

# Santos

## Review of Environmental Factors Collygra 1 Chip Hole - PEL 1 Gunnedah Basin

Prepared by:  
Santos QNT Pty Ltd  
ABN: 33083077196  
Issue date: 14/12/2010

## Executive Summary

### Background

Santos QNT Pty Ltd (Santos) has entered into a Farmin Agreement with the titleholder of PEL 1, Australian Coalbed Methane Pty Ltd to explore for petroleum (in accordance with the *Petroleum (Onshore) Act 1991*). Santos has been appointed the Operator for and on behalf of the titleholder under the Farmin Agreement.

Condition 1.0 of the PEL 1 licence states that prior to carrying out any drilling activities a Review of Environmental Factors (REF) is required to be submitted to the Department of Industry and Investment (DII) to enable a determination to be made under Part 5 of the *Environmental Planning and Assessment Act 1979*.

### The Proposal

Santos proposes to drill and complete the Collygra 1 well as a chip hole to obtain information on coal seam depths, seam thickness, continuity and permeability to assess the coal seam gas potential of the Gunnedah Basin in PEL 1.

The chip hole known as Collygra 1 will be located on privately owned land presently used for agricultural activities. The exact location of the well on the property (within 100 metres of the proposed location) will be determined following further refinement consultation with the landowner.

The objectives of Collygra 1 are to integrate depth, coal distribution, coal quality and coal deliverability results into existing regional data. The well will specifically target data gathering through coal seams in the 300 – 1000 metre depth range where current data volume is low. Maturation of the Hoskisson and/or Maules Creek prospective Coal Seam Gas (CSG) resources to higher confidence level to allow an associated volume of contingent resources to be assigned to coal resources in PEL 1 is a key well objective.

The activities involved with drilling the well will be:

- Construction/Upgrade of access roads to the proposed drill location so as to allow passage of the Lucas Drilling Rig and associated vehicles.
- Preparation of a lease location to accommodate the Drilling Rig and associated mobile offices (area of approximately 80 x 60 metres).
- Placing a temporary mobile office on the site.
- Constructing lined drilling sumps.
- Drilling of the well using Lucas Group Drilling Rig.
- Selective removal and analysis of rock cutting samples as retrieved during the drilling process at a sample interval to be identified by Santos personnel.

- Selectively conduct well testing (most likely conventional Drill Stem Tests).
- Plug and Abandon the well with Vibrating Wire Piezometers (VWP) pressure grouted in place at selected horizons for the purpose of monitoring future potential pore pressure changes in the aquifer and/or coal seam formations present. The well will be abandoned to all fluid flow.
- Installation of data logging equipment at surface for the purpose of recording of VWP data.
- The rehabilitation of the lease site in accordance with the landholders request. .

The drilling and completion of the four pilot wells is expected to occur over a 60 day period per well not including lease build, operations or site restoration. Lease construction activities of 42 days will be additional to this period and may not occur concurrently to the drilling and completion activities.

Where possible the use of an existing road network will be preferred. Any new access tracks required are intended to run parallel to existing fence lines. New gates or grids are to be installed in existing fence lines to facilitate safe, unimpeded vehicle access. The access track will be constructed by using imported gravel from an existing quarry.

### **Potential Environmental Impacts**

The shire councils of Narrabri, Gunnedah and Liverpool Plains regulate the Local Environmental Plans (LEP) applicable to PEL 1. The proposed Collygra 1 site is located in the Gunnedah Shire Council (GSC). The site is zoned Zone no. 1(a) Rural (Agricultural Protection) under Gunnedah LEP 1998.

Environmental aspects considered by Santos for the proposed location included potential impacts of noise, light and dust to the nearest sensitive receptor (i.e. greater than 1000m), proximity to a watercourse (i.e. greater than 40m), proximity to registered archaeological, flora or fauna sites and the potential for sediment and erosion from the proposed site (i.e. slope greater than 10 degrees).

The proposed site is located on flat land that has been previously cleared for rural activities. The nearest resident is located more than 1km to the south east of the site and no watercourse is within 40 metres.

Santos has contacted the affected landowner and negotiated agreements regarding land access, compensation and rehabilitation with the landholder of the land on which the site is to be drilled, together with the next nearest landholder. Regular contact with all landholders is to be maintained during the drilling and completion activities at the site.

The proposed site will avoid any threatened species and critical habitat.

The proposed activities have associated potential environmental impacts, which are common to drilling activities carried out elsewhere in the Gunnedah Basin. It is considered that the potential impacts can be successfully mitigated with the application of the management measures outlined in this document. The measures utilised by Santos and its contractors are consistent with the APPEA Code of Environmental Practice and are typical of good hydrocarbon field practice.

Section 5A of the *Environmental Planning and Assessment Act 1979* lists seven factors to be considered in relation to potential impacts on threatened species, populations or ecological communities, commonly referred to as the seven part test of significance. An assessment was made against the seven factors as provided in Section 2.2 and concluded that:

- There are no known threatened species that would be impacted by the planned activities. The size and nature of the proposal is unlikely to affect the life cycle of any viable populations of threatened flora/fauna if present.
- There are no known endangered populations that have been identified that would be impacted by this proposal. The size and nature of the proposal is unlikely to affect the life cycle of any viable populations of endangered populations if present at the site.
- There are no known endangered ecological communities or critically endangered communities that have been identified that would be impacted by this proposal.

Santos plans to avoid vegetation clearing at the site therefore the planned activities will not constitute a threatening process.

The potential environmental impacts have been assessed. It is considered that the likely potential environmental impacts with mitigation measures in place are negligible, and therefore the activities are not likely to have a significant impact on the environment. In particular, it is expected that:

- Impacts on landholders will be negligible;
- Impacts to air quality will be negligible, localised and insignificant;
- Adverse effects on water resources will be negligible;
- Off-site impacts to soils will be avoided and on-site impacts will be negligible and temporary;
- Noise impacts will be short term, and no threatened species or communities are likely to be significantly impacted;
- There will be no significant use of, or impact to, natural resources including groundwater;
- Impacts on the community and visual amenity will be negligible and short term, particularly as the site is in a sparsely populated area;
- Impacts to heritage places or sites will be avoided;

- Disturbances to pastoral and cropping land use will be negligible and short term and managed in consultation with affected landholder(s); and
- There will be no significant cumulative environmental impacts.

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## 1 Introduction

### 1.1 Background

Santos has now drilled a number of exploration core holes within Petroleum Exploration Licence (PEL 1) to assess the extent of gas bearing coal the region. This Review of Environmental Factors (REF) has been prepared for the drilling of one new chip hole in the Gunnedah Basin, being explored under the conditions of PEL 1 located in New South Wales (NSW).

Santos proposes to drill the Collygra 1 chip hole site located on a privately owned rural property that is presently used for agricultural activities with no native vegetation on or in the vicinity of the site that would need to be cleared. Existing access tracks will be upgraded for the site. This access track will have drains cut at regular intervals to reduce the risk of gullying and soil erosion. Vehicular activity will be minimised when the ground is soft after rain.

The licence for PEL 1 permits exploration for petroleum, including coal seam gas, by methods including drilling and completing of wells.

Condition 1.0 of the PEL 1 licence instrument states that, prior to carrying out any drilling activities, a REF is required to be submitted to the Department of Primary Industries-Mineral Resources (DPI-MR) section of the Department of Industry & Investment (DII) to enable a determination to be made under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The purpose of this REF is to assess the environmental impacts of the proposal to the fullest extent possible under section 111 of the EP&A Act and clause 228 of the *Environmental Planning and Assessment Regulation*.

## 1.2 Proponent Contact Information

The correspondence address for Santos is:

Operator: Santos QNT Pty Ltd (ABN 33 083 077 196) for and on behalf of the Titleholder Australian Coalbed Methane Pty Ltd

Address: Level 22, Santos Place, 32 Turbot Street, Brisbane, Qld, 4000

Telephone: 07 3838 3676

Email: [reception.brisbane@Santos.com](mailto:reception.brisbane@Santos.com)

Contact Person: Mr Jorge Pinedo, Team Leader Project Execution

## 1.3 Structure

This REF consists of:

Section 1: Introduction and contact details

Section 2: Summary of relevant regulations applicable to the activity;

Section 3: Proposed activities including location and timing;

Section 4: Description of the local environment including its physical, natural and socio-economic overview;

Section 5: Outline of the potential environmental impacts and mitigation measures; and

Section 6: Concluding comments on the likely impacts.

## 2 Legislation & Planning Framework

### 2.1 Planning Framework

#### 2.1.1 Overview

The *Environmental Planning & Assessment Act 1979* (EP&A Act) is the primary legislation regulating land use planning in NSW. It provides the framework for the development of state and local planning instruments that through their hierarchy determine the statutory process for environmental impact assessment. Under the EP&A Act there are three distinctive processes, which are:

- Part 3A, regulates specific types of 'projects' and requires an Environmental Assessment report to be prepared and submitted to the Department of Planning for the Planning Minister's approval;
- Part 4, regulates 'development' and requires a development application accompanied by a Statement of Environmental Effects to be submitted to council for development approval; and
- Part 5, regulates 'activities' and requires a Review of Environmental Factors for consideration by the determining authority.

The proposal satisfies the definition of an activity under Part 5 of the EP&A Act because the proposal:

- may be carried out without development consent;
- is not an exempt development; and
- requires the approval of a determining authority.

A determining authority, for the purposes of this activity, is defined in Part 5 of the EP&A Act to include, but is not limited to a public authority whose approval is required before an activity may be carried out. In relation to petroleum exploration licences the DII is the determining authority for approving exploration activities covered by this REF. In order to enable the determining authority to comply with its obligations under Part 5 of the EP&A Act, Santos has considered s.111 of the EP&A Act and Clause 228 of the *Environmental Planning Regulation* (See Section 5.11) in preparing this REF.

#### 2.1.2 Environmental planning instruments

The Environmental Planning Instruments (EPIs) regulate the permissibility to undertake an activity and the type of assessment process that is required. EPI is the generic term used to describe state environmental planning policies, regional environmental plans and local environmental plans.

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (SEPP 2007) recognises the importance to New South Wales of mining, petroleum production and extractive industries. SEPP 2007 seeks to facilitate the orderly and economic use of land containing mineral, petroleum and extractive material resources, whilst encouraging ecologically sustainable development.

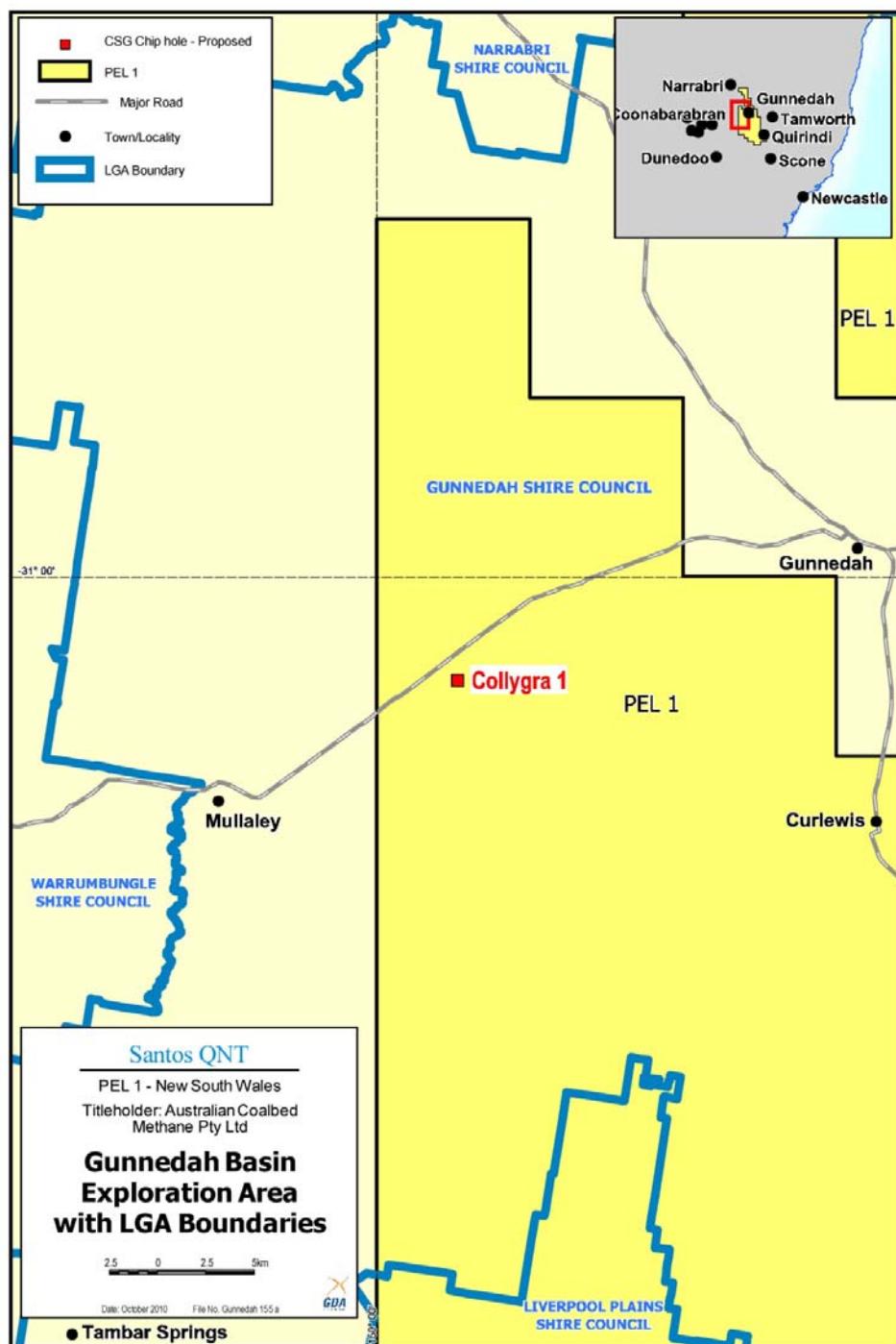
Subject to certain exemptions, SEPP 2007 allows development for the purposes of petroleum exploration to be carried out without development consent under Part 4 of the EP&A Act. The definition of petroleum under SEPP 2007 includes any naturally occurring hydrocarbon, whether in gaseous, liquid or solid state. SEPP 2007 has the effect that the proposed four wells may be carried out without development consent but will be subject to the assessment process under Part 5 of the EP&A Act.

### 2.1.3 Local environmental plans

The shire councils of Narrabri, Gunnedah and Liverpool Plains regulate the Local Environmental Plans (LEP) applicable to PEL 1. Figure 2.1 shows the location of the various LGAs and the proposed site.

The proposed Collygra 1 site is located in the Gunnedah Shire Council (GSC). The site is zoned Zone no. 1(a) Rural (Agricultural Protection) under Gunnedah LEP 1998. However, SEPP 2007 has the effect of making development of the purposes of petroleum exploration permissible without development consent but subject to Part 5 of the EP&A Act.

Figure 2-1: Local Government Areas Covering PEL 1



## 2.2 Legislative Requirements, Petroleum Licenses and Approvals Required

### **Petroleum (Onshore) Act 1991 (NSW)**

Santos has entered a Farmin Agreement with the holder of PEL 1 Australian Coalbed Methane (ACM) that grants the right to Santos as Operator to explore for petroleum (Section 7, *Petroleum (Onshore) Act 1991*) subject to meeting landholder and legislative requirements.

Prior to any exploration on private land, an access agreement and compensation arrangements must be agreed between the titleholder (or its agent) and the landowner (Petroleum (Onshore) Act 1991, Section 69). The legislation specifies those issues that must be covered by an access arrangement, which include:

- periods during which access may be permitted;
- parts of the land on which exploration may be undertaken;
- conditions to be observed during exploration, and
- compensation to be paid to the landholder.

In preparing this REF the necessary considerations found at the DII website at <http://www.dpi.nsw.gov.au/minerals/titles/landholders-rights> have been considered.

Whilst it is the Santos' intention to negotiate an acceptable agreement with any affected landowner, the above legislation also details the mechanisms by which an access and compensation agreement can be sought if a voluntary agreement cannot be obtained.

### **Environmental Planning and Assessment Act 1979 (NSW)**

Santos, on behalf of the titleholder, must also obtain an approval from the DII prior to carrying out drilling activities. Before granting the approval, the DII is required to comply with Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The DII is required to consider the environmental impact of the activity to the fullest extent possible. The purpose of this REF is to provide an environmental assessment of the proposed activity to enable DII to consider the environmental impact of the activity under Part 5 of the EP&A Act.

Under Section 5A of the EP&A Act, the DII is also required to consider whether the activity is likely to have a significant effect on threatened species, populations or ecological communities, or their habitats. Section 5A lists seven factors to be considered, commonly referred to the 'seven part' test of significance. These are as follows:

- 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; and
- 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

### **Protection of the Environment Operations Act 1997 (NSW)**

Under the *Protection of the Environment Operations Act 1997*, it is an offence to pollute waters. There are also broad offences of wilfully or negligently causing a substance to escape that causes or is likely to cause environmental harm without lawful authority.

Pollution incidents causing or threatening material harm must be notified to the Environment Protection Authority. Under Section 147 material harm means:

- harm to the environment is material if:

- a) it involves actual or potential harm to the health or safety of human beings or to ecosystems that is not trivial; or
- b) it results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding \$10,000 (or such other amount as is prescribed by the regulations), and loss includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment.

### **National Parks and Wildlife Act 1974 (NSW)**

The *National Parks and Wildlife Act 1974* (NPW Act), protects Aboriginal objects and places (under Part 6). The consent of the Director-General is required under section 90 of the NPW Act if the proposed activity will destroy, deface or damage an Aboriginal object.

The NPW Act with the Threatened Species Conservation Act 1997 (NSW) also protects threatened species, populations and ecological communities, their habitats and critical habitats (Part 8A).

### **Environment Protection and Biodiversity Conservation Act 1999 (Cth)**

The *Environment Protection and Biodiversity Conservation Act 1999* (Cth) protects matters of national significance. As outlined in Section 4.5.1 Santos does not consider that this proposal will trigger this Act, and does not propose to lodge a referral to the Commonwealth Sustainability, Environment, Water, Population and Communities (DSEWPC).

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

Under the regulations of the *Water Management Act 2000* there is an exemption (clause 18 (e) of the *Water Management (General) Regulation 2004* (NSW)) for the need of an access licence for persons lawfully engaged in prospecting or fossicking for minerals or petroleum under the *Mining Act 1992* or the *Petroleum (Onshore) Act 1991*, in relation to water required for that purpose.

The relevant Acts are summarised in Table 2.1.

Table 2-1: PEL 1 Licence Conditions and Applicable Legislation

Legislation	Requirements of Schedule 2 Licence Conditions	Administering Authority
<i>Petroleum (Onshore) Act 1991</i>	<p>The activities do not cause other than minimal/nil impact on features listed in Section 75 (i.e. of Aboriginal, Architectural, archaeological, historical or geological interest). Where these are present, an exploration protocol acceptable to the Department must be completed prior to exploration commencing to ensure that exploration activities will not have an adverse impact on these features.</p> <p>Full rehabilitation in accordance with Department guidelines/standards is carried out after completion of the exploration activities.</p>	Department of Industry & Investment – Mineral Resources
<i>Environmental Planning and Assessment Act 1979</i>	Assess the impact of the activity on the environment under Part 5 of the <i>Environmental Planning and Assessment Act 1979</i> (EP&A Act) from the DPI-MR prior to carrying out drilling activities.	Department of Primary Industry – Mineral Resources
<i>Threatened Species Conservation Act 1995</i>	The Licence holder is required to consult the register of Critical Habitat kept by the Director-General, and consider the significance of any notations in respect of the area of any proposed exploration activity	Department of Environment, Climate Change and Water
<i>Fisheries Management Act 1994</i>	Consult the register of critical habitat kept under this Act.	Department of Primary Industries – Fisheries
<i>National Parks and Wildlife Act 1974</i>	The activities do not contravene Part 6 (Aboriginal objects and Aboriginal places) of this Act.	National Parks and Wildlife Service
<i>Native Vegetation Conservation Act 1997 (now 2003)</i>	The licence holder must not cut, destroy, ringbark or remove any timber or other vegetative cover on any land subject of the licence except such as directly obstructs or prevents the carrying on of operations. Any clearing not authorised under the <i>Petroleum (Onshore) Act 1991</i> , must comply with the provisions of this Act.	Department of Environment, Climate Change and Water
<i>Rural Fires Act 1997</i>	Santos must take all precautions against causing an outbreak of fire and must comply with the provisions and regulations of the Act and must not burn off any grass, foliage or herbage without the current consent of the owner or occupier and the local fire authority.	NSW Rural Fires Service
<i>Water Act 1912</i>	Santos must take all precautions against intersecting an aquifer and will obtain Water Bore Licenses.	New South Wales Office of Water
<i>Local Environmental Plans</i>	Santos must consult the local Shire to seek approval for the siting of temporary accommodation	Gunnedah Shire Council

## 2.3 Zoning

The proposed Collygra 1 site is located in the GSC. Further details are presented in Table 3-1 and Figure 3.1.

