Review of Environmental Factors

Sicamous 1 Chip Hole – PEL 1, Gunnedah Basin

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| Lot 37 DP 755480 and 114 on DP755480, Goran Lake Road  
| Titleholder Declaration (Joint Titleholder): | As joint titleholder I declare that the information contained in this Review of Environmental Factors is neither false nor misleading.  
| Name: Santos QNT Pty Ltd (as joint title holder declaration)  
| Signature: | Date: |
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Appendix B: Aboriginal Heritage Duel Diligence Report, prepared by RPS
Appendix C: Santos Drill Rig Noise Assessment, prepared by SLR
Appendix D: Chip Hole Design, prepared by Santos
Appendix E: Environmental Management Plan, prepared by RPS
Appendix F: Advice on Lake Goran Flood Levels, prepared by RPS Aquaterra
Executive Summary

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

The subject site forms part of a property called “Hillgrove”, the homestead of which is just over 1km from the site to the north-west. Breeza State Forest is approximately 1km north of the proposal well lease.

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

- Ecological Assessment, prepared by RPS
- Aboriginal Heritage Due Diligence Report, prepared by RPS
- Santos Drill Rig Noise Assessment, prepared by Heggies (now SLR)
- Advice on Lake Goran flood levels, prepared by RPS Aquaterra

The Proposal

The proposed appraisal program includes drilling at the Sicamous 1 location to obtain information on coal depths, seam thickness, continuity, gas composition (as required) and reservoir pressure and permeability. Sicamous 1 is planned as a ‘chip hole’ which means that no continuous core is planned to be collected from the well. Following drilling to the well total depth and conduct of required well logging and testing the well will be plugged and abandoned with cement plugs from total depth to surface.

In summary, the process involves:

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

The drilling of the well is expected to occur over approximately 40 day period not including lease build, or site rehabilitation. There will be 14 days of lease construction activities prior to drilling the well. Rehabilitation activities of 30 days following the drilling of the well will be additional to this period. This equates to a total of approximately 84 days.

The hours of operation during the drilling will be on a 12 hour a day basis as negotiated with the landholder.
Environmental Impacts

Ecology

The proposed lease is located within a grazing pasture, and is currently void of vegetation due to wildfire. While the well lease is currently cleared of vegetation, it is likely to have previously supported White Box, as well as native grasses. As such, it is likely that the well lease is considered to be White Box-Yellow Box-Blakely’s Red Gum grassy woodland, an Endangered Ecological Community (EEC) listed under the Threatened Species Conservation Act (TSC Act). The proposed well lease location will result in disturbances to this area, namely top soil removal, and removal of regenerating vegetation.

The proposed activity is not considered to have a significant impact on the Threatened Ecological Community (TEC), as it will result in limited disturbance to ground cover vegetation only. No canopy vegetation is located within the well lease or adjacent to the access track. The proposed activity is considered to have minimal impacts on fauna habitat, as no canopy trees or structurally diverse vegetation will be cleared as part of construction.

Potential indirect ecological impacts associated with the proposed activity include dust generation, soil erosion, weed invasion, and transportation of weeds off site. Impacts are considered to be minimal.

The potential impacts associated with the proposed activities are generally short-term and temporary. The proposed well lease is located within an area that has been heavily disturbed by fire, and was previously likely to be comprised of disturbed native grassland. This area is in poor ecological condition, and of little habitat value due to the high levels of disturbance. As such, impacts are considered to be negligible.

Heritage

A due diligence investigation was carried out for the project area. This included a 10km x 10km search of the Office of Environment & Heritage’s (OEH’s) Aboriginal Heritage Information Management System (AHIMS) database. A total of 19 Aboriginal sites were identified, however none were identified within the vicinity of the proposed core hole location. The majority of sites recorded within a 10km radius of the project area were modified/scarred trees (63.19%). In addition, a review of environmental conditions, previous archaeological reports and a site inspection were carried out. As a result of the due diligence investigation, it was concluded that it was unlikely that the proposed work would disturb, harm or damage any Aboriginal object or place.

The site is wholly situated within the Gunnedah local Government area, approximately 7 km east of Goran Lake, and approximately 1km south of Breeza State Forest. A search of the Australian Heritage Database, the State Heritage Inventory and Gunnedah Local Environment Plan (LEP) indicate that there are no European heritage items registered within the vicinity of the project area.

Ground Water

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

There are potential impacts of any drilling in mixed multi-aquifer systems that relate to the possibility of cross contamination of aquifers, the possibility of contamination of the aquifers by drilling muds/fluids and groundwater discharging to the surface, which might cause flooding or impact on surface water quality depending on the discharge and receiving water qualities. However, it is anticipated that the proposed drilling and chip hole construction and abandonment methodologies will eliminate the risk.

There is also the potential impact of seepage of drilling mud, drilling additives and/or hydrocarbons (oils/lubricants etc) to shallow groundwater beneath the rig and chip hole site. During drilling, the circulating
drilling mud will establish a wall cake (low permeability “skin” around the wall of the hole) and also maintain a positive head (pressure) on the various aquifers intercepted (NB. there are no artesian pressures in the area). This will both prevent the ingress of groundwater to the hole (and any possible mixing or discharge to the surface) and also limit the ingress of drilling mud into the aquifers in the immediate vicinity of the chip hole.

At the completion of the drilling of the shallow and intermediate sections of the chip hole, the section will be cased with steel pipe and pressure cemented into place and this will provide a solid barrier to prevent any ingress, mixing or discharge of groundwater. Following the completion of drilling activities, the chip hole will be plugged and cement grouted, further providing a solid barrier to any of the possible mixing and cross contamination processes.

Mitigation measures include monitoring of private groundwater bores, lining of drilling sumps and removal of all drilling fluids prior to rehabilitation. Risks associated with hazardous substances are addressed within the Environmental Management Plan (EMP). Appropriate management measures to control the handling and storage of chemical and hazardous substances and for spill prevention and response and to minimise and manage waste will be implemented.

**Air**

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

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

**Noise**

Temporary noise generation will occur as a result of the drilling of the chip hole. This is likely to occur over a 40 day period. The closest residence is just over 1km from the proposed chip hole. Based on a generic noise assessment undertaken by Heggies (now SLR) for the relevant drill rig to be used in the proposal, noise levels at the residence are anticipated to be negligible and well within guideline levels.

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

**Surface water**

Goran Lake is located to the west of the proposed chip hole. The lake is ephemeral, with water levels fluctuating throughout the year. The well lease is approximately 200m from the highest level of the lake and above the highest known flood level of the lake. Goran Lake is identified as a nationally important wetland (however is not listed as a RAMSAR wetland).

There is the potential for the proposed activities to impact on the surface water quality of Goran Lake through sedimentation and site run-off. There is also the potential for chemicals and fuels to come in contact with surface waters. It is considered that the potential impacts associated with surface water can be appropriately managed if the mitigation measures identified in the REF are implemented. These include the handling and storage of fluids, fuels and waste water and the installation of sediment fences and traps.

**Soils**

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

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

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

**Chemical and hazardous substances management**

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

**Contaminated Land**

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

**Waste Minimisation and management**

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

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

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

**Natural resource use**

The key natural resources that would be affected by the proposed drilling operations are agricultural land resources and fuels for the drilling equipment and transportation of staff. A relatively minor proportion of the overall area of the property would be taken from agricultural use during the duration of works, approximately 74 days. The disturbed areas will be rehabilitated by returning them to at least their pre-operational state or to a condition agreed by the landholder. Therefore, there would be a temporary loss of the use of this agricultural land in agreement with the landholder and, in the context of the total agricultural land holding and the wider agricultural uses of the region, is of minimal significance.
Fuels will be used for equipment and also for works and staff vehicles although this is not likely to be a significant quantity of fuel use. However the fuel should be used as efficiently as possible through appropriate work behaviour (e.g. switching off equipment when not in use).

