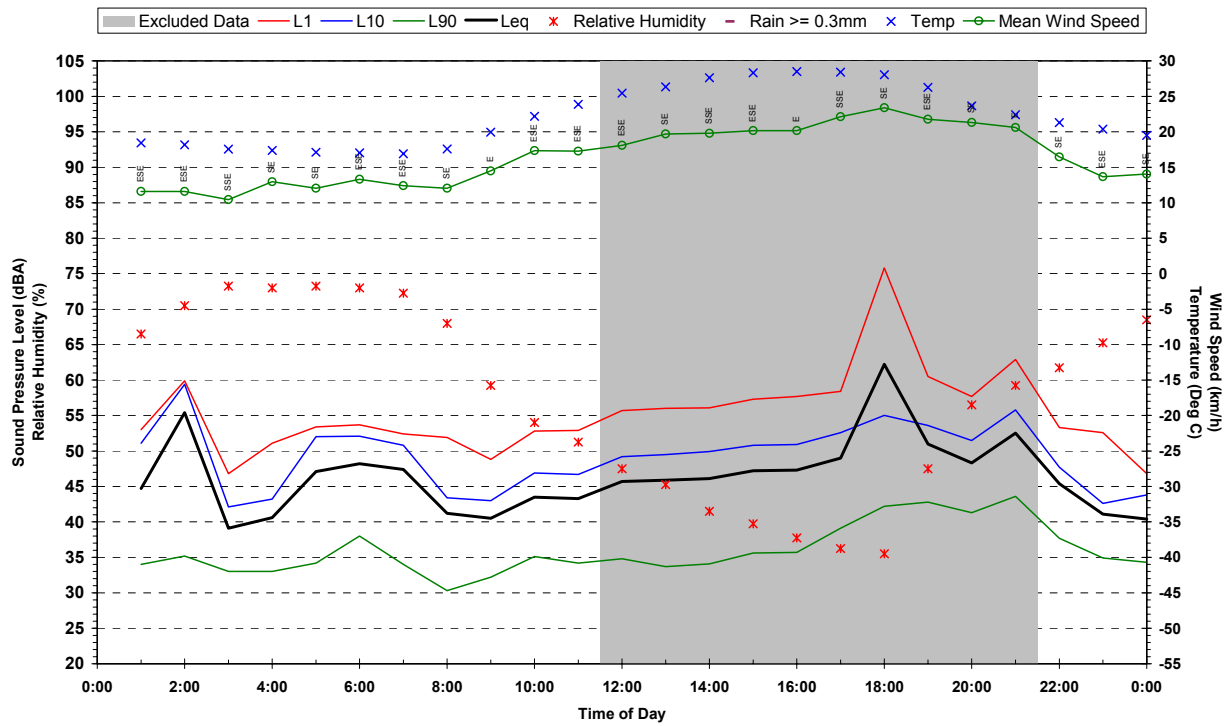


**Statistical Ambient Noise Levels**  
20-2014 - GLNG - Wisemans - Tuesday 10 March 2009

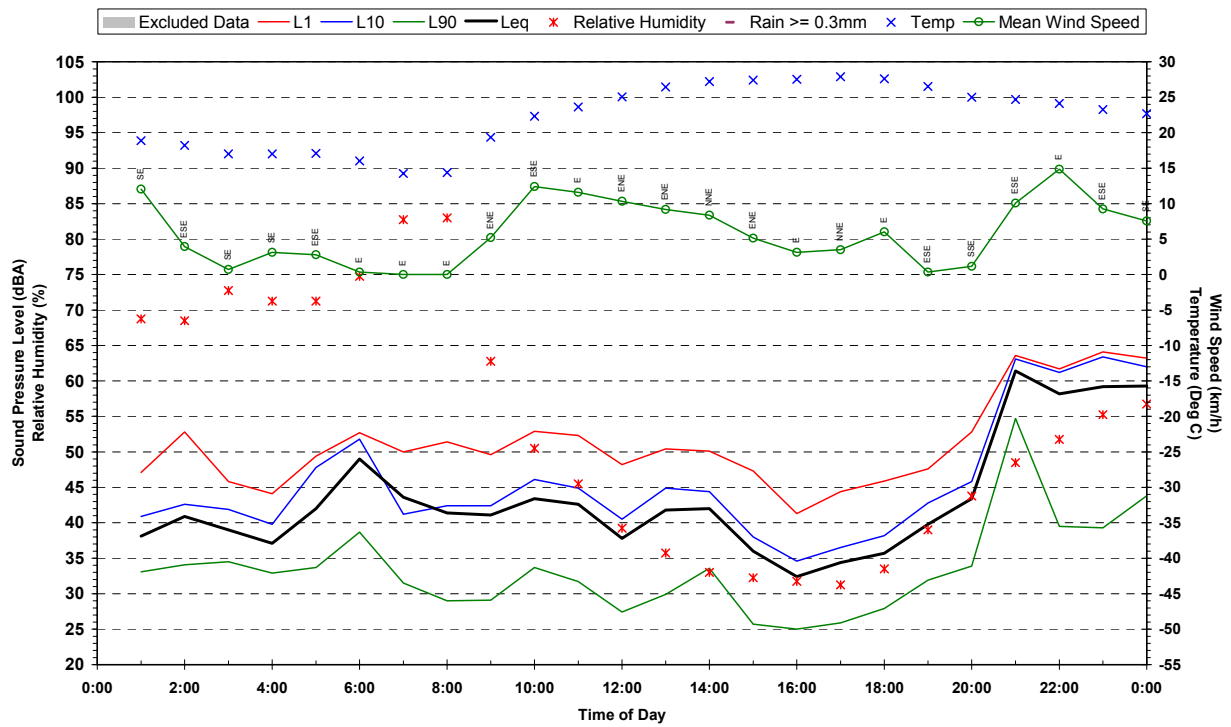


## UNATTENDED NOISE MONITORING AT WISEMANS – STATISTICAL NOISE PLOTS

**Statistical Ambient Noise Levels  
20-2014 - GLNG - Wisemans - Wednesday 11 March 2009**

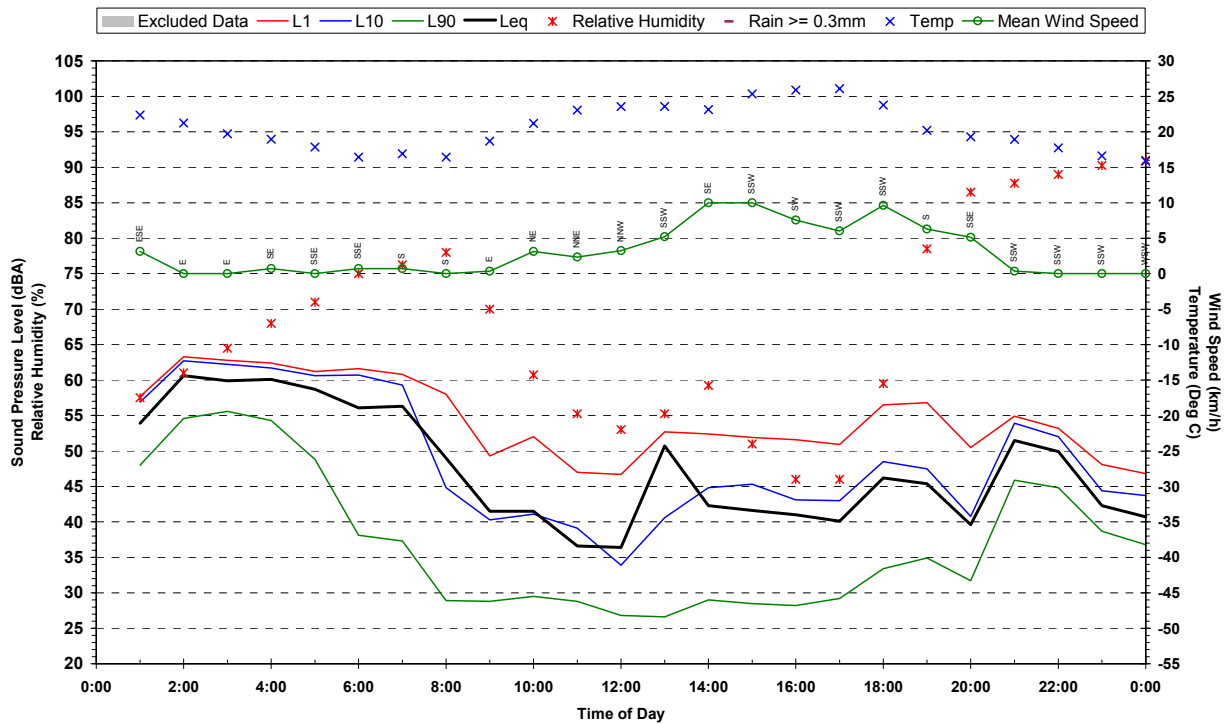


**Statistical Ambient Noise Levels  
20-2014 - GLNG - Wisemans - Thursday 12 March 2009**

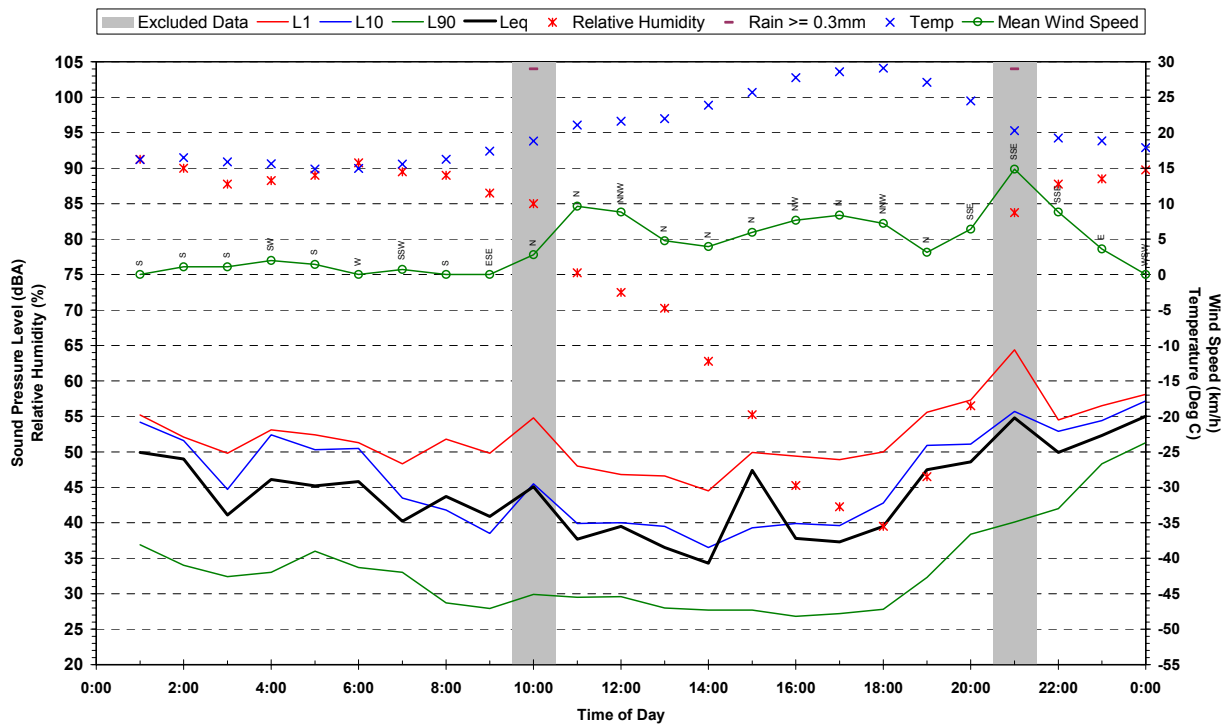


## UNATTENDED NOISE MONITORING AT WISEMANS – STATISTICAL NOISE PLOTS

**Statistical Ambient Noise Levels  
20-2014 - GLNG - Wisemans - Friday 13 March 2009**



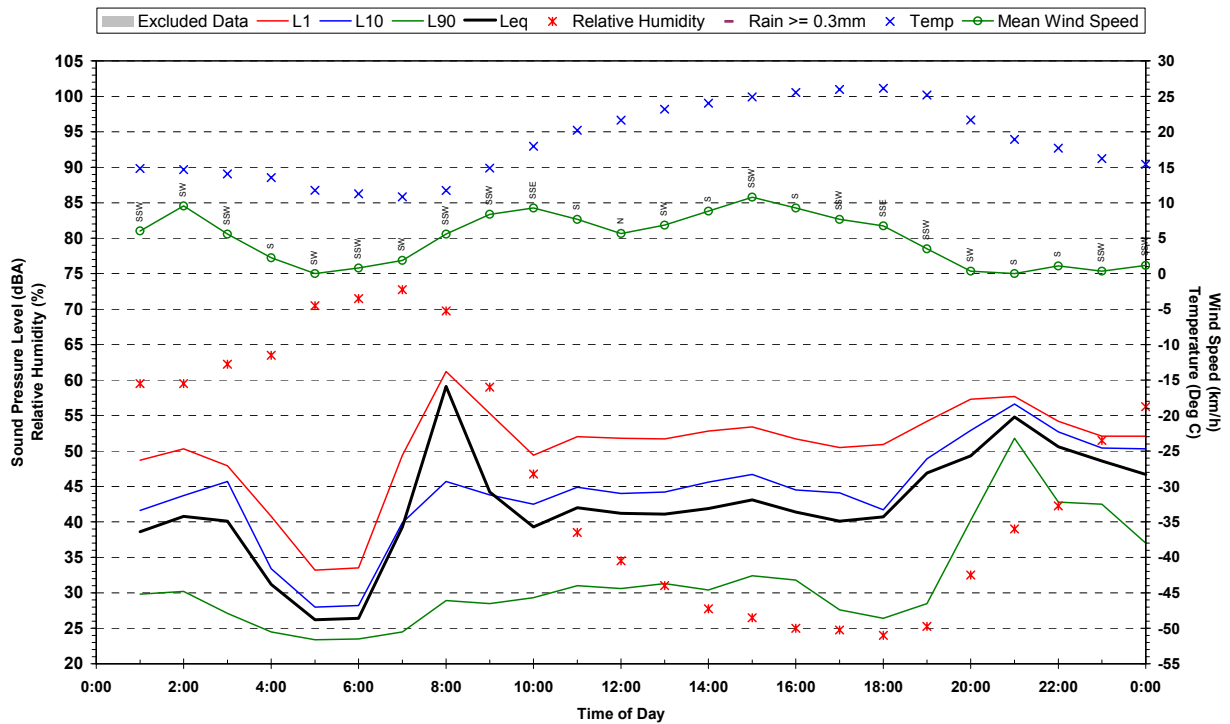
**Statistical Ambient Noise Levels  
20-2014 - GLNG - Wisemans - Saturday 14 March 2009**