The proposed site falls within the Gunnedah LEP Zone No. 1(a) Rural (Agricultural Protection). As noted in Section 2.1.3, the application of SEPP 2007 overrides the need to consider zoning controls, to determine permissibility of the activities covered by SEPP 2007 are permissible without consent.

## 2.4 Stakeholder Consultation

In April 2008, Santos commenced community consultation for the proposed coal seam gas (CSG) exploration program in the Gunnedah Basin. Stakeholder consultation is guided by Santos' community policy which states that 'We work to be a valued member of the communities of which we are a part'. For this reason, Santos is committed to ongoing consultation activities with key stakeholders prior to work starting and for the duration of our presence in the region.

Key stakeholder groups include:

- Landholders
- Business
- All levels of government
- 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 the differences between petroleum exploration legislation and mining legislation in NSW
- Identify issues that generate community interest and concern in the Gunnedah Basin

We recognise that many stakeholders have an interest in more than one PEL (for example Local, State and Federal government and their elected representatives and industry representative associations such as NSW Farmers' Association, Chambers of Commerce and Local Aboriginal Land Councils) and for that reason make available information about our activities across the entire exploration area using the following consultation methods:

1. Community consultation sessions and presentations are held early and late each year in areas that are close to upcoming work. Community consultation sessions are attended by subject specialists

(geologists, drilling engineers, hydrologists and hydrogeologists, government relations and stakeholder management).

2. AgQuip (every August) - Santos displays equipment and has up to eight subject specialists in attendance to answer questions from the public.
3. 1800 number - attended during business hours, all calls returned within 48 business hours.
4. Public email address – emails returned within 48 business hours.
5. Briefing of key Local, State and Federal government staff and elected representatives.
6. 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.
7. 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 (see <http://www.santos.com/exploration-acreage/gunnedah-basin-gas/fact-sheets-msds.aspx> )
8. Newsletter (4 times per year, direct mailed to a database of over 5 000 stakeholders)
9. Field trips to drill and seismic survey work sites (on request, year round).
10. Presentations to community groups (on request, year round).
11. Gunnedah regional office – 88 Marquis Street, Gunnedah.
12. Notification of neighbours (those sharing boundaries with properties on which Santos is working) prior to commencement of activities.

Neighbours within a 2km radius of the chip hole drilled by Santos are notified of work in advance by letter (with a full set of factsheets attached):

- Neighbours who own registered bores are advised that Santos will perform baseline testing on their bore at no cost to them. If they wish to proceed, they may sign the access permission form and return to Santos.
- Neighbours who do not own bores are advised that a neighbour has agreed to work with Santos.

## 3 Project Description

### 3.1 Location and Tenure

#### 3.1.1 Location

The aim of the project described below in Section 3.2 is to explore the Gunnedah Basin by drilling the Collygra 1 chip hole. Table 3.1 shows the co-ordinates of the proposed site and closest regional town and watercourse. Figure 3.1 shows the location of the site within PEL 1. The well is expected to be up to 1000 metres deep.

Table 3-1: Co-ordinates for the proposed chip hole site (GDA94)

Name	Longitude	Latitude	LGA	Nearest Town	Closest Watercourse
Collygra 1	150° 02' 37.48"	-31° 02' 53.49"	Gunnedah	Gunnedah, ~20km east	Collygra Creek, ~2km east

The site proposed in this REF is located on freehold land that is flat and has been previously disturbed by historic operating farm practices.

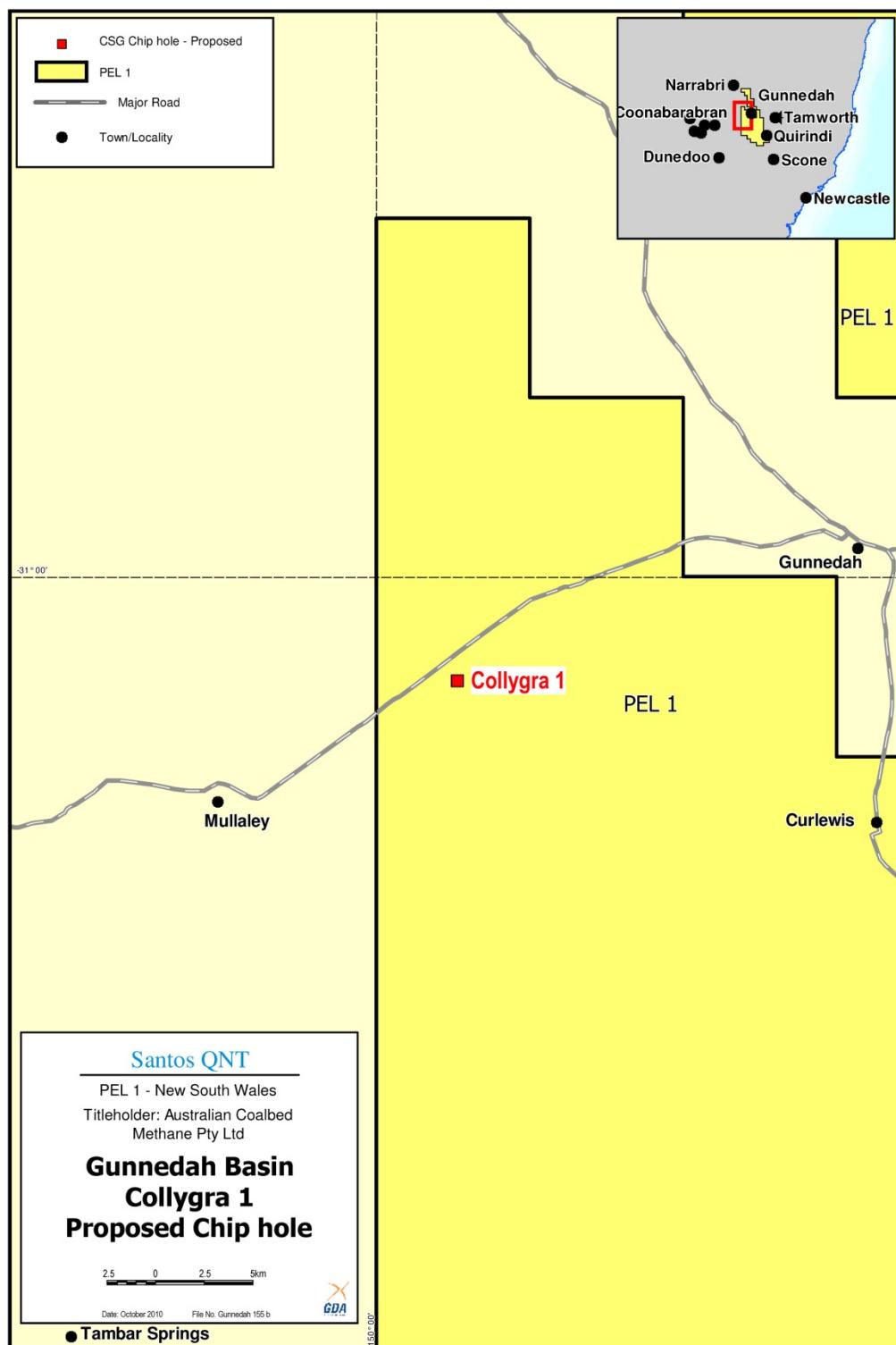
The proposed site is not located in:

- An area reserved or dedicated under the *National Parks and Wildlife Act 1974*;
- Land reserved or dedicated within the meaning of the *Crown Lands Act 1989* for preservation of other environmental protection purposes;
- A World Heritage Area;
- Environmental Protection Zones in environmental planning instruments;
- Lands protected under SEPP 14 – Coastal Wetlands;
- Lands protected under SEPP 26 – Littoral Rainforests;
- Land identified as wilderness under the *Wilderness Act 1987* or declared as wilderness under the *National Parks and Wildlife Act 1974*;
- Aquatic reserves dedicated under the *Fisheries Management Act 1994*;
- Wetland areas dedicated under the Ramsar Wetlands Convention;
- Land subject to a conservation agreement under the *National Parks and Wildlife Act 1974*;
- Western Lands Lease;
- Land identified as State Forest under the *Forestry Act 1916*; or
- Land identified as held in Estate as a Perpetual Lease.

The environmental information in this document is based upon NSW database searches for flora and fauna covering the Gunnedah LGA within

which the proposed site will be drilled. The Commonwealth EPBC Protected Matters database searches were conducted on a group basis with a number of other proposed projects based on a 20 km radius around the proposed Collygra 1.

Figure 3-1: Proposed Site Location



## 3.2 Planned Activities

To assess the coal seam gas potential of the Gunnedah Basin in PEL 1 it is proposed to drill the Collygra 1 chip hole to obtain information on coal depths, seam thickness continuity and permeability.

Santos proposes to undertake drilling activities for coal seam gas in accordance with the activities described below.

Santos has contacted and 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 such that impacts are minimal on the property operations.

The proposed route will avoid remnant trees and shrubs and steep slopes. Drains will be cut at regular intervals along the access track to reduce the risk of gullying and soil erosion if required. Vehicular activity will be minimised when the ground is soft after rain.

During site preparation earthworks, there will be some soil disturbance as a level drill pad will need to be constructed. The area to be disturbed for drilling activity will be approximately 80 by 60 metres (plus access tracks). Associated lined drilling sumps and a flare pit will be constructed on site. The major equipment used on site will be a drilling rig and associated temporary buildings.

### **Collygra 1**

Summary: Appraisal chip hole currently scheduled to spud early April 2011 on Lucas Rig 13. Primary target is Early Permian Maules Creek Formation, secondary targets are Hoskissons coal.

Program: Chip to base Maules Creek. Undertake DSTs over Maules Creek and Hoskissons and where warranted. Undertake lab analysis of coal samples. Undertake wireline logs as required.

Key objectives: Integrate depth, coal distribution, coal quality and coal deliverability results into regional understanding/model. Mature Maules Creek prospective resource to a contingent resource booking.

The well design will ensure compliance with the relevant legislation. An open hole of nominal 305mm diameter will be drilled through any alluvial and/or weathered material into competent rock and casing of nominal diameter 254mm will be cemented in place, which will have a blow out preventer installed on top of it. A nominal 216mm diameter hole will then be drilled using open hole rotary drilling to a depth above the primary target coal seams.

A 178mm intermediate casing will be installed at this depth prior to continuing drilling. An open hole of nominal 155 mm diameter will then be drilled to a depth below the target coal seams.

Once the well has reached its prognosed 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. DST evaluation may occur after completion of logging or on penetration of target formations. It is planned to abandon Collygra 1 with a permanent pressure monitoring string cemented in-place in the hole. It is planned that this well will function as a permanent pressure monitoring data gathering well gathering data on pore pressure in key formations of interest. The permanent completion is proposed to consist of a number of vibrating wire piezometer gauges attached to a 2-7/8" steel tubing. An exemption to abandon this steel tubing in the well across coal seams is being sought separately. Intermediate casing may be cut and removed.

The number of employees present at each site is expected to be up to 20 persons. The hours of operation during the drilling will be on a 12-hour a day basis, negotiated with the landowner.

Drilling activities are temporary and will not have any long-term impact on the visual amenity of the area. The drilling and completion of the chip hole is expected to occur over a 60 day period per well not including lease build, well completion operations or site restoration. Lease construction activities of 14 days per well will be additional to this period and may not occur concurrently to the drilling and completion activities.

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 MSDS information for all of said chemicals can be found in Appendix F: Drilling Chemicals MSDS Information.

### 3.3 Completion / Abandonment Activities

If at the time of completing the activities under this REF Santos choose not to continue, the wellbore will be plugged and abandoned and all land disturbances will be rehabilitated back to their pre-existing land use.

The chip hole will not be used for temporary monitoring purposes (e.g. standing water levels), therefore it will be abandoned and the site area rehabilitated in line with legislative, landowner and licence requirements. Cement will be set to fill the core hole from total depth to the surface. It is planned to abandon Collygra 1 with a permanent pressure monitoring string cemented in-place in the hole. The associated lease equipment

related to this monitoring purpose will be limited to a solar powered data logger and telemetry system as well as appropriate fencing around the equipment and casing stub. The cellar will be back filled. The area will then be rehabilitated in consultation with the landowner. The site will be monitored during this rehabilitation period.

### 3.4 Justification of the Activity

Drilling of the chip hole 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 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 exploration program consists of drilling a well, geologically logging, collecting cores, conducting drill stem tests, and wireline geophysical logging. These procedures are required to define and identify commercially valuable reserves of coal seam gas. Santos is committed to undertake this work as part of its obligations under the NSW petroleum legislation and its obligations contained in the Farm-in Agreement entered into with Australian Coalbed Methane Pty Ltd.

### 3.5 Evaluation of Alternatives

There is no reasonable industry alternative to the drilling method proposed in Section 3.2 if commercially useful amounts of coal seam gas are to be located and assessed. There is limited previous drilling in this area of the Gunnedah Basin that is sufficiently deep for the purposes of petroleum exploration. 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.

## 4 Regional Description

Unless otherwise stated the major source reference for this section is the Bioregions of New South Wales: their biodiversity, conservation and history in particular the Brigalow Belt South Bioregion (NSW National Parks and Wildlife Service, 2003).

Figure 4.1 shows the location of the proposed chip hole site in relation to NSW, and the township of Gunnedah. Figure 4.2 shows the proposed chip hole location; access as well as the closest residence.

Figure 4-1: Regional Map

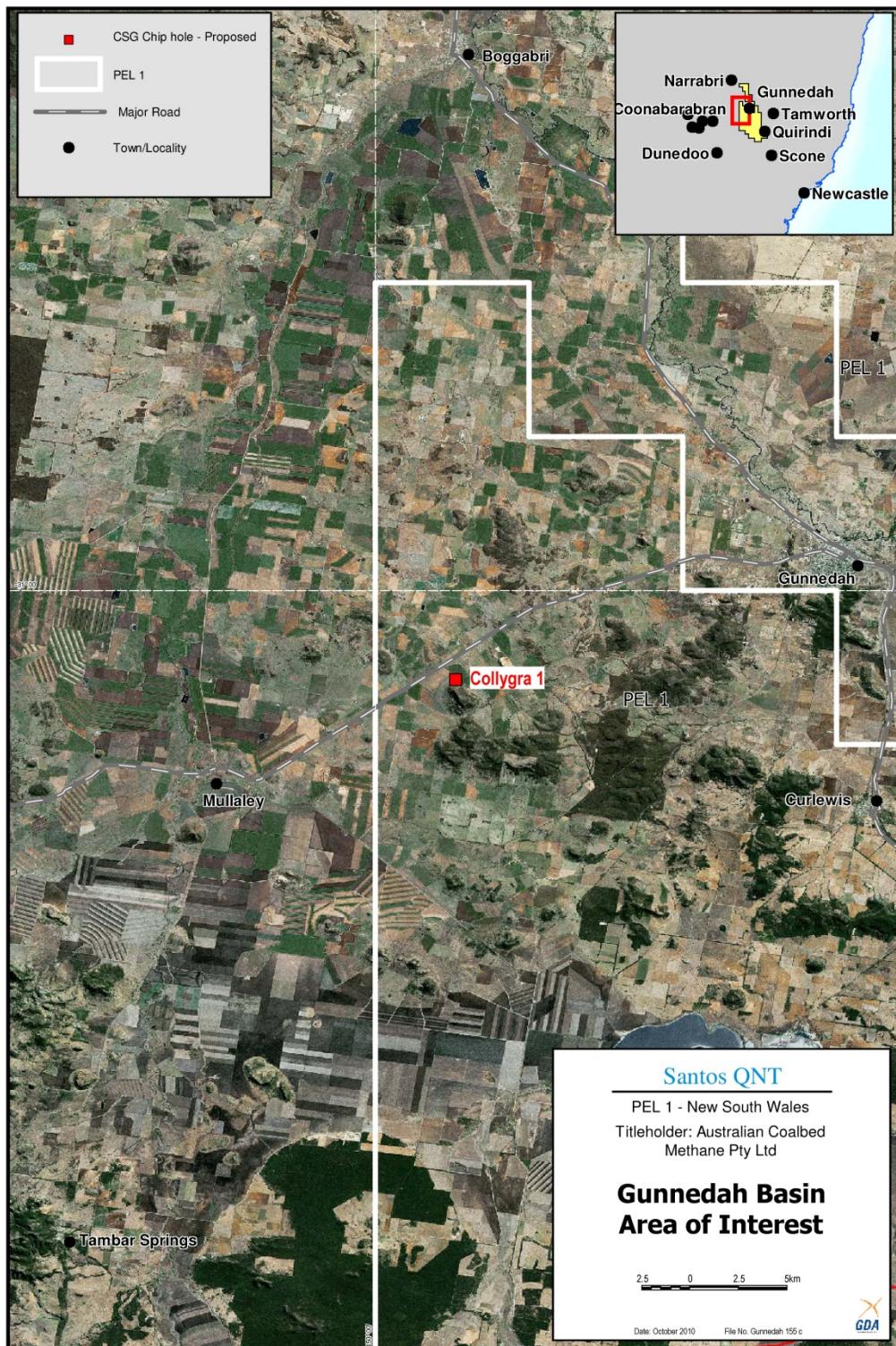
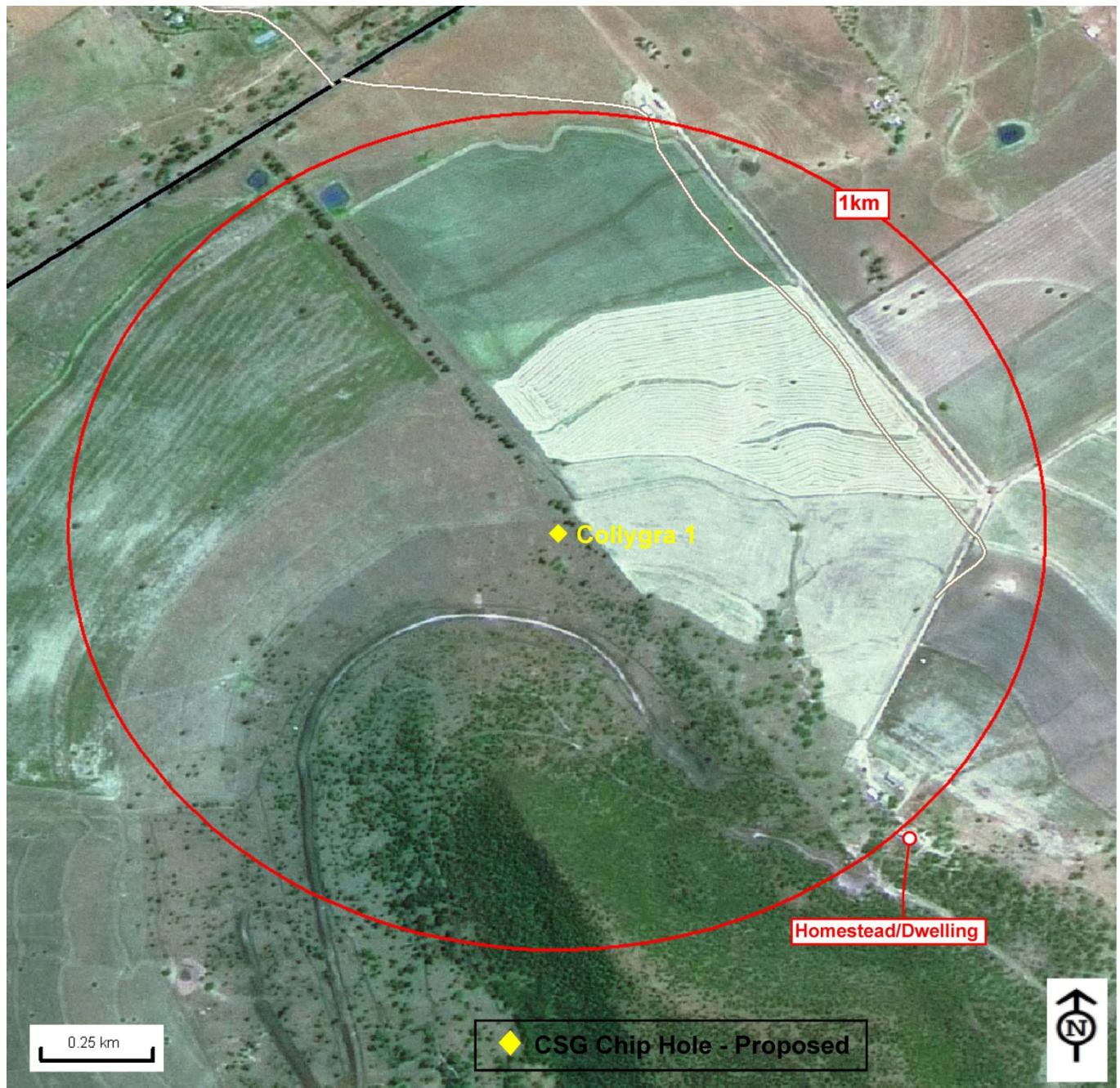


Figure 4-2: Aerial Photograph Showing Collygra 1



## 4.1 Bioregion

PEL 1 falls within the Brigalow Belt South Bioregion that extends from south of Dubbo in central-western NSW to mid-Queensland coast, of which about 20% is located in NSW. The towns of Baradine, Binnaway, Coonabarabran, Dubbo, Gunnedah, Merriwa, Moree and Narrabri occur within this bioregion. The nearest town to the proposed site is Gunnedah.