Local Community and Neighbouring Properties

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

The nearest residential dwelling is just over 1km to the north west of the site. The closest community is Spring Ridge which is approximately 12km to the south of the site. Breeza is approximately 20km to the east of the site and Curlewis approximately 18km to the north.

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

Drilling will be undertaken on a 12 hour basis and measures to mitigate noise are identified. There is not anticipated to be a significant visual impact because the activities are temporary.

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

Visual Assessment

The operations are temporary in nature, with a duration of approximately 84 days, and all equipment will be removed on completion of site activities. The closest residence is just over 1km away to the north-west. Following completion of the works all sites will be rehabilitated and would not detract from the overall scenic qualities of the area.

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

Land Use

There will be a temporary loss of use of approximately 4,800m$^2$ of agricultural land at the site. A further 300m$^2$ of land will be utilised for the new section of access track. During the works, new fencing and a gate will be erected to allow for the movement of the landowners livestock and minimise disruption to the landholder.

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

Cumulative Environmental Impacts

There will be no cumulative impacts associated with the proposal. There are only 2 other wells in the general vicinity of the site, with the closest being approximately 9km away.
Conclusion

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

1.1 Background

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

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

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

1.2 Technical Investigations

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

- Ecological Assessment, prepared by RPS
- Aboriginal Heritage Due Diligence Report, prepared by RPS
- Santos Drill Rig Noise Assessment, prepared by Heggies (now SLR)
- Advice on Lake Goran flood levels, prepared by RPS Aquaterra

1.3 Structure of REF

This REF comprises the following:

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

2.1 Location & description

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

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

The subject site forms part of a property called “Hillgrove” (refer Figure 2-5), which is situated on Goran Lake Road. The proposed well lease is located on Lot 114 DP 755480, with access from Goran Lake Road through Lot 37 DP 755480.

Breeza State Forest is approximately 1km north of the site. The majority of the study area is currently used for cattle and sheep grazing and has been historically cleared of native vegetation communities. However, isolated stands of vegetation occur across the study area. The site, including the proposed chip hole lease, has been recently disturbed by bushfire.
Figure 2-1 Location of Sicamous 1 Chip Hole
Figure 2-2

LGA Boundaries

PEL 1 - New South Wales
Titleholder: Santos QNT

S Santos QNT

Date: August 2011 File No. GUNNEDAH 215 A
Figure 2-3
Satellite Image
Santos QNT

PEL 1 - New South Wales

Titleholder: Santos QNT

Figure 2-4

Exploration Area with Coal and Mineral Tenures
The following photographs illustrate the subject site and proposed chip hole location.

Plate 2-1 View north-west across well lease, from south-east corner of lease

Plate 2-2 Box-Gum Woodland to east of the well lease

Plate 2-3 Box-Gum Woodland to north-east of the well lease

Plate 2-4 Existing access track located along south-western boundary of the well lease, and native grassland

Plate 2-5 Native grassland occurring to the south and west of the well lease
2.2 Topography

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

Refer to Figure 2-6 for further detail.

2.3 Ecology

An Ecological Assessment (Appendix A) has been prepared for the subject site and surrounds. The findings of the assessment are outlined below.

2.3.1 Flora

Two vegetation communities were delineated within the study area. These communities were:

- White Box Woodland; and
- Native Grassland.

The White Box Woodland vegetation community occurs across the eastern portion of the study area. This community is comprised of moderately sized, well spaced trees, with no sub-canopy and a very sparse shrub layer. A dense grassy ground layer is present. This community is regularly grazed and has been selectively logged, and is in a moderately disturbed condition as a result. Additionally, portions of this community have recently been subjected to bushfire and are currently void of shrubs and ground cover, but have an intact canopy layer. Despite the disturbed condition of this community, the floristic structure and character corresponds with the Endangered Ecological Community (EEC) known as White Box - Yellow Box - Blakely’s Red Gum Woodland which is listed within the schedules of the TSC Act.

The Native Grassland community occurs across the study area, including within the chip hole lease. It is characterised by a dense grassy ground layer, with no shrub or canopy vegetation. While portions of this community have recently been disturbed by wildfire, remaining areas are considered to be representative of the pre-fire condition. It is regularly grazed and has been cleared of canopy and shrub vegetation and is therefore highly disturbed. Emergent species in this area include Galvanised Burr and Prickly Pear. This community is generally in poor condition. Despite the disturbed condition of this community, the floristic structure of the grassland corresponds with the Endangered Ecological Community (EEC) known as White Box - Yellow Box - Blakely’s Red Gum Woodland which is listed within the schedules of the TSC Act.

No threatened flora species listed under the TSC Act and/or Environment Protection and Biodiversity Conservation Act (EPBC Act) were identified as occurring within the well lease. Two Class 4 noxious weeds, Prickly Pear and African Boxthorn, were recorded in the study area during the pre-clearance survey.

2.3.2 Fauna

Fauna observed within the study area were limited to opportunistic sightings during flora and habitat surveys. Several common native bird species were observed in the study area, including Australian Magpie (Cracticus tibicen), Brown Quail (Coturnix ypsilophora), Laughing Kookaburra (Dacelo novaeguineae), Red Rump Parrot (Psephotus haematonotus) and White-faced Heron (Egretta novaehollandiae). Potential European Rabbit (Oryctolagus cuniculus) scats were also observed on the site. Additionally, Koala scats were observed beneath White Box trees.
Ten threatened fauna species listed under the EPBC Act were identified as potentially occurring in the site locale (10km buffer). Forty threatened species listed under the TSC Act were identified as known to be occurring in the study area, based on the Atlas of NSW Wildlife.

Twelve migratory species were identified as potentially occurring in the site locale. The majority of these species are considered as potential overfly species, however the study area does not provide suitable habitat resources to support these species. It is considered possible that one migratory species, Cattle Egret (Adea ibis), potentially utilises the site.

The adjacent woodland community is considered to provide potential suitable marginal habitat to support several listed threatened fauna species. Additionally, Koala scats were observed in nearby woodland. The proposed well lease is not considered to comprise suitable habitat resources to support these listed species.

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

### 2.4 Water Resources

#### 2.4.1 Surface Water

PEL 1 is located in the Namoi catchment management area. In north west NSW, the catchment is bounded by the Great Dividing Range in the east, the Liverpool Ranges and Warrumbungle Ranges in the south and the Nandewar Ranges and Mt Kaputar to the north. Major tributaries of the Namoi River include Coxs Creek and the Mooki, Peel, Cockburn, Manilla and Macdonald Rivers all of which join the Namoi upstream of Boggabri. The catchment is over 350km long and stretches from Woolbrook in the east to Walgett on the western boundary (NCMA, 2011).

The subject site is located in the Goran sub-catchment. Goran sub-catchment comprises an area of 590km². The significant feature of this area is Goran Lake which is a wetland, with a surface area of approximately 8,800Ha and a volume of 123GL (Bewsher, 1995). The water level and surface area varies considerably in relation to rainfall and catchment run off due to the very gentle topographical gradients. Monitoring of lake levels has been undertaken from 1974 to 2005 (mainly to provide data on flood levels and risk to agricultural development) and the results show that on two occasions Lake levels reached just over 296.5m AHD. The Goran River, Yarraman Creek, Hut Gully Creek and Coomoo Coomoo Creek drain into Goran Lake which then drains via Native Dog Gully into the Mooki River near Breeza.

Goran Lake is largely an inland drainage feature and surface water does not leave the area except during flooding or above average periods of rainfall when lake levels exceed its nominal “full level” at 296.4m AHD.

The issues within the sub-catchment include flooding, soil erosion, high watertables and salinity hazard in some areas.