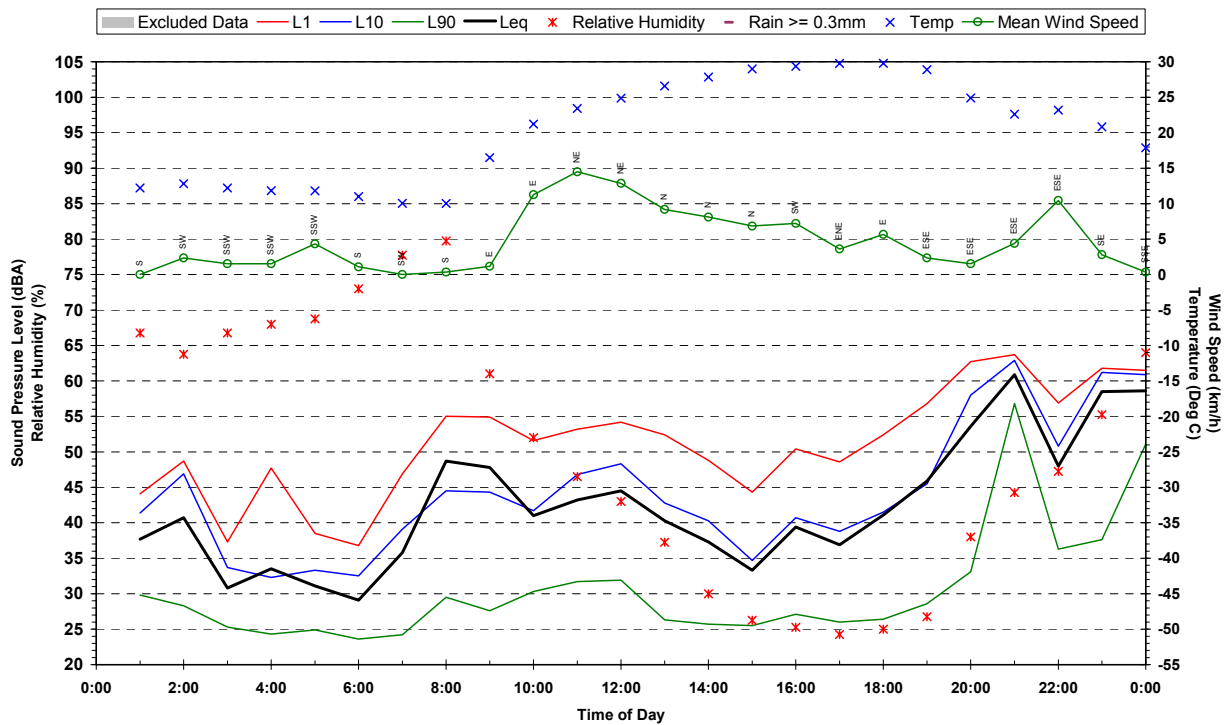


## UNATTENDED NOISE MONITORING AT WISEMANS – STATISTICAL NOISE PLOTS

**Statistical Ambient Noise Levels**  
20-2014 - GLNG - Wisemans - Tuesday 17 March 2009



**Statistical Ambient Noise Levels**  
20-2014 - GLNG - Wisemans - Wednesday 18 March 2009

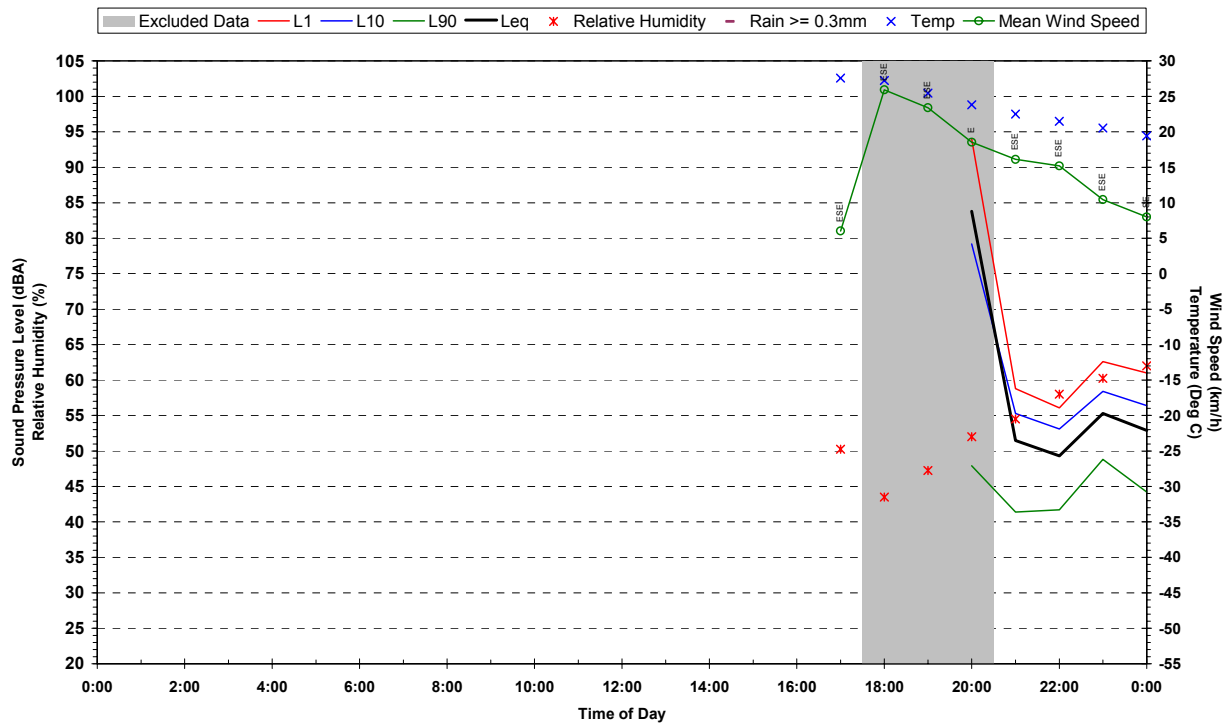




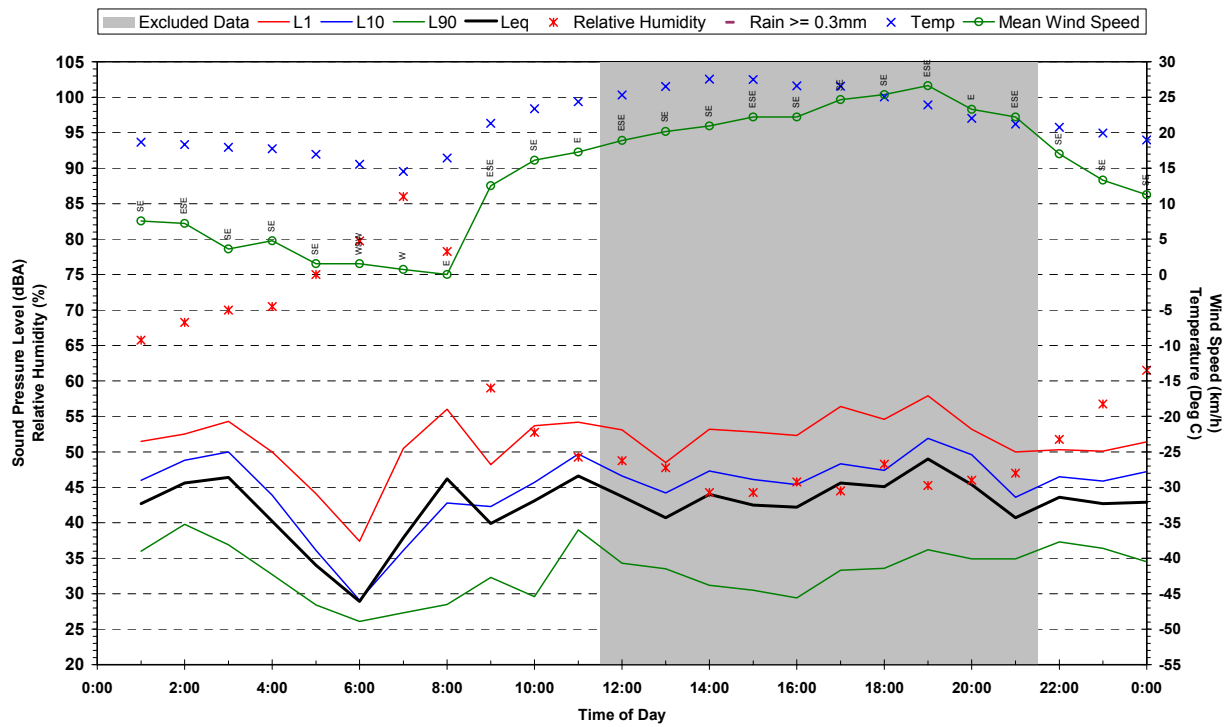


## UNATTENDED NOISE MONITORING AT STONEY CREEK 1 – STATISTICAL NOISE PLOTS

**Statistical Ambient Noise Levels**  
**20-2014 - GLNG - Stoney Creek 1 - Monday 9 March 2009**

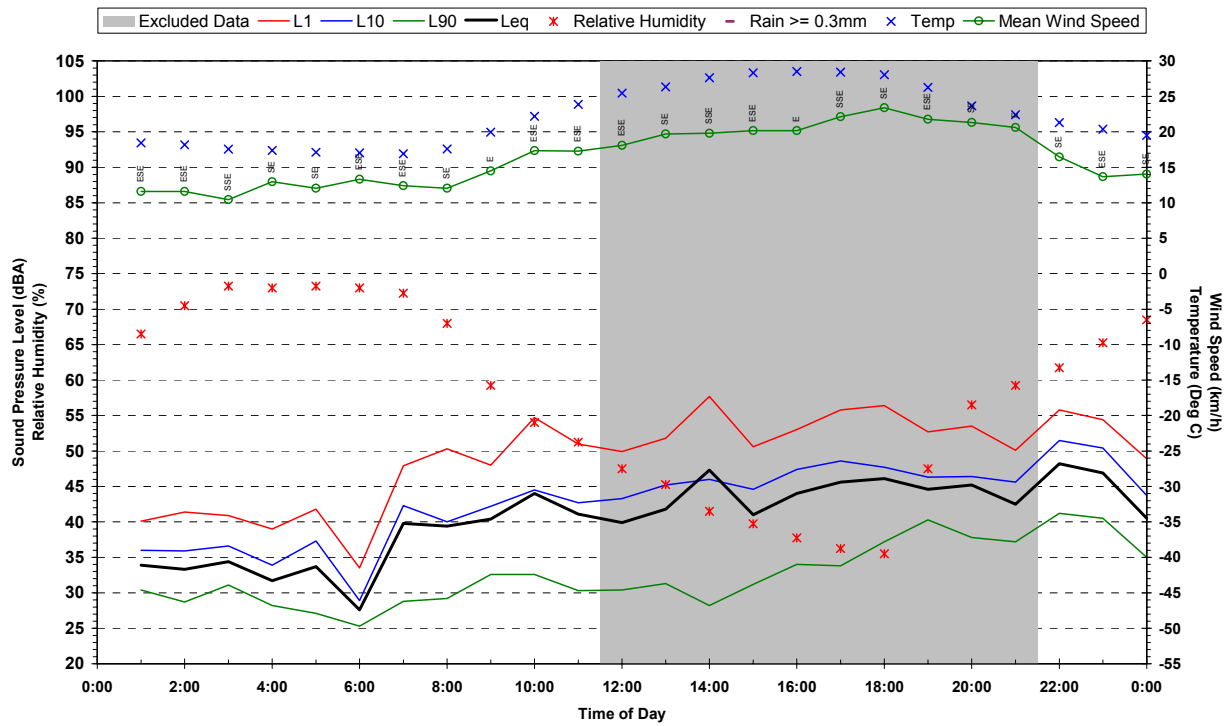


**Statistical Ambient Noise Levels**  
**20-2014 - GLNG - Stoney Creek 1 - Tuesday 10 March 2009**

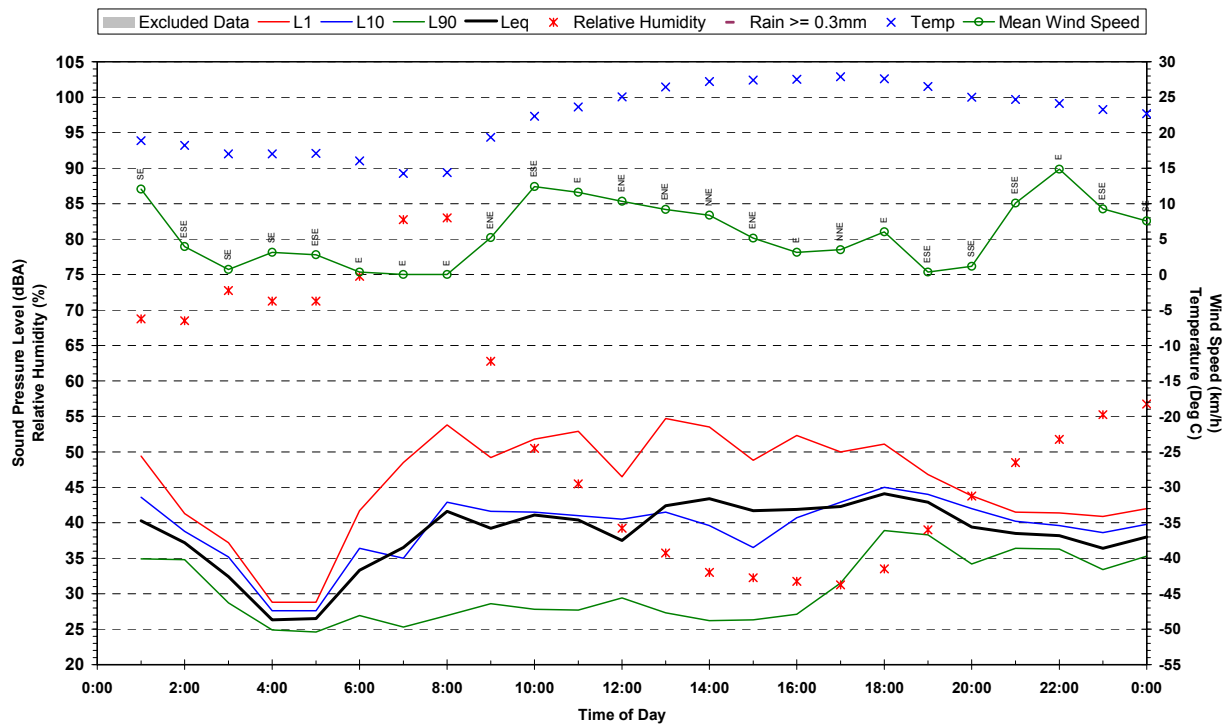


## UNATTENDED NOISE MONITORING AT STONEY CREEK 1 – STATISTICAL NOISE PLOTS

**Statistical Ambient Noise Levels**  
20-2014 - GLNG - Stoney Creek 1 - Wednesday 11 March 2009



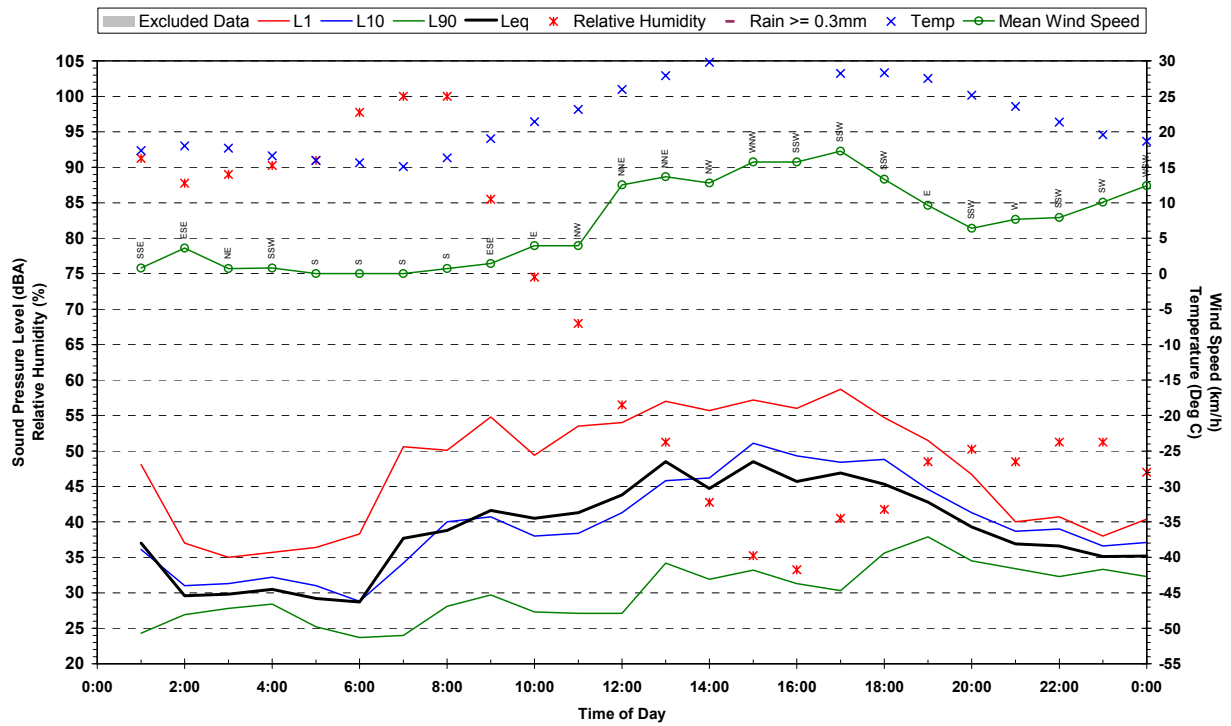
**Statistical Ambient Noise Levels**  
20-2014 - GLNG - Stoney Creek 1 - Thursday 12 March 2009



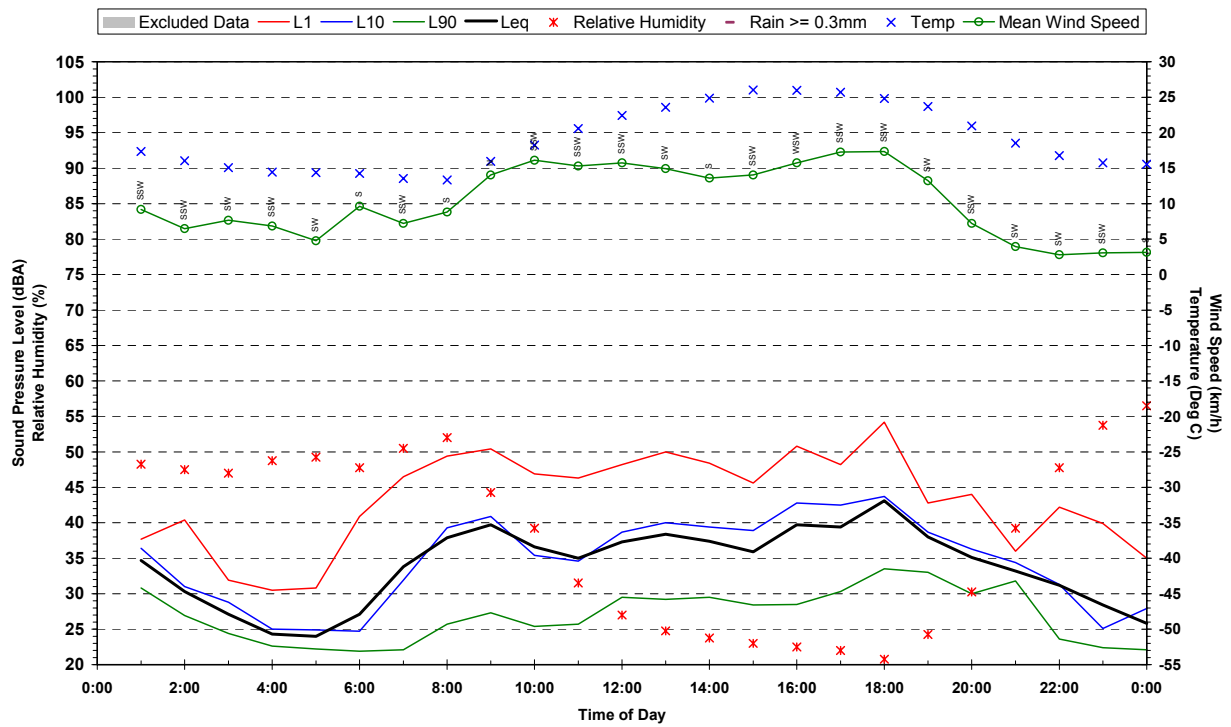


## UNATTENDED NOISE MONITORING AT STONEY CREEK 1 – STATISTICAL NOISE PLOTS

**Statistical Ambient Noise Levels**  
20-2014 - GLNG - Stoney Creek 1 - Sunday 15 March 2009



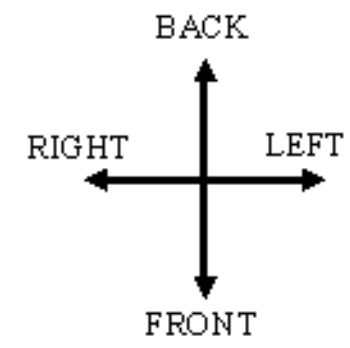
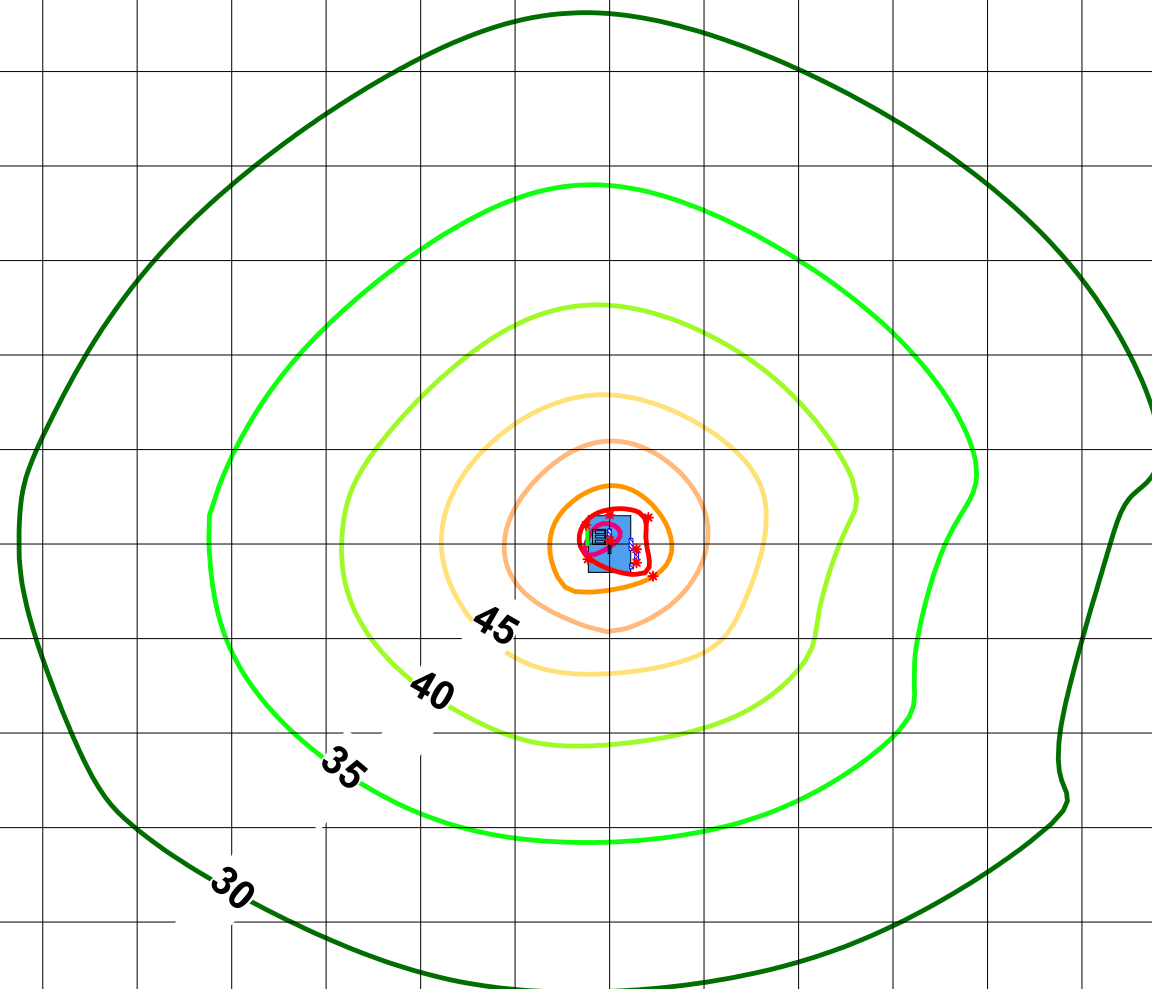
**Statistical Ambient Noise Levels**  
20-2014 - GLNG - Stoney Creek 1 - Monday 16 March 2009











Project specific intrusive noise criterion 30 dBA LAeq  
5 dB penalty for low frequency noise has been applied.

Grid sections  
100x100m

**LAeq (dBA)**

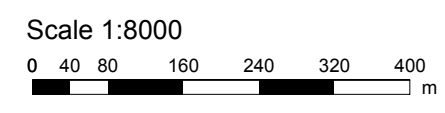
30 <	30 <= 35
35 <	35 <= 40
40 <	40 <= 45
45 <	45 <= 50
50 <	50 <= 55
55 <	55 <= 60
60 <	60 <= 65
65 <	65 <= 70
70 <	

**Legend**

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

**Note:**

Predictions at 1.5m above ground and assumes "Neutral" weather



**20-2014-R3  
SANTOS DRILL RIG  
(LAeq) Noise Contours**

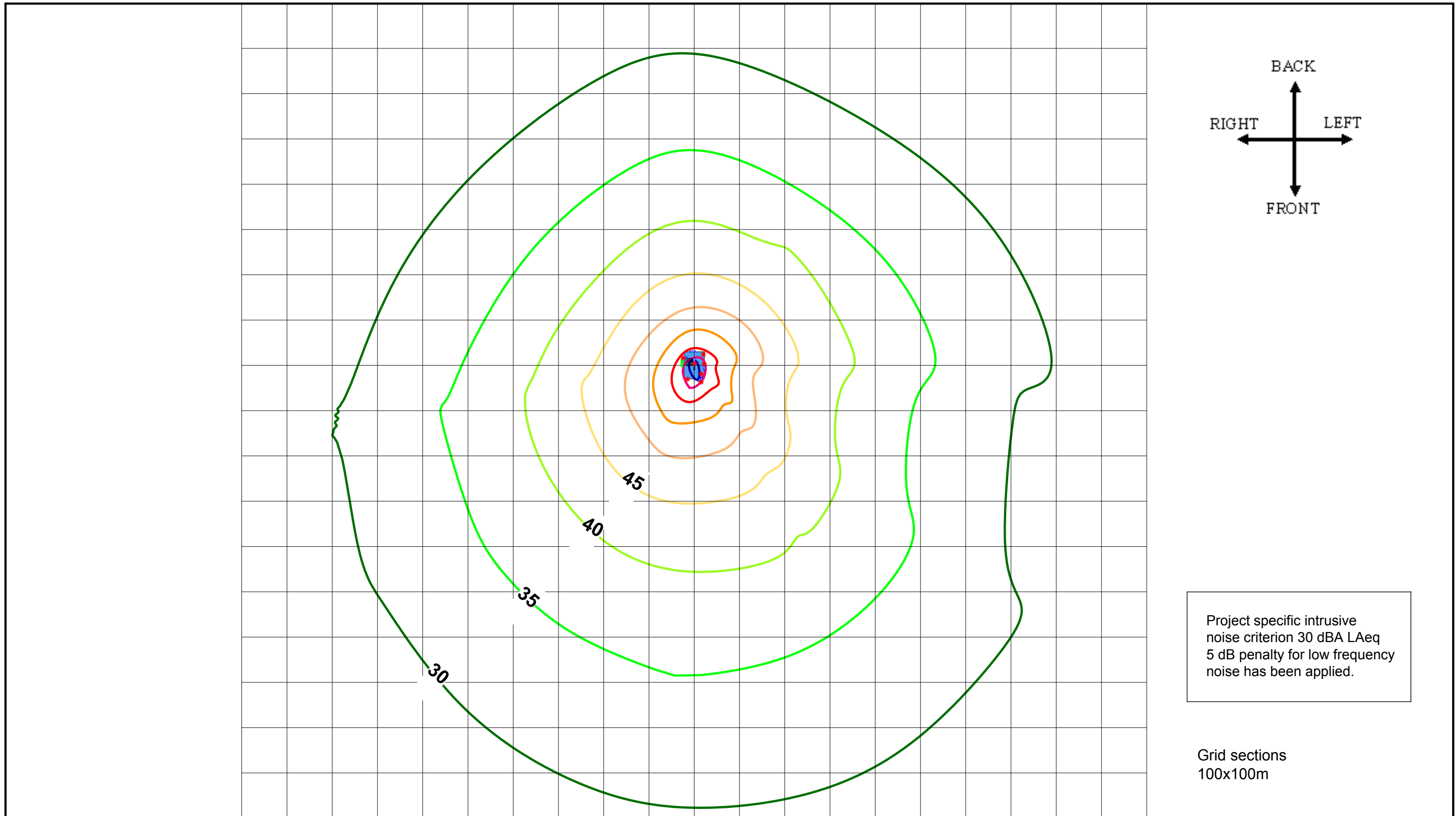
	Name	Date
Prepared	HM	2/04/09
Checked	MC	2/04/09
Authorised	MC	2/04/09

**Appendix C  
Map 1**

Predicted Noise Contours (LAeq)  
Drill Rig McD 33  
Drillstring testing operation



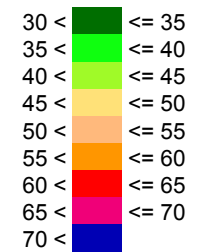
**HEGGIES**



Project specific intrusive noise criterion 30 dBA LAeq  
5 dB penalty for low frequency noise has been applied.