## 4.2 Climate

The bioregion is located with the eastern subhumid region of NSW. A subhumid climate, with no dry season and a hot summer, characterise the south-eastern section of the bioregion, while a generally dry subtropical climate dominates to the northwest. Minor patches to the southeast of the bioregion fall within the temperate zone with no dry season and a warm summer.

Situated between the tropical and temperate climatic zones, the Gunnedah region experiences very warm to hot summers and cool to mild winters. The town of Gunnedah, which is representative of the area, has average maximum temperatures varying from 34 degrees Celsius in January to 16.9 degrees Celsius in July, while average minima range from 18.3 degrees Celsius in January and to 3 degrees Celsius in July (BOM, 2010).

Rainfall in Gunnedah is higher in the summer months with an average annual rainfall of 618 millimetres (BOM, 2010).

## 4.3 Community – Social and Economic

### 4.3.1 Local Government Area

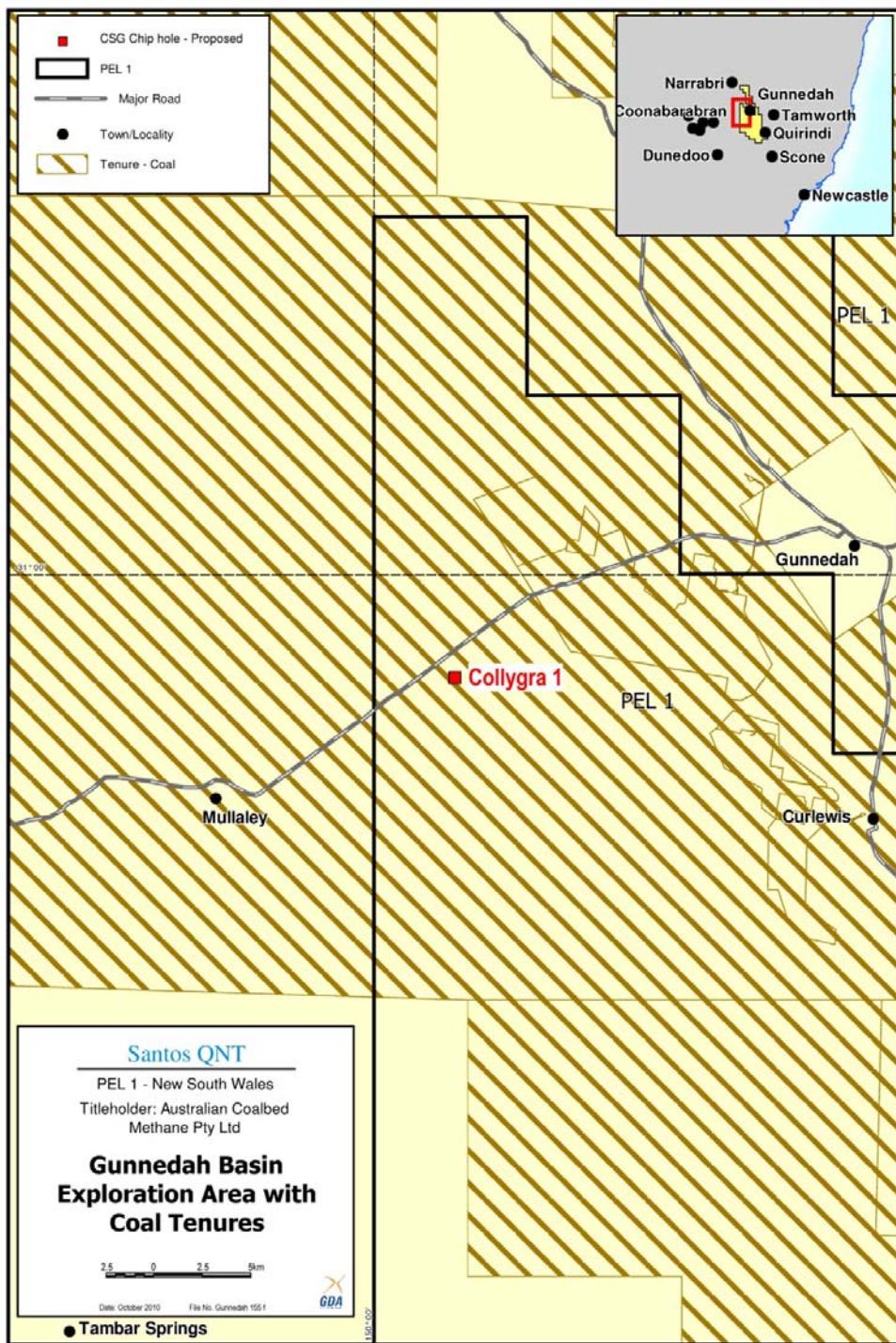
PEL 1, overlays three LGAs Narrabri, Gunnedah and Liverpool Plains. The planned activities are located within the Gunnedah LGA administered by the Gunnedah Shire Council.

### 4.3.2 Landuse

The Gunnedah and Liverpool Plains regions have 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.

Sheep, beef cattle and grain farming are major rural land uses. Coal mines are located in PEL 1, however these are not within the vicinity of the proposed site. PEL 1 in relation to the mining leases is shown in Figure 4-3.

Figure 4-3: PEL 1 and Mining Tenures



## 4.4 Cultural Heritage

### 4.4.1 Aboriginal Heritage

The Local Aboriginal Land Council for the area of interest is Red Chief Local Aboriginal Land Council based in the township of Gunnedah. A search of the NSW DECCW Aboriginal Heritage Information Management System (AHIMS) was made in 2008 (DECCW, 2008). Details of the results are not to be made available to the public. None of the sites identified in the AHIMS search are in close proximity to the planned sites. The nearest recorded Aboriginal heritage sites are located between 1 and 5 km from the closest sites.

The proposed sites are away from the banks of any waterholes, creeks and ridgelines that are generally accepted as having a higher potential for the location of Aboriginal objects and places. The site is proposed on pastoral land that has been disturbed by clearing, grazing, cropping and general agricultural pursuits.

An experienced Cultural Heritage Adviser has undertaken a Cultural Heritage Survey of the project site. No items of Aboriginal Cultural Heritage were found in the project area and the impact of the proposed activity on Aboriginal Cultural Heritage will be nil and a copy of the clearance certificate is annexed.

Given the results of the survey the proposed activity will not disturb or move an item of Aboriginal Cultural Heritage or to destroy, damage or deface an item of Aboriginal Cultural Heritage. Accordingly, an Aboriginal Heritage Impact Permit (AHIP) under the *National Parks and Wildlife Act 1974* is not required.

As of the 31<sup>st</sup> December 2009 there were no Native Title claims over the proposed site location<sup>1</sup>.

### 4.4.2 Non-Indigenous Cultural Heritage

A search of the Commonwealth register of National Estate (DSEWPC, 2010b) sites found 10 sites within the Gunnedah LGA. While the search tool does not provide a specific location of each registered site, the majority of sites listed were most likely within town boundaries or Nature Reserves and National Parks. The proposed chip hole site is not located within those areas.

The New South Wales Heritage Register for the Gunnedah identified 4 item listed under the New South Wales *Heritage Act* and 42 items listed

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<sup>1</sup> See Map at [http://www.nntt.gov.au/Publications-And-Research/Maps-and-Spatial-Reports/Documents/Quarterly%20Maps/NSW\\_ACT\\_JBT\\_NTDA\\_Schedule.PDF](http://www.nntt.gov.au/Publications-And-Research/Maps-and-Spatial-Reports/Documents/Quarterly%20Maps/NSW_ACT_JBT_NTDA_Schedule.PDF)

by Local Government and State agencies (NSW Department of Planning, 2010). Like the National Register these items are usually located within town boundaries and therefore will be avoided during the proposed activities.

## 4.5 Flora and Fauna

The information presented below is based on a desktop assessment that included searching various published literature, government databases and an examination of aerial photographs of the area of interest. It should be noted that an initial assessment of proposed location has shown that the site will be located in cleared grazing land.

The NSW Department of Environment, Climate Change and Water (DECCW) Atlas of NSW Wildlife On-line database was searched for records of threatened ecological communities, plants and animals within the Gunnedah LGAs (DECC 2010).

Matters of conservation significance listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) that are known or predicted to occur in the area was determined using the EPBC Protected Matters search tool based on a 20km radius from Collygra 1 (DSEWPC 2010a).

### 4.5.1 Plant Communities

Fourteen (14) Endangered Ecological Communities (EEC) are listed under the TSC Act and as occurring within the Namoi CMA. Of these only three communities have the potential to occur and these are White Box Yellow Box Blakely's Red Gum Woodland, Fuzzy Box on alluvials of South West Slopes, Darling Riverine Plains and the Brigalow Belt South and Native Vegetation on Cracking Clay Soils on the Liverpool Plains. The proposed site is highly modified with the majority of the area comprising paddocks and consequently none of the EECs listed occur.

Since European settlement the majority of the Gunnedah LGA has been cleared or thinned for cropping and grazing. This applies to the proposed chip hole location. For the Namoi River catchment to the north of the PEL 1 Lampert and Short (2004) state that:

- Remnant vegetation is now limited to areas where agriculture is restricted, due to inaccessibility or low soil fertility;
- Along many streamlines riparian vegetation corridors are thin and discontinuous or non-existent; and
- Where a riparian corridor has been maintained it is often structurally compromised and/or dominated by exotics.

The same can be said for the proposed site as it is planned to be located in already heavily disturbed area away from remnant vegetation and streamline riparian vegetation.

#### 4.5.2 Significant flora

There are three endangered ecological communities within the bioregion listed under Schedule 1 of the *Threatened Species Conservation Act 1995* (NSW) (TSC Act). These are the Semi-evergreen Vine Thicket (*Cadellia pentastylis*) (*Ooline or scrub myrtle*), Brigalow, and Carbeen open forest communities. NPWS (2003) found that the bioregion is important for the long-term viability of these vegetation communities that are predominantly found here, with a small area lying in the Nandewar Bioregion. The Carbeen open forest communities are now restricted to the Brigalow Belt South Bioregion and very limited areas of the Darling Riverine Plains Bioregion. The White Box-Yellow Box-Blakely's Red Gum-Grassy Woodland and Derived Native Grassland threatened ecological community also occurs in this bioregion. It is nationally endangered and protected under the EPBC Act 1999, however site has been cleared for rural activities.

A search of the NSW DECC on-line database Atlas of NSW wildlife listed 4 threatened flora species within the Gunnedah LGA (DECC 2010). The species are listed in Appendix A. The proposed site has been previously cleared for rural activities and therefore does not provide suitable habitat for any of these listed species.

#### 4.5.3 Corridors and Connectivity

The proposed site is situated in an agricultural landscape and most of the adjacent lands have been cleared with only isolated pockets of remnant / regrowth bushland remaining within the broad valley area to the west of Gunnedah. In such landscapes, the road reserves and riparian vegetation provide important linear connections through the landscape. In this instance paddock trees are also important in providing stepping-stone habitat for the Koala and potentially for a number of bird species.

#### 4.5.4 Declared Noxious Weeds

In NSW the identification, classification and control of noxious weeds is governed by the *Noxious Weeds Act 1993* (NW Act). Plants that have been declared as noxious weeds are classified into specific control classes in each Local Control Area. Those plants listed as Noxious Weeds for the Gunnedah LGA are provided in Appendix B. It is likely that a number of other noxious weeds also occur within the area but are not listed for the LGA.

#### 4.5.5 Significant Fauna

A search of the NSW DECC on-line database Atlas of NSW wildlife listed 49 threatened fauna species within the Gunnedah LGA (DECC 2010). The species are listed in Appendix C.

The core hole site has been cleared for rural activities and will not be critical habitat for any of these listed species.

#### 4.5.6 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

Seven vegetation communities listed under the EPBC Act may occur in the locality (20 km radius) (DSEWPC 2010a). Of these only two have the potential to occur and these are White Box Yellow Box Blakely's Red Gum Woodland and Native Vegetation on Cracking Clay Soils on the Liverpool Plains, both of which are listed as Critically Endangered. The proposed site is highly modified with the majority of the area comprising paddocks and consequently none of the EECs listed occur.

Predictive modelling indicates that 6 fauna, 4 flora and 7 migratory species listed under the EPBC Act have the potential to occur within the locality of the site (i.e. 20 km) and these are listed in Appendix D along with their likelihood of occurrence.

#### 4.5.7 SEPP 44 - Koala Habitat Protection

An assessment under *State Environment Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44) is required as the Gunnedah LGA is listed under Schedule 1 of SEPP 44. This SEPP requires the identification and protection of core koala habitat within the LGA. Core Koala habitat means an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (i.e. females with young) and recent sightings of and historical records of a population. Potential koala habitat means areas of native vegetation where the trees of the types listed in Schedule 2 of the Act, constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

In considering these requirements and its highly modified nature the site area can not be considered Core Koala Habitat and as such SEPP 44 does not apply. Notwithstanding this, the site specific Koala management plan for the proposed site is that all Eucalypt trees will be excluded from within any fence compound as these may provide foraging habitat and refuge for Koala.

### 4.6 Protected Areas

There are over 750 protected areas in NSW. They range from World Heritage Listed areas through to Wetlands (protected under State Environmental Protection Policy (SEPP) 14). Some of which can cope

moderately easily with varying types of human activities. Others are more fragile and require a higher level of protection. All such areas located within PEL 1 are protected under Commonwealth or State legislation.

#### 4.6.1 National Parks and Reserves

No National Parks or Reserves are located within the boundary of PEL 1. The Pilliga Nature Reserve is the closest being greater than 20km west of the proposed Collygra 1 site.

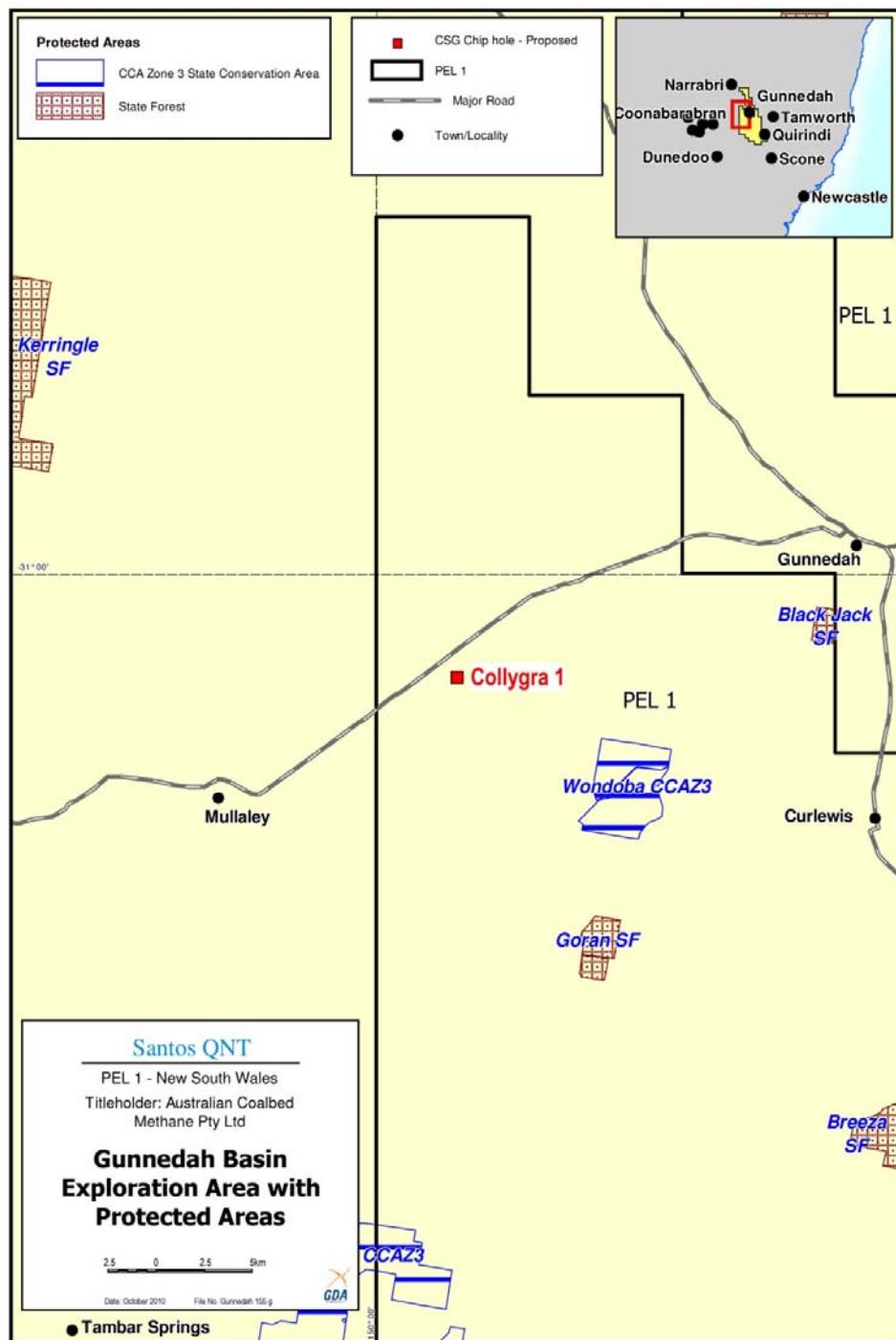
#### 4.6.2 Community Conservations Areas

PEL 1 falls under area administered by the *Brigalow and Nandewar Community Conservation Area Act 2005*. This Act under its schedules identifies four types of Community Conservation areas namely:

- Zone 1 of the Community Conservation Area means the land described or referred to in Schedule 1-Conservation and Recreation Zone (Includes National Parks);
- Zone 2 of the Community Conservation Area means the land described or referred to in Schedule 2-Conservation and Aboriginal Culture Zone;
- Zone 3 of the Community Conservation Area means the land described or referred to in Schedule 3-Conservation, Recreation and Mineral Extraction Zone; and
- Zone 4 of the Community Conservation Area means the land described or referred to in Schedule 4-Forestry, Recreation and Mineral Extraction Zone.