Further information about Lake Goran flood levels is provided in the advice from RPS Aquaterra in Appendix F. Figure 2-7 shows the drainage in the vicinity of the well lease. Mooki River is to the east and runs approximately north south. Coomoo Coomoo Creek is to the south and runs approximately north east to south west.
2.5 Groundwater

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

The main aquifers in the area of the proposed chip hole are associated with both the shallow alluvium and those occurring in the underlying basement rock units. Alluvial aquifers are generally those that are closer to the surface and associated with more porous soil and rock materials. The consolidated formations (e.g. hard rock aquifers) of the Gunnedah Basin comprise interbedded coals, sandstone and siltstones and are not considered major groundwater sources.

The Gunnedah Basin is divided into Groundwater Management Areas (GMAs), which each correspond to a different hydrogeological system. The chip hole site is within the Gunnedah Basin GMA (GMA604).

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

2.6 Heritage

2.6.1 Aboriginal heritage

A due diligence investigation was carried out for the project area (Appendix B). This included a 10km x 10km search of the Office of Environment & Heritage’s (OEH’s) Aboriginal Heritage Information Management System (AHIMS) database. A total of 19 Aboriginal sites were identified, however none were identified within the vicinity of the proposed core hole location. The majority of sites recorded within a 10km radius of the project area were modified/scarred trees (63.19%). In addition, a review of environmental conditions, previous archaeological reports and a site inspection were carried out.

The site was inspected by Santos’ cultural heritage officer. No items of significance were identified, and no features likely to contain archaeological deposits were found.

2.6.2 Other heritage

The project area is wholly situated within the Gunnedah local Government area. A search of the Australian Heritage Database, the State Heritage Inventory and Gunnedah Local Environment Plan (LEP) indicate that there are no European heritage items registered within the vicinity of the project area.

2.7 Environmentally Sensitive Areas

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

- Breeza State Forest is approximately 1km to the north of the proposed well lease
- Doona State Forest approximately 13km to the south east
• Spring Ridge State Forest approximately 13km to the south
• Goran State Forest approximately 15km to the north west
• Trinkey State Conservation Area approximately 21km to the south west
• Wondoba State Conservation Area approximately 19km to the north west

Lake Goran is an ephemeral lake, the water levels of which fluctuate throughout the year. The well lease is located approximately 200m east of the highest level of the lake. It is listed as a nationally significant wetland in the *Directory of important wetlands in Australia*, however it is not listed as a Ramsar wetland.

<table>
<thead>
<tr>
<th>Table 2-1 Environmentally Sensitive Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Is the proposal located within any of the following:</strong></td>
</tr>
<tr>
<td>An area reserved or dedicated under the National Parks and Wildlife Act 1974?</td>
</tr>
<tr>
<td>Is the proposal located within land reserved or dedicated within the meaning of the Crown Lands Act 1989 for preservation of other environmental protection purposes?</td>
</tr>
<tr>
<td>A World Heritage Area?</td>
</tr>
<tr>
<td>Environmental Protection Zones in environmental planning instruments?</td>
</tr>
<tr>
<td>Lands protected under SEPP 14 – Coastal Wetlands?</td>
</tr>
<tr>
<td>Lands protected under SEPP 26 – Littoral Rainforests?</td>
</tr>
<tr>
<td>Land identified as wilderness under the Wilderness Act 1987 or declared as wilderness under the National Parks and Wildlife Act 1974?</td>
</tr>
<tr>
<td>Aquatic reserves dedicated under the Fisheries Management Act 1994?</td>
</tr>
<tr>
<td>Wetland areas dedicated under the Ramsar Wetlands Convention?</td>
</tr>
<tr>
<td>Land subject to a conservation agreement under the National Parks and Wildlife Act 1974?</td>
</tr>
<tr>
<td>Land identified as State Forest under the Forestry Act 1916?</td>
</tr>
<tr>
<td>Western Lands Lease</td>
</tr>
<tr>
<td>Freehold or Crown Land. If Crown Land, what type?</td>
</tr>
</tbody>
</table>

2.8 Climate

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

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

<table>
<thead>
<tr>
<th>Table 2-2 Climate Statistics from Curlewis (Wongalee) (rainfall) &amp; Gunnedah Resource Centre (temp) BoM Weather Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Statistic</strong></td>
</tr>
<tr>
<td>Mean Max Temp (°C)</td>
</tr>
<tr>
<td>Mean Min Temp (°C)</td>
</tr>
<tr>
<td>Mean Rainfall (mm)</td>
</tr>
</tbody>
</table>
2.9 Soils

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

**Cracking Clay Soils**

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

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

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

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

**Clay and Loam Soils.**

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

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

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

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

**Duplex and ‘Gravelly’ Soils**

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

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

These soils are very poor in terms of fertility and are of lesser value due to their porosity and high leaching qualities. They are likely to be deficient in phosphorus, nitrogen, sulphur and some trace elements. The pH ranges from mildly acid at the surface (pH 6 to 6.5) to alkaline at depth (pH 8 to 8.5).
They have a low to medium shrink-swelling capacity ranging from 10 per cent at the surface to 11.2 per cent at 50 centimetres, 13.6 per cent at 100 centimetres and 16.4 per cent at 200 centimetres.

**Clay Loams with Red Clay Subsoils**

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

Characteristically, the Euchrozem's colour graduates from red to reddish-brown and brown and grades from a clay loam or light clay into a medium to heavy textured clay soil at depth. The A1 horizon is self mulching with a depth of 15 centimetres. The structure of the A1 changes from a weak to strong crumb structure at the surface to a fine to medium blocky structure at depth. The boundary between the A1 and B1 horizons is gradual with no evidence of an A2 horizon. The B2 horizon is more blocky in structure with smooth faced, dense peds. When moist the soil is moderately friable but becomes hard when dry. The B2 horizon is much larger than the B1 and often consists of gravelly clay. Some calcium carbonate nodules are evident in the B horizon.

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

**Highly Erodable - Hard Setting Soils**

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

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

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

**Skeletal Soils**

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

### 2.10 Geology

#### 2.10.1 Regional Geology

PEL 1 is located in the central portion of the Gunnedah Basin where Jurassic and Cretaceous Surat Basin sediments unconformably overlie Permo Triassic Gunnedah Basin sediments (Figure 2-9). The Gunnedah Basin covers an area of more than 15,000km² and is defined in structural terms as being bounded to the east by the Hunter Mooki Thrust Fault System and the New England Fold Belt, and to the west by the Lachlan Fold Belt onto which the Gunnedah Basin sediments gradually onlap.
Metavolcanics, meta-sediments and minor ignimbritic volcanics of the Lachlan Fold Belt form much of the basement under the western part of the Gunnedah Basin and the Rocky Glen Ridge. Widespread Late Carboniferous and Early Permian mafic lavas were succeeded by paralic-lacustrine environments with sediments of the Leard and Goonbri Formations deposited. This was followed by low energy fluvial conditions in which the coal measures of the Maules Creek Formation were deposited.

### Figure 2-9 Stratigraphy of the Gunnedah Basin

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 Hoskisson Coal seam that is readily correlated across the Basin. The thickness of the Hoskisson Coal ranges from less than 1m in the west to more than 12m in the north and to 18m in the south-east.

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

The Digby Formation is marked by a basal conglomerate that has been derived from the New England Fold Belt. This unit thickens towards the east and onlaps onto the older sediments and basement to the west. Reservoir quality is generally poor due to a tight sandstone matrix. Thick near-shore marine shales of the overlying Napperby Formation are considered a potential seal to any hydrocarbons reservoir in the Digby Formation.

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

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

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

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

3.1 Introduction

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

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

In summary, the process involves:

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

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

3.2 Site preparation & equipment

Various works will be required in order to prepare the site for the proposed drilling, including preparation of the well lease, upgrading of existing track, construction of approximately 50m additional track, as well as positioning the drill rig and associated temporary buildings and equipment on the site. The major equipment used on site will be a drilling rig and associated temporary buildings. These works are summarised further in this section. Figure 3-1 illustrates the location of the proposed well lease and access. Figure 3-2 illustrates the proposed site layout for the well lease and access track. Figure 3-3 illustrates the proposed erosion and sediment control measures for the well lease.
During site preparation, there will be some soil disturbance as a level drill pad will need to be constructed at the well lease using cut and fill.Associated lined drilling sumps and a flare pit will also be constructed on site for use during drilling operations. The area to be disturbed for drilling activity is outlined in Table 3.1.