Grid sections  
100x100m

**LAeq (dBA)**



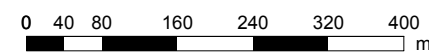
**Legend**

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

**Note:**

Predictions at 1.5m above ground and assumes "Neutral" weather

Scale 1:8000



**20-2014-R3  
SANTOS DRILL RIG  
(LAeq) Noise Contours**

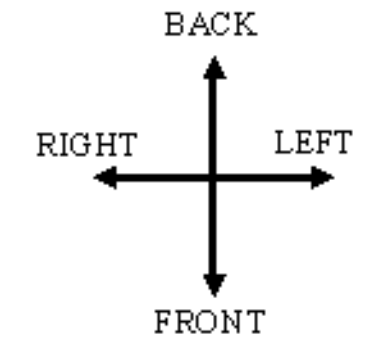
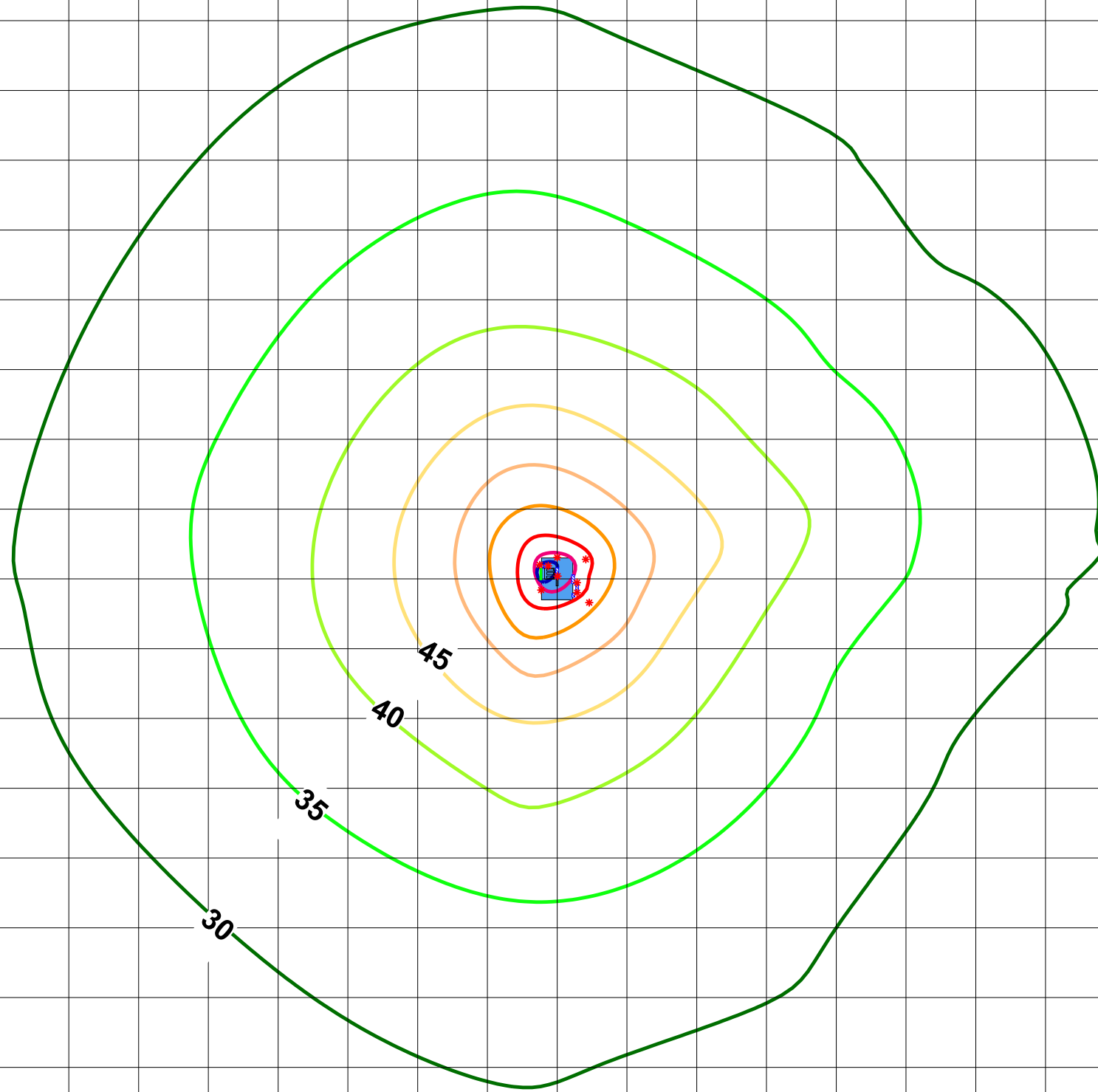
	Name	Date
Prepared	HM	2/04/09
Checked	MC	2/04/09
Authorised	MC	2/04/09

**Appendix C  
Map 2**

Predicted Noise Contours (LAeq)  
Drill Rig McD 29  
Core drilling operation



**HEGGIES**



Project specific intrusive noise criterion 30 dBA LAeq  
5 dB penalty for low frequency noise has been applied.

Grid sections  
100x100m

**LAeq (dBA)**

30 <	30 <= 35
35 <	35 <= 40
40 <	40 <= 45
45 <	45 <= 50
50 <	50 <= 55
55 <	55 <= 60
60 <	60 <= 65
65 <	65 <= 70
70 <	

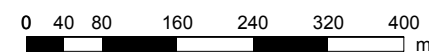
**Legend**

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

**Note:**

Predictions at 1.5m above ground and assumes "Neutral" weather

Scale 1:8000



**20-2014-R3  
SANTOS DRILL RIG  
(LAeq) Noise Contours**

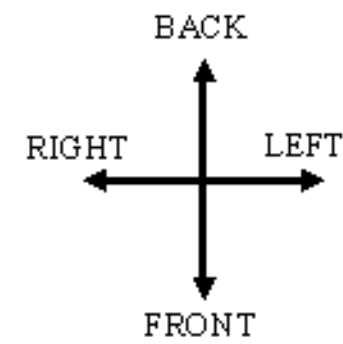
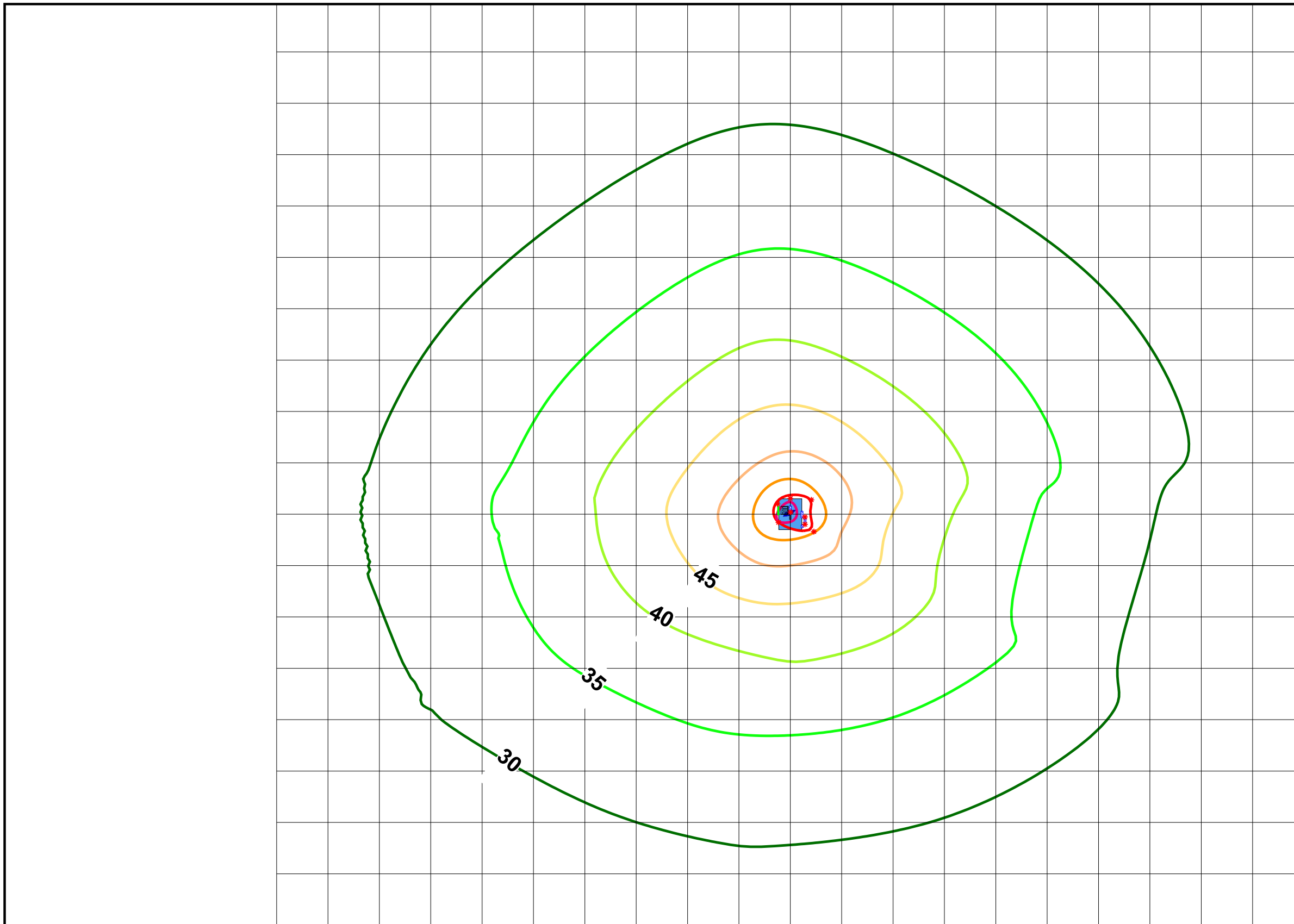
	Name	Date
Prepared	HM	2/04/09
Checked	MC	2/04/09
Authorised	MC	2/04/09

**Appendix C  
Map 3**

Predicted Noise Contours (LAeq)  
Drill Rig McD 33  
Open hole drilling operation



**HEGGIES**



Project specific intrusive noise criterion 30 dBA LAeq  
5 dB penalty for low frequency noise has been applied.

Grid sections  
100x100m

**LAeq (dBA)**

30 <	30 <= 35
35 <	35 <= 40
40 <	40 <= 45
45 <	45 <= 50
50 <	50 <= 55
55 <	55 <= 60
60 <	60 <= 65
65 <	65 <= 70
70 <	

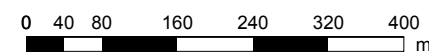
**Legend**

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

**Note:**

Predictions at 1.5m above ground and assumes "Worst Case" weather

Scale 1:8000



**20-2014-R3  
SANTOS DRILL RIG  
(LAeq) Noise Contours**

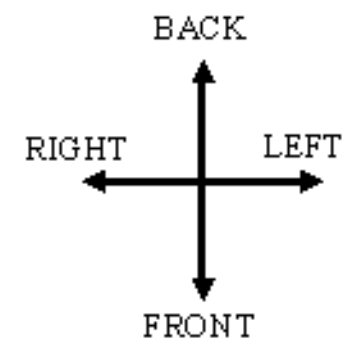
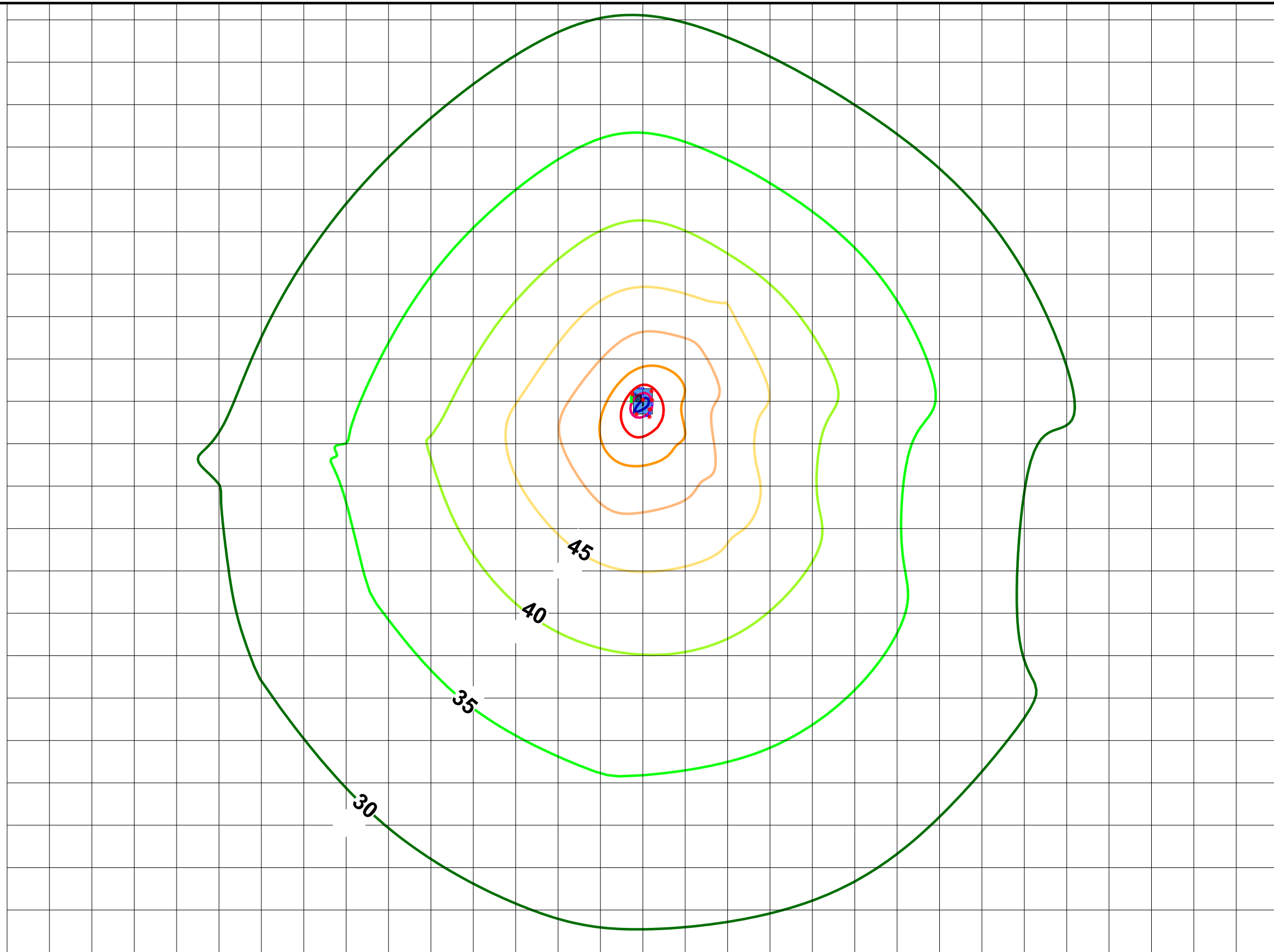
	Name	Date
Prepared	HM	2/04/09
Checked	MC	2/04/09
Authorised	MC	2/04/09

**Appendix C  
Map 4**

Predicted Noise Contours (LAeq)  
Drill Rig McD 33  
Drillstring testing operation



**HEGGIES**



Project specific intrusive noise criterion 30 dBA LAeq  
5 dB penalty for low frequency noise has been applied.

Grid sections  
100x100m

**LAeq (dBA)**

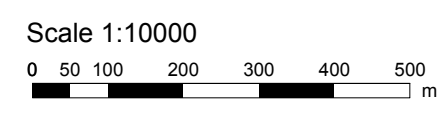
30 <	≤ 35
35 <	≤ 40
40 <	≤ 45
45 <	≤ 50
50 <	≤ 55
55 <	≤ 60
60 <	≤ 65
65 <	≤ 70
70 <	

**Legend**

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

**Note:**

Predictions at 1.5m above ground and assumes "Worst Case" weather



**20-2014-R3  
SANTOS DRILL RIG  
(LAeq) Noise Contours**

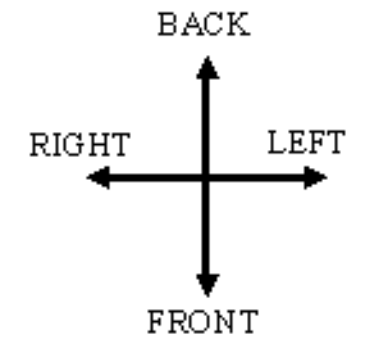
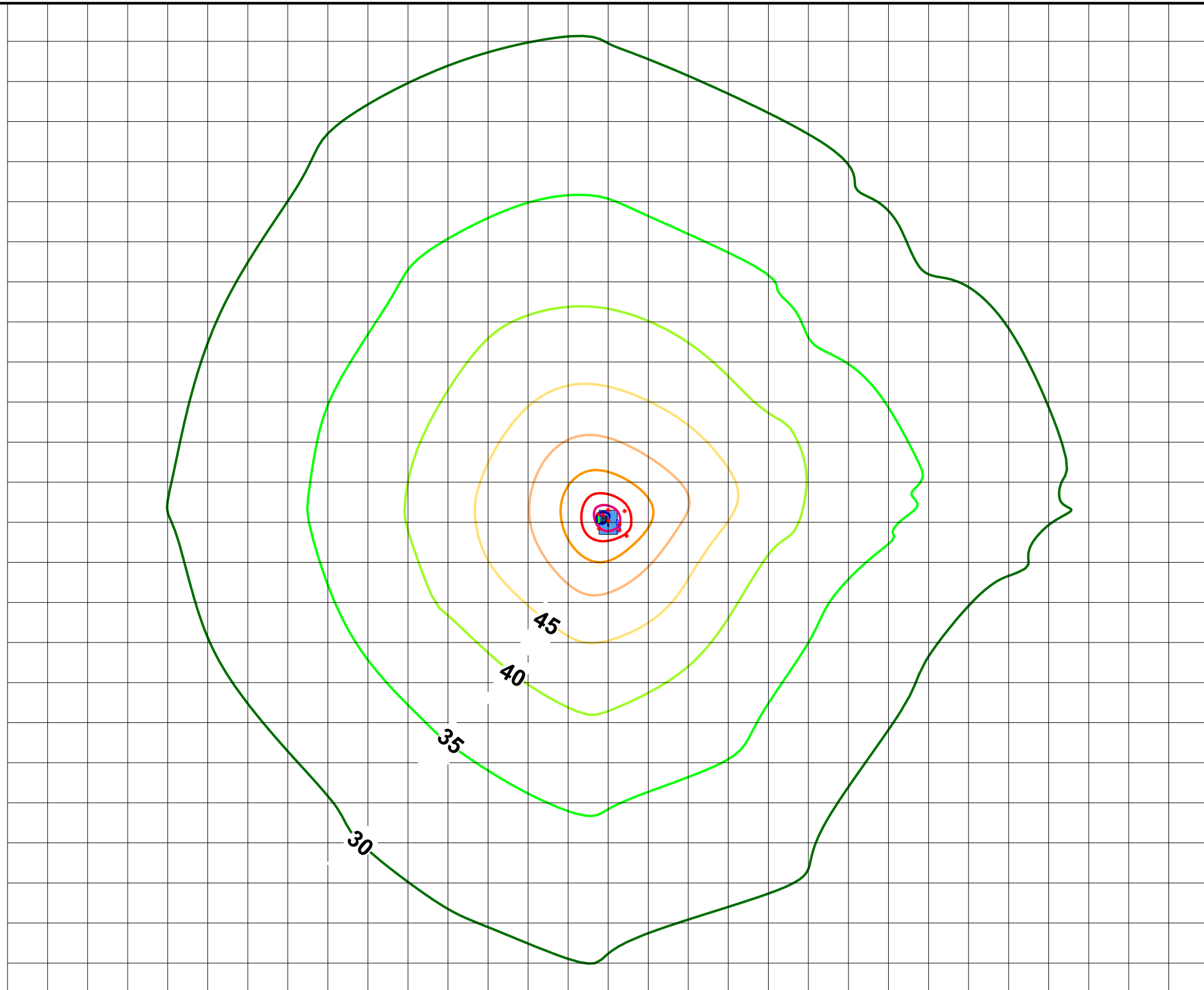
	Name	Date
Prepared	HM	2/04/09
Checked	MC	2/04/09
Authorised	MC	2/04/09

**Appendix C  
Map 5**

Predicted Noise Contours (LAeq)  
Drill Rig McD 29  
Core drilling operation



**HEGGIES**



Project specific intrusive noise criterion 30 dBA LAeq  
5 dB penalty for low frequency noise has been applied.