There are a number of State forest reserves in PEL 1 that have been designated Community Conservation Areas (See Figure 4-4). None of these areas will be affected by the proposed activities.

Figure 4-4: Location of National Parks, Nature Reserves and Community Conservation Areas



## 4.7 Geology

### 4.7.1 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. The Gunnedah Basin, covers an area of more than 15,000 sq km 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 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.

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 representing the last major depositional episode in PEL 1.

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.

Figure 4-5: Stratigraphy of the Gunnedah Basin  
**Gunnedah Basin Lithostratigraphy**

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			
TRIASSIC	MIDDLE	PT2.2-PT3	BLACK JACK GROUP	NEA SUBGROUP	GARRAWILLA VOLCANICS		GARRAWILLA VOLCANICS		
					DERIAH FORMATION				
	EARLY	PT1-PT2.1			NAPPERBY FORMATION		NAPPERBY LACUSTRINE SYSTEM		
					DIGBY FORMATION	ULINDA SANDSTONE	DIGBY ALLUVIAL SYSTEM		
						BOMERA CONG.			
		COOGAL SUBGROUP		TRINKEY FORMATION	SPRINGFIELD C.M.	DOONA			
				WALLALA FORMATION	CLIFT C.M.				
	LATE	PP5		BROTHERS SUBGROUP	CLARE SANDSTONE	BREEZA C.M.	EASTERN FLUVIAL SYSTEM		
					BENELABRI FM	HOWES HILL C.M.			
				MILLIE GROUP	HOSKISSONS COAL	CAROONA C.M.	LACUSTRINE & WESTERN FLUVIAL SYSTEMS		
				PP4.3	BRIGALOW FORMATION		HOSKISSONS PEAT-SWAMP SYSTEM		
					ARKARULA FORMATION		ARKARULA SHALLOW-MARINE SYSTEM		
PERMIAN	PP4.3	PP4.2			PAMBOOLA FORMATION	MELVILLES C.M.	UPPER WATERMARK / LOWER BLACK JACK DELTA SYSTEMS		
					WATERMARK FORMATION				
					PORCUPINE FORMATION		PORCUPINE-LOWER WATERMARK MARINE-SHELF SYSTEM		
		PP4.1		MAULES CREEK FORMATION					
				GOONBRI & LEARD FORMATIONS					
	PP3.2-PP3.3	PP2.1	BELLATA GROUP	PP3.1	BOGGABRI VOLCANICS, WERRIE BASALT, METAVOLCANICS & METASEDIMENTS		BROWN		
				PP2.2			LEARD-MAULES CREEK ALLUVIAL/LACUSTRINE SYSTEMS		

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#### 4.7.2 Soils

The soils in the Gunnedah Shire are some of the most richly fertile in Australia. In 1976 they were categorised by the Department of Conservation and Management into six mapping units that are based on:

- surface cracking of the soil;
- soil texture;

- topography; and
- apparent erodability.

The six units, including the dominant soil types found within each, are summarised below.

### 1. Cracking Clay Soils

These are the dominant soils in the Gunnedah Shire.

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 (7.5 YR 3/1) and very dark brown (10 YR 2/2) to black (7.5 YR 2/1) when moist.

The surface soil comprises an organic matter layer (Ao) overlying the A1 horizon, which is a dark coloured, medium to light textured clay soil and has a depth of 2 to 10 centimetres. Its structure is crumb of fine block with a self mulching property. The A1 horizon graduates into a well structured medium to heavy clay B1 horizon with no apparent sign of the A2 horizon.

The B1 horizon shares a similar colour to the A1 and has a high degree of dense blocky aggregates in its structure. This graduates into the B2 horizon composed of yellowish-brown or grey-brown medium to heavy clay. The B2 horizon has a strong, coarse lenticular macrostructure with many large slickensides. The B3 graduates into colluvial and alluvial material at depth. The lower B1 and B2 horizons contain calcium carbonate nodules.

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.

In virgin black earths, well developed gilgais, with a vertical of 10-30 centimetres are associated with deeper soils. Gilgais occur in two distinct patterns depending on the topographical position:

- On gentle colluvial slopes of linear forms with a wavelength commonly in the range of 5 to 7 metres.
- On the broad near level plains taking the form of mounds crudely circular in plan, and varying from two to several metres in width.

This mapping unit also includes the red, brown and grey cracking clays. These have similar characteristics to the black earths but are not associated with gilgai formation.

## 2. 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.

The medium clay soils have weakly differentiated profiles and differ in colour from dark brown (7.5 YR 3/2 moist) to very dark brown (10 YR 2/2 moist). The A1 horizon consists of an earthy fabric with rounded peds and varies in depth from 5 to 20 centimetres according to the topography. The B horizon has an angular blocky structure with shiny smooth faced peds and ranges from medium to heavy clay with depth.

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 percent.

## 3. 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 (7.5 YR 4/1 to 7.5 YR 5/2 moist) sandy loam to loam A horizon, graduating into a reddish brown (5 YR 5/6 moist) clay B horizon, with gravel being present throughout the profile. Depending on topography, the A horizon varies in depth from 10 to 50 centimetres, and has a weak crumb to block structure which is hard when dry. The boundary between the A and B horizons is very clear and abrupt.

The B horizon varies in texture from medium clay along the ridges to a heavy, reddish brown clay to the east of Gunnedah. Its structure ranges from strong prismatic to block in the upper 15 centimetres to blocky as depth increases. Clay skins are well developed and peds separate easily. Carbonate nodules are present throughout.

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.

#### 4. 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 (2.5 YR 4/6 to 5 YR 4/4 to 7.5 YR 5/2 moist) 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.

#### 5. Highly Erodible - 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 reddish-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.

The Non-Calcic Brown Soils have no A2 horizon with the boundary between the A1 and B horizons being very distinct.

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.

## 6. Skeletal Soils

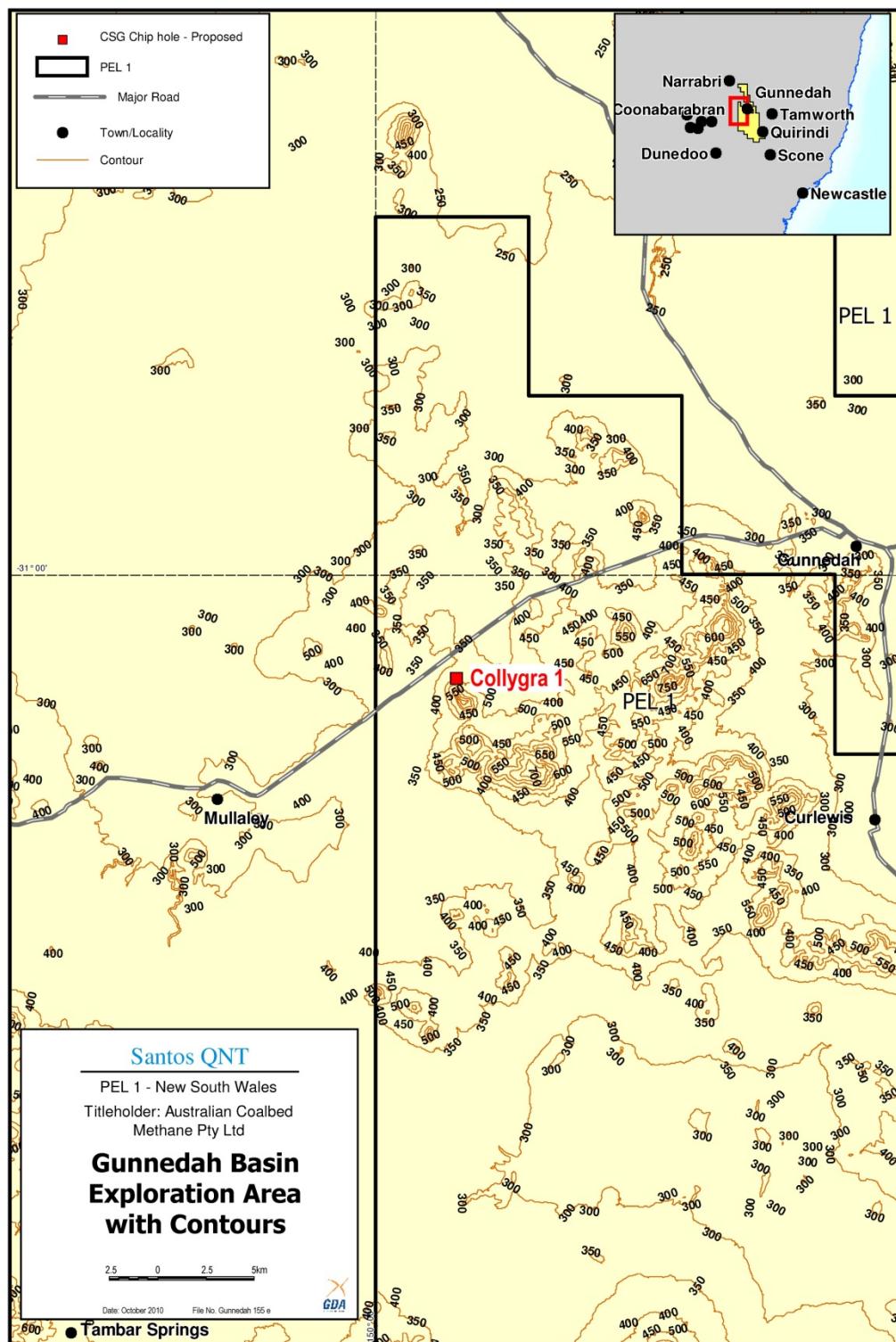
These soils are primarily found along the ridge crests and the steeper slopes with the major soil type being Lithosols. They contain large amounts of parent rock material and are usually very stony with soil depth ranging from 2 to 20 centimetres.

The soils at the proposed site are likely to be one or a combination of common soil types.

## 4.8 Topography

The Gunnedah Shire is situated 264 metres above sea level on the Liverpool Plain in the Namoi River Valley. The predominant topographical features are level flood plains of the Namoi and Mooki Rivers and Cox's Creek with 85% of the Shire having a land slope of less than 3 degrees. These plains are in long corridors that range from 15 to 40 kilometres across before the landform becomes slightly undulating. Three residual hill ridge systems rise from 300 to 500 metres above sea level but land slopes of greater than 15 degrees are found on only 1% of the Shire area. Figure 4-5 shows the topography of the drilling area is flat to undulating.

Figure 4-6: Local Topography within the vicinity of the Site



## 4.9 Water Resources

### 4.9.1 Surface Water

PEL 1 overlies the Namoi catchment management area. The Namoi Catchment in northwest NSW 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. Stretching from Woolbrook in the east to Walgett on the western boundary the catchment is over 350 kilometres long (NCMA 2010).

The site is located within the Mid Catchment Area – Bluevale sub-catchment. The Bluevale sub-catchment is located within the Liverpool Plains between Gunnedah and Boggabri. It covers an area of 1247km<sup>2</sup> and has elevations ranging from 886m on top of the Kelvin Hills to 240m ASL near Boggabri (NCMA 2010).

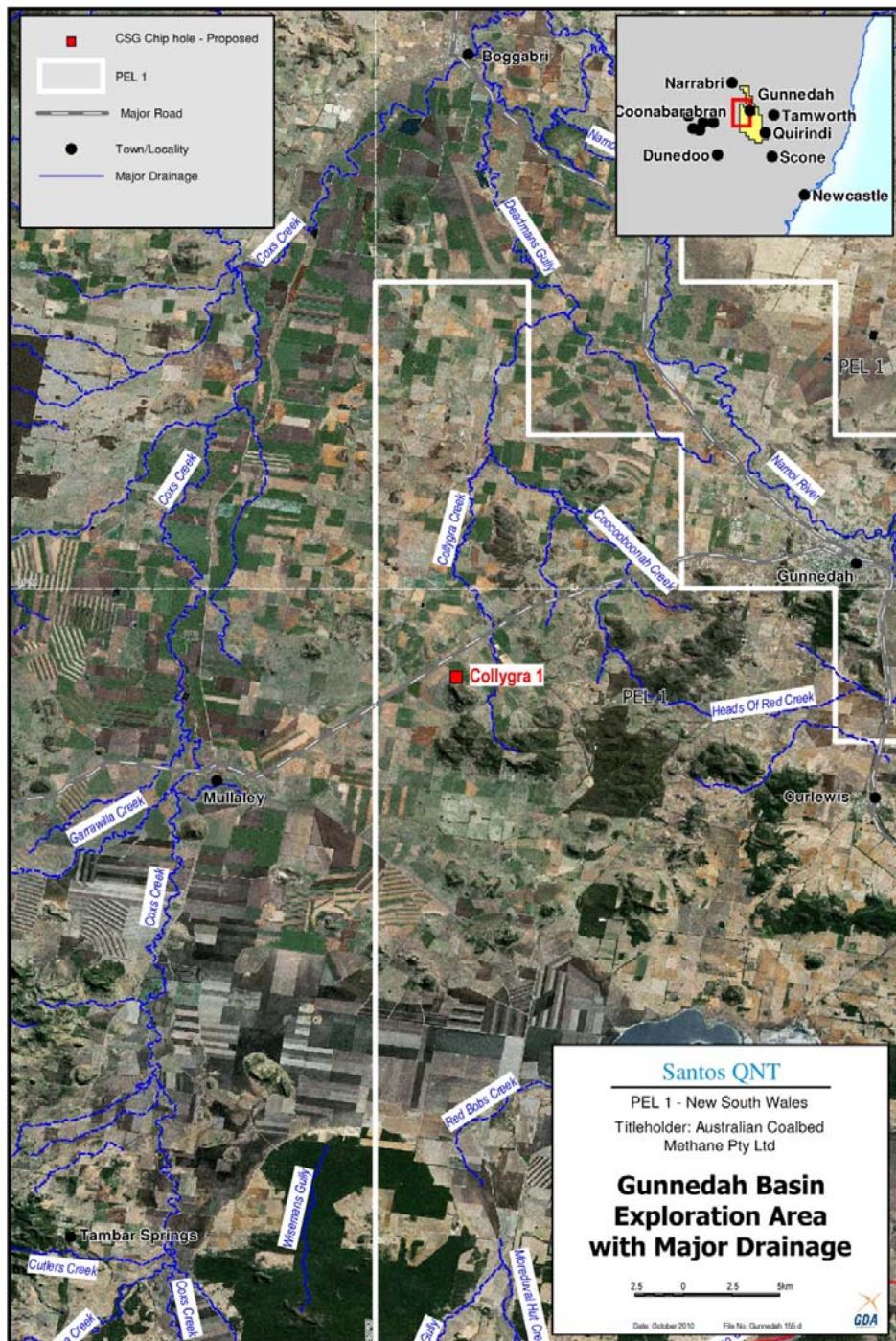
The Bluevale sub-catchment is dissected by the Namoi River. Main tributaries include Driggle Draggle Creek and Barbers Lagoon, north east of the Namoi River and Coocooboonah, Collygra and Native Cat creeks and Deadmans Gully to the southeast (NCMA 2010).

Table 4-1 shows the location of the closest watercourse to the proposed site and Figure 4-7 shows the major drainage across PEL 1.

Table 4-1: Closest watercourse to the site

Name	Closest Watercourse
Collygra 1	Collygra Creek, ~2km east

Figure 4-7: Major Drainage within PEL 1.



#### 4.9.2 Groundwater

Ground water in the Namoi catchment supports an irrigation industry worth in excess of \$380m as well as being the water supply for many towns and intensive industries such as feedlots. There are a total of 700 licence holders in the Namoi (NCMA 2010).

The groundwater sources include all water contained in the unconsolidated alluvial sediment aquifers associated with the Namoi River and its tributaries. Deep bores in the lower Namoi access the Great Artesian Basin water source (NCMA 2010).

It is expected that groundwater at the site and within surrounding areas will 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. Depending on the topography and climate, they may be connected to surface water features and transmit waters to or receive waters from them. Alternatively, a hard rock aquifer is an aquifer where groundwater is stored and flows through very small (relatively) joints or fractures in bedrock. They generally yield less water than porous rock (alluvial) aquifers but in some cases may provide high yielding bores.

## 5 Environmental Impacts and Mitigation Measures

### 5.1 General

The following section addresses the potential and actual impacts of Santos' operations in relation to this REF.

#### 5.1.1 EHSMS

Santos' EHSMS governs the methodology in which Santos conducts its business with regard to Safety and the Environment. There are 14 standards relevant to the Environment describing how the company will conduct its activities considering relevant legislation and industry best practice.

The activities will be undertaken in accordance with Santos' Environmental, Health and Safety Management System (EHSMS), the Australian Petroleum Production and Exploration Association Code of Environmental Practice – October 2008 (APPEA 2008) and the Schedule of Onshore Petroleum Exploration and Production Safety Requirements (DPI, 1992).

#### 5.1.2 Risk Assessment

A risk assessment was carried out to identify the potential environmental impacts associated with the proposed activities. Santos' Risk Matrix (see Appendix E) was used to determine the risk rating for each of the environmental elements identified as potentially being impacted. The risk ratings were determined prior to applying mitigation strategies and safeguards and then after considering measures to reduce risk. The unmitigated risk rating and residual risk ratings are both provided and ranged from a 1-3, which means that the risk identified can be managed through routine monitoring and procedures.

Table 5-1 shows the risk matrix including the management controls and performance management indicators that will be utilised by Santos during the drilling activities. The focus of environmental management is to avoid where possible, then minimise and mitigate any impacts.

### 5.2 Air Emissions

#### 5.2.1 Existing Environment

The existing air quality is typical of a rural area with the majority of air emissions and pollutants arising from existing rural activities, namely:

- Stock grazing;
- Land clearing and soil preparation;

- Sowing and harvesting of crops;
- Vehicle and heavy machinery movements; and
- Bushfires and burn-offs.

## 5.2.2 Potential Impacts

The proposed activity has the potential to introduce additional air emissions arising from sources including:

- Vehicle movements to and from the site; or
- Construction and rehabilitation of the proposed access tracks and well lease; or
- Drilling and testing of the wells; or
- Operation of plant (such as temporary power generation); or
- Flaring of gas.

The air emissions are dust and greenhouse gases.

### 5.2.2.1 *Dust*

The dust generated by the mobilisation of the drilling and ancillary equipment travelling to and from a location will vary depending on road and weather conditions.

The site has a bitumen road to the property entrance. The rig mobilisation, consisting up to 10 trailer loads, may require additional preparation of access ways to facilitate the safe entry of the drilling rig. Damage to any access roads will be repaired as soon as possible after occurrence to minimise any impact on the landholder or the public. It is not expected to have any significant impacts on roadside vegetation.

Internal roads on the property will be well-compacted roads therefore dust will not be a significant issue unless in extremely dry conditions. Due to the close proximity of the drill holes rig movements are minimised, decreasing dust generation. Where required dust suppression using a water cart will be used to reduce dust generation. Speed limits on rig traffic will be imposed to minimise dust when travelling on access roads within the property. See Figure 4.2 for site access roads and lease layout.

Liaison with local homesteads that may be affected by rig traffic will take place, informing occupants of possible high traffic periods (i.e. during transport of the rig and equipment).