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

<table>
<thead>
<tr>
<th>Area of Disturbance</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sicamous 1</td>
<td>Pad level will be created with cut to fill a pad level of approximately RL300AHD.</td>
</tr>
<tr>
<td>80m X 60m with an overall area of disturbance of 4,800m².</td>
<td></td>
</tr>
<tr>
<td>Additional Track</td>
<td>To be topped with approximately 150mm gravel to provide all weather access.</td>
</tr>
<tr>
<td>6m x ~50m, with an overall area of disturbance of approx 300m²</td>
<td></td>
</tr>
</tbody>
</table>

Further detail about the chip hole design is provided in Appendix D.
Well Lease Construction

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

Access track improvements and construction

There is an existing track which provides access to the location through Lot 37 DP 755480. Upgrading of this track with gravel will be required, however no widening is necessary.

The following is a list of the detailed works involved.

- The existing track will be top dressed with 100mm road base.
- Track is to be top dressed to allow wet weather access.
- Two cattle ramps and two sets of double gates and end assemblies to be installed in two locations along the access track.

Drill rig positioning & operation

- Equipment will enter/exit the site via the main access gate. Equipment will include generator units, lighting towers, site offices, stores and other various temporary buildings and equipment required for the duration of drilling.
- Moving and rigging up/down of equipment (i.e. installation and dismantling of rig equipment) is expected to take up to 3 days (3 per rig up, 3 per rig down).

Ancillary equipment will be required on site during the course of the drilling activities, including wireline trucks, cementing trucks and service company vehicles, these vehicles will exit and enter the site as required.
Notes:
1. Strip 150mm Topsoil of site and stockpile in area shown. Erect 2m fence around topsoil to segregate soil from excavated material.
2. Contour bank (0.5 metre high x 1 metre wide) to be constructed as shown.
3. All batters to be 1:1
4. Gravel to be placed at the direction of Santos Representative
5. All sites to be fenced and 1 x 8m double gates installed
6. Access tracks to be constructed as shown
7. Excavated material from Sump/Pit to be placed behind pit and compacted as shown
8. Cellar and Conductor (6 metre x 12.2m) to be installed. Conductor to be set in centre of Cellar with top of conductor at 1.5m below surface level. Cellar floor to be 1.8m below surface level. Covers to be placed on cellar after installation
9. Hardstand area to be excavated (if required), backfilled and compact with suitable gravel
10. Area outside of hardstand area to be graded at 1% away from pad and appropriate drainage, bunding and erosion control installed
11. Fence to be 6 line, 70cm hinged joint fence, steel corner posts & droppers.
OVERFLOW CHANNEL
0.5M WIDE x 0.5M DEEP

SILT FENCE

EXCAVATED MATERIAL

CUBED AROUND PITS 0.5M HIGH

BUND BETWEEN PITS WITH CHANNEL THROUGH TO ADJOINING PIT

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

LINER INSTALLATION SEQUENCE

EROSION CONTROL

Figure 3-2

SICCAMOUS 1 - FINAL

SANTOS LTD.

1 WELL LEASE PAD

SUMP & EROSION CONTROL
3.3 Drilling Activities

The well will have a specific design ensuring compliance with relevant legislation. A nominal 10-3/4” (273mm) cemented conductor is to be installed by the lease builder to approximately 6m below ground level. The surface hole of 8 1/2” (216mm) will be rotary drilled to approximately 150mRT, where a 7” (178mm) steel surface casing will be landed and pressure cemented in place with cement to surface. The main hole of diameter 6-1/8” (156mm) will be drilled from the 7” (178mm) casing shoe to well total depth planned to be 20m into the Boggabri Volcanics at approximately 590mRT based on the pre-drill geological prognosis. DSTs or equivalent downhole evaluations may be conducted on penetration over selected Late and Early Permian Coals with testing to be performed in accordance with legislative requirements.

The closest offset wells to the proposed activities are Calala 1 (9km) and Glasserton 1 (11km).

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

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

3.4 Abandonment and rehabilitation

The well will be cemented, plugged and abandoned in accordance with DTIRIS requirements and rehabilitated following completion of activities within the allowed regulatory timeframe. A steel identification plate installed near the top of the hole > 1 metres below the surface.

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

Revegetation & rehabilitation will be undertaken within the required regulatory timeframe. All improvement works to private tracks will be retained for the benefit of the landholder.

3.5 Duration

Drilling activities are temporary and will not have any long-term impact on the visual amenity of the area. The drilling of the well is expected to occur over a 40 day period not including lease build, or site rehabilitation. There will be 14 days of lease construction activities prior to drilling the well. Rehabilitation activities of 30 days following the drilling of the well will be additional to this period.

This equates to a total of approximately 54 days of construction and drilling and 30 days of rehabilitation, as outlined in the table below.
### Table 3-2 Duration of drilling and site activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Expected Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lease Build</td>
<td>14 days</td>
</tr>
<tr>
<td>Drilling</td>
<td>40 days</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>30 days</td>
</tr>
</tbody>
</table>

#### 3.6 Staff & Hours of Operation

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

The hours of operation during the drilling and work over will be on a 12 hour a day basis as negotiated with the landholder. Personnel movements to and from site will be minimised outside of a single shift change per day but may be necessary due to emergency situations or specific activities (e.g. crews and service companies entering and leaving site to conduct specific activities).

#### 3.7 Chemicals

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

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

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

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

3.9 Alternatives

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

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

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

The site was located in consultation with the landholder and with the assistance of a scouting party comprised of Santos’ Project Representatives, Cultural Heritage Officer and Civil Works Advisor. Third party surveyors and ecologists were also consulted to assist in positioning of the well lease as part of the scouting process.

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

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

3.10 Stakeholder Consultation

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

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

Consultation aims to:

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

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

- Notification of neighbours (those sharing boundaries with properties where Santos is working) prior to commencement of activities.
- Community consultation sessions and presentations are held throughout the year at areas that are close to upcoming work. Community consultation sessions are attended by subject specialists (e.g. geologists, drilling engineers, hydrologists and hydrogeologists) to enable the community to speak directly to the people responsible for the work being undertaken in the area.
- AgQuip (every August) - Santos displays equipment and has up to eight subject specialists in attendance to answer questions from the public. The display at Agquip in August 2010 included a mock pilot well site with all of the kit that will be on site for a pilot test.
- 1800 number - attended during business hours, all calls returned within 48 business hours.
- Public email address – emails returned within 48 business hours.
- Newsletter (4 times per year, direct mailed to a database of over 5,000 stakeholders).
- Briefing of key Local, State and Federal government staff and elected representatives.
Field trips to drill and seismic work sites (on request, year round).

Presentations to community groups (on request, year round).


Website www.santos.com/gunnedah – information includes factsheets, newsletters and presentations, frequently asked questions, photographs of sites and equipment, materials safety data sheets for chemicals used, upcoming events, industry terminology and a link to the Namoi Catchment Water Study website.

Gunnedah regional office – 88 Marquis Street, Gunnedah.

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

Community consultation sessions (public meetings) were run at Spring Ridge on Tuesday 23 March and Gunnedah on Wednesday 24 March 2010. Both ran from 2-8pm. In the afternoon, team members (drilling engineer, geologist, hydrologist) engaged with landholders in one-on-one conversations. In the evening, pilot-focused presentations on geology, drilling and water handling were given in a facilitated session. The sessions were advertised in local papers (2 weeks prior to event), in the March edition of the newsletter (sent to 5,000 recipients) and by email. Approximately 70 people attended the session held in Spring Ridge.