Grid sections  
100x100m

**LAeq (dBA)**

30 <	30 <= 35
35 <	35 <= 40
40 <	40 <= 45
45 <	45 <= 50
50 <	50 <= 55
55 <	55 <= 60
60 <	60 <= 65
65 <	65 <= 70
70 <	

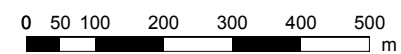
**Legend**

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

**Note:**

Predictions at 1.5m above ground and assumes "Worst Case" weather

Scale 1:11000



**20-2014-R3  
SANTOS DRILL RIG  
(LAeq) Noise Contours**

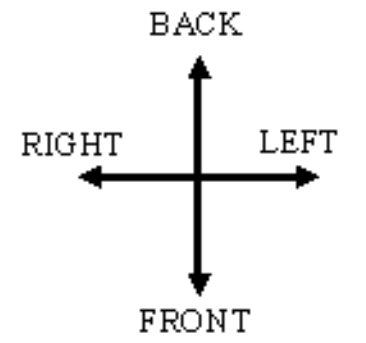
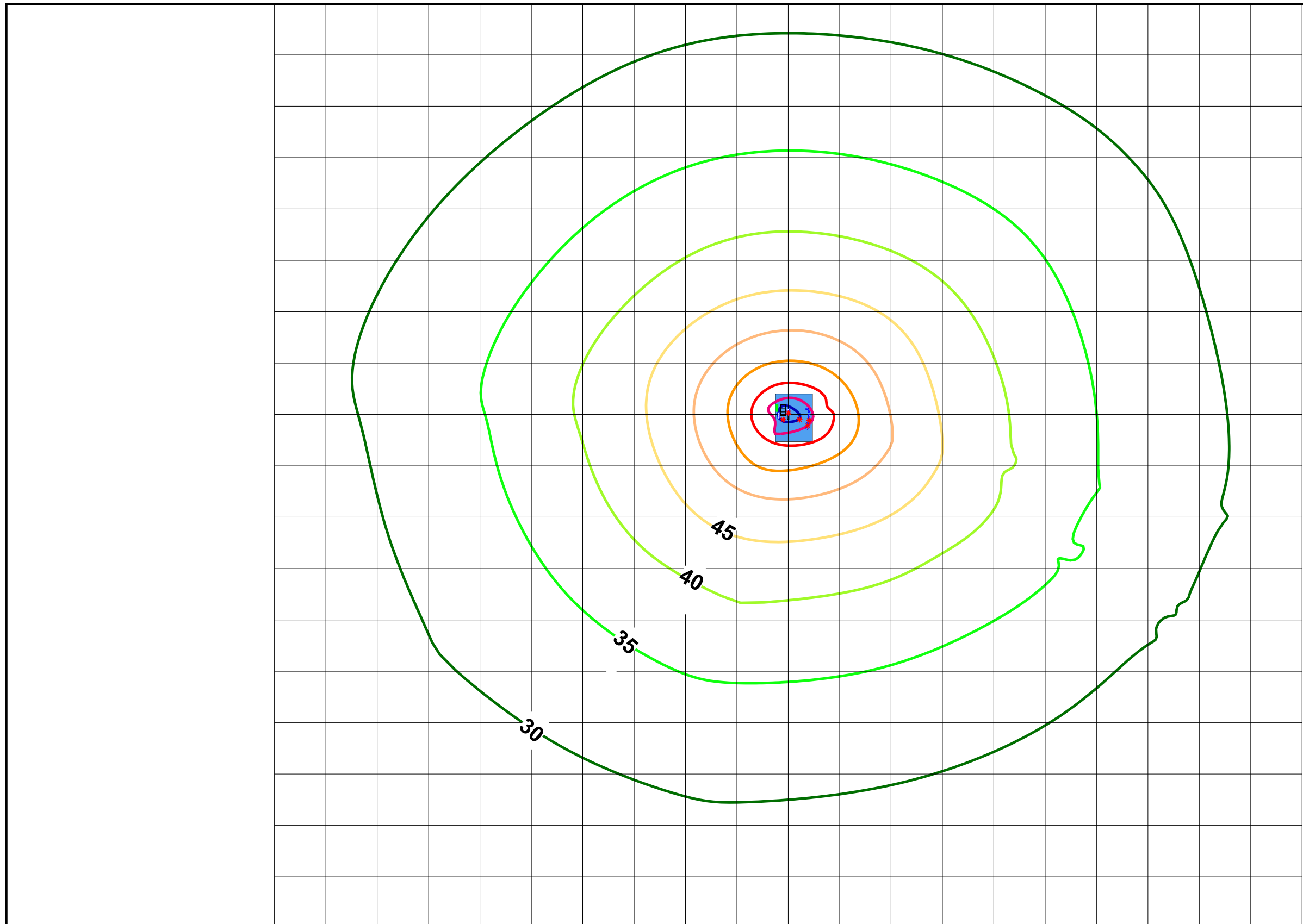
	Name	Date
Prepared	HM	2/04/09
Checked	MC	2/04/09
Authorised	MC	2/04/09

**Appendix C  
Map 6**

Predicted Noise Contours (LAeq)  
Drill Rig McD 33  
Open hole drilling operation



**HEGGIES**



Project specific intrusive noise criterion 30 dBA LAeq  
5 dB penalty for low frequency noise has been applied.

Grid sections  
100x100m

**LAeq (dBA)**

30 <	30 <= 35
35 <	35 <= 40
40 <	40 <= 45
45 <	45 <= 50
50 <	50 <= 55
55 <	55 <= 60
60 <	60 <= 65
65 <	65 <= 70
70 <	

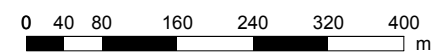
**Legend**

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

**Note:**

Predictions at 1.5m above ground and assumes "Neutral" weather

Scale 1:8000



**20-2014-R3  
SANTOS DRILL RIG  
(LAeq) Noise Contours**

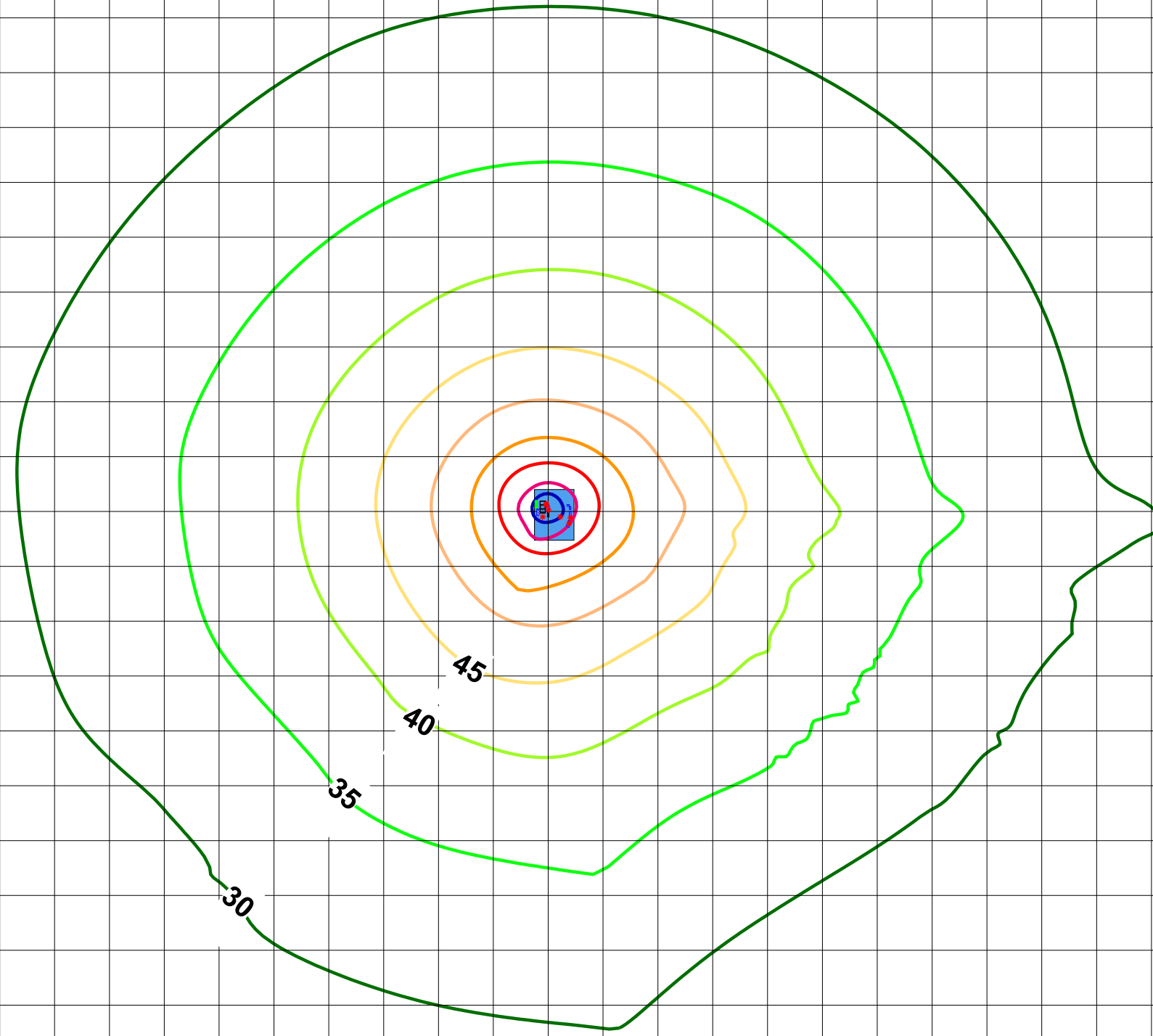
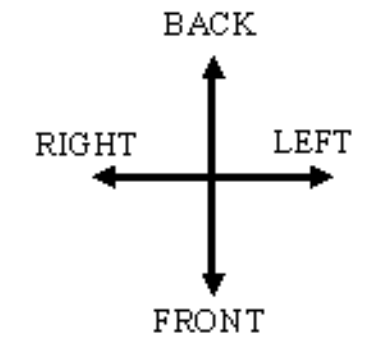
	Name	Date
Prepared	HM	16/04/09
Checked	MC	16/04/09
Authorised	MC	17/04/09

**Appendix D  
Map 1**

Predicted Noise Contours (LAeq)  
Drill Rig MDC 105  
Core drilling operation



**HEGGIES**



Project specific intrusive noise criterion 35 dBA LAeq

Grid sections 100x100m

**LAeq (dBA)**

30 <	30 <= 35
35 <	35 <= 40
40 <	40 <= 45
45 <	45 <= 50
50 <	50 <= 55
55 <	55 <= 60
60 <	60 <= 65
65 <	65 <= 70
70 <	

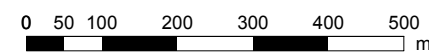
**Legend**

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

**Note:**

Predictions at 1.5m above ground and assumes "Neutral" weather

Scale 1:10000



**20-2014-R3  
SANTOS DRILL RIG  
(LAeq) Noise Contours**

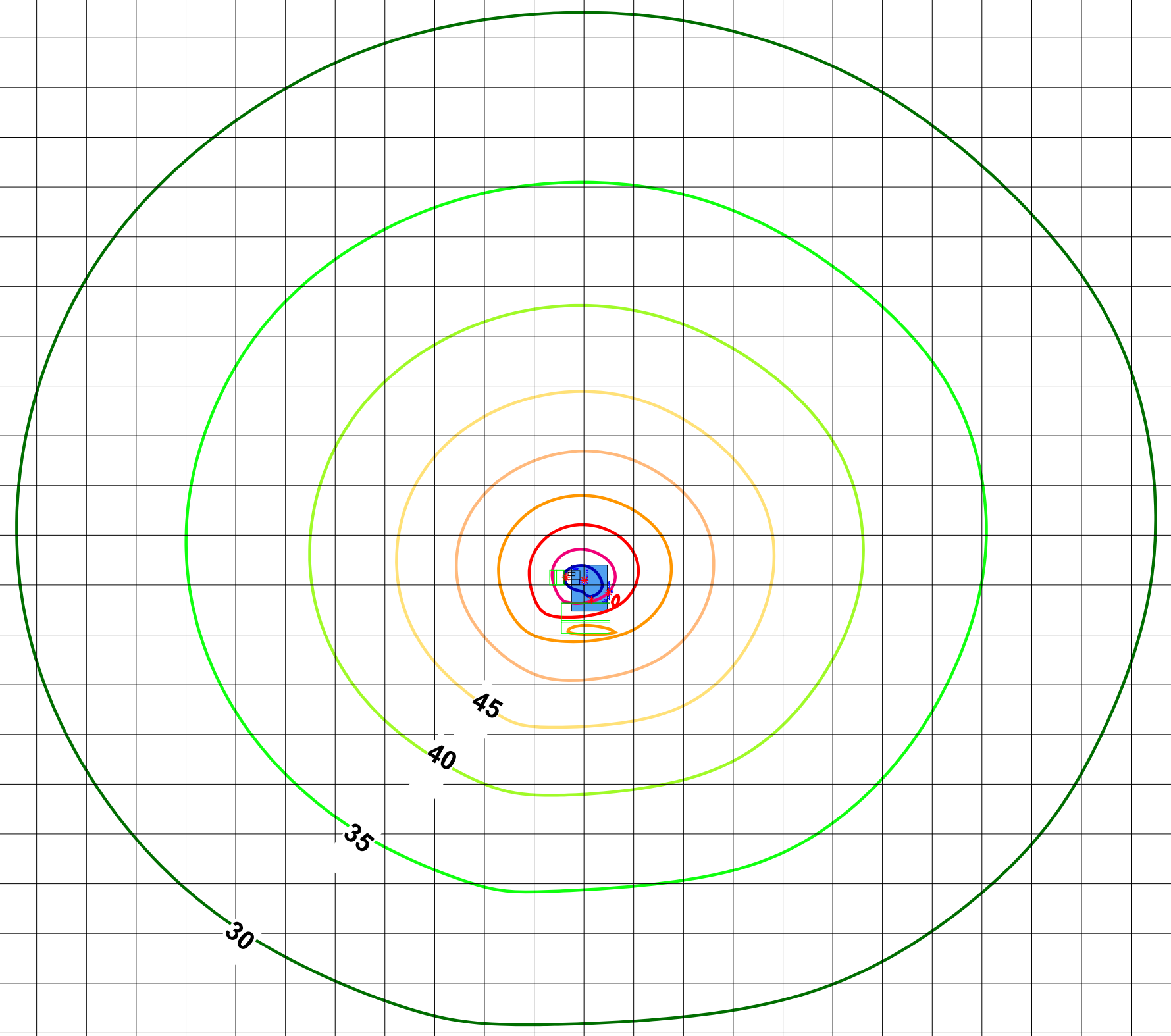
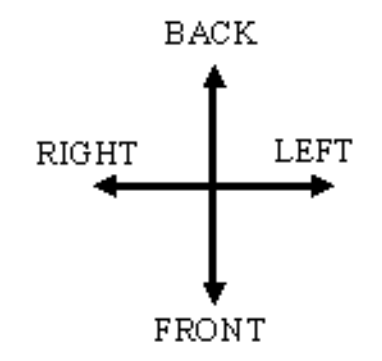
	Name	Date
Prepared	HM	16/04/09
Checked	MC	16/04/09
Authorised	MC	17/04/09

**Appendix D  
Map 2**

Predicted Noise Contours (LAeq)  
Drill Rig MDC 105  
Drilling operation including the mud pump



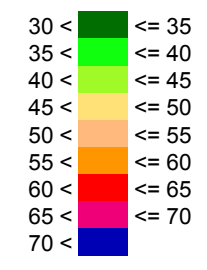
**HEGGIES**



Project specific intrusive noise criterion 35 dBA LAeq

Grid sections 100x100m

**LAeq (dBA)**

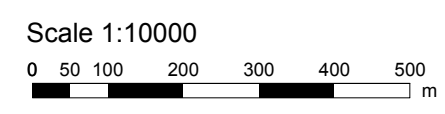


**Legend**

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

**Note:**

Predictions at 1.5m above ground and assumes "Neutral" weather



**20-2014-R3  
SANTOS DRILL RIG  
(LAeq) Noise Contours**

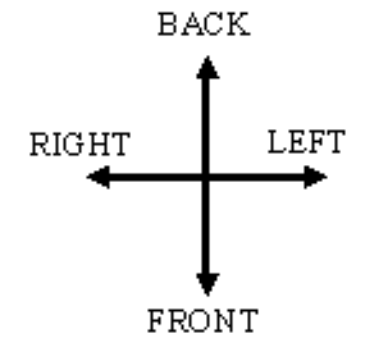
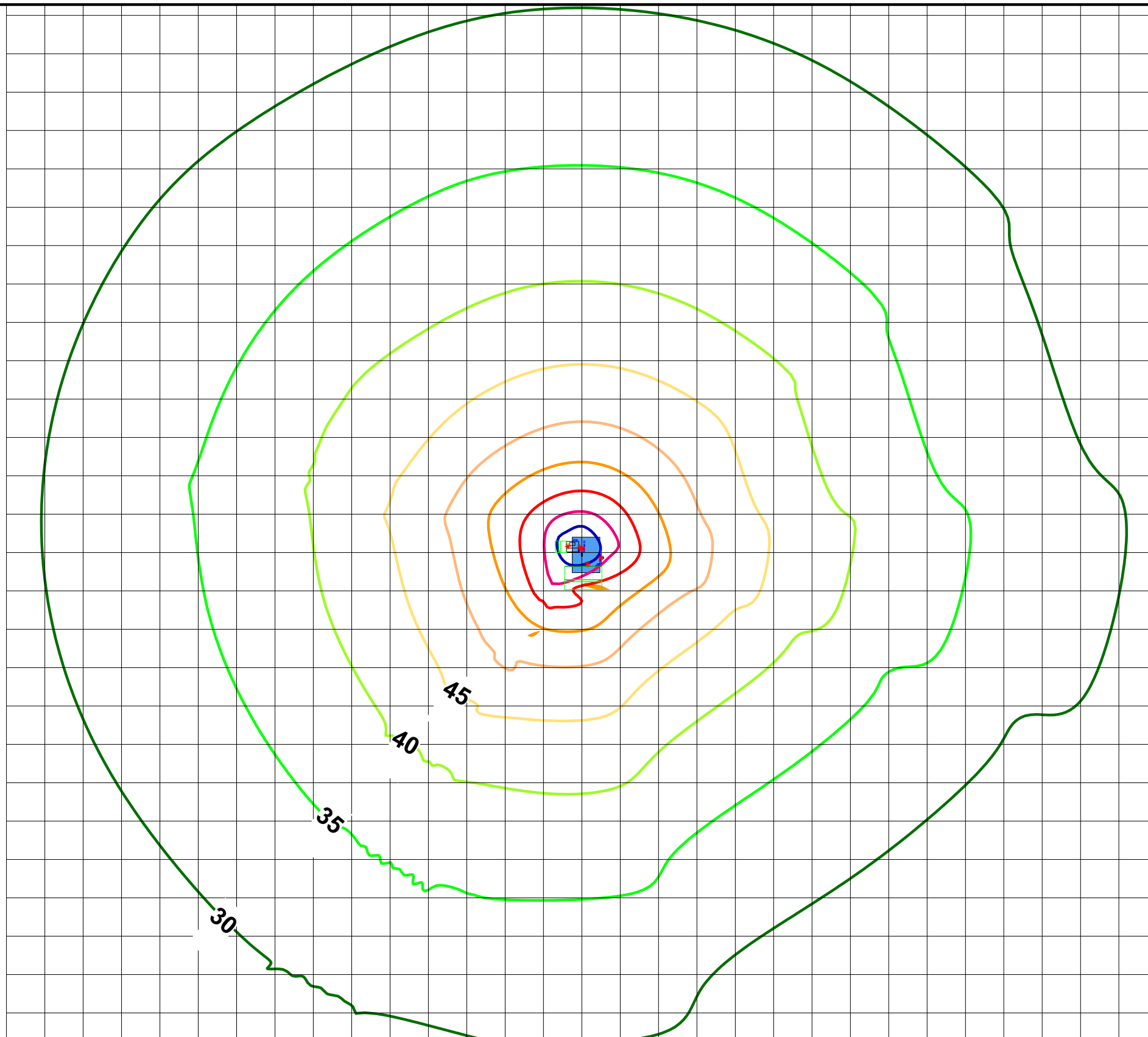
	Name	Date
Prepared	HM	17/04/09
Checked	MC	17/04/09
Authorised	MC	17/04/09

**Appendix D  
Map 3**

Predicted Noise Contours (LAeq)  
Drill Rig Atlas 1  
Core drilling operation



**HEGGIES**



Project specific intrusive noise criterion 35 dBA LAeq

Grid sections 100x100m

**LAeq (dBA)**

30 <	30 - 35
35 <	35 - 40
40 <	40 - 45
45 <	45 - 50
50 <	50 - 55
55 <	55 - 60
60 <	60 - 65
65 <	65 - 70
70 <	> 70