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

### 5.2.2.2 *Greenhouse Gasses*

Operation of diesel fuelled vehicular traffic, plant and drilling rig, will be for the duration of the activities (Section 3.2). Accordingly there will be

minimal emissions associated with the activities and they are not expected to impact on air quality or be a major contributor of greenhouse gases.

Gas bearing formations are targeted by the drilling activities. A number of safety precautions and contingencies including flaring of gas are therefore incorporated into the drilling program in order to minimise any risk to personnel or plant on the site.

An appropriately sized and located flare pit is installed at the end of the "flare line" at the commencement of drilling operations. The drill rig operator will locate the "flare line" so that gas is directed into the flare pit where an ignition source can safely burn/flare any gas that is encountered during drilling.

Santos has an established process for flaring produced gas during Drill Stem Testing. Approval from the relevant DII Safety Inspector will be sought prior to any gas flaring except for drill stem testing as part of drilling safety procedures.

### 5.2.3 Mitigation Measures

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

- Access tracks are well compacted during constructed.
- Minimise land disturbance areas.
- Cover or stabilise any stockpiles.
- Water trafficked areas that produce dust if required.
- Speed restrictions will be enforced on internal site access tracks.
- Gas will be flared as a safety precaution during drilling and testing activities.

### 5.2.4 Residual Risk

Due to the air emission being proposed will be generated as a result of the petroleum activities being similar to the typical rural activities the likely impacts on air quality in the vicinity of the proposed site is negligible.

## 5.3 Community, Social and Economic

### 5.3.1 Existing Environment

The catchment has been used extensively for agricultural activities since the early 1800s. The main agricultural activities include sheep, beef cattle and grain crops. The particular area of the proposed drilling activities is largely rural. There is also number of coal mine operations within the broad region.

Santos has entered into a Land Access Agreement with the landowner in respect to land access conditions, compensation, rehabilitation and other matters as required under the *Petroleum (Onshore) Act 2007*. Consultation has involved the conducting of various land enquiries and meetings with the landowners in question. Further regular contact with landholders will be made as necessary. Other matters such as air quality, weeds, water, and noise are addressed in sections 5.2, 5.6 and 5.3.

The landscape in the region is dominated by broad views of rural properties, with scattered pastoral infrastructure such as bores, tanks, dams, fences, roads, homesteads and other buildings.

### 5.3.2 Potential Impacts

The immediate landholder will experience the majority of potential social and economic impacts, as the largest disturbance will be on their property.

The potential direct impacts include disturbance to current farming activities, livestock and indirect impacts as a result of a bushfire that may impact on pasture, farm assets, people as well as native flora, fauna and stock.

Most of the potential economic impacts are anticipated to be positive for the Gunnedah area including increased economic and employment opportunities within the greater Shire Council Areas.

The visual impacts of drilling will include the drill rig and with associated shacks and vehicles (See Section 3.2). Impacts will be temporary and insignificant and all equipment will be removed at the end of the drilling program.

The hours of operation during the drilling will be on a 12 hour a day basis negotiated and agreed with the landowner.

Drilling activities are temporary and will not have any long-term impact on the visual amenity of the area. The period of the activities to be undertaken will be up to 60 days per well (see Section 3.2). Lease construction activities of up to 6 weeks (including all leases and access tracks) and if required lease rehabilitation activities of 7 days per well will be additional to this period and may not occur concurrently to the drilling activities.

### 5.3.3 Mitigation Measures

To minimise impacts on landholders the following actions will be undertaken:

- Prior to the commencement of activities at each site, the landholder is provided with a notice of the planned activities, in particular construction of the access tracks and the lease and drilling. The

notification includes immediate neighbours of the land on which the activities are to take place. Reasonable requests by landholders for rescheduling of activities will be considered.

- Ongoing contact will be maintained with the landholder to ensure that any concerns are immediately addressed.
- If unfenced roads are present on the roads to/from the rig, then as part of the site induction or journey management program, drivers will be made aware of the hazard this presents.
- Internal access roads will be maintained in a condition satisfactory to the DII and Landholders until restoration of the lease is completed.
- If fencing is required, the site will be adequately fenced with a lockable gate and adequate signs warning of potential danger will be erected.
- Drilling site will be selected such that a cleared buffer exists outside the drilling pad area to maintain an effective barrier against bushfires.
- The flare pit will be kept free of grass and leaf litter.
- A fire control water pump and hoses on site will be maintained.
- Liaison will occur with the local rural fire service officer.
- Fires on the surface of the land will be prohibited at each of the well site.
- Hot work (e.g. welding) specific procedures will be in place.
- The area of land disturbance will be minimised subject to safety constraints.
- The site will be maintained in a clean and tidy condition.
- Santos will implement policies for local hiring and procurement of goods whenever possible to maximise local benefits.
- Where possible leases will be located so that there is a natural feature to obstruct views to neighbouring residences.
- Site will be kept in a neat and tidy state at all times.
- Site not located near tourist sites.

#### 5.3.4 Residual Risk

With the implementation of the mitigations measures the likely impacts on the landholder and local community is negligible.

The activities are temporary and the area to be used is small relative to the surrounding agricultural area. Once the activities are completed and no longer required for assessment the disturbed land will be reinstated to that of the surrounding environment in agreement with the landholder.

There is a risk that the visual impact of the rig on site will not be acceptable to all stakeholders in the area, however the site is not located near any tourist sites, are largely out of site of neighbouring landholders, and the activities are of a temporary nature therefore the residual risk of visual impact is negligible.

## 5.4 Cultural Heritage

### 5.4.1 Existing Environment

The land where the site is proposed (including access tracks) has been previously disturbed and cleared. A search of the DECCW AHIMS database for the general area of the proposed drilling has been made (DECCW, 2008). No Aboriginal objects or places are recorded in close proximity (within 1km) of the proposed site.

An experienced Aboriginal cultural heritage adviser has undertaken a Cultural Heritage Survey of the project site.

### 5.4.2 Potential Impacts

The potential impacts on cultural heritage include only the disturbance of unrecorded artefacts or sites.

### 5.4.3 Mitigation Measures

To minimise any potential impacts the following management measures will be implemented:

- Heritage exclusion zones or sites identified during the heritage site inspection shall be avoided.
- Personnel, vehicles and equipment shall be restricted to designated work areas and access tracks.
- Aboriginal heritage issues and the potential for discovery of sites shall be covered in site inductions.

If a site is discovered during site preparation works, the following procedure shall be implemented:

**Step 1** Cease immediately all activities that could in any way interfere with or disturb the discovered site and/ or object.

**Step 2** Promptly report discovery to the Team Leader Cultural Heritage, the Cultural Heritage Coordinator or the Cultural Heritage Field Supervisor.

**DO NOT** disturb or collect anything from the site. Santos Cultural Heritage personnel will advise of appropriate action to be followed in order for surface disturbance activities to recommence.

The discovery of cultural heritage on the site is recorded by Santos using the Discovery of Cultural Heritage Site Form.

### 5.4.4 Residual Risk

Based on the location of the proposed activities in a highly disturbed area and results of the Cultural Heritage Survey, no impacts are expected on Aboriginal Cultural Heritage.

Due to the high level of disturbance at the proposed site, the likelihood of finding an intact artefact or site in this area is remote however the consequence is major. The residual risk of disturbing an artefact or site remains remote.

## 5.5 Flora and Fauna

### 5.5.1 Existing Environment

The proposed site is located on agricultural land that has been previously cleared by past rural activities. Section 4.5.4 lists the potential noxious weeds identified at the proposed site.

### 5.5.2 Potential Impacts

The potential impacts on flora and fauna as a result of activities undertaken are:

- Direct Impacts:
  - Loss of habitat from the removal of selected trees to allow vehicle and equipment access and lease construction; or
  - Loss and fragmentation of habitat from the clearing of vegetation; or
  - Spread of weed seed and pest animals due to vehicle and equipment movement; or
  - Fauna mortality due to vehicle strike; or
- Indirect Impacts:
  - Noise impacts to fauna from drilling activities and fixed and mobile plant; or
  - Reduction in vegetation productivity due to dust deposition on leaves; or
  - Contamination of habitat associated with spills of fuels or chemicals.

Assessments under the NSW EP&A Act, including those species, populations and communities listed under the TSC Act concluded that significant impacts are unlikely and that a Species Impact Statement is not required. A number of threatened species were listed as occurring within the locality but habitat for only a very small percentage of these occur due to its highly modified nature.

Similarly, it was concluded that MNES listed under the Commonwealth EPBC Act would not be significantly impacted and consequently it is unlikely to be considered a controlled action. The study area supports very limited habitat for native fauna as it is comprised of highly modified agricultural lands. Marginal potential habitat for a number of species exists within the study area and locality, and consequently these species

have been considered using the EPBC Act Administrative Guidelines for Significance (Commonwealth of Australia 2006).

The impacts of the activity on flora and fauna are minor and temporary. The footprint of the project would fall entirely within cleared grazing lands and would avoid the removal of trees (See Figures 4-2).

There is a potential for the introduction of a new weed and pest species to the site via the entry of vehicles and plant. This impact is assessed to be low.

### 5.5.3 Mitigation Measures

To minimise the potential impacts on fauna and flora the following actions will be implemented:

- Use previously disturbed areas where possible.
- The works area for the lease should be fenced to ensure that machinery remains in the designated works zone.
- The site specific Koala management plan is that Eucalypt trees should be excluded from within the fenced compounds as these may provide foraging habitat and refuge for Koala.
- Vehicle numbers and speed would be strictly limited to reduce the risk of fauna injuries.
- The drilling site would be fenced with temporary stock-proof fencing and bunded where appropriate.
- All drilling fluid would be contained on site and if required disposed of at a suitably licenced facility.
- Weeds would be controlled on all restored sites.
- Ongoing monitoring and, if necessary, restoration maintenance would be undertaken until grass cover has re-established.
- Rubbish should be collected and removed off site to prevent it entering the waterway and causing harm to fauna.
- All vehicles coming from declared weed infested to non-declared weed areas are required to utilise vehicle washing facilities or any temporary washing facilities established for this purpose.
- All vehicle movements are restricted to defined areas agreed upon with the Landholder/s.
- Land disturbance is to be minimised to prevent the germination of weed seeds that may already exist in the soil.
- If a declared weed or weed of concern is discovered, it shall be monitored to ensure it does not spread from the area of infestation.
- All land disturbed by Santos is to be returned to a condition consistent with the adjacent area or to landholder requirements at the end of the rehabilitation process.

#### 5.5.4 Residual Risk

The minor and temporary nature of land disturbance from the proposal means that any impacts on flora and fauna are temporary and minor and will be managed to protect current values.

An assessment under the NSW EP&A Act, including those species, populations and communities listed under the TSC Act concluded that significant impacts are unlikely and that a Species Impact Statement is not required. Similarly, it was concluded that MNES listed under the Commonwealth EPBC Act would not be significantly impacted and consequently it is unlikely to be considered a controlled action.

The footprint of the project will fall entirely within cleared grazing lands and would avoid the removal of trees.

The potential for the introduction of a new weed and pest species to the site via the entry of vehicles and plant is low. The need for washing and/or brushing down of the drilling rig, support vehicles and ancillary equipment will depend on the location from which the drilling contractor and other equipment will mobilise from.

### 5.6 Noise Emissions

#### 5.6.1 Existing Environment

The existing background noise environment is typical of a rural area, with low levels of background noise dominated by natural sources (e.g. wind, animals and insects) and intermittent noise from vehicular traffic and agricultural activities.

No residence is within 1km of the proposed site.

The environmental values adopted for the project are:

- The protection or enhancement of an environment conducive to the wellbeing of an individual, including the individual's opportunity to have sleep, relaxation and conversation without unreasonable interference from intrusive noise; and
- The protection or enhancement of an environment conducive to the wellbeing of the community or a part of the community, including its social and economic amenity.

#### 5.6.2 Potential Impacts

The potential impacts as a result of activities undertaken are:

- Increased noise levels at sensitive receptors from additional noise sources including generators, drilling and flaring activities or intermittent noise sources such as vehicle and equipment movements or earthworks.

The duration of any noise impacts will be limited to the period that the activities are carried out (see Section 3.2).

### 5.6.3 Mitigation Measures

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

- No lease will be constructed within 1km of an existing residence without consent of the resident;
- Landholder notification will be given prior to commencement of drilling;
- Appropriately informing potentially affected residences and other relevant parties in advance of any activities and providing those people with updated information as required;
- Complaints will be responded to in a timely manner;
- Noise monitoring may be undertaken on receipt of a non-vexatious complaint;
- Where noise disturbance cannot be avoided, Santos will investigate alternative arrangements to suit the landholder; and
- Noise barriers will be implemented if necessary.

### 5.6.4 Residual Risk

Potential impacts associated with noise are a function of the noise levels of sources, the dimensions of sources, distance to receptors, terrain and cover, topographic and climatic conditions, and the characteristics of the receptors.

An environmental indicator that will be utilised by Santos to determine whether noise objectives have been maintained is complaints, since maintenance of amenity is effectively the overriding objective.

The equipment used for the mobilisation and powering of the drilling rigs have mufflers installed on their respective power plants and prime movers. The site is located more than 1 km from the nearest residence, combined with the muffling of the engines and the short term nature of the drilling activity, operations are unlikely to create any significant noise impacts for neighbouring residents.

Through previous monitoring of Santos contracted rigs there is an understanding of the noise impact on the surrounding sensitive receptors. The drill site has been located further than 1 km from the nearest landholder residence, therefore it is unlikely that noise from the rig will impact the nearest sensitive receptor and thus the residual risk is negligible.

## 5.7 Soils, Land-Use and Terrain

### 5.7.1 Existing Environment

Land stability and erosion hazard is a function of soil type, topography, vegetative cover, rainfall intensity, and soil disturbance.

The soils in the vicinity of the site are a valuable resource to the existing pastoral or agricultural interests of the landholder.

The proposed activities will involve earthworks within a defined footprint for the installation of temporary and/or permanent access tracks and well leases.

The area is rural and there would be a variety of chemicals that could be stored and used through out the region. The drilling activities require the use of many chemicals and other hazardous substances (namely fuel (diesel) and drill fluid additives (see Appendix F)). These goods will be transported and store on site for use.

### 5.7.2 Potential Impacts

The potential impacts as a result of activities undertaken are:

- Increase in the erosion potential of the land in areas that are subject to clearing or disturbance during the site establishment activities; or
- Increase in turbidity and suspended loads of waters through the erosion of sediments disturbed by the proposed activities; or
- Land contamination from hydrocarbon spillage (mainly lube oils and diesel fuel spills) from vehicles and mobile plant and equipment, storage and handling of fuels and chemicals; or access track or lease establishment activities may result in mobilisation of such contaminants off-site or increase the level of exposure of contaminants to workers; or
- The drilling activities will involve the generation of drilling fluids and waste oil and chemicals associated with these activities.

These impacts are limited to the area of disturbance required by the activities that are to be carried out (see Section 3.2).

### 5.7.3 Mitigation Measures

To minimise the potential impacts on soils and landuse the following actions will be implemented:

- All land disturbance activities will be discussed and agreed with the Landholder prior to commencement.
- Restricting the area to be disturbed to the minimum required for safe operations.

- The area of all disturbances will be determined and placed within Santos' Geographic Information System (GIS).
- Stockpiling top soil separately from other spoil so that it can be used in restoration activities.
- Erosion and sediment control structures are placed to minimise erosion of disturbed areas and prevent the contamination of land and waters.
- Implement an inspection and maintenance program for the erosion and sediment control features when installed.
- Return of natural/previous land contours.
- Reseeding if required in consultation with landholders.
- Removal of all imported spoil material.

To minimise the potential impacts of chemical and hazardous substances the following actions will be implemented:

- The amount of hazardous material stored and used on site shall be kept to the minimum practicable for the activities.
- Hazardous materials shall be transported, stored and handled in accordance with the requirements of relevant legislation (e.g. Road and Rail Transport (Dangerous Goods) Act 1997, Australian Dangerous Goods Code) and Australian Standard 1940.
- Fuels, lubricants and chemicals shall be stored and handled within containment areas (such as portable bunding) that are designed to prevent the release of spilt substances to the immediate neighbouring environment.
- A spill kit appropriate to operations of this size will be available at site.
- Material Safety Data Sheets and handling procedures for hazardous chemicals and materials shall be kept on site.

Spill response measures will include:

- Personnel shall be advised of the location and use of the spill containment equipment in the site induction.
- Spills or leaks shall be immediately reported to the senior Santos representative onsite and clean up actions initiated.
- In the event of a spill, the material shall be contained to the smallest area practicable.
- Spilt material and contaminated soils shall be treated on site with landholder acceptance or removed off-site for disposal at an appropriately licensed facility, as determined in consultation with DECCW and DPI-MR.
- Spills shall be reported in accordance with regulatory and licensing requirements. There is a duty to notify the appropriate regulatory authority (broadly, the DECCW or the local council) of pollution incidents where material harm to the environment is caused or threatened (see Section 2.1 for definition of material harm).

The information about a pollution incident required to be included in a notification consists of:

- The time, date, nature, duration and location of the incident.
- The nature, the estimated quantity or volume and the concentration of any pollutants involved.
- The circumstances in which the incident occurred (including the cause of the incident, if known).
- The action taken or proposed to be taken to deal with the incident and any resulting pollution or threatened pollution.
- Other information prescribed by the regulations.

#### 5.7.4 Residual Risk

Soil disturbance is necessary as a level drill pad is required for the drill rig. This will require topsoil to be removed and stockpiled for replacement during site rehabilitation. The area to be disturbed for drilling activity will be approximately 80 by 60 metres incorporating a level surface for operation including lined drilling sumps and a flare pit for each site (plus access track).

If imported material is required for the hard-stand area, it will be sourced from the local area and if required, permission will be obtained from the landholder prior to this being undertaken.

Once drilling and completions operations are completed the drill pad will be rehabilitated to accommodate the remaining facilities required for operating the well. Rehabilitation will be in accordance with the landholder's requirements.

The proposed site has been previously disturbed by rural activities therefore the likely impact on the existing soils and land useability is considered low. Based on the current agricultural activities and previous restoration of sites in the area, the residual risk is negligible for ongoing erosion and land degradability beyond reinstatement of the site.

An inventory (as provided by Santos) of the additional components used in drilling and completion is provided in Appendix F. Drilling and completion fluids are used during the drilling process and are designed to clog up the formation pore spaces such that the fluid remains contained within the confines of the borehole and thereby maintains its capacity to lift out the drill cuttings and so facilitate the efficient drilling of the borehole, its main purpose. The drilling fluids are not pressurised and do not penetrate by more than a metre, the various rock-types through which the borehole is drilled. These fluids are widely used across Australia and the world for the drilling of water wells, oil wells and exploration boreholes.

With the implementation of the mitigations measures the likely impacts of chemical and hazardous substances on land is negligible.

## 5.8 Waste

### 5.8.1 Existing Environment

Currently there is no waste disposal facility at the proposed site.

The worksite will require the provision of systems for the management of sewage wastes. Personnel numbers can reach up to 20 in the case of drilling operations.

All industrial solid wastes created during drilling and well operations will be collected in designated skips for eventual disposal to an appropriately licensed facility.

Water based drilling fluids and associated cuttings, will be stored in an excavated sump. Cuttings may remain in the sump or be removed, and a liner may or not be utilised depending on an environmental assessment of each location. The liner, if used, will be removed once the sump is no longer required. Topsoil will be respread over restored surfaces at final abandonment of the site to encourage revegetation of disturbed surfaces.

### 5.8.2 Potential Impacts

Potential beneficial uses of waste generated by activities include:

- Opportunity for reuse or recycling of valuable materials, compounds, and constituents that may otherwise become wastes and thereby be disposed of without obtaining maximum benefit from reuse or recycling. An example is scrap metal.

Potential adverse impacts of waste generated by activities include:

- Land or surface water pollution caused by release or spills of solid or liquid waste either directly to land or surface waters, or indirectly via storm water runoff to receiving waters from waste contaminated sites; or
- Groundwater contamination caused by release or spills of solid or liquid waste to land and subsequent transport of mobile or soluble waste constituents to the groundwater resource
- Littering caused by lack of suitable containment measures for general rubbish, scrap metal or other waste; or
- Odours caused by improper storage or treatment of putrescibles waste; or
- Illegal dumping of wastes generated on site including drilling fluid.