In addition to the sessions early last year, eight Ask Santos Community consultation sessions have been held late last year and early this year as outlined in the table below. The presentations used at each of these sessions are available on Santos’ website at www.santos.com/gunnedah.

<table>
<thead>
<tr>
<th>TOPIC</th>
<th>QUIRINDI</th>
<th>GUNNEDAH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gunnedah Basin Geology</td>
<td>17 November 2010</td>
<td>18 November 2010</td>
</tr>
<tr>
<td>Pilot testing design principles</td>
<td>8 December 2010</td>
<td>9 December 2010</td>
</tr>
<tr>
<td>Pilot testing water handling principles</td>
<td>9 February 2011</td>
<td>10 February 2011</td>
</tr>
<tr>
<td>Beneficial water reuse</td>
<td>13 April 2011</td>
<td>14 April 2011</td>
</tr>
</tbody>
</table>

Briefings provided to the local shire councils (Liverpool Plains and Gunnedah).

The newsletters (directly mailed to over 5 000 property owners and stakeholders in the region) provided detailed information on various aspects of our pilot testing activities specifically:

» June 2010 - water handling during pilot testing;
» November 2010 - gave further information on pilot site logistics, water monitoring and coal geology;
» December 2010 - explains specific field operations and work plans for 2011.
4.0 Regulatory Context

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

4.1 Petroleum (Onshore) Act

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

(a) any naturally occurring hydrocarbon, whether in a gaseous, liquid or solid state, or
(b) any naturally occurring mixture of hydrocarbons, whether in a gaseous, liquid or solid state, or
(c) any naturally occurring mixture of one or more hydrocarbons, whether in a gaseous, liquid or solid state, and one or more of the following, that is to say, hydrogen sulphide, nitrogen, helium, carbon dioxide and water,

and includes any substance referred to in paragraph (a), (b) or (c) that has been returned to a natural reservoir, but does not include coal or oil shale or any substance prescribed to be a mineral for the purposes of the Mining Act 1992.

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

**Category 1**
- Geological mapping
- Rock sampling (by hand held equipment)
- All reconnaissance drilling other than petroleum exploration holes
- Geophysical surveys other than seismic
- Airborne surveys

**Category 2**
- Access tracks or line clearing involving formed construction or significant native vegetation disturbance

**Category 3**
- Petroleum exploration holes
- Seismic surveys

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

4.2.1 Overview

The Environmental Planning and Assessment Act 1979 (NSW) (EP&A Act) regulates development carried out in New South Wales. The carrying out of development is regulated under either Part 3A (this has been repealed and is being replaced by a new system), Part 4 or Part 5 of the EP&A Act.

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

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

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

4.2.2 Determining Authorities and the REF

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

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

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

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

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

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

(d) **in relation to the habitat of a threatened species, population or ecological community:**

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

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

### 4.2.3 Gunnedah Shire Local Environmental Plan

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

(a) to protect the use and efficiency of prime agricultural land while permitting appropriate development subject to suitable subdivision controls,

(b) to permit other forms of development which are ancillary to rural land uses or that, as a result of their nature, require siting outside the urban area,

(c) to avoid further fragmentation and alienation of useable rural land,

(d) to retain the low density nature of settlement within the rural areas and ensure that any future development does not create unreasonable demands on the existing infrastructure or available services,

(e) to provide for the requirements of the rural community,

(f) to maintain safety and convenience along main roads by discouraging uses that are likely to generate traffic volumes which disrupt traffic flow,

(g) to ensure that the existing level of scenic amenity is maintained by requiring development to have regard for significant ridgelines and hilltops.
The proposed development of the chip hole is not expected to impact on the use and efficiency of prime agricultural land or fragment usable rural land and is considered generally consistent with the objectives of the zone.

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

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

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

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

\[
\text{areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15\% of the total number of trees in the upper or lower strata of the tree component.}
\]

Core koala habitat is defined as:

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

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

The Ecological Assessment in Appendix A reports that while White Box is present across the property, and constitutes 15% of the total number of trees in the upper canopy, the proposed chip hole lease does not include any canopy trees. The proposed chip hole lease is therefore not considered to provide potential Koala habitat. The proposed activity will not result in the removal or interference of canopy trees.

### 4.3 Environment Protection and Biodiversity Conservation Act

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

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

- Is undertaken by the Commonwealth and will have or is likely to have a significant impact on the environment;
- Is undertaken by any person on Commonwealth land and will have or is likely to have a significant impact on the environment; or
- Is a nuclear action.

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

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

A person proposing to take an action that the person thinks is not a controlled action may refer the proposal to the Minister for the Minister's decision whether or not the action is a controlled action.

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

The proposed activities are not in a World Heritage area, and are not in close proximity to any such area. The proposed activities are not upstream or in an area where there is any form of Ramsar Wetlands.

Twelve migratory species, ten threatened fauna species, eight threatened flora species and five ecological communities were identified as potentially occurring in the site locale. The Ecological Assessment (Appendix A) outlines that the proposed activity is unlikely to have a significant impact on these species. As such, an assessment under the EPBC Act Policy Statement 1.1 - Significant Impact Guidelines Matters of National Environmental Significance (DEWHA, 2009) is not considered necessary.

The proposed activities are not expected to have, or be likely to have, a significant impact on MNES including, in particular, listed threatened species or listed migratory species under the EPBC Act.

4.4 Threatened Species Conservation Act

The objects of the Threatened Species Conservation 1995 (NSW) (TSC Act) include:
- To conserve biological diversity and promote ecologically sustainable development;
- Prevent the extinction and promote the recovery of threatened species, populations and ecological communities;
- To protect the critical habitat of those threatened species, populations and ecological communities that are endangered; and
- To ensure that the impact of any action affecting threatened species, populations and ecological preventing the extinction and promoting the recovery of threatened species, populations and ecological communities is properly assessed.
The TSC Act provides the procedure for the listing of threatened species, populations and ecological communities and key threatening processes in New South Wales and the preparation and implementation of recovery plans and threat abatement plans.

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

The White Box – Yellow Box – Blakeley’s Red Gum Woodland is listed as an EEC under the TSC Act and was identified as occurring on the site. The potential direct and indirect impacts that may be associated with the proposal are considered to be minimal. A range of mitigation and management measures have been identified, targeted at minimising impacts on White Box-Yellow Box-Blakeley’s Red Gum Woodland. No significant impact on the White Box-Yellow Box-Blakeley’s Red Gum Woodland EEC will occur as a result of the proposed activity and no licences under the TSC Act will be required.

4.5 National Parks and Wildlife Act

Threatened Species

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

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

Aboriginal Cultural Heritage

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

It is an offence under the NPW Act to:

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

A cultural heritage site inspection of the proposed disturbance areas has been undertaken. No Aboriginal places or objects were identified during the site inspection of the sites for the proposed activities. A Due Diligence cultural heritage assessment has been undertaken by RPS and is provided in Appendix B. The report concludes that it is unlikely that the proposed work will disturb, harm or damage any Aboriginal object or place.
4.6 Heritage Act

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

any deposit, artefact, object or material evidence that:

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

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

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

4.7 Protection of the Environment Operations Act

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

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

4.8 Water Legislation

Water Act 2007 (Cth)

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

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

Water Act 1912 (NSW)

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

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

**Water Management Act 2000 (NSW)**

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

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

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

5.1 Introduction

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

- Ecological Assessment, prepared by RPS
- Cultural Heritage Assessment, prepared by Santos
- Santos Drill Rig Noise Assessment, prepared by Heggies (now SLR)
- Advice on Lake Goran Flood Levels, prepared by Aquaterra

5.2 Ecology

5.2.1 Flora and Fauna

Impacts

An Ecological Assessment, which addresses potential impacts on threatened flora, fauna and ecological communities has been undertaken by RPS and is provided in Appendix A.