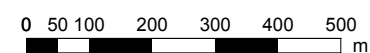
**Legend**

- Building
- \* Point source
- Berm top
- Grid 100x100m
- Drill Site

**Note:**

Predictions at 1.5m above ground and assumes "Neutral" weather

Scale 1:12000



**20-2014-R3  
SANTOS DRILL RIG  
(LAeq) Noise Contours**

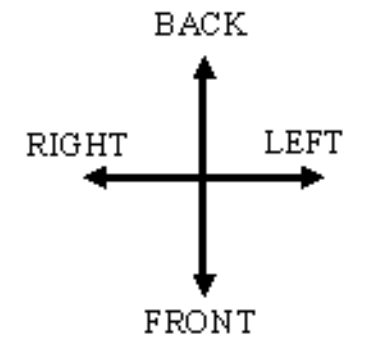
	Name	Date
Prepared	HM	17/04/09
Checked	MC	17/04/09
Authorised	MC	17/04/09

**Appendix D  
Map 4**

Predicted Noise Contours (LAeq)  
Drill Rig Atlas 1  
Drilling operation including the mud pump

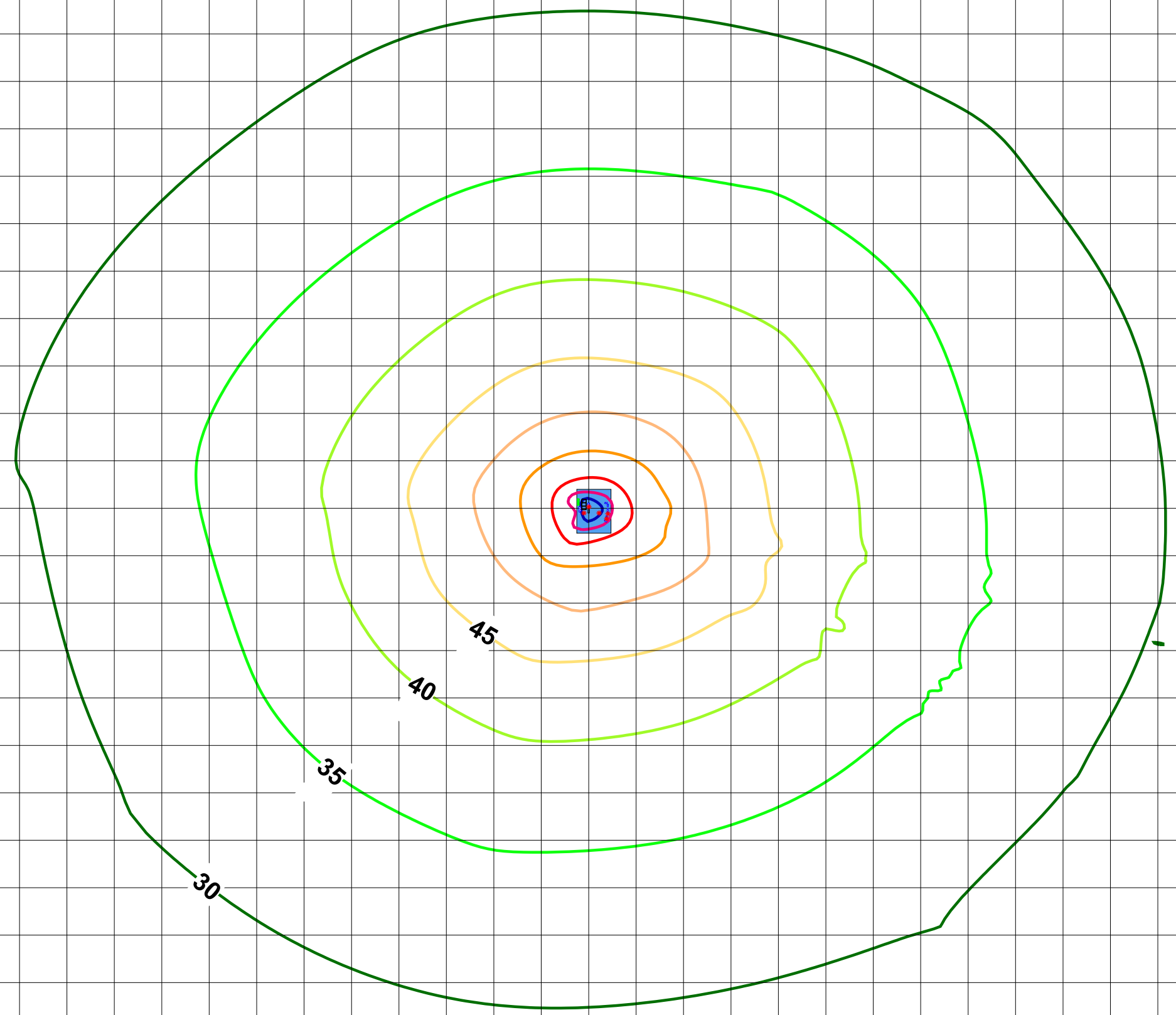


**HEGGIES**



Project specific intrusive noise criterion 30 dBA LAeq  
5 dB penalty for low frequency noise has been applied.

Grid sections  
100x100m



**L<sub>Aeq</sub> (dBA)**

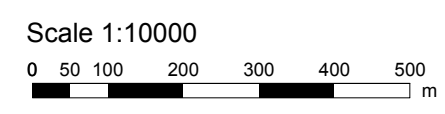
30 <	<= 35
35 <	<= 40
40 <	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	<= 65
65 <	<= 70
70 <	

**Legend**

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

**Note:**

Predictions at 1.5m above ground and assumes "Worst case" weather



**20-2014-R3  
SANTOS DRILL RIG  
(L<sub>Aeq</sub>) Noise Contours**

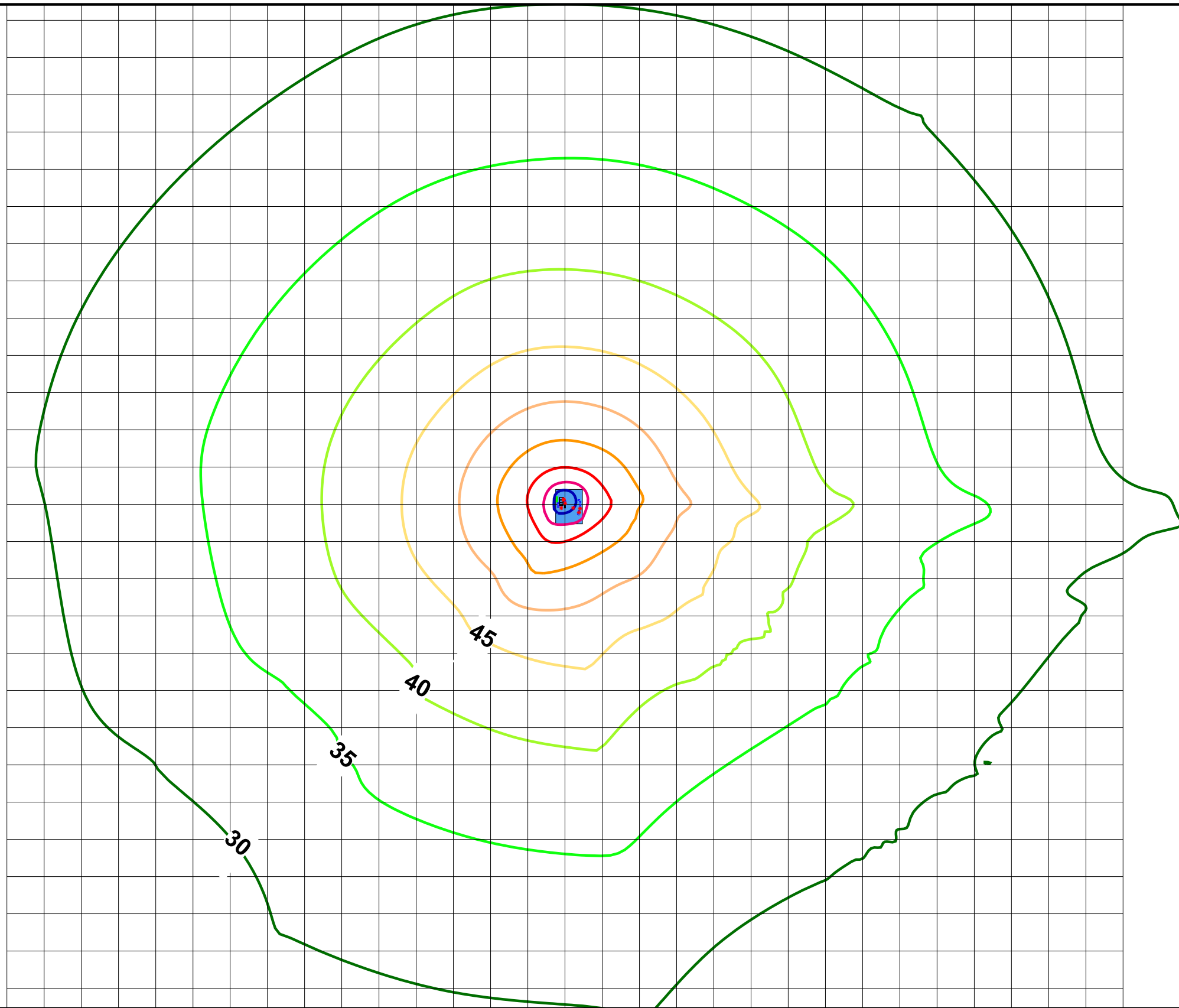
	Name	Date
Prepared	HM	16/04/09
Checked	MC	16/04/09
Authorised	MC	17/04/09

**Appendix D  
Map 5**

Predicted Noise Contours (L<sub>Aeq</sub>)  
Drill Rig MDC 105  
Core drilling operation



**HEGGIES**



Project specific intrusive noise criterion 35 dBA LAeq

Grid sections 100x100m

**LAeq (dBA)**

30 <	█	<= 35
35 <	█	<= 40
40 <	█	<= 45
45 <	█	<= 50
50 <	█	<= 55
55 <	█	<= 60
60 <	█	<= 65
65 <	█	<= 70
70 <	█	

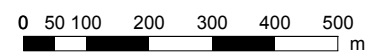
**Legend**

- █ Building
- Point source
- █ Berm top
- █ Grid 100x100m
- █ Drill Site

**Note:**

Predictions at 1.5m above ground and assumes "Worst case" weather

Scale 1:12000



**20-2014-R3  
SANTOS DRILL RIG  
(LAeq) Noise Contours**

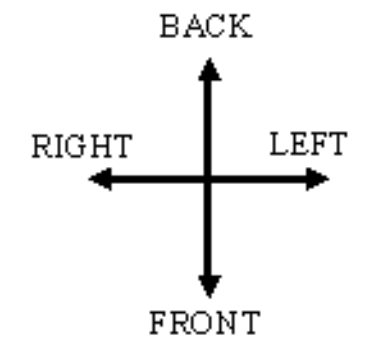
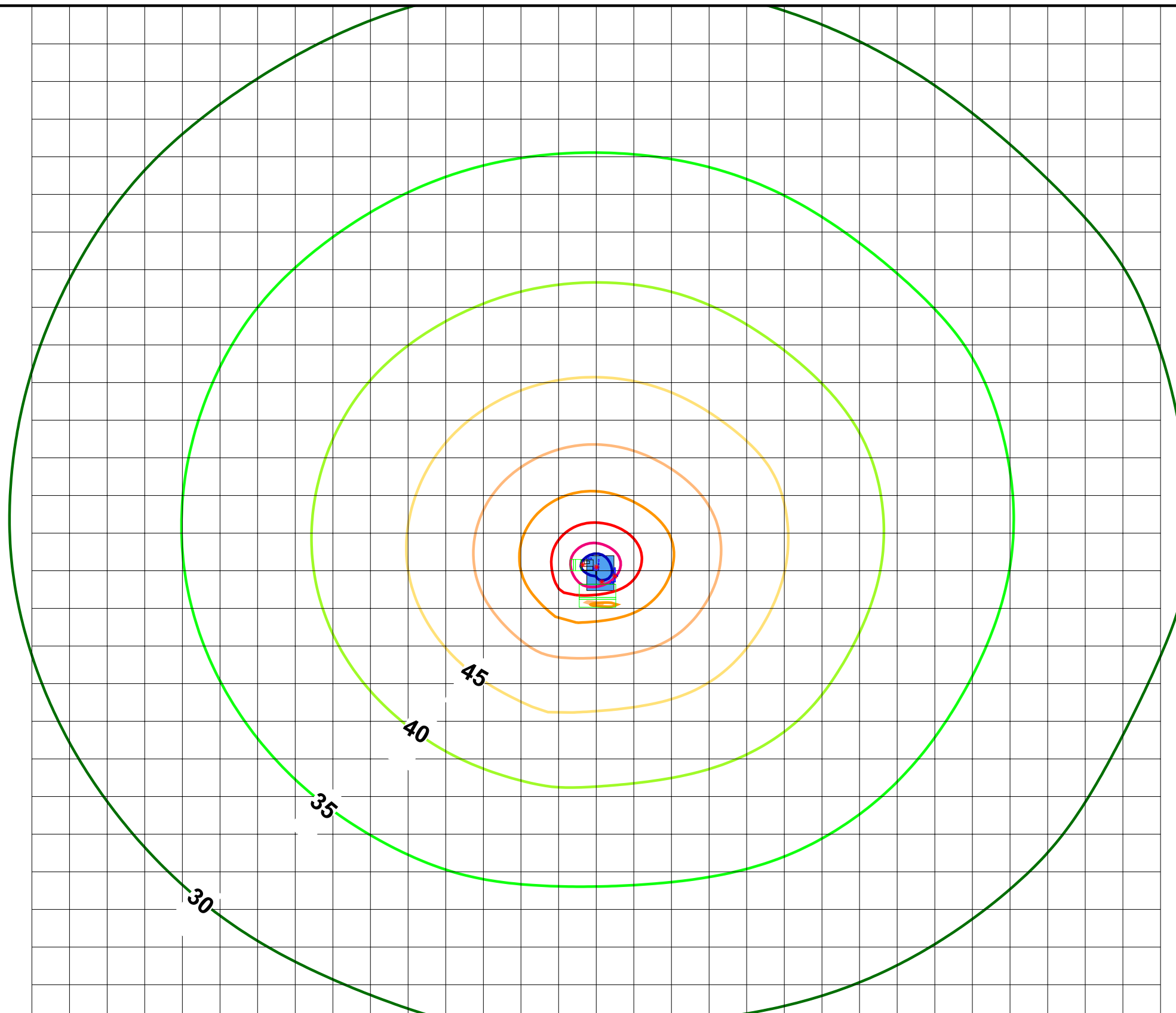
	Name	Date
Prepared	HM	16/04/09
Checked	MC	16/04/09
Authorised	MC	17/04/09

**Appendix D  
Map 6**

Predicted Noise Contours (LAeq)  
Drill Rig MDC 105  
Drilling operation including the mud pump



**HEGGIES**



Project specific intrusive noise criterion 35 dBA LAeq

Grid sections 100x100m

**L<sub>Aeq</sub> (dBA)**

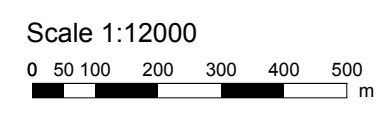
30 <	█	<= 35
35 <	█	<= 40
40 <	█	<= 45
45 <	█	<= 50
50 <	█	<= 55
55 <	█	<= 60
60 <	█	<= 65
65 <	█	<= 70
70 <	█	

**Legend**

- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

**Note:**

Predictions at 1.5m above ground and assumes "Worst case" weather



**20-2014-R3  
SANTOS DRILL RIG  
(L<sub>Aeq</sub>) Noise Contours**

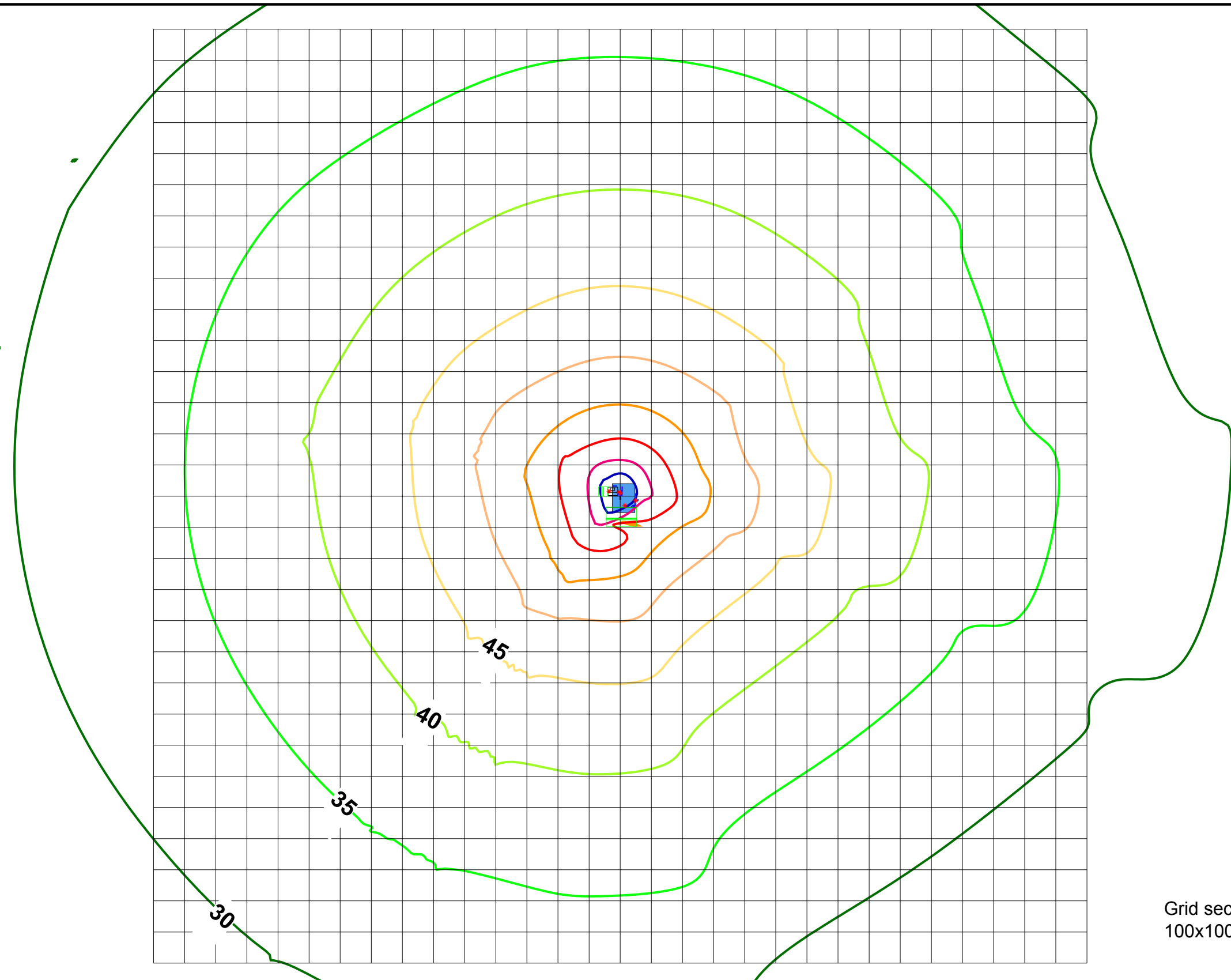
	Name	Date
Prepared	HM	17/04/09
Checked	MC	17/04/09
Authorised	MC	17/04/09

**Appendix D  
Map 7**

Predicted Noise Contours (L<sub>Aeq</sub>)  
Drill Rig Atlas 1  
Core drilling operation



**HEGGIES**



Project specific intrusive noise criterion 35 dBA LAeq

Grid sections 100x100m

**LAeq (dBA)**

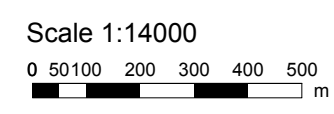
30 <	35
35 <	40
40 <	45
45 <	50
50 <	55
55 <	60
60 <	65
65 <	70
70 <	

**Legend**

- Building
- ★ Point source
- Berm top
- Grid 100x100m
- Drill Site

**Note:**

Predictions at 1.5m above ground and assumes "Worst case" weather



**20-2014-R3  
SANTOS DRILL RIG  
(LAeq) Noise Contours**

	Name	Date
Prepared	HM	17/04/09
Checked	MC	17/04/09
Authorised	MC	17/04/09

**Appendix D  
Map 8**

Predicted Noise Contours (LAeq)  
Drill Rig Atlas 1  
Drilling operation including the mud pump