### 5.8.3 Mitigation Measures

Waste management measures include:

- Waste material (including domestic waste) shall be collected and stored in suitable bins to prevent loss and scavenging by stock, wildlife and feral animals.

- Where practicable, recyclable material (e.g. glass and cans, scrap metals, used chemical and fuel drums and timber pallets) shall be collected in designated skips for recycling.
- The waste bins shall be removed from the site as necessary following completion of drilling and their contents are to be deposited at a licensed waste management facility for appropriate disposal.
- Contractors are Pre-qualified under Santos' EHSMS and appropriately licensed.
- All wastes are to be transported in covered or sealed containers to prevent the loss of waste materials during transport.
- Waste shall be transported in accordance with appropriate standards and legislative requirements.
- All industrial waste materials including liquids and solids will be removed for reuse or disposed at an appropriate site.
- Santos representative will be housed on site.
- Rig crews will be housed at accommodation in nearby towns.
- 'portaloos' will be provided at the site and maintained as required by a suitable contractor.
- Flare pits may also be fenced.
- Sumps containing waste fluids/cuttings shall be fenced off immediately following the rig moving off the premises.
- If a liner is used it will be removed, and depending on site conditions, cuttings may be disposed of a suitable location.
- A perimeter fence around the site will be considered at each site, if required to enclose all sumps etc.

#### 5.8.4 Residual Risk

As all waste generated by the activities will be transported offsite for appropriate disposal there are no impacts expected on the site.

### 5.9 Surface and Ground Water Resources

#### 5.9.1 Existing Environment

There are no creeks or water bodies in the immediate vicinity (e.g. 40m) of the proposed site that could be potentially affected if there are any spill incidents during the proposed activities. The closest surface water resource is more than 2km east of Collygra 1.

As discussed in Section 4.9.2, groundwater is likely to be intersected by the drilling activities, however these will be cased off and cemented to isolate them from the primary objective (namely coal seams). No water production will occur from outside of the coal seam zones and no water pumping is proposed (see Section 3.2).

Water for the drilling, access track and lease build activities will be sourced from a local dam or Council. A landholder agreement is in place for its use.

### 5.9.2 Potential Impacts

The potential impacts on surface water as a result of activities are:

- Increase in turbidity and suspended loads through the erosion of sediments disturbed by earthworks activities; or
- Increase in turbidity and suspended loads through the erosion of sediments from works adjacent to and within drainage lines and water courses; or
- Increase in turbidity and suspended loads through the erosion of sediments and the release of contaminants through flooding and inundation; or
- Increase in turbidity and suspended loads through mobilisation of drilling mud; or
- Increase in turbidity and suspended loads through incomplete rehabilitation of disturbed areas; or
- Increase in turbidity and suspended loads through erosion from storm water run-off from access tracks or well leases; or
- Decrease in water quality through the release of oils or other chemicals (including saline associated water) from leaks and spills and surface water run-off from well leases; or
- Decrease in water quality through the improper disposal of litter and other debris from wastes; or
- Lack of water supply through a decrease in water quality and access to water resources (including shallow aquifers); or
- Decrease in environmental flows associated with the diversion of surface water or use of local water sources including shallow groundwater.

The potential impacts on groundwater as a result of activities are:

- Loss of shallow groundwater recharge as a result of land clearing or alteration of topography; or
- Cross contamination of aquifers as a result of drilling or interconnection of aquifers; or
- Contamination through the infiltration of water through contaminated soil and the subsequent migration of contaminants. This may result from uncontrolled spills and leaks of fuels or chemicals; or
- Contamination through surface water run-off from contaminated areas and subsequent infiltration; or
- Loss of shallow groundwater resources and environmental flows into surface water bodies such as watercourses and lakes.

These impacts are limited to the area of the proposed activities (see Section 3.2).

### 5.9.3 Mitigation Measures

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

- 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.
- Waste water removed from site will be managed by a contractor licensed to carry and handle water.
- Bunding of all areas storing or handling fuel, fuel using equipment, and chemicals, in line with Australian Standard 1940 – 1993; The Storage and Handling of Flammable and Combustible Liquids
- Where applicable maintenance of roads, drains, bund walls, contour and diversion banks, will occur. All drainage structures are to be maintained for the life of the development.
- During rehabilitation, diversion banks and ripping along the contour will be completed to prevent the concentration and momentum of water flow as required.
- Utilising over-balanced drilling techniques to prevent formation fluid from raising through the well the surface.
- Casing the well with cement and steel before different formations are intersected; casing is pressure tested (refer to Section 3.2).
- Cementing to surface before well completion.

In the case of a drilling sump, a liner may be used depending on the environment assessment of a given location. If a liner is used it will be removed after drilling with the water re-used or taken to an appropriate site for disposal. After the rig has left site the temporary fenced will remain around any sumps left open to protect livestock and other animals.

As discussed in Section 5.7.4 drilling and completion fluids are used during the drilling process and are designed to clog up the formation pore spaces such that the fluid remains contained within the confines of the borehole and thereby maintains its capacity to lift out the drill cuttings and so facilitate the efficient drilling of the borehole, its main purpose.

Associated water from the targeted coal seams is not expected to be produced as part of the drilling activity, therefore no mitigation measures are proposed.

#### 5.9.4 Residual Risk

With the implementation of the mitigations measures the likely impacts on surface and groundwater resources due to the activities is negligible.

### 5.10 Cumulative Environmental Impacts

The proposed activities are temporary in nature and the site will be restored to enable previous land-uses to continue into the future. The mitigation measures outlined will ensure that there are no significant cumulative environmental impacts.

Table 5-1: Risk Assessment for the Proposed Activities

Aspect	Potential Impacts	UMRR <sup>2</sup>	Management Controls	RRR <sup>3</sup>	Performance Indicator	Records
<b>Air Emissions</b>	<ul style="list-style-type: none"> <li>Expected air emissions / air quality issues associated with the short term activities may include:</li> <li>Combustion exhausts from the flare stack (during testing);</li> <li>Fugitive emissions from (vehicles); and</li> <li>Dust emissions from earthworks and vehicular activity.</li> <li>Fugitive emissions from vehicles used during appraisal activities are anticipated to be minor due to the small scale of activities planned.</li> <li>These sources are likely to be negligible in the context of existing activities including grazing and transport within the area.</li> </ul>	1	<ul style="list-style-type: none"> <li>Reducing the speed of vehicles on field roads.</li> <li>Watering of roads when appropriate or when agreed.</li> <li>Investigating dust complaints and responding appropriately.</li> <li>Planning the location of activities in consultation with landholders should control impacts.</li> </ul>	1	<ul style="list-style-type: none"> <li>Minimal complaints from Landholders regarding dust impacts.</li> <li>Amicable resolution of complaints</li> </ul>	<ul style="list-style-type: none"> <li>All complaints made by the Landholder and any subsequent actions are to be recorded in the Complaints Register.</li> </ul>

<sup>2</sup> UMRR = Unmitigated Risk Rating

<sup>3</sup> RRR = Residual Risk Rating

Aspect	Potential Impacts	UMRR <sup>2</sup>	Management Controls	RRR <sup>3</sup>	Performance Indicator	Records
<b>Community – Social and Economic</b>	<ul style="list-style-type: none"> <li>The primary contact during planning and development will be with the Landholder.</li> <li>The activities have the potential to impact upon landholders.</li> <li>In general, land access will be addressed in compensation/access agreements prior to the commencement of petroleum activities.</li> <li>Visual amenity will reduced in the short-term.</li> </ul>	2	<ul style="list-style-type: none"> <li>Access will be discussed with the Landholder during the field scouting period and compensation finalised.</li> <li>Land requirements and locations for infrastructure will be discussed during the pilot design period with the Landholder.</li> <li>Where practical infrastructure will be located within previously disturbed areas.</li> <li>Land requirements will be minimised to that required for safe operations.</li> <li>Land no longer required for normal operations will be rehabilitated and where practical returned to its previous use in consultation with the Landholder.</li> </ul>	1	<ul style="list-style-type: none"> <li>All land disturbed by Santos is to be returned to a condition consistent with the adjacent area and in consultation with the landholder.</li> </ul>	<ul style="list-style-type: none"> <li>Santos records contracts with landholders.</li> </ul>
<b>Bushfire</b>	<ul style="list-style-type: none"> <li>Threat to the community, flora and fauna or sensitive areas.</li> </ul>	2	<ul style="list-style-type: none"> <li>Drilling sites will be selected such that a cleared buffer exists outside the drilling pad area to maintain an effective barrier against bushfires.</li> <li>Leases located so that flare pit has buffer from vegetation</li> </ul>	1	<ul style="list-style-type: none"> <li>No fires occur as a result of the proposed activities.</li> </ul>	<ul style="list-style-type: none"> <li>Incident notification records.</li> </ul>

Aspect	Potential Impacts	UMRR <sup>2</sup>	Management Controls	RRR <sup>3</sup>	Performance Indicator	Records
			<ul style="list-style-type: none"> <li>The flare pit will be kept free of grass and leaf litter.</li> <li>A fire control water pump and hoses on site will be maintained.</li> <li>Liaison will occur with the local rural fire service officer.</li> <li>Fires on the surface of the land will be prohibited at the well site;</li> <li>Hot work (e.g. welding) specific procedures will be in place.</li> <li>The site will be cleared to minimise the potential for ignition of surrounding pasture.</li> <li>Diesel machinery will be utilised for all activities.</li> </ul>			
<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Indigenous heritage. Site or artefact of indigenous culture may be inadvertently damaged.</li> <li>Non-Indigenous Heritage: Sites or artefacts of non-indigenous settlement may be inadvertently damaged.</li> </ul>	3	<ul style="list-style-type: none"> <li>Development will occur in cleared/disturbed areas minimising the risk of impact on cultural heritage.</li> <li>All disturbance activities are reviewed to ensure development avoids impacting on cultural heritage before commencement.</li> <li>The proposed site is part of an operating farm on a highly</li> </ul>	1	<ul style="list-style-type: none"> <li>Cultural heritage clearance completed prior to ground disturbance.</li> <li>No indigenous or non-indigenous sites are disturbed by the proposed activities.</li> </ul>	<ul style="list-style-type: none"> <li>Records of any cultural heritage site are maintained.</li> </ul>

Aspect	Potential Impacts	UMRR <sup>2</sup>	Management Controls	RRR <sup>3</sup>	Performance Indicator	Records
			<ul style="list-style-type: none"> <li>disturbed area that has previously been cleared.</li> <li>It is not expected that there will be any impact on indigenous and non-indigenous cultural heritage values of the area.</li> </ul>			
<b>Flora and Fauna</b>	<ul style="list-style-type: none"> <li>The proposed location has previously been highly disturbed by agricultural activities.</li> <li>No threatened flora or fauna or sensitive areas will be impacted by the proposed activities.</li> </ul>	3	<ul style="list-style-type: none"> <li>Use of areas already disturbed.</li> <li>No unplanned or unapproved damage to flora and fauna.</li> <li>Restoration of disturbed areas to commence as soon as practical.</li> </ul>	1	<ul style="list-style-type: none"> <li>Routine work reports will be recorded and reviewed by each supervisor or manager.</li> <li>Recommendations and corrective actions arising from audits and reviews will be implemented.</li> <li>Ongoing monitoring to assess the success and integrity of construction and rehabilitation measure and ensure appropriate follow-up rehabilitation measures is implemented.</li> </ul>	<ul style="list-style-type: none"> <li>Santos will maintain records during construction and operation of all monitoring and assessment activities.</li> </ul>
<b>Weed Management</b>	<ul style="list-style-type: none"> <li>Introduction or spread of weeds through the</li> </ul>	2	<ul style="list-style-type: none"> <li>All vehicles coming from declared weed infested to non-declared weed</li> </ul>	1	<ul style="list-style-type: none"> <li>Identify and document areas of</li> </ul>	<ul style="list-style-type: none"> <li>Vehicle Hygiene</li> </ul>

Aspect	Potential Impacts	UMRR <sup>2</sup>	Management Controls	RRR <sup>3</sup>	Performance Indicator	Records
	movement of earthworks equipment, drilling rig and general traffic.		<p>areas are required to utilise vehicle washing facilities or any temporary washing facilities established for this purpose.</p> <ul style="list-style-type: none"> <li>• All vehicle movements are restricted to defined areas agreed upon with the Landholder/s.</li> <li>• Land disturbance is to be minimised to prevent the germination of weed seeds that may already exist in the soil.</li> <li>• If a declared weed or weed of concern is discovered, it shall be monitored to ensure it does not spread from the area of infestation.</li> <li>• All land disturbed by Santos is to be returned to a condition consistent with the adjacent area or to landholder requirements at the end of the rehabilitation process.</li> </ul>		<p>new weed infestations in the Incident Management System.</p>	Records.
<b>Noise Emissions</b>	<ul style="list-style-type: none"> <li>• Activities to be undertaken during drilling operations include drilling, running casing and cementing, DST and geophysical logging.</li> <li>• All activities apart from access to the site are</li> </ul>	<b>2</b>	<ul style="list-style-type: none"> <li>• To manage noise and minimise impacts the following management strategies/controls will be implemented:</li> <li>• Landholder notification will be given prior to</li> </ul>	<b>1</b>	<ul style="list-style-type: none"> <li>• All noise complaints will be recorded in the Complaints Register.</li> <li>• Amicable resolution of complaints</li> </ul>	<ul style="list-style-type: none"> <li>• Maintenance carried out on equipment is to be recorded.</li> <li>• Complaints Register.</li> </ul>

Aspect	Potential Impacts	UMRR <sup>2</sup>	Management Controls	RRR <sup>3</sup>	Performance Indicator	Records
	<ul style="list-style-type: none"> <li>confined to the drill pad with all work carried out during daytime hours only.</li> <li>Main vehicle movements are based around personnel movements to and from site. There are however the occasional deliveries and other personnel accessing the site outside of these times.</li> </ul>		<ul style="list-style-type: none"> <li>commencement of drilling.</li> <li>Equipment will be maintained so that noise levels remain constant.</li> <li>Complaints will be responded to in a timely manner.</li> <li>Where noise disturbance cannot be avoided, Santos will investigate alternative arrangements to suit the landholder.</li> <li>Noise barriers will be implemented if necessary</li> <li>The equipment used for the mobilisation and powering of the drilling rig have mufflers installed on their respective power plants and prime movers.</li> <li>The proposed drilling site is a distance of greater than 1km to the nearest dwelling in any direction.</li> </ul>			
<b>Soils, Land Use and Terrain</b>	<ul style="list-style-type: none"> <li>It is considered that the largest potential environmental impact associated with the activity is soil erosion from the disturbed land at the drill site and access tracks.</li> <li>Spills causing</li> </ul>	2	<ul style="list-style-type: none"> <li>All activities associated with land disturbance will be discussed with the Landholder prior to commencement.</li> <li>The area of all disturbances will be determined and placed</li> </ul>	1	<ul style="list-style-type: none"> <li>The site is rehabilitated upon completion of the activities.</li> </ul>	<ul style="list-style-type: none"> <li>Records of disturbance are maintained within Santos' GIS.</li> </ul>

Aspect	Potential Impacts	UMRR <sup>2</sup>	Management Controls	RRR <sup>3</sup>	Performance Indicator	Records
	contaminated land.		<p>within Santos' Geographic Information System (GIS).</p> <ul style="list-style-type: none"> <li>• An environmental assessment will be carried out prior to the acceptance of a site for a new activity.</li> <li>• This assessment determines landholder values, habitats, vegetation, and areas of significant environmental/cultural value to be avoided.</li> <li>• The assessment also outlines areas or issues requiring particular environmental management.</li> <li>• Bunding of all areas storing or handling fuel, fuel using equipment, and chemicals, in line with Australian Standard 1940; The Storage and Handling of Flammable and Combustible Liquids</li> <li>• Construction and Use of erosion control devices</li> </ul>			
<b>Waste</b>	<ul style="list-style-type: none"> <li>• No waste will be disposed of on site.</li> <li>• Domestic waste including sewage.</li> </ul>	<b>3</b>	<ul style="list-style-type: none"> <li>• General and recyclable wastes (including glass, paper and plastic) generated during construction will be</li> </ul>	<b>1</b>	<ul style="list-style-type: none"> <li>• Post construction checks to ensure all waste has been appropriately</li> </ul>	<ul style="list-style-type: none"> <li>• Waste management records.</li> <li>• Complaints</li> </ul>

Aspect	Potential Impacts	UMRR <sup>2</sup>	Management Controls	RRR <sup>3</sup>	Performance Indicator	Records
			<ul style="list-style-type: none"> <li>transported to landfill and recycling facilities on a routine basis.</li> <li>Regulated waste will be collected by licensed contractors for off-site disposal.</li> <li>Sewage will be collected by licensed contractor for off-site disposal.</li> <li>Complaints are addressed in a timely manner.</li> <li>Waste is disposed of at appropriate end point.</li> <li>All waste management non-compliances are managed in the Incident Management System.</li> <li>Any complaints from the landholders regarding waste management are recorded in the Complaints Register.</li> </ul>		<ul style="list-style-type: none"> <li>removed and disposed of.</li> <li>Operational checks to establish that all waste has been appropriately removed from the operational areas, or correctly stored and waiting for removal.</li> </ul>	register.
<b>Surface and Ground Water Resources</b>	<ul style="list-style-type: none"> <li>Incident or accident that may result in a release of oils or other chemicals maintenance fluids to the ground.</li> <li>Spills of chemicals or hazardous materials</li> </ul>	2	<ul style="list-style-type: none"> <li>Water removed from site will be managed by a contractor licensed to carry and handle water.</li> <li>Bunding of all areas storing or handling fuel,</li> </ul>	1	<ul style="list-style-type: none"> <li>No incidents where substances are released to surface or ground water causing contamination.</li> </ul>	<ul style="list-style-type: none"> <li>Records of spills, leaks and associated clean ups are to be managed using the</li> </ul>

Aspect	Potential Impacts	UMRR <sup>2</sup>	Management Controls	RRR <sup>3</sup>	Performance Indicator	Records
	<ul style="list-style-type: none"> <li>Transport of sediments disturbed by erosion of soils during construction activities.</li> </ul>		<p>fuel using equipment, and chemicals, in line with Australian Standard 1940 – 1993; The Storage and Handling of Flammable and Combustible Liquids</p> <ul style="list-style-type: none"> <li>Where applicable maintenance of roads, drains, bund walls, contour and diversion banks, will occur. All drainage structures are to be maintained for the life of the development.</li> <li>Utilizing over-balanced drilling techniques to prevent formation fluid from rising through the well the surface;</li> <li>Losses cured by LCM (cellulose material such as sawdust), most fluids will return to the surface;</li> <li>Casing the well with cement and steel before different formations are intersected; casing is pressure tested;</li> <li>Cementing to surface before well completion;</li> <li>Drilling muds while drilling assists in controlling fluid movement; and</li> </ul>		<ul style="list-style-type: none"> <li>Diversion mechanisms in place, regularly checked and maintained to redirect natural stormwater movement where required.</li> </ul>	<p>Incident Management System.</p> <ul style="list-style-type: none"> <li>Maintenance carried out to remedy any erosion and water channelling is to be recorded using the Incident Management System.</li> <li>Records of water storage inspections to be maintained.</li> </ul>

Aspect	Potential Impacts	UMRR <sup>2</sup>	Management Controls	RRR <sup>3</sup>	Performance Indicator	Records
			<ul style="list-style-type: none"><li>• Drilling and cementing procedures to ensure good oilfield practice.</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>			

## 5.11 Clause 228 Checklist

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 below.