The proposed lease is located within a grazing pasture, and is currently void of vegetation due to wildfire. While the chip hole lease is currently cleared of vegetation, it is likely to have previously supported White Box, as well as native grasses. As such, it is likely that the chip hole lease is considered to be White Box-Yellow Box-Blakely’s Red Gum grassy woodland, an EEC listed under the TSC Act. The proposed well lease location will result in disturbances to this area, namely top soil removal, and removal of regenerating vegetation.

Access to the site will utilise existing tracks, however impacts associated with the use of these access tracks include potential edge effects to native grassland communities adjacent to the access track. No canopy trees are located adjacent to the access track.

The proposed activity is not considered to have a significant impact on the TEC, as it will result in limited disturbance to ground cover vegetation only. No canopy vegetation is located within the well lease or adjacent to the access track.

The proposed activity is considered to have minimal impacts on fauna habitat, as no canopy trees or structurally diverse vegetation will be cleared as part of construction.

Potential indirect ecological impacts associated with the proposed activity include dust generation, soil erosion, weed invasion, and transportation of weeds off site. Impacts are considered to be minimal.

Temporary short-term impacts will be associated with the establishment and operation of the chip hole lease site. There will be no long term impacts.
The proposed rehabilitation of the chip hole lease site and access track will reinstate a native ground cover. Given the poor state of vegetation within the chip hole lease, re-instatement of vegetation will improve the ecological condition from the current condition. Rehabilitation will be completed within 6 months of decommissioning. In consideration of site rehabilitation activities that are to occur at the chip hole site once decommissioning has occurred, it is unlikely that there will be any long-term impacts associated with the proposed activities.

The proposed activities have the potential to create favourable conditions for additional introduced weed species within the study area, which could potentially lead to an increase of existing weed populations. This is most likely to occur where soil disturbance is to occur. All plant and machinery will be washed down and cleaned of any foreign soil and seed prior to being transported onsite to prevent the potential spread of introduced weeds and pathogens.

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

Noise pollution as a result of vehicles, machinery and drilling may deter native fauna from utilising the surrounding habitat. The proposed activities could affect the migration and dispersal ability of native fauna particularly in relation to noise and vehicular movements.

The potential impacts associated with the proposed activities are generally short-term and temporary. The proposed chip hole lease is located within an area that has been heavily disturbed by fire, and was previously likely to be comprised of disturbed native grassland. This area is in poor ecological condition, and of little habitat value due to the high levels of disturbance. As such, impacts are considered to be negligible.

5.2.2 Key Threatening Processes Relevant to Proposed Activities

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

<table>
<thead>
<tr>
<th>Key Threatening Process</th>
<th>Relevance to Proposed Activities</th>
</tr>
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<tbody>
<tr>
<td>Invasion of native plant communities by exotic perennial grasses</td>
<td>The site has been disturbed by exotic perennial grasses, however there exists the potential for the invasion of additional weed species.</td>
</tr>
<tr>
<td>Clearing of native vegetation</td>
<td>The chip hole has been sited in a heavily disturbed area to avoid the need for unnecessary vegetation clearing. Prior to wildfire, the chip hole lease was comprised of ground covers only. No canopy vegetation will be removed.</td>
</tr>
<tr>
<td>Loss of hollow-bearing trees</td>
<td>No hollow bearing trees will be removed as part of this activity.</td>
</tr>
<tr>
<td>Removal of dead trees and dead wood</td>
<td>No dead ‘stag’ trees will be removed from the study area.</td>
</tr>
<tr>
<td>Infection of native plants by <em>Phytophthora cinnamomi</em></td>
<td>There exists the potential for the importation of this pathogen on unclean vehicles and plant machinery. It is recommended that all vehicles be cleaned of foreign soil from other sites to ensure that this pathogen is not introduced.</td>
</tr>
</tbody>
</table>
5.2.3 Matters of National Significance

As part of the Ecological Assessment (Appendix A), an EPBC Act Protected Matters Search was undertaken within the SEWPac on-line database to generate a list of those Matters of National Environmental Significance (MNES) from the area, which may have the potential to occur within the subject site. This data, combined with other local knowledge and records was utilised to assess whether the type of activity proposed on the site will have or is likely to have a significant impact upon a MNES, or on the environment of Commonwealth land.

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

Table 5-2 Matters of National Environmental Significance

<table>
<thead>
<tr>
<th>Matter of National Environmental Significance</th>
<th>Overview</th>
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<tbody>
<tr>
<td>World Heritage Properties</td>
<td>The site is not a World Heritage area, and is not in close proximity to any such area.</td>
</tr>
<tr>
<td>Wetlands protected by international treaty (the RAMSAR convention)</td>
<td>The site is not part of any RAMSAR Wetland area. Goran Lake is not a RAMSAR wetland. However, it is listed on the Directory of Important Wetlands in Australia as a Seasonal/intermittent freshwater lake.</td>
</tr>
<tr>
<td>Nationally listed threatened species, migratory species and ecological communities:</td>
<td>Twelve migratory species, ten threatened fauna species, eight threatened flora species and five ecological communities were identified as potentially occurring in the site locale. The proposed activity is unlikely to have a significant impact on these species. As such, an assessment under the EPBC Act Policy Statement 1.1 - Significant Impact Guidelines Matters of National Environmental Significance (DEWHA, 2009) is not considered necessary. Goran Lake provides viable breeding and foraging habitat for listed migratory species. The proposed activities are unlikely to impact upon any migratory species and/or their habitats that occur at Goran Lake, due to the distance between the activity site and Goran Lake and the expected short timeframe of the proposed activities.</td>
</tr>
<tr>
<td>All nuclear actions</td>
<td>No type of nuclear activity is proposed for the site.</td>
</tr>
<tr>
<td>Commonwealth marine areas</td>
<td>The proposed activity on the site will not have a significantly adverse effect on any Commonwealth marine area.</td>
</tr>
<tr>
<td>Great Barrier Reef Marine Park</td>
<td>The proposed activity on the site will not have a significantly adverse effect on the Great Barrier Reef Marine Park.</td>
</tr>
</tbody>
</table>

Mitigation Measures

Mitigation comprises the following:

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

- Spill management procedures will be implemented as required.
- Rubbish will be collected and removed from the site.
- Appropriate erosion and sediment control measures will be utilised as required.
- Following construction of the chip hole lease, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Rehabilitation will include native grasses that are representative of the existing vegetation composition.
- An Environmental Management Plan (Appendix E) has been prepared for the proposed activity and will be adhered to by site personnel at all times.

### 5.3 Heritage

#### 5.3.1 Aboriginal heritage

**Impacts**

A due diligence investigation was carried out for the project area (Appendix B). This included a 10km x 10km search of the Office of Environment & Heritage’s (OEH’s) Aboriginal Heritage Information Management System (AHIMS) database. A total of 19 Aboriginal sites were identified, however none were identified within the vicinity of the proposed core hole location. The majority of sites recorded within a 10km radius of the project area were modified/scarred trees (63.19%). In addition, a review of environmental conditions, previous archaeological reports and a site inspection were carried out.

The site was also inspected by Santos’ cultural heritage officer. No items of significance were identified, and no features likely to contain archaeological deposits were found.

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

**Mitigation Measures**

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

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

- In the event that skeletal remains are uncovered, work must cease immediately in that area and the area fenced. Santos shall then contact the NSW Police and follow the advised procedure. If the skeletal remains are determined to be Aboriginal, Santos shall then contact the OEH and relevant Aboriginal Community Stakeholders in order to determine an action plan for the management of the skeletal remains prior to works commencing.

5.3.2 Other Cultural Heritage

Impacts

The project area is wholly situated within the Gunnedah local Government area. A search of the Australian Heritage Database, the State Heritage Inventory and Gunnedah Local Environment Plan (LEP) indicate that there are no European heritage items registered within the vicinity of the project area.