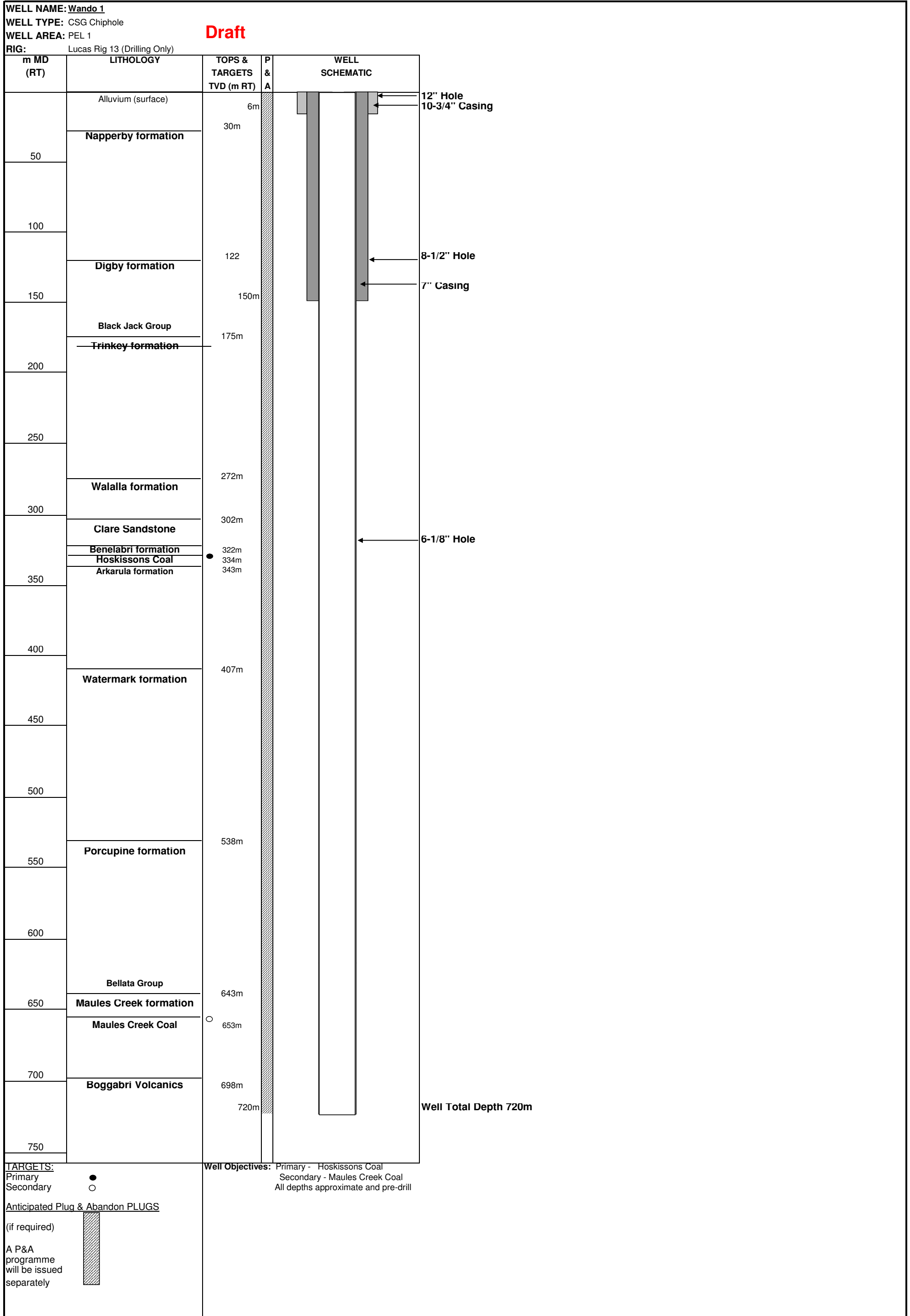
**HEGGIES**

---

# Appendix D

Chip Hole Design

prepared by Santos



---

# Appendix E

Environmental Management Plan

prepared by RPS



# Environmental Management Plan

**Wando I Chip Hole – PEL I,  
Gunnedah Basin**

Prepared by:

**RPS AUSTRALIA EAST PTY LTD**

743 Ann Street  
PO Box 1559  
FORTITUDE VALLEY QLD 4006

T: 617 3237 8899  
F: 617 3237 8833  
E: Brad.Dreis@rpsgroup.com.au  
W: rpsgroup.com.au

Report Number: 106107-2-EMP  
Version / Date: FR, Rev 0 / June 2011

Prepared for:

**SANTOS QNT PTY LTD**

Level 22, Santos Place  
32 Turbot Street  
BRISBANE QLD 4000

T: 07 3838 3676  
F: 07 3838 3700

## Important Note

Apart from fair dealing for the purposes of private study, research, criticism, or review as permitted under the Copyright Act, no part of this report, its attachments or appendices may be reproduced by any process without the written consent of RPS Australia East Pty Ltd. All enquiries should be directed to RPS Australia East Pty Ltd.

We have prepared this report for the sole purposes of Santos QNT Pty Ltd ("Client") for the specific purpose only for which it is supplied. This report is strictly limited to the purpose and the facts and matters stated in it and does not apply directly or indirectly and will not be used for any other application, purpose, use or matter.

In preparing this report we have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

This report is presented without the assumption of a duty of care to any other person (other than the Client) ("Third Party"). The report may not contain sufficient information for the purposes of a Third Party or for other uses. Without the prior written consent of RPS Australia East Pty Ltd:

This report may not be relied on by a Third Party; and

RPS Australia East Pty Ltd will not be liable to a Third Party for any loss, damage, liability or claim arising out of or incidental to a Third Party publishing, using or relying on the facts, content, opinions or subject matter contained in this report.

If a Third Party uses or relies on the facts, content, opinions or subject matter contained in this report with or without the consent of RPS Australia East Pty Ltd, RPS Australia East Pty Ltd disclaims all risk and the Third Party assumes all risk and releases and indemnifies and agrees to keep indemnified RPS Australia East Pty Ltd from any loss, damage, claim or liability arising directly or indirectly from the use of or reliance on this report.

In this note, a reference to loss and damage includes past and prospective economic loss, loss of profits, damage to property, injury to any person (including death) costs and expenses incurred in taking measures to prevent, mitigate or rectify any harm, loss of opportunity, legal costs, compensation, interest and any other direct, indirect, consequential or financial or other loss.

## Document Status

<i>Version</i>	<i>Purpose of Document</i>	<i>Orig</i>	<i>Review</i>	<i>Review Date</i>	<i>QA Review</i>	<i>RPS Release Approval</i>	<i>Issue Date</i>
<i>A</i>	<i>Draft for review</i>	<i>SB / HR</i>	<i>BD</i>	<i>7/6/2011</i>	<i>BD</i>	<i>BD</i>	<i>11/6/2011</i>
<i>0</i>	<i>Final for submission</i>	<i>HR</i>	<i>Santos</i>	<i>15/6/2011</i>	<i>BD</i>	<i>BD</i>	<i>16/6/2011</i>

## Contents

<b>1.0</b>	<b>INTRODUCTION .....</b>	<b>1</b>
1.1	DESCRIPTION OF THE ACTION .....	1
1.1.1	Introduction.....	1
1.1.2	Site Preparation & Equipment.....	2
1.1.3	Drill Rig Positioning & Operation.....	3
1.1.4	Drilling Activities .....	3
1.1.5	Abandonment and Rehabilitation.....	3
1.1.6	Duration.....	4
1.1.7	Staff & Hours of Operation .....	4
1.1.8	Chemicals.....	4
1.1.9	Justification of Activity.....	5
1.1.10	Alternatives.....	6
1.2	SITE PARTICULARS .....	7
1.2.1	Regional Location .....	7
1.2.2	Study Area Description .....	7
1.2.3	Topography .....	7
<b>2.0</b>	<b>ENVIRONMENTAL MANAGEMENT PLAN .....</b>	<b>8</b>
2.1	PURPOSE OF THE EMP .....	8
2.2	OBJECTIVES .....	8
2.3	RESPONSIBILITIES.....	8
2.3.1	Project Manager .....	9
2.3.2	Drilling Contractor .....	9
2.3.3	Civil Works Contractor .....	9
2.3.4	Environmental Advisor / Auditor.....	9
2.3.5	Heritage Supervisor .....	9
2.3.6	Supervising Ecologist.....	10
2.3.7	Project Liaison.....	10
2.4	PROCEDURES .....	10
2.5	TRAINING AND AWARENESS.....	10
2.5.1	Induction.....	10
2.5.2	Job Specific Training.....	10

2.5.3	Environmental Awareness .....	11
2.6	COMMUNICATION .....	11
2.7	DOCUMENTATION AND REPORTING.....	11
2.8	REVIEW AND IMPROVEMENT .....	12
<b>3.0</b>	<b>CONSTRUCTION MANAGEMENT .....</b>	<b>13</b>
3.1	OVERVIEW .....	13
3.2	VEGETATION MANAGEMENT .....	13
3.2.1	Overview .....	13
3.2.2	Environmental Issues.....	13
3.2.3	Management Measures .....	14
3.3	FAUNA MANAGEMENT.....	15
3.3.1	Overview .....	15
3.3.2	Environmental Issues.....	15
3.3.3	Management Measures .....	15
3.4	HERITAGE MANAGEMENT .....	16
3.4.1	Environmental Issues.....	16
3.4.2	Management Measures .....	16
3.5	ACCESS.....	17
3.5.1	Overview .....	17
3.5.2	Environmental Issues.....	17
3.5.3	Management Measures .....	18
3.6	CLEARING .....	18
3.6.1	Overview .....	18
3.6.2	Environmental Issues.....	18
3.6.3	Management Measures .....	18
3.7	GRADING.....	19
3.7.1	Overview .....	19
3.7.2	Environmental Issues.....	19
3.7.3	Management Measures .....	19
3.8	CONTAMINATED LAND .....	19
3.8.1	Overview .....	19
3.8.2	Impacts.....	19
3.8.3	Mitigation Measures .....	20

CLEAN UP AND WASTE MANAGEMENT .....	20
3.8.4 Overview .....	20
3.8.5 Environmental Issues .....	20
3.8.6 Management Measures .....	21
3.9 EROSION AND SEDIMENT CONTROL .....	22
3.9.1 Overview .....	22
3.9.2 Environmental Issues .....	22
3.9.3 Management Measures .....	22
3.10 NOISE CONTROL .....	22
3.10.1 Overview .....	22
3.10.2 Environmental Issues .....	23
3.10.3 Management Measures .....	23
3.11 DUST CONTROL .....	24
3.11.1 Overview .....	24
3.11.2 Environmental Issues .....	24
3.11.3 Management Measures .....	24
3.12 WEED CONTROL .....	24
3.12.1 Overview .....	24
3.12.2 Environmental Issues .....	25
3.12.3 Management Measures .....	25
3.13 DISEASE CONTROL .....	26
3.13.1 Overview .....	26
3.13.2 Environmental Issues .....	26
3.13.3 Management Measures .....	26
3.14 BUSHFIRE PREVENTION .....	27
3.14.1 Overview .....	27
3.14.2 Environmental Issues .....	27
3.14.3 Management Measures .....	27
<b>4.0 DECOMMISSIONING .....</b>	<b>28</b>
4.1 EQUIPMENT REMOVAL .....	28
4.2 SITE REHABILITATION .....	28
4.2.1 Timing and Objectives .....	28
4.2.2 Species Schedule .....	29

---

4.2.3	Rehabilitation Performance Criteria, Monitoring and Actions .....	29
<b>5.0</b>	<b>REPORTING .....</b>	<b>31</b>

## Tables

Table 1.1	Areas of disturbance & cut and fill for well leases .....	2
Table 1.2	Duration of drilling and site activities .....	4
Table 3.1	Weed Removal Techniques .....	25
Table 4.1	Native Grassland Species Selection.....	29
Table 4.2	Rehabilitation Management Schedule – Chip hole Lease .....	29

## 1.0 Introduction

Santos QNT Pty Ltd (Santos) as operator for and on behalf of the titleholder is proposing to undertake drilling activities to assess the coal seam gas potential of the Gunnedah Basin in PEL 1.

RPS was engaged to prepare this Environmental Management Plan (EMP) to accompany the Review of Environmental Factors (REF) for the proposed activities to be submitted to the Department of Industry and Investment in accordance with the *Environmental Planning and Assessment Act 1979* (NSW). RPS has also prepared a preliminary ecological assessment (EA). Terms used in the project REF and the EA have the same meaning in this EMP.

### 1.1 Description of the Action

#### 1.1.1 Introduction

Santos proposes to undertake drilling activities to assess the coal seam gas potential of the Gunnedah Basin in PEL 1, which are the subject of this REF.

The proposed appraisal program includes drilling at the Wando 1 location to obtain information on coal depths, seam thickness, continuity, gas composition (as required) and reservoir pressure and permeability. Drill stem testing (DST) or equivalent downhole evaluation is planned to be undertaken on target coal seams to collect information on reservoir pressure and gain an indication of permeability. Drill cuttings may also be collected and analysed for gas composition information. Wando 1 is planned as a 'chiphole' which means that no continuous core is planned to be collected from the well. Following drilling to the well total depth and conduct of required well logging and testing the well will be plugged and abandoned with cement plugs from total depth to surface.

In summary, the process involves:

- preparation of lease access tracks utilising existing access tracks as much as is practical;
- preparation of a level drill pad (also referred to as "well lease area");
- placement of a drilling rig and ancillary equipment at the well lease;
- drilling of the well;
- collection and analysis of drill cuttings (as required);
- conduct well testing and wireline logging (as required);
- plugging and abandonment of the well;
- removal of equipment and imported materials from the site; and
- full rehabilitation of the site in line with legislative and landholder requirements.

Santos has negotiated an access, compensation and rehabilitation agreement with the affected landowner in respect to land access, compensation and rehabilitation. A scouting survey has been undertaken in consultation with the relevant landholder prior to drilling taking place to locate the site with an emphasis on minimisation of impacts on the environment and property operations.

### 1.1.2 Site Preparation & Equipment

Various works will be required in order to prepare the site for the proposed drilling, including preparation of the well lease, access track improvements and construction as well as positioning the drill rig and associated temporary buildings and equipment on the site. The major equipment used on site will be a drilling rig and associated temporary buildings. These works are summarised further in this section. Figure 3.1 and Figure 3.2 of the REF illustrate the proposed site layout for the well lease and access tracks. Figure 3.3 of the REF illustrates the proposed erosion and sediment control measures for the well lease.

During site preparation, there will be some soil disturbance as a level drill pad will need to be constructed at the well lease. Associated lined drilling sumps and a flare pit will also be constructed on site for use during drilling operations. The area to be disturbed for drilling activity is outlined in **Table 1.1**.

**Table 1.1 Areas of disturbance & cut and fill for well leases**

Well Lease	Area of Disturbance	Pad Level
Wando	86m X 64m with an overall area of disturbance of 5,504m <sup>2</sup> .	Existing pit will be backfilled, compacted and graded to establish a pad level at approximately RL 338.20m AHD.
Access Track	500 x 6m = 3,000m <sup>2</sup>	n/a

#### Well Lease Construction

- Civil works equipment will be moved to site including bulldozer, excavator, grader, roller, water trucks, other trucks and support and light vehicles;
- Portable amenities will be located on site during construction.;
- Any topsoil will be stripped and stockpiled;
- Required sumps will be excavated and lined with impermeable plastic sheeting;
- The lease area will be graded, rolled and otherwise constructed per Figure 3.2 of the REF;
- A 10-3/4" steel conductor casing will be pre-installed at approximately 6m depth by the civil works crews ahead of the rig arriving on site; and
- The well lease pad will be fenced in a conventional manner consistent with the fencing on the landholders property.

#### Access Track Improvements and Construction

There is an existing track which provides partial access to the location. Upgrading of this track with gravel will be required, however no widening is necessary. Approximately 500m of new access track is required to be constructed to enable access to the well lease. The following is a list of the detailed works involved.

- All access tracks will be constructed 6m in width;
- The new access track will have a topdress of 150 mm of road base;
- The existing track will have approximately 500m dressed with 100mm road base;
- Track is to be constructed to allow wet weather access; and

- Two sets of double gates and end assemblies to be installed in two locations on the northern boundary of the well lease.

### **1.1.3 Drill Rig Positioning & Operation**

- Equipment will enter/exit the site via the main access gate. Equipment will include generator units, lighting towers, site offices, stores and other various buildings and equipment required for the duration of drilling;
- Moving and rigging up/down of equipment (i.e. installation and dismantling of rig equipment) is expected to take up to 3 days per site (3 per rig up, 3 per rig down); and
- Ancillary equipment will be required on site during the course of the drilling activities, including wireline trucks, cementing trucks and service company vehicles, these vehicles will exit and enter the site as required.

### **1.1.4 Drilling Activities**

The well will have a specific design ensuring compliance with relevant legislation. A nominal 10-3/4" (273mm) cemented conductor is to be installed by the lease builder to approximately 6 m below ground level. Surface hole of 8 1/2" (216mm) will be rotary drilled to approximately 150mRT, where a 7" (178mm) steel surface casing will be landed and pressure cemented in place with cement to surface. The main hole of diameter 6-1/8" (156mm) will be drilled from the 7" (178mm) casing shoe to well total depth planned to be 20m into the Boggabri Volcanics at approximately 720mRT based on the pre-drill geological prognosis. DSTs or equivalent downhole evaluations may be conducted on penetration over selected Late and Early Permian Coals with testing to be performed in accordance with legislative requirements.

The closest offset wells to the proposed activities are Wondobah Ddh 1 (5.35km), Millie Ddh 1 (10.13km) and Goran 1 (8.12km).

Once the well has reached its total depth, geophysical wire-line logs will be run over the entire length of the hole to identify major stratigraphic units, intersected coal seam depth and seam thickness. Further DST or equivalent downhole evaluation may follow after completion of logging. Following logging and any post TD activities, the well will be fully plugged and abandoned from bottom to top with cement plugs. A separate P&A program will be issued at a later date. Regulatory approval is required for the abandonment program prior to abandonment operations commencing.

It is worth noting that due to poor quantity of stratigraphic data in the vicinity of the planned well it is estimated that the pre-drill prognosed formation tops may be forecast in error of up to +/- 100m.

### **1.1.5 Abandonment and Rehabilitation**

The well will be cemented, plugged and abandoned in accordance with DTIRIS requirements and rehabilitated following completion of activities within the allowed regulatory timeframe, unless needed for further exploration testing. In the case of plug and abandonment, the intermediate casing would be removed above the top of cement (where required and practicable) and a steel identification plate installed near the top of the hole > 1 metres below the surface.

Once the drilling and testing activities are complete, the disturbed area is proposed to be rehabilitated with appropriate mitigation measures and environmental safeguards implemented to minimise potential impacts. All rehabilitation works will be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation in accordance with the relevant statutory requirements.

Revegetation & rehabilitation will be undertaken within the required regulatory timeframe. All private tracks used during operations are generally returned to their pre-operations state or to a condition agreed by the landholder.

### 1.1.6 Duration

Drilling activities are temporary and will not have any long-term impact on the visual amenity of the area. The drilling of the well is expected to occur over a 30 day period not including lease build, or site restoration. There will be 14 days of lease construction activities prior to drilling the well. Rehabilitation activities of 30 days following the drilling of the well will be additional to this period.

This equates to a total of approximately 44 days of construction and drilling and 30 days of rehabilitation, as outlined in the table below.

**Table 1.2 Duration of drilling and site activities**

Activity	Expected Duration
Lease Build	14 days
Drilling	30 days
Rehabilitation	30 days

### 1.1.7 Staff & Hours of Operation

The number of employees present on the site at any one time is expected to be up to 20 persons. It is not proposed to provide a workers camp on the site, with off-shift drilling crews to be located in nearby accommodation with travel to and from site to be provided.

The hours of operation during the drilling and work over will be on a 24-hour a day basis as negotiated with the landholder. Personnel movements to and from site will be minimised outside of a single shift change per day but may be necessary due to emergency situations or specific activities (e.g. crews and service companies entering and leaving site to conduct specific activities).

### 1.1.8 Chemicals

A number of chemicals are planned to be utilised to facilitate the efficient and safe drilling of the wells in line with best oilfield practice. These chemicals are typical of those generally used in oilfield activities. These chemicals will be used either to deliver the wells as planned or will be held in contingency to handle unplanned scenarios (e.g. stuck pipe, excessive mud losses etc.). The Material Safety Data Sheet (MSDS) information for all of these chemicals can be found on the Santos web site (<http://www.santos.com/exploration-acreage/gunnedah-basin-gas/fact-sheets-msds.aspx>). The fluids are

water based (not synthetic or oil based) and recycled for reuse as much as possible during the drilling process. The following list summarises the list of relevant chemical MSDS for the proposed activities.

- AMC Xtra-Sweep
- AMC Lime
- AMC Hammer Oil
- AMC Aus-Ben
- AMC Aus-Gel
- AMC Aus-Plug
- Barite
- Caustic Soda (Rheochem)
- Citric Acid (Rheochem)
- Frascseal Fine, Medium
- Drispac (Regular and Superlo) Polymer
- Soda Ash Dense
- SAPP
- Poly-Bore™
- CSR Raw Sugar / Brown Sugar
- Mud Flush III
- Guar gum, propoxylated
- Fly Ash – Eraring
- Flocele 3/8"
- AMC EP Bit Lube
- Econolite Additive
- Rheolube
- Idcide-20
- JK-261
- Sodium Bicarbonate
- Kwikseal (Fine/Medium/Coarse)
- Xanthan Gum (XC)
- Rheopac R/LV/UL/RD/LVD
- Pheno Seal
- Potassium Chloride (Rheochem)
- AMC CR-650
- Cement – Standard – Class A
- CFR-3
- CAL-Seal 60
- Calcium Chloride – Flake
- Bentonite
- AMC Superfoam
- Salt (Rheochem)
- AMC PAC R
- Baroid Quikmud
- Quickseal (Fine/Medium/Coarse)
- Defoam-A
- Trugel 13-A
- JK 161-LV

### 1.1.9 Justification of Activity

Drilling of the Wando 1 well is a necessary step in the ongoing exploration and evaluation of the hydrocarbon potential in PEL 1, which to date has undergone limited petroleum exploration. Discovery and appraisal of coal seam gas resources in the area has the potential to increase the state's reserves and revenue from gas and underpin future exploration or production in the region.