Table 5-2: Clause 228 Checklist

<b>Factor</b>	<b>Positive/Negative Impact</b>
<p><i>Any environmental impact on the community</i></p> <p>The proposed site lies approximately 20 km west of Gunnedah.</p> <p>Minor short term impacts such as increase local traffic would be experienced. Safeguards proposed in Section 5 and Table 5-1 would minimise these impacts.</p>	Short term negative
<p><i>Any transformation of a locality</i></p> <p>There would be localised and non-permanent visual impact on the immediate vicinity of the site for the duration of the programme. Safeguards proposed in Section 5 and Table 5-1 would minimise these impacts.</p>	Short term negative
<p><i>Any environmental impact on the ecosystems of the locality</i></p> <p>The area of proposed activities is highly disturbed, no environmental impacts of the ecosystems of the locality would occur as a result of the project.</p>	Nil
<p><i>Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality</i></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 5-1 the potential for a reduction is considered negligible.</p>	Nil
<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> <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>	Nil

<b>Factor</b>	<b>Positive/Negative Impact</b>
<p><i>Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)</i></p> <p>The proposal would not significantly impact on the habitat of protected fauna.</p>	Nil
<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> <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>	Nil
<p><i>Any long-term effects on the environment</i></p> <p>The proposal would have no long-term effects on the environment</p>	Nil
<p><i>Any degradation of the quality of the environment</i></p> <p>There is potential for minor short term environmental degradation due to visual or dust impacts. Safeguards proposed in Section 5 and Table 5-1 would minimise these impacts.</p>	Minor short term negative
<p><i>Any risk to the safety of the environment</i></p> <p>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.</p>	Minor short term negative
<p><i>Any reduction in the range of beneficial uses of the environment</i></p> <p>The footprint of activities for the proposal would not result in any reduction in the range of beneficial use of the environment.</p>	Nil
<p><i>Any pollution of the environment</i></p> <p>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.</p>	Nil
<p><i>Any environmental problems associated with the disposal of waste</i></p>	Nil

<b>Factor</b>	<b>Positive/Negative Impact</b>
<p>Drill cuttings would be essentially inert and any drilling fluid conditions would be biodegradable or similarly inert and would be allowed to dry onsite and disposed of in drilling sumps.</p> <p>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 proposed activity waste production will be minimal.</p>	
<p><i>Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply</i></p> <p>Resources required for the proposal are not in limited supply in the area.</p>	Nil

## 6 Conclusions

Drilling of the proposed chip hole is a necessary step in evaluating the hydrocarbon potential of PEL 1. Discovery of coal seam gas resources in this area has the potential to increase the state's reserves and revenue from gas and underpin future exploration or production in the region.

A Land Access Agreement is in place for the landholder where the proposed site is located and that agreement addresses matters of access, compensation and rehabilitation. Santos will communicate with neighbouring landholders so as to identify any concerns with regard to planned activities.

The proposed activities have associated potential environmental impacts, which are common to drilling activities such as those carried out elsewhere in the Gunnedah Basin. It is considered that the potential impacts can be successfully mitigated with the application of the management strategies outlined in this document. The strategies are consistent with the APPEA Code of Environmental Practice and are typical of good hydrocarbon field practice.

Section 5A of the EP Act lists seven factors to be considered in relation to potential impacts on threatened species, populations or ecological communities, commonly referred to the seven part test of significance. An assessment was made against the seven factors to be considered under Section 5A of the EP &P Act i.e. "seven part test of significance" and concluded that:

- There are no known threatened species that would be impacted by the planned activities. The size and nature of the proposal is unlikely to effect the life cycle of any viable populations of threatened flora/fauna if present;
- There are no known endangered populations that have been identified that would be impacted by this proposal. The size and nature of the proposal is unlikely to effect the life cycle of any viable populations of endangered populations;
- There are no known endangered ecological communities or critically endangered communities that have been identified that would be impacted by this proposal; and
- It is not proposed to clear any critical habitat for this proposal.

With the implementation of the management measures outlined in Section 5, it is expected that:

- Impacts on landholders will be minimal;
- Impacts to air quality will be minor, localised and insignificant;
- Adverse effects on water resources will be minimal during drilling;
- Off-site impacts to soils will be avoided and on-site impacts will be minor and temporary;

- The potential noise impacts will be short term, and no threatened species or communities are likely to be impacted;
- There will be no significant use of, or impact to, natural resources;
- Impacts on the community and visual amenity will be insignificant and short term, particularly as the site is in a sparsely populated area;
- Impacts to known heritage places or sites will be avoided;
- Disturbances to pastoral and agricultural land use will be minor and short term and managed in consultation with affected landholder(s); and
- There will be no significant cumulative environmental impacts.

## 7 References

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**Further reading:**

Petroleum Exploration Licence (PEL) 1 Licence Instrument

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## Appendix A.

### Threatened Flora Species located in the Gunnedah LGA

Source: DECCW, NSW NPWS Atlas of Threatened Species database.

Species	Common Name	Status	Distribution/Habitat/Ecology
<i>Dichanthium setosum</i>	Bluegrass	Vulnerable	<p>Bluegrass occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, as well as in Queensland and Western Australia. It occurs widely on private property, including in the Inverell, Guyra, Armidale and Glen Innes areas.</p> <p>Associated with heavy basaltic black soils. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. It is open to question whether the species tolerates or is promoted by a certain amount of disturbance, or whether this is indicative of the threatening processes behind its depleted habitat.</p> <p>Locally common or found as scattered clumps in populations.</p> <p>Flowering time is mostly in summer.</p>
<i>Digitaria porrecta</i>	Finger Panic Grass	Endangered	<p>Finger Panic Grass occurs in NSW and Queensland. In NSW it is found on the North West Slopes and Plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran. It largely occurs on private land.</p> <p>Native grassland, woodlands or open forest with a grassy understorey, on richer soils. Often found along roadsides and travelling stock routes where there is light grazing and occasional fire.</p> <p><i>Digitaria porrecta</i> is a perennial tussock-forming grass that can vegetatively reproduce.</p> <p>Flowering season is summer or late summer.</p>
<i>Hakea Pulvinifera</i>	Lake Keepit Hakea	Endangered	<p>Lake Keepit Hakea is confined to the North West Slopes of NSW, where it is known from a single population near Lake Keepit, north-east of Gunnedah.</p>
<i>Cadellia pentastylis</i>	Ooline	Vulnerable	<p>Occurs along the western edge of the North West Slopes from north of Gunnedah to west of Tenterfield. Also occurs in Queensland. The natural range of Ooline is from 24°S to 30°S in the 500 to 750 mm per annum rainfall belt.</p>

## Appendix B.

### Noxious weeds likely to be found in region

Source: DPI Noxious weed declarations for Gunnedah Shire Council

Weed	Class	Legal requirements
African boxthorn [Lycium ferocissimum ]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
African feathergrass [Pennisetum macrourum ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
African turnipweed [Sisymbrium runcinatum ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
African turnipweed [Sisymbrium thellungii ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Alligator weed [Alternanthera philoxeroides ]	2	The plant must be eradicated from the land and the land must be kept free of the plant
Anchored water hyacinth [Eichhornia azurea]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Annual ragweed [Ambrosia artemisiifolia ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Arrowhead [Sagittaria montevidensis ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Artichoke thistle [Cynara cardunculus ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Athel pine [Tamarix aphylla ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Bathurst/Noogoora/Hunter/South American/Californian/cockle burr [Xanthium species ]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Bear-skin fescue [Festuca gautieri]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration

Weed	Class	Legal requirements
Black knapweed [ <i>Centaurea nigra</i> ]	1	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p> <p>This is an All of NSW declaration</p>
Blackberry [ <i>Rubus fruticosus</i> aggregate species ] except cultivars Black satin, Chehalem, Chester Thornless, Dirksen Thornless, Loch Ness, Murrindindi, Silvan, Smoothstem, Thornfree	4	<p>The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed</p> <p>This is an All of NSW declaration</p>
Blue heliotrope [ <i>Heliotropium amplexicaule</i> ]	4	<p>The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority</p>
Bridal creeper [ <i>Asparagus asparagoides</i> ]	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
Broomrapes [ <i>Orobanche</i> species] Includes all <i>Orobanche</i> species except the native <i>O. cernua</i> variety <i>australiana</i> and <i>O. minor</i>	1	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p> <p>This is an All of NSW declaration</p>
Burr ragweed [ <i>Ambrosia confertiflora</i> ]	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
Cabomba [ <i>Cabomba caroliniana</i> ]	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
Cayenne snakeweed [ <i>Stachytarpheta cayennensis</i> ]	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
Chilean needle grass [ <i>Nassella neesiana</i> ]	4	<p>The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed</p>
Chinese violet [ <i>Asystasia gangetica</i> subspecies <i>micrantha</i> ]	1	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p> <p>This is an All of NSW declaration</p>
Clockweed [ <i>Gaura parviflora</i> ]	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
Columbus grass [ <i>Sorghum x alnum</i> ]	4	<p>The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority</p>

Weed	Class	Legal requirements
Corn sowthistle [Sonchus arvensis ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Dodder [Cuscuta species]  Includes All Cuscuta species except the native species C. australis, C. tasmanica and C. victoriana	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
East Indian hygrophila [Hygrophila polysperma]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Espartillo [Achnatherum brachychaetum ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Eurasian water milfoil [Myriophyllum spicatum]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Fine-bristled burr grass [Cenchrus brownii ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Fountain grass [Pennisetum setaceum ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Gallon's curse [Cenchrus biflorus ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Galvanised burr [Sclerolaena birchii]	4	The plant must be controlled where it impacts on normal agricultural practices including cropping and pasture management
Giant Parramatta grass [Sporobolus fertilis ]	3	The plant must be fully and continuously suppressed and destroyed
Glaucous starthistle [Carthamus glaucus ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Golden dodder [Cuscuta campestris]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Golden thistle [Scolymus hispanicus ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration

Weed	Class	Legal requirements
Green cestrum [Cestrum parqui ]	3	The plant must be fully and continuously suppressed and destroyed
Harrisia cactus [Harrisia species ]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed  This is an All of NSW declaration
Hawkweed [Hieracium species]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Hemlock [Conium maculatum ]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Horsetail [Equisetum species]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Hymenachne [Hymenachne amplexicaulis]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Italian bugloss [Echium species ]		See Paterson's curse, Vipers bugloss, Italian bugloss
Johnson grass [Sorghum halepense ]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Karoo thorn [Acacia karroo]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Kochia [Bassia scoparia] except Bassia scoparia subspecies trichophylla	1	except B.scoparia subspecies trichophylla  The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Lagarosiphon [Lagarosiphon major]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Lantana [Lantana species ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Leafy elodea [Egeria densa]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration

Weed	Class	Legal requirements
Lippia [Phyla canescens]	4	<p>The plant must not be sold, propagated or knowingly distributed by any person other than a person involved in hay or lucerne production. The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.</p> <p>This is an All of NSW declaration</p>
Long-leaf willow primrose [Ludwigia longifolia ]	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
Long-style feather grass [Pennisetum villosum ]	4	<p>The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority</p>
Mesquite [Prosopis species ]	2	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p>
Mexican feather grass [Nassella tenuissima ]	1	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p> <p>This is an All of NSW declaration</p>
Mexican poppy [Argemone mexicana ]	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
Miconia [Miconia species]	1	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p> <p>This is an All of NSW declaration</p>
Mimosa [Mimosa pigra]	1	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p> <p>This is an All of NSW declaration</p>
Mossman River grass [Cenchrus echinatus ]	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
Mother-of-millions [Bryophyllum species and hybrids ]	4	<p>The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed</p>
Noogoora burr [Xanthium species ]		<p>See Bathurst/Noogoora/Hunter/South American/Californian/cockle burr</p>
Onion grass [Romulea species] Includes all Romulea species and varieties except R. rosea var. australis	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>

Weed	Class	Legal requirements
Oxalis [Oxalis species and varieties]  Includes all Oxalis species and varieties except the native species <i>O. chnoodes</i> , <i>O. exilis</i> , <i>O. perennans</i> , <i>O. radicosa</i> , <i>O. rubens</i> , and <i>O. thompsoniae</i>	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Pampas grass [Cortaderia species ]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Parkinsonia [Parkinsonia aculeata ]	2	The plant must be eradicated from the land and the land must be kept free of the plant
Parthenium weed [Parthenium hysterophorus]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Paterson's curse, Vipers bugloss, Italian bugloss [Echium species ]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Perennial ragweed [Ambrosia psilostachya ]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Pond apple [Annona glabra]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Prickly acacia [Acacia nilotica]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Prickly pear [Cylindropuntia species ]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed  This is an All of NSW declaration
Prickly pear [Opuntia species except <i>O. ficus-indica</i> ]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed  This is an All of NSW declaration
Red rice [Oryza rufipogon ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration

Weed	Class	Legal requirements
Rhus tree [ <i>Toxicodendron succedaneum</i> ]	4	<p>The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority</p> <p>This is an All of NSW declaration</p>
Rubberglove [ <i>Cryptostegia grandiflora</i> ]	1	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p> <p>This is an All of NSW declaration</p>
Sagittaria [ <i>Sagittaria platyphylla</i> ]	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
Salvinia [ <i>Salvinia molesta</i> ]	2	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p>
Sand oat [ <i>Avena strigosa</i> ]	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
Senegal tea plant [ <i>Gymnocoronis spilanthoides</i> ]	1	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p> <p>This is an All of NSW declaration</p>
Serrated tussock [ <i>Nassella trichotoma</i> ]	4	<p>The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed</p>
Siam weed [ <i>Chromolaena odorata</i> ]	1	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p> <p>This is an All of NSW declaration</p>
Silk forage sorghum [ <i>Sorghum</i> species hybrid cultivar ]	4	<p>The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority</p>
Silver-leaf nightshade [ <i>Solanum elaeagnifolium</i> ]	3	<p>The plant must be fully and continuously suppressed and destroyed</p>
Smooth-stemmed turnip [ <i>Brassica barrelieri</i> subspecies <i>oxyrrhina</i> ]	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
Soldier thistle [ <i>Picnomon acarna</i> ]	5	<p>The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with</p> <p>This is an All of NSW declaration</p>
Spotted knapweed [ <i>Centaurea maculosa</i> ]	1	<p>The plant must be eradicated from the land and the land must be kept free of the plant</p> <p>This is an All of NSW declaration</p>

Weed	Class	Legal requirements
St. John's wort [Hypericum perforatum ]	3	The plant must be fully and continuously suppressed and destroyed
Texas blueweed [Helianthus ciliaris ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Tree-of-heaven [Ailanthus altissima ]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Water caltrop [Trapa species]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Water hyacinth [Eichhornia crassipes ]	2	The plant must be eradicated from the land and the land must be kept free of the plant
Water lettuce [Pistia stratiotes]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Water soldier [Stratiotes aloides]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Wild radish [Raphanus raphanistrum ]	4	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority
Willows [Salix species]  Includes all Salix species except S. babylonica, S. x reichardtii, S. x calodendron	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration
Witchweed [Striga species]  Includes all Striga species except native species and Striga parviflora	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Yellow burrhead [Limnocharis flava]	1	The plant must be eradicated from the land and the land must be kept free of the plant  This is an All of NSW declaration
Yellow nutgrass [Cyperus esculentus ]	5	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with  This is an All of NSW declaration

## Appendix C.

### Threatened Fauna Species in Gunnedah LGA

Source: DECCW, NSW NPWS Atlas of Threatened Species database.

Species	Common Name	Status	Distribution/habitat/foraging/breeding
<b>Aves</b>			
<i>Pyrrholaemus sagittatus</i>	Speckled Warbler	Vulnerable	<p>The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100ha survive.</p> <p>The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area.</p> <p>The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees. Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding.</p> <p>The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter. A side entrance allows the bird to walk directly inside.</p>
<i>Circus assimilis</i>	Spotted Harrier	Vulnerable	No information available in the Atlas.
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard	Vulnerable	<p>The Black-breasted Buzzard is found sparsely in areas of less than 500mm rainfall i.e. north-western NSW.</p> <p>Lives in a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat.</p> <p>Breeds from August to October near water in a tall tree.</p>
<i>Hieraetus morphnoides</i>	Little Eagle	Vulnerable	No information available in the Atlas.
<i>Lophoictinia isura</i>	Square-tailed kite	Vulnerable	<p>The Square-tailed Kite ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March. Found in a variety of timbered habitats. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country. Is a specialist hunter of passerines. Appears to occupy large hunting ranges of more than 100km<sup>2</sup>. Breeding July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.</p>

<b>Species</b>	<b>Common Name</b>	<b>Status</b>	<b>Distribution/habitat/foraging/breeding</b>
<i>Stictinetta naevosa</i>	Freckled Duck	Vulnerable	The Freckled Duck is found primarily in south-eastern and south-western Australia, occurring as a vagrant elsewhere. It breeds in large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system, particularly along the Paroo and Lachlan Rivers, and other rivers within the Riverina. The duck is forced to disperse during extensive inland droughts when wetlands in the Murray River basin provide important habitat. The species may also occur as far as coastal NSW and Victoria during such times. Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.
<i>Burhinus grallarius</i>	Bush Stone-curlew	Endangered	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights.
<i>Calyptorhynchus lathami</i>	Glossy Black Cockatoo	Vulnerable	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak ( <i>Allocasuarina littoralis</i> ), Forest She-oak ( <i>A. torulosa</i> ) or Drooping She-oak ( <i>A. verticillata</i> ) occur.
<i>Climacteris picumnus</i>	Brown Treecreeper	Vulnerable	<p>The Brown Treecreeper is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges.</p> <p>The Brown Treecreeper climbs up the trunks and branches of trees in search of food. It probes into cavities and under loose bark with its long downward curving bill. In this way it searches for insects and their larvae. The most favoured insects are ants. Some feeding also takes place on the ground on fallen logs. Sometimes, birds can be seen diving on ground-dwelling prey from a perch in a tree. Feeding normally takes place in pairs or small groups.</p> <p>Brown Treecreepers breed from June to January each year. During this season, pairs often have two broods of two to three young. The nest is a collection of grasses, feathers and other soft material, placed in a suitable tree hollow or similar site.</p>

Species	Common Name	Status	Distribution/habitat/foraging/breeding
<i>Stagonopleura guttata</i>	Diamond Firetail	Vulnerable	<p>The Diamond Firetail is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. Not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. This species has a scattered distribution over the rest of NSW. Also found in the Australian Capital Territory, Queensland, Victoria and South Australia.</p> <p>Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands. Also occurs in open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.</p> <p>Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season).</p>
<i>Leipoa ocellata</i>	Malleefowl	Endangered	<p>Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300-450 mm mean annual rainfall) areas. Less frequently found in other eucalypt woodlands (e.g., mixed Western Grey Box and Yellow Gum or Bimble Box, Ironbark-Callitris Pine, Callitris Pine, Mulga (<i>Acacia aneura</i>), and Gidgee (<i>A. cambagei</i>)).</p>
<i>Grantiella Picta</i>	Painted honey-eater	Vulnerable	<p>The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema. Insects and nectar from mistletoe or eucalypts are occasionally eaten. Nest from spring to autumn in a small, delicate nest hanging within the outer canopy of drooping eucalypts, she-oak, paperbark or mistletoe branches.</p>
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	Vulnerable	<p>The subspecies is widespread, from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond River district. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (<i>Eucalyptus sideroxylon</i>), White Box (<i>Eucalyptus albens</i>), Grey Box (<i>Eucalyptus microcarpa</i>), Yellow Box (<i>Eucalyptus melliodora</i>) and Forest Red Gum (<i>Eucalyptus tereticornis</i>).</p> <p>Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees. A gregarious species usually seen in pairs and small groups of up to 12 birds. Feeding territories are large making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 hectares.</p>