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

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

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

Mitigation Measures

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

5.4 Ground water

Impacts

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

There are potential impacts of any drilling in mixed multi-aquifer systems that relate to the possibility of cross contamination of aquifers, the possibility of contamination of the aquifers by drilling muds/fluids and groundwater discharging to the surface, which might cause flooding or impact on surface water quality depending on the discharge and receiving water qualities. However, it is anticipated that the proposed drilling and chip hole construction and abandonment methodologies would eliminate the risk.

There is also the potential impact of seepage of drilling mud, drilling additives and/or hydrocarbons (oils/lubricants etc) to shallow groundwater beneath the rig and chip hole site. During drilling, the circulating
drilling mud will establish a wall cake (low permeability “skin” around the wall of the hole) and also maintain a positive head (pressure) on the various aquifers intercepted (NB. there are no artesian pressures in the area). This will both prevent the ingress of groundwater to the hole (and any possible mixing or discharge to the surface) and also limit the ingress of drilling mud into the aquifers to the immediate vicinity of the chip hole.

At the completion of the drilling of the shallow and intermediate sections of the chip hole, the section will be cased with steel pipe and pressure cemented into place and this will provide a solid barrier to prevent any ingress, mixing or discharge of groundwater. Following the completion of drilling activities, the chip hole will be plugged and cement grouted, further providing a solid barrier to any of the possible mixing and cross contamination processes.

Mitigation measures to minimise/negate the risk of impacts and to confirm that no impact has occurred are identified below.

**Mitigation Measures**

To minimise impacts on groundwater, the following mitigation measures are proposed.

- There is negligible risk of cross contamination of aquifers or discharge of groundwater to the surface as a result of the proposed drilling, chip hole construction and abandonment methodologies. However, in order confirm that no impacts have occurred, it is proposed that:
  - Monitoring of private groundwater bores within a 2km radius (with landholder permission) be undertaken before drilling commences, to more clearly establish baseline conditions and then continue monitoring on a regular basis throughout the duration of all drilling activities. It is proposed that monitoring will include water level and water quality (electrical conductivity) observations.

- In order to manage/prevent the risk of any seepage of drilling fluids to shallow groundwater, it is recommended that:
  - The drilling sumps should be lined (with an appropriate impermeable material) and that all drilling fluids are completely removed from site prior to site rehabilitation.

The management measures to control the handling and storage of chemical and hazardous substances and for spill prevention and response are identified in Section 5.9 Hazardous and Chemical Substances Management. Implementation of the EMP (Appendix E) should minimise or negate risks of contamination of ground and surface water. In addition to the above, the natural existence of shallow subsurface alluvium (which contains relatively impermeable clays) will further minimise potential water quality risks associated with possible partial failure of these mitigation measures. These clays will tend to hold any contaminant in the near surface zone above the water table.

Measures to minimise and manage waste are identified in Section 5.11 Waste Minimisation and Management.
5.5 Air Impacts

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

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

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

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

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

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

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

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

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

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

Mitigation Measures

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

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

The site is located in an agricultural area and the existing noise levels are relatively low. There are no residential properties within 1km of the site.

The nearest residential dwelling is just over 1km from the site to the north west. The closest community is Spring Ridge which is approximately 12km to the south of the site. Curlewis is approximately 18km to the north and Breeza is approximately 20km to the east of the site.

Drilling activities are temporary and noise will be generated by the construction of the lease and track infrastructure for a duration of approximately 14 days, drilling over approximately 40 days and rehabilitation for 30 days.

This equates to a total of approximately 54 days of construction and drilling and 30 days of rehabilitation. Drilling activities will be 12 hours per day with lease and track construction activities to be conducted over a 12 hour day shift. Mufflers are installed on the power plants and prime movers used for the powering and mobilisation of the drilling rig.

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

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

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

**Noise Criterion**

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

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

According to the generic Drill Rig 13 assessment (formerly known as McDermott 29), at 1km noise levels from the Drill Rig 13 are likely to be 30dBA during calm weather and 33 dBA during temperature inversion weather. These levels of noise are negligible and below the specific noise criteria of 40 dBA and 35 dBA for daytime and night time activities respectively.

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

**Mitigation Measures**

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

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

5.7 Surface water

Impacts

Goran Lake is located to the west of the proposed chip hole. The lake is ephemeral, with water levels fluctuating throughout the year. The proposed well lease is located approximately 200m from the highest water level of the lake. The lake is identified as a nationally important wetland (however is not listed as a RAMSAR wetland).

Investigations have been made in relation to the impacts and likelihood of flooding of the lake (refer Appendix F). The assessment was based on information received from:
- NSW Office of Water (NOW);
- Inland Flood Unit, Office of Environment and Heritage in Tamworth;
- Bureau of Meteorology; and
- A review of work conducted by other consultants (Most relevant is: Bewsher Consulting, 1995, Hydrological Study of Lake Goran, prepared for Department of Water Resources).

Some of the main features of the lake and key findings of the investigation are as follows:
- The Bewsher report described the lake as having a surface area of 8,800 Ha and a volume of 123 GL;
- The area surrounding the lake is generally low lying and forms part of the Liverpool Plains. The water level and the surface area of the lake vary considerably in response to rainfall and catchment runoff as a result of very gentle topographical gradients. When full, large volumes of water are needed to obtain small increments in water levels and the accompanying increase in surface area is substantial;
- The nominal full supply level of the lake is 296.4 m AHD according to the Bewsher report;
- The probability of the lake spilling is about 14% based on the period of measured lake levels (1974 to 2005);
- The highest recorded lake level during the period of monitoring is 296.79 m AHD. The probability of occurrence of the this event is 2%, based on the period of lake level monitoring; and
- The highest observed lake level within the 112 years of simulated results presented in the Bewsher Report was about 296.85 m AHD in 1890. The probability of this occurring as deduced from the occurrence of rainfall amounts between 1880 and 2010 is about 0.5% or 1:200 years.

There is the potential for the proposed activities to impact on the surface water quality of Goran Lake through sedimentation and site run-off. These issues and associated mitigation measures are discussed in detail in Section 5.8 below.

There is also the potential for chemicals and fuels to come in contact with surface waters. These issues and associated mitigation measures are discussed in detail in Sections 5.9 and 5.10 below.
The proposed well lease is located at 300m AHD and above the level of the lake at 296.4m AHD when full and also above the highest recorded flood level of 296.79m AHD. Water for drilling operations will be sourced from Council or another licensed provider.

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

**Mitigation Measures**

Proposed measures to protect surface waters include:

- Contaminated waters will be contained and where necessary disposed of at an appropriate facility.
- Drilling fluids will be contained on site and not discharged to surrounding watercourses. Over-balanced drill techniques to be utilised to prevent formation fluid from rising through the well to the surface.
- Excessive fluid losses will be cured by LCM (cellulose material such as sawdust) to ensure most fluids return to the surface.
- Sediment fences and traps will be installed so as to prevent soil loss or sedimentation (see sedimentation plan in Figure 3.2).
- Fuel and lubricants will be stored on site only when necessary and maintained off site whenever possible.
- All areas storing or handling fuel, fuel using equipment, and chemicals will be bunded in accordance with Australian Standard 1940 – 2004; The Storage and Handling of Flammable and Combustible Liquids.
- The maintenance and cleaning of vehicles and other equipment or plant will be carried out in areas from where the resultant contaminants cannot be released into any waters.
- Wastewater removed from site will be managed by a contractor licensed to carry and handle water.
- Where applicable maintenance of roads, drains, bund walls, contour and diversion banks to occur. All drainage structures will be maintained for the life of the development.
- Disturbed land will be rehabilitated to pre-operational quality or better, to minimise sediment erosion.
- During rehabilitation, diversion banks and ripping along the contour will be completed to prevent the concentration and momentum of water flow as required.