The proposed program consists of preparing a lease site and access tracks, drilling a well, wireline geophysical logging, drill stem testing or equivalent downhole evaluation, casing and cementing using steel casing strings, plugging and abandoning of the well and rehabilitation of the site. These procedures are required to define and identify potentially commercially valuable reserves of coal seam gas. Santos is

committed to undertake this work as part of its obligations under NSW petroleum legislation and its obligations contained in the Farm-in Agreement entered into with Australian Coalbed Methane Pty Ltd.

### **1.1.10 Alternatives**

There is limited previous drilling in this area of the Gunnedah Basin that is sufficiently deep for the purposes of petroleum exploration. The proposed drilling operation is essential to gain detailed stratigraphical data and information on target coal seam pressures and permeabilities. Sampling of drill cuttings for gas composition may also be undertaken to gather data on gas composition heterogeneity throughout the target coal seams in PEL 1. Due to the highly specialised nature of the proposed works, drill cutting sampling and well testing are the only feasible method available to obtain reliable and accurate gas composition and pressure and permeability data for the local coal resource. Geophysical methods available (e.g. seismic), which could be applied to exploration would show the structure of the basin but would not provide the ability to sample and analyse the stratigraphy of the Gunnedah Basin to quantify coal seam gas potential.

The location of the appraisal hole is a substantial factor in the evaluation of the potential coal seam gas resource. The initial location of the appraisal hole was carefully considered by the project team, in consultation with specialist consultants and agricultural operators and taking into account the underlying geology, the existing environment and the current land use.

The selection of the proposed chip hole site located on privately owned land has been based upon the ecological protection principles of avoidance and harm minimisation. The site has been selected to avoid and/or minimise potential ecological impacts. The well lease site selection process identified areas where historical disturbances had modified the natural condition and where zero or minimal vegetation clearing, tree removal and earthworks would be required to establish the well lease and associated infrastructure, including the access track.

The site was located in consultation with the landholder and with the assistance of a scouting party comprised of Santos' Project Representatives, Cultural Heritage Officers and Lease Construction Experts. Third party surveyors and Ecologists were also consulted to assist in positioning of the well lease as part of the scouting process.

Once all known constraints were identified on the site, this information was used to delineate areas to be avoided in the initial appraisal hole location identification process. This included areas which would require unnecessary intrusion on sensitive ecological communities or significant cut and fill to accommodate level drilling pad and all weather vehicular access.

The final area identified for the appraisal hole operations have been determined to avoid existing constraints as much as is practical. By undertaking the site identification methodology outlined above, the evaluation of alternative sites for the drilling program were undertaken using an adaptive management approach, where constraints were identified, verified in the field and avoided. The resulting appraisal hole location area is considered the most appropriate location both from a resource investigation perspective and to minimise any potential environmental impacts.

---

## 1.2 Site Particulars

### 1.2.1 Regional Location

The study area is located approximately 2.5km north east of Milroy, and 18km west of Curlewis, within the Gunnedah Shire Council Local Government Area (LGA). The property is within the Brigalow Belt South IBRA Bioregion and Liverpool Plains IBRA Subregion. The property is located approximately 3km to the west of Wondoba State Conservation Area.

### 1.2.2 Study Area Description

The property is approximately 155.3ha, however the study area is limited to a 16.8ha area surrounding the proposed chip hole lease (**Figure 1.1**). The topography of the study area is flat. The property is currently used for cattle grazing, and is comprised of numerous fenced paddocks consisting of native and exotic grass species. Additional infrastructure includes stock yards, sheds, and a residence.

The majority of the property has been previously selectively cleared through historical land management practices, however a small stand of woodland vegetation and scattered canopy trees occur across the property.

The property is bound to the north by Goscombe Road, and to the south by Mount Knowies Road. The property is surrounded by grazing lands. A vegetated road reserve and isolated stands of woodland vegetation providing a tenuous link to Wondoba State Conservation Area.

The proposed chip hole lease is located within a grazing area, adjacent to a small stand of woodland vegetation. A small rubbish pit occurs within the proposed chip hole lease (**Figure 1.1**).

### 1.2.3 Topography

The topography of the subject site is flat to undulating. It is located at approximately 300m to 350m Australian Height Datum (AHD) and land rises to the north, east, south and west.

---

## 2.0 Environmental Management Plan

### 2.1 Purpose of the EMP

This EMP has been prepared to ensure that the proposed activities are undertaken in accordance with relevant legislation, policies and guidelines. The mitigation measures outlined within this EMP are designed to ensure that the impact upon the environment are minimised, and that any impacts that do occur are managed appropriately

### 2.2 Objectives

The objectives of this EMP are to:

- Ensure cultural heritage sites are not impacted unnecessarily by land disturbance;
- Avoid sites of known scientific and natural significance;
- Minimise or where possible avoids clearance of native trees and shrubs;
- Minimise risks to wildlife and stock;
- Avoid the introduction or spread of pest plants and animals and implement control measures as necessary;
- Minimise disturbance and avoid contamination to soil;
- Include erosion control measures in vulnerable locations;
- Ensure that noise and dust issues are adequately dealt with in order to minimise likely impacts upon the surrounding environments;
- Optimise (in order of most to least preferable) waste avoidance, reduction, reuse, recycling, treatment and disposal;
- Provide adequate measures in relation to bushfire protection and ignition that may affect the surrounding environments; and
- Consider post-construction land use.

### 2.3 Responsibilities

Responsibility for the environmental management will be structured and be both broad-based company policy related and individually assigned. While designated individuals will be responsible for certain aspects of the construction, operation, and decommissioning activities, all staff will be responsible for environmental management to a certain extent

The following information provides a summary of each of the defined roles.

### 2.3.1 Project Manager

During the Wando 1 activities the Project Execution Manager is responsible for the overall execution of the activities and will ensure appropriate environmental management and compliance throughout the project execution activities.

### 2.3.2 Drilling Contractor

During drilling operations and within the drilling lease areas the Drilling Rig Manager is the on-site person responsible for ensuring appropriate environmental management and compliance. Overall responsibility for ensuring drilling activity environmental management and compliance falls with the Santos CSG Drilling and Completions Environmental Advisor following site approval.

### 2.3.3 Civil Works Contractor

During civil works activities the responsibility for environmental management and compliance rests with the Santos Construction Supervisor. The Site Supervisor provided by the Civil Works Contractor is responsible for any immediate actions required to ensure on-site environmental management and compliance only in the on-site absence of the Santos Construction Supervisor and is responsible for timely reporting of any issues directly to the Santos Construction Supervisor.

### 2.3.4 Environmental Advisor / Auditor

The Santos Environmental Advisor is the field-based person responsible for advising the Drilling Contractor and Civil Works and other relevant parties on the requirements of the EMP to ensure that the requirements are implemented.

Such personnel need to be appropriately qualified and undertake activities such as the following:

- Inspecting construction works on a regular basis to ensure compliance with relevant requirements;
- Maintaining a written and photographic record of the construction activities for reference;
- Identifying potential problem areas and ensuring that they are treated adequately;
- Advising all construction staff on their environmental responsibilities;
- Reporting situations of non-compliance to the Santos Project Manager;
- Ensuring sensitive areas previously identified by studies (such as threatened plants or heritage items) are flagged out and that personnel are informed of their significance; and
- Monitoring environmental performance of the construction activities.

### 2.3.5 Heritage Supervisor

The Santos Heritage Supervisor will be consulted as required. They may be required to monitor the protection of Aboriginal artefacts or European heritage. They are also required to flag items of significance for construction workers to avoid.

### **2.3.6 Supervising Ecologist**

The Supervising Ecologist is required to monitor all vegetation clearing and pruning activities to ensure vegetation and fauna management procedures are implemented. The Supervising Ecologist is to provide advice during the site rehabilitation and monitor revegetation. They are also required to prepare or provide input into required reporting.

### **2.3.7 Project Liaison**

The Santos Project Liaison manager is responsible for regular and ongoing communication as required to external parties. The Santos Project Liaison manager is responsible for ensuring any public complaints are effectively managed.

## **2.4 Procedures**

Procedures need to be put in place to ensure that there are set standards and management requirements that need to be considered. This EMP outlines procedures in the Construction Management, Operation Management and Decommissioning Management sections as to what procedures are, in relation to each environmental issue.

## **2.5 Training and Awareness**

Training and awareness is an integral part of the protection of the environment and the implementation of an EMP. A comprehensive environmental training program will encompass inductions, job specific training, and environmental awareness programs.

### **2.5.1 Induction**

Santos has a comprehensive, multi level induction program. All contractors and personnel will complete the Santos Level 1 induction as the basis of completing any works for the company and covers company values, policies, Environment Health and Safety Management System (EHS MS) and other core information.

The Gunnedah Level 2 induction covers EHS matters that are specific to the NSW and Gunnedah area in which the company operates, minimum standards and expectations.

The Site Level 3 is an on-site induction specific to a smaller area of work, such as a drill site or a pilot chip hole site. Conditions and requirements for this site are covered in this induction.

### **2.5.2 Job Specific Training**

Santos operators and staff undertake competency based training, in line with the requirements of their role. These are assessed periodically and identified gaps addressed in a training and development plan for each individual.

All Santos personnel and contractors are required to have a working knowledge of the Santos EHS MS, site specific conditions relating to works being completed on site.

---

### 2.5.3 Environmental Awareness

Prior to a scope of work commencing on a Santos site, an 'icebreaker' is held with all relevant parties to the work scope. Environmental conditions associated with the works in addition to any health and safety issues are identified and discussed in detail. Toolbox meetings are held at the start of each day where these requirements are refreshed to ensure that all persons on site are aware of the requirements and have opportunity to discuss concerns in an open forum.

## 2.6 Communication

Regular and ongoing communication will be required to inform external parties as to the progress and success of the environmental aspects of the activity. The primary point of contact will be the appointed project liaison person. External parties are likely to include:

- Landholders;
- Business;
- Local, State and Federal government;
- NSW Farmers Association;
- Namoi Catchment Management Authority;
- Utilities operators;
- Local Aboriginal Land Councils; and
- Special interest and activist groups.

## 2.7 Documentation and Reporting

A record of the implementation and results of the EMP is an important tool to enable internal and external authorities to check the procedures and the monitoring results. Assessment of compliance with statutory authorities, success in achieving objectives, any environmental outcomes and their significance and the effectiveness of the EMP will be documented.

Documentation and recording is proposed to include:

- Records of induction and training attendees;
- Inspection reports;
- Non-compliance reports;
- Accident or incident reports; and
- Audit result reports.

## 2.8 Review and Improvement

Given the short-term nature of the proposal, a review and improvement process is not required. However, in the event of a notable environmental incident, the EMP will be updated to reflect any required changes to management practices.

---

## 3.0 Construction Management

### 3.1 Overview

The construction phase incorporates the following activities:

- preparation of lease access tracks utilising existing access tracks as much as is practical;
- preparation of a level drill pad (also referred to as “chip hole lease area”);
- placement of a drilling rig and ancillary equipment at the chip hole lease;
- drilling of the chip hole; and
- removal of equipment and imported materials from the site.

The sections below outline environmental issues and management actions to be implemented throughout the construction phase.

### 3.2 Vegetation Management

#### 3.2.1 Overview

Temporary short-term impacts will be associated with the establishment and operation of the chip hole lease site. The proposed rehabilitation and revegetation of the chip hole lease site will reinstate native ground covers. Therefore, it is unlikely that there will be any long-term impacts associated with the proposed chip hole site. Furthermore, the rehabilitation and revegetation of the activity site and study area is likely to benefit the local ecology over the long-term, particularly given the current poor ecological condition of the site.

Approximately 0.3ha of disturbed ground cover vegetation will be removed to construct 500m of access track.

#### 3.2.2 Environmental Issues

Direct impacts associated with the proposal include the clearing of vegetation which is considered to be the TSC Act White Box - Yellow Box - Blakely's Red Gum Woodland Endangered Ecological Community (EEC), despite being dominated by weed species. The proposed chip hole lease is located within a pasture, with scattered Eucalypts and a stand of White Cypress occurring adjacent to the lease. The chip hole lease has been selected to avoid the need to clear canopy vegetation. Vegetation disturbance will be limited to ground cover vegetation that is comprised of native and introduced species. While mature canopy species occur to the north and south of the proposed chip hole lease, mitigation measures will be implemented to ensure these trees are not impacted throughout construction activities. Clearing of pasture grasses will also be required to construct the access track.

### 3.2.3 Management Measures

The following vegetation management measures will be implemented throughout the construction phase.

- The disturbance area will be appropriately fenced to ensure machinery is limited to the designated disturbance area. Fencing will also ensure that all adjacent canopy trees are appropriately protected throughout construction works;
- The extent of clearing required along access tracks will be clearly pegged;
- Where canopy trees occur along the access to be constructed, tree protection measures will be installed to ensure no damage;
- Any felled non-native vegetation will be disposed of at an appropriate waste disposal facility;
- Stockpiling of felled vegetation and soils will occur only within the designated work areas. Ensure stockpiles are not:
  - » Located in an area which significantly isolate, fragments or dissects tracts of vegetation connectivity, or results in an increase in threatening processes; On slopes of greater than 10%;
  - » Do not impede vehicle, stock or wildlife movements;
- Install erosion and sediment control devices to ensure stockpile remains intact; and
- Any existing habitat values (e.g. hollow logs) will be salvaged and placed in adjoining undisturbed areas.
- All contractors will be specifically advised of designated work area. The following activities are not to occur outside of designated work areas to minimise impacts on native vegetation:
  - » Vehicle movements;
  - » Storage and mixing of materials
  - » Vehicle parking;
  - » Liquid disposal;
  - » Machinery repairs and/or refueling;
  - » Construction site office or shed;
  - » Combustion of any material;
  - » Stockpiling of soil, rubble or debris; and
  - » Any filling or excavation including trenching, topsoil skimming and/or surface excavation;
- Vehicle speeds will be limited to reduce the potential of fauna strike and to reduce dust generation;
- To minimise potential impacts on adjacent grazing lands, all liquids (fuel, oil, cleaning agents, drilling liquids etc) will be stored appropriately and disposed of at suitably licensed facilities. Spill

management procedures will be implemented as required. Rubbish will be collected and removed from the site. Appropriate erosion and sediment control measures will be utilised as required.;

- Following construction of the chip hole lease, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Rehabilitation will include native grasses that are representative of the existing vegetation composition of the study area.

### **3.3 Fauna Management**

#### **3.3.1 Overview**

The proposed activity is considered to have minimal impacts on fauna habitat, as no canopy trees will be cleared as part of construction. However, construction activities have the potential to impact upon fauna populations, such as reptiles and Koala, through vehicle strike, noise and dust pollution.

#### **3.3.2 Environmental Issues**

Evidence of Koala usage was observed in the study area, adjacent to the chip hole lease. As no Koala habitat trees will be cleared, the impacts to Koala are considered minimal. However, the breeding cycle, roosting, sheltering and foraging behaviour for some species, particularly the Koala, may potentially be temporarily impacted by the proposed activities that utilise habitat resources adjacent to the chip hole lease due to additional noise, light, and vehicle traffic.

Noise pollution as a result of vehicles, machinery and drilling may temporarily deter native fauna, including Koalas, from utilising the study area and immediate surrounding areas as habitat.

#### **3.3.3 Management Measures**

The following fauna management measures are to be implemented throughout the construction phase:

- Chip hole lease will be clearly fenced using temporary fauna exclusion fencing prior to vegetation clearing commencing;
- Fencing is to comply with the following specifications:
  - » mesh wire that is at least 1.5 m high, be clad with 13 line marsupial hinge joint and capped with a 600 mm wide strip of galvanised sheeting across the top of the fence to impede access;
  - » Fence bracing/supports will be located within the construction area;
  - » Fencing will have a gap of less than 100 mm between the ground and the bottom of the fence;
  - » The fence will be kept clear of fallen branches and vines; and
  - » No barbed wire or electric fencing will be used.

- Construction equipment and vehicles will be stored within designated work areas, and not within areas of adjacent habitat;
- All construction vehicles/machinery are to use the designated access tracks, and follow the speed limits; and
- No domestic pets (including dogs or cats) will be allowed on site during construction.

### 3.4 Heritage Management

#### 3.4.1 Environmental Issues

The site was inspected by Santos' cultural heritage officer in March 2011. No items of significance were identified, and no features likely to contain archaeological deposits were found. A Cultural Heritage Assessment was subsequently prepared (Appendix B of the REF) for the site, which concluded that Aboriginal objects are unlikely to occur in the subject area.

A search of the NSW OEH Aboriginal Heritage Information Management System (AHIMS) undertaken as part of the assessment was made on 17 June 2011 and found that there were no items of cultural heritage located on the site or in the vicinity of the site.

It is considered that the potential impacts associated with Aboriginal heritage can be appropriately managed if the mitigation measures presented below are proposed.

There are no items of heritage significance listed as occurring on the subject site in either the Gunnedah LEP 1998 or on the NSW State Heritage Register. A number of items of local and State heritage significance were recorded as occurring within the Gunnedah Local Government Area, however these are not located in close proximity to the subject site.

Four sites within the Gunnedah LGA are listed on the Commonwealth Register of National Estate, however none of these are on the subject site.

It is considered that the potential impacts associated with other cultural heritage can be appropriately managed if the mitigation measures presented below are implemented.

#### 3.4.2 Management Measures

The following mitigation measures will be implemented throughout the construction phase to limit any potential impact on any unknown Aboriginal sites or objects:

- Minimise impact to areas outside the area of operation through appropriate on site induction of all employees and contractors attending site;
- Vehicle access is to remain within existing tracks where possible in order to minimise potential impacts on surrounding vegetation and reduce erosion;
- In the event that any vegetation clearing is required to allow large machinery access to a given area, soil disturbance will be kept to a minimum;

- If works fall outside of the areas inspected for the purposes of the cultural heritage assessment or access routes are altered Santos will have those areas investigated by a qualified archaeologist;
- If an Aboriginal object or site is identified at any point during the proposed works, all works in the vicinity will cease immediately. That area will be temporarily fenced with high visibility tape or barrier fencing in order to prevent further impact and a suitably qualified archaeologist contacted. Works in that location will not proceed until the site has been registered with the OEH and an appropriate course of action determined by the archaeologist. In most instances this would involve applying for an Aboriginal Heritage Impact Permit (AHIP) from OEH in consultation with the Aboriginal Community; and
- In the event that skeletal remains are uncovered, work will cease immediately in that area and the area fenced. Employees to complete the Santos Discovery of Cultural Heritage Site Form located on the Santos intranet. Santos will then contact the NSW Police and follow the advised procedure. If the skeletal remains are determined to be Aboriginal, Santos will then contact the OEH and relevant Aboriginal Community Stakeholders in order to determine an action plan for the management of the skeletal remains prior to works commencing.

It is considered highly unlikely that any items of European cultural heritage significance will be impacted by the proposed drilling. Nonetheless, heritage items are protected by legislation in NSW. If an object is found during drilling or other subsurface works that is considered to be of any heritage significance, all works shall cease, and a qualified archaeologist shall be contacted.

## 3.5 Access

### 3.5.1 Overview

Access tracks are required so that all personnel and materials can be efficiently directed to the construction site. It is important to ensure that while access to the site will be provided, the impacts upon the environment resulting from the use of such access will be controlled and minimised.

### 3.5.2 Environmental Issues

The following environmental issues have been identified as key issues potentially arising from the construction of access tracks:

- Increased safety hazard resulting from increases in traffic volume;
- Access track proliferation;
- Soil compaction, erosion and sediment release to land and water;
- Incursion of disease, weeds, vermin or destructive influences to the site;
- Temporary disruption to landholders;
- Degradation of existing road infrastructure; and
- Unauthorised third party access to previously inaccessible areas.

---

### 3.5.3 Management Measures

The following management measures will be implemented throughout the construction of access tracks:

- During the creation of access tracks, erosion or sediment release will be controlled adequately; and
- Appropriate measures will be employed to prevent surface damage to public roads (e.g. limiting dirt track access during wet weather and protecting bitumen surfaces where tracked machinery is required to cross roads).

The following measures will be implemented throughout the construction phase to ensure access tracks are appropriately utilised:

- Access tracks will be speed limited to 20km/h; and
- Vehicle parking will be restricted to designated areas.

## 3.6 Clearing

### 3.6.1 Overview

Clearing of ground covers only is required within the chip hole lease and access track. No canopy vegetation will be removed as part of this activity. Vegetation disturbance for the access track will be limited to the removal of 0.3ha of disturbed ground cover vegetation only, while the chip hole will result in the removal of approximately 0.5ha of disturbed ground cover vegetation.

### 3.6.2 Environmental Issues

The following issues have been identified as key issues potentially arising from vegetation clearing activities:

- Soil erosion;
- Sediment release;
- Increased potential for weed species introduction; and
- Disturbance to heritage sites.

### 3.6.3 Management Measures

The following management measures will be implemented throughout the construction phase:

- Vegetation clearance will be minimised as far as practicable;
- Clearing will be limited to designated work areas;
- Cleared topsoils and ground covers will be stockpiled separately in a manner which:
  - » facilitates respreading or salvaging;
  - » does not impede vehicles, stock or wildlife;

- » avoids damage to adjacent live vegetation; and
- Surface rock will be stockpiled in an adjacent area for respreading.

### 3.7 Grading

#### 3.7.1 Overview

Grading may be required along the access tracks. Grading comprises the removal of topsoil and subsoil and is required where the soil conditions cannot accommodate construction activities.

#### 3.7.2 Environmental Issues

The following issues have been identified as key issues potentially arising from grading:

- Soil erosion and sediment release;
- Soil mixing, compaction and topsoil loss; and
- Increased potential for the spread of weeds and pathogens.