Species	Common Name	Status	Distribution/habitat/foraging/breeding
<i>Xanthomyza phrygia</i>	Regent Honeyeater	Endangered	<p>The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundera-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years non-breeding flocks converge on flowering coastal woodlands and forests.</p> <p>The Regent Honeyeater is a flagship threatened woodland bird whose conservation will benefit a large suite of other threatened and declining woodland fauna. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species.</p>
<i>Daphoenositta chrysoptera</i>	Varied Sittella	Vulnerable	No information available in the Atlas.
<i>Melanodryas cucullata</i>	Hooded Robin	Vulnerable	No information available in the Atlas.
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subspecies)	Vulnerable	<p>The Grey-crowned Babbler is found throughout large parts of northern Australia and in south-eastern Australia. In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Hay.</p> <p>Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Feed on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses</p> <p>Build and maintain several conspicuous, dome-shaped stick nests about the size of a football. A nest is used as a dormitory for roosting each night. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts. Nests are maintained year round, and old nests are often dismantled to build new ones.</p>
<i>Glossopsitta pusilla</i>	Little Lorikeet	Vulnerable	No information available in the Atlas.
<i>Lathamus discolor</i>	Swift Parrot	Endangered	<p>The Swift Parrot is small parrot about 25 cm long. It is bright green with red around the bill, throat and forehead. Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland.</p> <p>In NSW mostly occurs on the coast and south west slopes. Commonly used lerp infested trees include Grey Box E. microcarpa, Grey Box E. moluccana and Blackbutt E. pilularis.</p> <p>Return to home foraging sites on a cyclic basis depending on food availability. Following winter they return to Tasmania where they breed from September to January, nesting in old trees with hollows and feeding in forests dominated by Tasmanian Blue Gum E. globulus. Migrates to the Australian south-east mainland between March and October</p>

<b>Species</b>	<b>Common Name</b>	<b>Status</b>	<b>Distribution/habitat/foraging/breeding</b>
<i>Neophema pulchella</i>	Turquoise Parrot	Vulnerable	The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Forages quietly and may be quite tolerant of disturbance. However, if flushed it will fly to a nearby tree and then return to the ground to browse as soon as the danger has passed. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.
<i>Ninox connivens</i>	7.1.1.1.1 Barking Owl	Vulnerable	The Barking Owl is found throughout Australia except for the central arid regions and Tasmania. It is quite common in parts of northern Australia, but is generally considered uncommon in southern Australia. It has declined across much of its distribution across NSW and now occurs only sparsely. It is most frequently recorded on the western slopes and plains. It is rarely recorded in the far west or in coastal and escarpment forests. Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as Acacia and Casuarina species, or the dense clumps of canopy leaves in large Eucalypts.
<i>Tyto novaehollandiae</i>	Masked Owl	Vulnerable	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. A forest owl, but often hunts along the edges of forests, including roadsides. The typical diet consists of tree-dwelling and ground mammals, especially rats. Pairs have a large home-range of 500 to 1000 hectares. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.
<b>Mammalian</b>			

Species	Common Name	Status	Distribution/habitat/foraging/breeding
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	Vulnerable	<p>The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes.</p> <p>Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest.</p> <p>Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable.</p> <p>Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (<i>Pseudocheirus peregrinus</i>) dreys or thickets of vegetation, (eg. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks.</p> <p>Appear to be mainly solitary, each individual using several nests, with males having non-exclusive home-ranges of about 0.68 hectares and females about 0.35 hectares.</p> <p>Young can be born whenever food sources are available, however most births occur between late spring and early autumn.</p>
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	Vulnerable	<p>Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Mostly nocturnal, although will hunt during the day; spends most of the time on the ground, although also an excellent climber and may raid possum and glider dens and prey on roosting birds.</p>
<i>Saccopteryx flaviventris</i>	Yellow-bellied Sheathtail-bat	Vulnerable	<p>The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country.</p>
<i>Macropus dorsalis</i>	Black-striped Wallaby	Endangered	<p>From the Townsville area in Queensland to northern NSW where it occurs on both sides of the Great Divide. On the north west slopes of NSW it occurs in Brigalow remnants to south of Narrabri. On the north coast it is confined to the upper catchments of the Clarence and Richmond Rivers. Preferred habitat is characterised by dense woody or shrubby vegetation within three metres of the ground. This dense vegetation must occur near a more open, grassy area to provide suitable feeding habitat. On the north west slopes, associated with dense vegetation, including brigalow, ooline and semi-evergreen vine thicket.</p> <p>On the north coast, closely associated with dry rainforest but also occur in moist eucalypt forest with a rainforest understorey or a dense shrub layer.</p>

<b>Species</b>	<b>Common Name</b>	<b>Status</b>	<b>Distribution/habitat/foraging/breeding</b>
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	Vulnerable	The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW. Habitat and ecology Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. Usually solitary but also recorded roosting communally, probably insectivorous.
<i>Petaurus norfolcensis</i>	Squirrel Glider	Vulnerable	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. 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. Prefers mixed species stands with a shrub or Acacia midstorey. Require abundant tree hollows for refuge and nest sites. Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.
<i>Phascolarctos cinereus</i>	Koala	Vulnerable	The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the western region. It was historically abundant on the south coast of NSW, but now occurs in sparse and possibly disjunct populations. Koalas are also known from several sites on the southern tablelands. Inhabit eucalypt woodlands and forests and feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Inactive for most of the day, feeding and moving mostly at night. Spend most of their time in trees, but will descend and traverse open ground to move between trees. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size. Generally solitary, but have complex social hierarchies based on a dominant male with a territory overlapping several females and subordinate males on the periphery. Females breed at two years of age and produce one young per year.
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	Vulnerable	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin ( <i>Hirundo ariel</i> ), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies.

<b>Species</b>	<b>Common Name</b>	<b>Status</b>	<b>Distribution/habitat/foraging/breeding</b>
<i>Chalinolobus picatus</i>	Little Pied Bat	Vulnerable	The Little-Pied Bat is found in inland Queensland and NSW (including Western Plains and slopes) extending slightly into South Australia and Victoria. Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee, Bimbil box. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. Can tolerate high temperatures and dryness but need access to nearby open water. Feeds on moths and possibly other flying invertebrates.
<i>Nyctophilus timoriensis</i> (South-eastern form)	Greater Long-eared Bat	Vulnerable	Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species. Inhabits a variety of vegetation types, including mallee, bulloke Allocasuarina leuhmanni and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark. Slow flying agile bat, utilising the understorey to hunt non-flying prey - especially caterpillars and beetles - and will even hunt on the ground. Mating takes place in autumn with one or two young born in late spring to early summer.
<b>Reptiles</b>			
<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake	Vulnerable	A patchy distribution from north-east Queensland to north-east NSW. In NSW it occurs from the coast to the western side of the Great Divide as far south as Tuggerah. 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. Shelter during the day between loose bark and tree-trunks, or in hollow trunks and limbs of dead trees. The main prey is tree frogs although lizards and small mammals are also taken.
<i>Underwoodisaurus sphyrurus</i>	Border Thick-tailed Gecko	Vulnerable	Found only on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree. Most common in the granite country of the New England Tablelands. Often occurs on steep rocky or scree slopes. Favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter.
<i>Aprasia parapulchella</i>	Pink-tailed Legless lizard	Vulnerable	The Pink-tailed Worm Lizard is only known from the Central and Southern Tablelands, and the South Western Slopes. Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass ( <i>Themeda australis</i> ). Feeds on the larvae and eggs of the ants with which it shares its burrows. It is thought that this species lays 2 eggs inside the ant nests during summer; the young first appear in March.
<b>Rodents</b>			
<i>Pseudomys pilligaensis</i>	Pilliga Mouse	Vulnerable	Distribution restricted to the Pilliga region of New South Wales.

## Appendix D.

### EPBC Threatened Species

Species	Common Name	Status	Distribution/habitat/foraging/breeding
<b>Birds</b>			
<i>Leipoa ocellata</i>	Malleefowl	Vulnerable	Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300-450 mm mean annual rainfall) areas. Less frequently found in other eucalypt woodlands (e.g., mixed Western Grey Box and Yellow Gum or Bimble Box, Ironbark-Callitris Pine, Callitris Pine, Mulga ( <i>Acacia aneura</i> ), and Gidgee( <i>A. cambagei</i> )).
<i>Polytelis swainsonii</i>	Superb Parrot	Vulnerable	The Superb Parrot is a medium-sized (length: 40 cm; weight: 130–160 g) parrot with bright green plumage and a long tail. The species is usually seen in small flocks, and occasionally larger ones of up to 60 or more birds. When females are incubating, flocks may be comprised only of males.  The Superb Parrot occurs only in south-eastern Australia. The Superb Parrot is found in NSW and northern Victoria, where it occurs on the inland slopes of the Great Divide and on adjacent plains, especially along the major river-systems; vagrants have also been recorded in southern Queensland.
<i>Lathamus discolor</i>	Swift Parrot	Endangered	Breeds in Tasmania; migrates in autumn and winter to mainland; forages in nectar rich iron bark forests
<i>Rostratula australis</i>	Australian Painted Snipe	Vulnerable	The Australian Painted Snipe is usually found in shallow inland wetlands, either freshwater or brackish, that are either permanently or temporarily filled. It is a cryptic bird that is hard to see and often overlooked. Usually only single birds are seen, though larger groups of up to 30 have been recorded. It nests on the ground amongst tall reed-like vegetation near water, and feeds near the water's edge and on mudflats, taking invertebrates, such as insects and worms, and seeds.

Species	Common Name	Status	Distribution/habitat/foraging/breeding
<i>Anthochaera phrygia</i>	Regent Honeyeater	Endangered	<p>The Regent Honeyeater was once common in the woodlands of eastern Australia, particularly along the inland slopes of the Great Dividing Range. It once occurred as far west as Adelaide, but has now disappeared from South Australia and western Victoria. Within this reduced range its population is fragmented, and the only breeding habitat is in north-eastern Victoria and the central coast of New South Wales.</p> <p>Regent Honeyeaters feed on nectar and insects within box-ironbark eucalypt forests. When they're not breeding, birds roam widely in search of these unpredictable food sources.</p> <p>Approximately 75% of this habitat has been destroyed by clearing, and the habitat that remains is being degraded by the continuing removal of trees.</p>
<b>Frogs</b>			
<i>Litoria booroongensis</i>	Booroolong Frog	Endangered	<p>The Booroolong Frog is an amphibious frog known only from the tablelands and slopes of New South Wales. It typically inhabits rocky western-flowing creeks and their headwaters, although a small number of animals have also been recorded in eastern-flowing streams.</p> <p>It is a seasonal breeder which is found on or under rocks and debris of suitable streams. Although nocturnal, this species can also be found on rocks in or near the water during daylight hours. Surveys of western-flowing streams from the Northern Tablelands conducted over the past 15 years have failed to locate these frogs in all but one locality, although historical records indicate they were once widespread. It is suspected that the species is regionally extinct in all but the south of this area.</p>
<b>Mammals</b>			
<i>Chalinolobus dwyeri</i>	Large eared Pied Bat	Vulnerable	<p>Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.</p>

Species	Common Name	Status	Distribution/habitat/foraging/breeding
<i>Petrogale penicillata</i>	Brush-tailed Rock Wallaby	Vulnerable	<p>Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.</p> <p>Shelter or bask during the day in rock crevices, caves and overhangs and are most active at night. Highly territorial and have strong site fidelity with an average home range size of about 15 ha.</p>
<i>Nyctophilus timoriensis</i> (South-eastern form)	Greater Long-eared Bat	Vulnerable	<p>Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species.</p> <p>Inhabits a variety of vegetation types, including mallee, bulloke Allocasuarina leuhmanni and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland.</p> <p>Roosts in tree hollows, crevices, and under loose bark. Slow flying agile bat, utilising the understorey to hunt non-flying prey - especially caterpillars and beetles - and will even hunt on the ground. Mating takes place in autumn with one or two young born in late spring to early summer.</p>
<i>Dasyurus maculatus</i> (SE mainland population)	Spot-tailed Quoll	Endangered	<p>Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.</p> <p>Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.</p> <p>Mostly nocturnal, although will hunt during the day; spends most of the time on the ground, although also an excellent climber and may raid possum and glider dens and prey on roosting birds.</p>

Species	Common Name	Status	Distribution/habitat/foraging/breeding
<i>Pteropus poliocephalus</i>	Grey-headed flying-fox	Vulnerable	<p>Grey-headed Flying-foxes are found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria.</p> <p>Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Annual mating commences in January and a single young is born each October or November.</p>
<b>Plants</b>			
<i>Cynanchum elegans</i>	White-flowered Wax Plant	Endangered	<p>Restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. The species has been recorded as far west as Merriwa in the upper Hunter River valley.</p> <p>The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation.</p> <p>Flowering occurs between August and May, with a peak in November. Flower abundance on individual plants varies from sparse to prolific.</p>
<i>Digitaria porrecta</i>	Finger Panic grass	Endangered	<p>Finger Panic Grass occurs in NSW and Queensland. In NSW it is found on the North West Slopes and Plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran. It largely occurs on private land.</p>
<i>Diuris sheaffiana</i>	Tricolour Diuris Pink Donkey Orchid	Vulnerable	<p>The Pine Donkey Orchid grows in sclerophyll forest among grass, often with native Cypress Pine (<i>Callitris</i> spp.). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW.</p> <p>Usually recorded as common and locally frequent in populations, however only one or two plants have also been observed at sites. The species has been noted as growing in large colonies.</p> <p>Disturbance regimes are not known, although the species is usually recorded from disturbed habitats.</p> <p>Associated species include <i>Callitris glaucophylla</i>, <i>Eucalyptus populnea</i>, <i>Eucalyptus intertexta</i>, Ironbark and <i>Acacia</i> shrubland. The understorey is often grassy with herbaceous plants such as <i>Bulbine</i> species.</p> <p>Flowers from September to November or generally spring. The species is a tuberous, deciduous terrestrial orchid and the flowers have a pleasant, light sweet scent.</p>

Species	Common Name	Status	Distribution/habitat/foraging/breeding
<i>Philotheca ericifolia</i>		Vulnerable	<p><i>Philotheca ericifolia</i> is a shrub growing to 2 m high with white, possibly pink flowers.</p> <p>This species inhabits the north-western slopes and central western slopes of NSW, from the upper Hunter Valley, to Pilliga and to the Peak Hill district. The species is found at Goonoo Forest near Mogriguy, Pilliga Forest, Harvey Ranges and Peak Hill. It is conserved in Wingen Maid NR, where there are fewer than 1000 plants.</p> <p>There have been many recent collections of the species. A large population is reported to occur in Biddon SF near Gilgandra.</p> <p>This species occurs in drainage areas in dry sclerophyll open forest or woodland on sandstone, and in heath on damp sandy flats and gullies. Specific microclimates include damp sandy flats, alluvial deposits of coarse gravel in dry creek beds and along a spur receiving soakage from high ground. Associated species include <i>Eucalyptus crebra</i>, <i>Beyeria viscosa</i> and <i>Philotheca australis</i>.</p>
<i>Thesium australe</i>	Austral Toadflax	Vulnerable	<p>Austral Toad-flax is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands.</p> <p>Occurs in grassland or grassy woodland. Often found in damp sites in association with Kangaroo Grass (<i>Themeda australis</i>).</p> <p>A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.</p>
<i>Tylophora linearis</i>		Endangered	<p>Found in the Barraba, Mendooran, Temora and West Wyalong districts in the northern and central western slopes of NSW. Records include Crow Mountain near Barraba, Goonoo SF, Pilliga West SF, Cumbil SF, Eura SF, Coolbaggie NR, Goobang NP and Beni CCA.</p> <p>Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of <i>Eucalyptus fibrosa</i>, <i>Eucalyptus sideroxylon</i>, <i>Eucalyptus albens</i>, <i>Callitris endlicheri</i>, <i>Callitris glaucophylla</i> and <i>Allocasuarina luehmannii</i>.</p> <p>Flowers in spring, with flowers recorded in November or May with fruiting probably 2 to 3 months later.</p>

## Appendix E.

### Santos Group Risk Assessment Matrix

Santos Group Risk Matrix		Consequences				
Consequence Type		Negligible	Minor	Moderate	Major	Critical
<b>Health and Safety</b>	Minor injury - first aid treatment	Injury requiring medical treatment with no lost time	Injury requiring medical treatment, time off work and rehabilitation	Permanent disabling injury and/or long term off work	Fatality	
<b>Natural Environment</b>	Negligible impact on fauna/flora, habitat, aquatic ecosystem or water resources. Incident reporting according to routine protocols	Impact on fauna, flora and/or habitat but no negative effects on ecosystem. Requires immediate regulator notification	Short term impact on sensitive environmental features (e.g. gibber plain). Triggers regulatory investigation.	Long term impact of regional significance on sensitive environmental features (e.g. wetlands). Likely to result in regulatory intervention/action	Destruction of sensitive environmental features. Severe impact on ecosystem. Regulatory & high level Government intervention/ action.	
<b>Reputation</b>	Minimal impact to reputation	Some impact on business reputation	Moderate to small impact on business reputation.	Significant impact on business reputation and/or national media exposure.	Critical impact on business reputation /or international media exposure	
<b>Financial</b>	Financial loss from \$0 to \$500,000	Financial loss from \$500,000 to \$5 Million.	Financial loss from \$5 Million to \$50 Million	Financial loss from \$50 Million to \$100 Million	Financial loss in excess of \$100 Million	

		Consequences					
Consequence Type		Negligible	Minor	Moderate	Major	Critical	
		I	II	III	IV	V	
Almost Certain Is expected to occur in most circumstances	Likelihood	A	2	3	4	5	5
		B	1	3	3	4	5
		C	1	2	3	3	4
		D	1	1	2	2	3
		E	1	1	1	1	2

	Risk Level		Guideline for Risk Management
	5		Immediate action or suspend activity. Notify VP. RMP by 1 week
	4		Allocate manager responsibility, notify VP - RMP by 2 weeks
	3		Allocate manager responsibility - RMP by 1 month
	2		Manage by specific monitoring of controls. RMP by 3 months
	1		Manage by routine procedures and regular monitoring

## Appendix F.

### Drilling Chemicals MSDS Information

## Cultural Heritage Clearance

# Request for Cultural Heritage Clearance Form (Version 3.1, 26 March 2009)

## Request Details

Asset Type:	Well Road
Asset Name:	Collygra 1 - rev 1
Description of activity, including location and machinery involved	Dozer, Excavator and Grader to construct lease and access track
Activity Start Date:	29/11/2010
Activity End Date:	6/12/2010
Project Cost Code:	5637941-242
State:	NSW
Tenement:	PEL 1
Requestor Name:	Tanya Mann
Request Date:	13/10/2010

Requestor Contact Detail	Requestor Contact Detail Type
07 3838 3379	Phone

Please input the latitude and longitude for the location of the activity, 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	
	-31	2	51.17	150	2	33.31	revised location of Collygr...

Please also provide the GPS Datum from the GPS, which will usually be GDA94.

GPS Datum:	GDA94
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Please attach a location map, photographs or other documents and their description to provide as much information as possible.

Location Map Or Photograph	Description

## Clearance Details

Relevant CHMP, CHMA Or Legislation:	NSW
Does this clearance require the involvement of the relevant Aboriginal Group?	<input type="radio"/> Yes <input checked="" type="radio"/> No

## Approval Details

Approval Basis:	No survey or inspection required
Has the Activity Location Or Alignment Changed?	<input type="radio"/> Yes <input checked="" type="radio"/> No
If the Activity Location or Alignment has changed, please provide details here:	
Approval Comments:	

Approved Location if different to that Requested; Degrees, Minutes, Seconds

Latitude			Longitude		
Deg	Min	Sec	Deg	Min	Sec

Please add any supporting documentation as necessary.

Approval Supporting Document	Approval Supporting Document Description
<input type="button" value="File Attachment"/>	The lease site does not have features that may contain Aboriginal cultural heritage. The area has been heavily disturbed by agriculture including land clearing, grazing and farming infrastructure.

Approved By:	Steven Coghill
Approved Date:	22/11/2010
Has the Requestor Received the	<input checked="" type="radio"/> Yes <input type="radio"/> No

Approval?	
When was the requestor sent the Approval?	22/11/2010