#### 3.7.3 Management Measures

The following management measures will be implemented throughout the construction phase:

- Graded soil will be stockpiled separately from other materials (e.g. vegetation), where it can be readily recovered for respreading and where it will not be lost through wind or water erosion or other means;
- Graded soil will not be stockpiled where it has the potential to result in sedimentation or acidification of land; and
- Topsoil containment measures (e.g. berms and sediment fencing) will be used as necessary.

### 3.8 Contaminated Land

#### 3.8.1 Overview

Illegal dumping has occurred on the proposed well lease in the past where various items of agricultural and domestic hard refuse (e.g. rubber, metal, plastic, wood) have been dumped in an excavated pit. The pit is approximately 45m x 5m and 1.6m deep. The pit required removal to facilitate the construction of the chip hole lease.

#### 3.8.2 Impacts

While no chemical testing of the dumped material has been undertaken, there is a possibility that localised soil contamination may be present. It is proposed to remove the waste from the site and dispose of it at a licensed facility. Prior to removal, waste will be classified in accordance with the OEH *Waste Classification Guidelines* by a suitably qualified person. While the waste is expected to be inert, if

evidence of any contamination is identified validation testing of the soils will be undertaken to ensure all contaminated material is removed prior to the commencement of works. The stockpiled material excavated when the rubbish pit was formed will be backfilled into the pit to create a level drilling pad.

The proposed activities will pose minimal impact on the soils. No soil is proposed to be removed from the site. On completion of drilling all excavated material would be backfilled. Based upon the history of the locations and the minimal impact to site soils during operations, land contamination issues are considered to be minimal for the proposed activity.

It is considered that the potential impacts associated with contamination can be appropriately managed if the mitigation measures presented below are implemented.

### **3.8.3 Mitigation Measures**

Specific mitigation measures are proposed in relation to the management of the rubbish pit on site, as follows:

- Prior to commencing earthworks on site, waste will be classified in accordance with the OEH Waste Classification Guidelines by a suitable qualified person and removed to an appropriate licensed facility; and
- If evidence of any contamination is identified during removal, validation testing will be undertaken to ensure that all contaminated material is removed prior to the commencement of earthworks.

## **Clean Up and Waste Management**

### **3.8.4 Overview**

Drill cuttings and some general site operations waste will be produced as part of the proposed drilling operations. Any solvents, oils and other general waste would need to be managed in an appropriate manner to avoid health risks and contamination of land and waterways. Following drilling and removal of excess drilling fluid from the sump, dried cuttings will be removed and transported to an appropriate licensed waste facility.

Clean up involves the removal of waste materials and drilling equipment from the construction areas.

A regular service of amenities will be conducted and waste will be removed to a licensed facility.

### **3.8.5 Environmental Issues**

The following issues have been identified as key issues potentially arising from clean up and waste management:

- Protection of soil and water quality;
- Erosion and sediment control; and
- Waste minimisation and appropriate disposal.

---

### 3.8.6 Management Measures

The following management measures will be implemented throughout the construction phase:

#### Solid Inert Wastes

Appropriate solid waste management measures will be applied during the construction phase, including:

- Encouraging suppliers to reduce and/or collect packaging;
- Stockpiling reusable and recyclable wastes, such as timber skids, pallets, drums, and scrap metals;
- Supplying designated collection bins at work sites for aluminium cans, glass and paper recycling;
- Collecting and transporting general refuse to local Municipal Council approved disposal sites; and
- Designated work areas will be maintained to an orderly and hygienic standard.

#### Liquid Inert Wastes

- Drilling muds will consist of approved water based products or synthetic lubricants, and will be contained within the fluid circulation system (i.e. drilling sumps, fluid pump system and drilling orifice) during drilling; and
- Drilling muds will be recycled for use where practicable, or disposed of in accordance with regulatory and requirements as set out in the REF.

#### Hazardous Wastes

Hazardous wastes are those which pose an immediate potential risk to human health and/or the environment, including cleaning chemicals, waste oils, and sewerage. Mitigation measures include:

- Managing hazardous wastes in accordance with all relevant regulatory requirements. Many hazardous wastes may also be declared as prescribed wastes under State or Territory legislation for which specific management requirements may be imposed (e.g. waste inventories, tracking systems and permitting);
- Sewage and sullage disposal via approved septic systems, mobile chemical treatment systems or alternatively disposed to municipal sewage treatment plants;
- All waste chemicals and other toxic materials will be stored and collected for safe transport off-site for reuse, recycling, treatment or disposal at locations approved by relevant regulatory authorities;
- Hydrocarbon wastes, including lube oils and oily sludges, will be collected for safe transport off-site for reuse, recycling, treatment or disposal at approved locations;
- Hazardous waste storage areas will be suitably designed to adequately contain any spills (e.g. bunded in accordance with statutory requirements); and
- Contaminated soils will be managed according to their concentration of contaminants, their leachability and the extent of area affected.

---

## 3.9 Erosion and Sediment Control

### 3.9.1 Overview

Erosion and Sediment Control measures are required in order to avoid soil loss and resultant sedimentation of low-lying environments. Construction activities involving earthworks increase erosion risks by exposing soils through the removal of protective features such as vegetation cover. Clearing and grading required for construction will involve risks in relation to this potential impact. As a result, various components within this EMP refer to activity-specific erosion and sediment control measures.

### 3.9.2 Environmental Issues

The following are considered to be the key environmental issues in relation to erosion and sediment control for the construction phase:

- Loss of topsoil and sub-soils;
- Siltation and sedimentation;
- Reduced potential for rehabilitation success; and
- Long term stability of disturbed areas.

### 3.9.3 Management Measures

The following erosion and sediment controls will be implemented throughout the construction phase:

- Any displaced soil gathered during operations will be stockpiled within designated work areas. This soil to be used as backfill at the conclusion of drilling operations;
- Maintain existing ground cover where possible;
- Stabilise entry/exit points to the work site;
- Install sediment fence at downstream limit of disturbance areas;
- If filling of track is required, geotextile fabric will be used as a base so that all imported fill can be removed following completion of works;
- Store all drill cuttings within the designated work area, and contain with sediment fence;
- Black soils will be avoided throughout the duration of works; and
- Rehabilitate the disturbed area upon completion of required pilot activities.

## 3.10 Noise Control

### 3.10.1 Overview

The site is located in an agricultural area and the existing noise levels are relatively low. Noise will be generated by the construction of the infrastructure for a duration of approximately 14 days, drilling over approximately 30 days and rehabilitation for 30 days. There will also be noise associated with the

movement of trucks and cars associated with the works. The majority of noise will be associated with the operation of the drill rig.

Activities will be undertaken 24 hours per day, as negotiated with the landholder. Mufflers are installed on the power plants and prime movers used for the powering and mobilisation of the drilling rig. Drilling operations will be undertaken in accordance with landowner and State government requirements.

Due to the short term nature of the project, potential noise emissions from the site are assessed in relation to the levels set out in the Department of Climate Change and Water (DECCW) (now Office of Environment and Heritage) Interim Construction Noise Guideline 2009. The results of the study show the predicted noise levels at a range of distances from the equipment and considers both neutral and worst case weather conditions.

### **3.10.2 Environmental Issues**

Noise pollution as a result of vehicles, machinery and drilling may deter native fauna, including Koalas, from utilising the study area and immediate surrounding areas as habitat. The proposed activities could affect the migration and dispersal ability of native fauna particularly in relation to noise and vehicular movements. The proposed activities may result in increased noise pollution which has the potential to disrupt the breeding cycle and the foraging and roosting behaviour of some native fauna species.

### **3.10.3 Management Measures**

The following mitigation measures will be implemented throughout the construction phase:

To minimise the potential impacts on noise the following actions will be implemented:

- Santos will maintain close liaison with the landholder and relocate them should noise impacts be unsatisfactory;
- Santos will ensure that any community issues of concern will be met with a prompt response;
- Santos will undertake to refine on site noise mitigation measures and plant operating procedures where practical;
- Consideration will be given to the implementation of acoustical mitigation measures if required, at the nearest receiver;
- Consideration will be given to negotiated agreements with property holders;
- Landholder notification will be given prior to commencement of drilling;
- Equipment will be maintained so that noise levels remain constant; and
- Noise monitoring may be undertaken on receipt of a complaint.

---

## 3.11 Dust Control

### 3.11.1 Overview

The existing air quality of the locality is typical of a rural area with the majority of air emissions and pollutants arising from existing agricultural activities including stock grazing, land clearing and soil preparation, sowing and harvesting of crops, vehicle and heavy machinery movements; bushfires and burn-offs.

### 3.11.2 Environmental Issues

The potential for the activity to introduce additional air emissions would arise from the following sources:

- vehicle movements to and from the sites;
- construction and rehabilitation of the proposed access tracks and well lease;
- drilling of the chip hole.

### 3.11.3 Management Measures

To minimise impacts on air quality the following actions will be undertaken:

- Access tracks will be maintained in a compacted state;
- Land disturbance areas will be minimised;
- Water will be applied to exposed soils as required to prevent dust generation. Water supplies will be of an appropriate water quality and will not lead to soil contamination (e.g. saline groundwater or contaminated waste water);
- Dust generated from soil stockpiles will be minimised by ensuring exposure time is minimised, applying water, covering stockpiles with protective materials (e.g. hessian, tarpaulins); and
- Slow speed restrictions will be enforced on internal site access tracks.

## 3.12 Weed Control

### 3.12.1 Overview

The proposal has the potential to create favourable conditions for introduced weed species within the study area, which could potentially lead to an increase of existing weed populations. This is most likely to occur where soil disturbance is to occur.

### 3.12.2 Environmental Issues

Key environmental issues associated with weed control include:

- The spread of weed species on and off site;
- Potential for unsustainable rehabilitation; and
- Competition from weed species and displacement of native flora.

### 3.12.3 Management Measures

- All plant and machinery will be washed down and cleaned of any foreign soil and seed prior to being transported onsite to prevent the potential spread of introduced weeds and pathogens;
- All cleared weed species will be stockpiled separately, and removed off site. Weed material is not to be re-used as part of site rehabilitation;
- Where practical, clearing will commence in areas of low weed infestation, and move towards areas of high weed infestation;
- Weed infestations identified by the supervising ecologist within and adjacent to access tracks and chip hole lease will be eradicated by hand, with non-residual herbicide, or mechanical removal. Appropriate weed removal techniques are outlined in **Table 3.1**.

**Table 3.1 Weed Removal Techniques**

Weed Type	Removal Technique	Method
Woody Weeds	Cut and Paint	<ul style="list-style-type: none"> <li>▪ Make a horizontal cut through the stem close to the ground using secateurs, loppers or a bush saw; and</li> <li>▪ Immediately apply herbicide to the exposed flat stump surface.</li> </ul>
	Stem Injection	<ul style="list-style-type: none"> <li>▪ At the base of the tree drill holes at a 45 degree angle into the sapwood;</li> <li>▪ Fill each hole with herbicide immediately; and</li> <li>▪ Repeat the process at 5 cm intervals around the tree.</li> </ul>
	Frilling or Chipping	<ul style="list-style-type: none"> <li>▪ At the base of the tree make a cut into the sapwood with a chisel or axe;</li> <li>▪ Fill each cut with herbicide immediately; and</li> <li>▪ Repeat the process at 5 cm intervals around the tree.</li> </ul>
Small Plants	Hand removal	<ul style="list-style-type: none"> <li>▪ Remove any seeds or fruits and carefully place into a bag;</li> <li>▪ Grasp stem at ground level, rock plant backwards and forwards to loosen roots and pull out; and</li> <li>▪ Tap the roots to dislodge any soil, replace disturbed soil and pat down.</li> </ul>
Vines and Scramblers	Hand removal	<ul style="list-style-type: none"> <li>▪ Take hold of one runner and pull towards yourself;</li> <li>▪ Check points of resistance where fibrous roots grow from the nodes;</li> </ul>

Weed Type	Removal Technique	Method
		scrape/cut and painted with herbicide; and <ul style="list-style-type: none"> <li>Any reproductive parts need to be bagged.</li> </ul>
	Stem Scraping	<ul style="list-style-type: none"> <li>Scrape 15 to 30 cm of the stem with a knife to reach the layer below the bark/outer layer; and</li> <li>Immediately apply herbicide along the length of the scrape.</li> </ul>
Weeds with Underground Reproductive Structures	Hand removal	<ul style="list-style-type: none"> <li>Remove and bag seeds or fruits;</li> <li>Push a narrow trowel or knife into the ground beside the tap root, carefully loosen the soil and repeat this step around the taproot;</li> <li>Grasp the stem at ground level, rock plant backwards and forwards and gently pull removing the plant; and</li> <li>Tap the roots to dislodge soil, replace disturbed soil and pat down.</li> </ul>
	Crowning	<ul style="list-style-type: none"> <li>Remove and bag stems with seed or fruit;</li> <li>Grasp the leaves or stems together so the base of the plant is visible;</li> <li>Insert the knife or lever at an angle close to the crown;</li> <li>Cut through all the roots around the crown; and</li> <li>Remove and bag the crown.</li> </ul>
	Stem Swiping	<ul style="list-style-type: none"> <li>Remove any seed or fruit and bag; and</li> <li>Using an herbicide applicator, swipe the stems/leaves.</li> </ul>

### 3.13 Disease Control

#### 3.13.1 Overview

Disease control is required due to the potential for particular plant / soil diseases to be spread, particularly *Phytophthora*. *Phytophthora* can be spread via unregulated exposure and movement of soils between areas of construction. Measures will therefore be implemented to avoid such disease facilitation from occurring.

#### 3.13.2 Environmental Issues

The following are key environmental issues in relation to disease control:

- Damage to native vegetation possibly leading to death;
- Loss of biodiversity; and
- Poor regeneration.

#### 3.13.3 Management Measures

- If machinery is transported from an area of confirmed infection to the site, stringent wash down will be completed before leaving the area, removing all soil and vegetative material from cabins, trays, and under carriages;
- Construction personnel will be trained adequately in pest management and hygiene procedures; and
- All machinery to be clean of foreign soil and propagative matter to avoid the importation of *Phytophthora*.

---

### 3.14 Bushfire Prevention

#### 3.14.1 Overview

Bushfire prevention needs to be considered as there is the potential for bushfires to ignite as a result of the construction activities. This can occur as a result of vehicles operating in dry flammable areas, conducting construction activities, and as a result of equipment such as petrol-driven pumps and generators.

#### 3.14.2 Environmental Issues

The following key environmental issues are associated with bushfires:

- Soil erosion and sedimentation;
- Damage to, or loss of, flora and fauna;
- Damage to, or loss of, wildlife habitat;
- Impacts to primary industry production; and
- Damage to, or loss of, third party infrastructure.

#### 3.14.3 Management Measures

The following measures will be implemented throughout the construction phase:

- scheduling construction to avoid high fire danger periods where possible;
- clearing all flammable material from around potential fire ignition sources;
- ensuring flammable materials are cleared from the immediate vicinity of field equipment which may pose a potential fire hazard e.g. petrol driven pumps, generators;
- maintenance and operation of all machinery so as to comply with relevant fire safety standards thus minimising fire risk; and
- machinery and vehicles not in use will be parked in areas free of flammable material and vegetation (e.g. not parked over shrubs, tall grass or cleared vegetation residue).

Fire response preparation measures will be implemented throughout the construction phase, including:

- Storage of appropriate fire fighting equipment in accordance with the requirements of the relevant State Fire Protection Regulations. Equipment will be of the required standard and be inspected and chip hole maintained throughout the construction phase;
- Equipping construction machinery and vehicles with fire fighting equipment at the appropriate times in accordance with the relevant Fire Protection Regulations; and
- Construction workforce bushfire education and training shall be undertaken as appropriate detailing fire prevention and safety, personnel responsibilities and basic fire suppression.

---

## 4.0 Decommissioning

The decommissioning activities are outlined in **Section 1.1**, and includes:

- Plugging and abandonment of the well;
- Removal of equipment and imported materials from the site; and
- Full rehabilitation of the site in line with legislative and landholder requirements.

### 4.1 Equipment Removal

All equipment and imported materials will be removed off site under the following management procedures:

- All site equipment will be removed using existing access tracks to minimise weed spread and further disturbances;
- All fencing and erosion and sediment control devices will be pulled down and taken off site.
- All holes and drains will be backfilled to ground level, stockpiles to be levelled or removed off site; and
- All wastes removed off site and disposed off at the appropriate facility.

### 4.2 Site Rehabilitation

The proposed rehabilitation and revegetation of the well lease site will reinstate native groundcover revegetation. All rehabilitation works will be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation in accordance with the relevant statutory requirements.

Revegetation & rehabilitation will be undertaken within any specified regulatory timeframe. All private tracks used during operations, as well as the access track that requires construction will remain on site, as agreed by the landholder.

#### 4.2.1 Timing and Objectives

Rehabilitation will occur within 6 months of decommissioning. Rehabilitation will ensure the site is restored to pre-operational quality or better, dependent on available soil quality. Rehabilitation will aim to:

- Ensure a stable landform is maintained;
- Re-instate the site to a stable landform that is representative of the pre-clearing vegetation condition and composition, or better;
- and
- Ensure a self-sustaining landform is achieved.

## 4.2.2 Species Schedule

The desired rehabilitation species have been identified in **Table 4.1**. These species are native species representative of the existing community. These species should be added to a hydro mulch mix and sprayed over the well lease area.

**Table 4.1 Native Grassland Species Selection**

Scientific Name	Common Name
<i>Wahlenbergia gracillis</i>	Australian Bluebell
<i>Aristida vagans</i>	Threeawn Speargrass
<i>Austrostipa aristiglumis</i>	Plains Grass
<i>Bothriochloa decipiens</i>	Pitted Blue-grass
<i>Chloris divaricata</i>	Slender Chloris
<i>Sporobolus creber</i>	Slender Rat's Tail Grass

## 4.2.3 Rehabilitation Performance Criteria, Monitoring and Actions

To determine the success of rehabilitation efforts a number of performance criteria for the site have been developed in **Table 4.2**. This table also identifies rehabilitation actions to be implemented and monitoring requirements to evaluate rehabilitation success. Monitoring will be undertaken by a suitably qualified person (e.g. restoration ecologist).

**Table 4.2 Rehabilitation Management Schedule – Chip hole Lease**

Rehabilitation Management Schedule		
<b>Performance Criteria</b>	Rehabilitation is considered finalised when the performance criteria outlined below are met. Where these criteria have not been met by the end of the assessable period, further monitoring and maintenance will be required until success is achieved.	
	<b>Performance Criteria</b>	<b>Success Verification</b>
		<b>60 days since rehabilitation</b>
		<b>1 Year since rehabilitation</b>
	1. Evidence of ground cover (ground cover includes mulch, plants and habitat features)	≥70% ground cover
2. Correct species used	Evidence of native species generation	Presence of 3 or more native species listed in <b>Table 4.1</b>
3. Minimal presence of declared pest plants	≤30% declared weed cover	≤10% declared weed cover
4. Minimal signs of subsidence or erosion	Landform reshaped and topsoil respread. Seeding completed. Erosion and sediment control	Minimal evidence of erosion. Stable and self-sufficient landform.

Rehabilitation Management Schedule		
		measures in place.
<b>Timing</b>	<b>Rehabilitation Actions</b>	<b>Responsibility</b>
Upon Decommissioning	<ul style="list-style-type: none"> <li>▪ Erosion and sediment control measures are implemented to reduce runoff and disturbances prior to rehabilitation; and</li> <li>▪ Control weeds present on site.</li> </ul>	Santos
Within 6 months of decommissioning	<ul style="list-style-type: none"> <li>▪ Control weeds present on site;</li> <li>▪ Respread topsoil;</li> <li>▪ Spray and maintain hydromulch as per revegetation contractors requirements; and</li> <li>▪ Ensure erosion and sediment control measures are implemented as required.</li> </ul>	Santos
<b>Timing</b>	<b>Monitoring Tasks</b>	<b>Responsibility</b>
60 days since rehabilitation	<ul style="list-style-type: none"> <li>▪ Survey undertaken by ecologist to verify 60 day performance criteria. Surveys to document rehabilitation success with site data and photo monitoring; and</li> <li>▪ Review rehabilitation success and investigate areas that have been unsuccessful.</li> </ul>	Santos & Ecologist
1 year since rehabilitation	<ul style="list-style-type: none"> <li>▪ Survey undertaken by ecologist to verify 1 year performance criteria. Surveys to document rehabilitation success with site data and photo monitoring; and</li> <li>▪ Review rehabilitation success and investigate areas that have been unsuccessful.</li> </ul>	Santos & Ecologist
	<b>Maintenance Tasks / Corrective Procedures</b>	<b>Responsibility</b>
Following each monitoring event	<ul style="list-style-type: none"> <li>▪ Reinstate erosion &amp; sediment controls as required (e.g. jute matting, mulch, sediment fencing in areas suffering erosion);</li> <li>▪ Treat declared weed species and manage spread of other weeds; and</li> <li>▪ Review rehabilitation success and investigate areas that have been unsuccessful.</li> </ul>	Santos
<b>Timing</b>	<b>Reporting</b>	<b>Responsibility</b>
Following each monitoring event or as required by site approval.	<ul style="list-style-type: none"> <li>▪ Report identifying results of monitoring events with assessment against each performance criteria.</li> </ul>	Santos & Ecologist

---

## 5.0 Reporting

A report will be prepared following decommissioning of the facility, including all records of the EMP implementation, as well as a summary of incidents and mitigation measures. The final report is to include an assessment of compliance with statutory authorities, success in achieving objectives, and any environmental outcomes. The report is to be completed within 6 months of decommissioning, and kept by Santos QNT Pty Ltd.

Ongoing rehabilitation will be undertaken after report completion, as per **Section 4.2**. Records of rehabilitation monitoring will be kept on file by Santos QNT Pty Ltd.