**5.8 Soils**

**Impacts**

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

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

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

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

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

**Mitigation Measures**

The erosion and sediment control measures are proposed as follows:

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

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

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

**5.9 Chemical and hazardous substances management**

**Impacts**

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

**Mitigation Measures**

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

### 5.10 Contaminated land

**Impacts**

The location’s history of agriculture suggests that the area is unlikely to have been previously contaminated.

The drilling operation will pose minimal impact on the soils. No soil is proposed to be removed from the site. On the completion of drilling all excavated material would be backfilled. Based upon the history of the locations and the minimal impact to site soils during operations, land contamination issues are considered to be minimal for the proposed activity.

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

**Mitigation Measures**

Those mitigation measures identified in Sections 5.8, 5.9 and 5.11 aim to ensure that any contamination risk is appropriately managed. No other specific measures are considered necessary.

### 5.11 Waste minimisation and management

**Impacts**

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

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

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

**Mitigation Measures**

- A general waste management strategy based upon the principles of reduce, reuse and recycling will be implemented.
- A specific Site Waste Management Plan for drilling activities will be prepared and implemented by the
drilling contractor.

- All staff and contractors will be made aware of waste management procedures during induction.
- Appropriate waste containers will be provided on the site.
- Any waste generated is to be disposed of in an appropriate manner in accordance with relevant standards and guidelines.
- Spills of waste material shall be dealt with in a prompt and thorough manner, and reported to the appropriate authority if necessary.
- General refuse will be collected and transported to an approved recycling or disposal site.
- Onsite waste disposal is prohibited.
- Hazardous waste will be managed in accordance with existing guidelines and standards.

5.12 Natural resource use

Impacts

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

The subject site is part of a property comprising land used for agriculture. The location for the proposed chip hole has been selected taking into account the potential temporary loss of the land during this time. The total area of works and therefore the amount of agricultural land that would be temporarily taken out of agricultural use for the duration of the project is approximately 4,800m². This represents a relatively minor proportion of the overall area of the property. Approximately 300m² of land will also be utilised for the new section of access track, which is to remain following completion of works at the request of the landowner.

The lease build and drilling is anticipated to take a approximately 54 days and the rehabilitation approximately one month. The disturbed areas (excluding the access track, which is to remain) will be rehabilitated by returning them to at least their pre-operational state or to a condition agreed by the landholder. Therefore, there would be a temporary loss of the use of this agricultural land in agreement with the landholder and, in the context of the total agricultural land holding and the wider agricultural uses of the region, is of minimal significance.

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

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

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

Mitigation Measures

The temporary loss of the use of the agricultural land will be mitigated through rehabilitation in the short to medium term.
The use of fuel is not considered to be significant however the fuel will be used as efficiently as possible through appropriate work behaviour (e.g. switching off equipment when not in use).

5.13 Local Community and Neighbouring Properties

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

The proposed works that are the subject of this REF are temporary (as described in Section 3.5). The nearest residential dwelling is just over 1km to the north west of the site. The closest community is Spring Ridge which is approximately 12km to the south of the site. Breeza is approximately 20km to the east of the site and Curlewis approximately 18km to the north.

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

Santos has negotiated an access, compensation and rehabilitation agreement with the affected landowner in respect to land access, compensation and rehabilitation as required under the Petroleum (Onshore) Act 1991. A scouting survey has been undertaken in consultation with the relevant landholder prior to drilling taking place to locate the site with an emphasis on minimisation of impacts on the environment and property operations.

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

Activities will be 12 hours per day in negotiation with the landholder and measures to mitigate noise are identified in Section 5.6 above.

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

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

Mitigation Measures

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

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

Impacts

The operations are temporary in nature, with a duration of approximately 84 days and all equipment will be removed on completion of site activities. The closest residence is just over 1km away to the north west. Following completion of the works all sites will be rehabilitated and would not detract from the overall scenic qualities of the area.

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

Mitigation Measures

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

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

5.15 Land use

Impacts

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

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

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

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

Mitigation Measures

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

5.16 Cumulative Environmental Impacts

The closest offset wells to the proposed activities are Calala 1 (9km) and Glasserton 1 (11km). These wells have been plugged and abandoned and there will therefore be no cumulative impacts associated with drilling or site activities associated with these wells. This includes impacts in relation to noise, traffic and ecology.
5.17 Summary of Mitigation Measures

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

Table 5-3 Summary of Mitigation Measures

<table>
<thead>
<tr>
<th>Potential Impact</th>
<th>Proposed Mitigation Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecology</td>
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<td>• Following construction of the chip hole, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Rehabilitation will include native grasses that are representative of the existing vegetation composition.</td>
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<td>• Following construction of the chip hole lease, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Rehabilitation will include native grasses that are representative of the existing vegetation composition.</td>
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<td>• An Environmental Management Plan (Appendix E) has been prepared for the proposed activity and will be adhered to by site personnel at all times.</td>
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<tr>
<td></td>
<td>• In the event that any vegetation clearing is required to allow large machinery access to a given area, soil disturbance shall be kept to a minimum. Subject to ecological constraints, it is preferable for vegetation to be cut with a chain saw rather than bulldozed, and trees and bushes shall be cut at their base just above ground level where possible.</td>
</tr>
<tr>
<td></td>
<td>• If works fall outside of the areas inspected for the purposes of the cultural heritage assessment or access routes are altered those areas must be further investigated by a qualified archaeologist.</td>
</tr>
<tr>
<td></td>
<td>• If an Aboriginal object or site is identified at any point during the proposed works, all works in the vicinity must cease immediately. That area shall be temporarily fenced with high visibility tape or barrier fencing in order to prevent further impact and a suitably qualified archaeologist contacted. Works in that location shall not proceed until the site has been registered with the OEH and an appropriate course of action determined by the archaeologist. In most instances this would involve applying for an Aboriginal Heritage Impact Permit (AHIP) from OEH in consultation with the Aboriginal Community.</td>
</tr>
<tr>
<td></td>
<td>• In the event that skeletal remains are uncovered, work must cease immediately in that area and the area fenced. Santos shall then contact the NSW Police and follow the advised procedure. If the skeletal remains are determined to be Aboriginal, Santos shall then contact the OEH and relevant Aboriginal Community Stakeholders in order to determine an action plan for the management of the skeletal remains prior to works commencing.</td>
</tr>
<tr>
<td>Other Heritage</td>
<td>• It is considered highly unlikely that any items of European cultural heritage significance will be impacted by the proposed drilling. Nonetheless, heritage items are protected by legislation in</td>
</tr>
</tbody>
</table>
### Potential Impact: NSW. If an object is found during drilling or other subsurface works that is considered to be of any heritage significance, all works shall cease, and a qualified archaeologist shall be contacted.

### Proposed Mitigation Measure

<table>
<thead>
<tr>
<th>Groundwater</th>
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<tbody>
<tr>
<td>Monitoring of private groundwater bores within a 2km radius (with landholder permission) be undertaken before drilling commences, to more clearly establish baseline conditions and then continue monitoring on a regular basis throughout the duration of all drilling activities. It is proposed that monitoring will include water level and water quality (electrical conductivity) observations.</td>
</tr>
<tr>
<td>The drilling sumps should be lined (with an appropriate impermeable material) and that all drilling fluids are completely removed from site prior to site rehabilitation.</td>
</tr>
</tbody>
</table>

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

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

| Surface Water |
| Contaminated waters will be contained and where necessary disposed of at an appropriate facility. |
| Drilling fluids will be contained on site and not discharged to surrounding watercourses. Over-balanced drill techniques to be utilised to prevent formation fluid from rising through the well to the surface. |
| Excessive fluid losses will be cured by LCM (cellulose material such as sawdust) to ensure most fluids return to the surface. |
| Sediment fences and traps will be installed so as to prevent soil loss or sedimentation (see sedimentation plan in Figure 3.2). |
| Fuel and lubricants will be stored on site only when necessary and maintained off site whenever possible. |
| All areas storing or handling fuel, fuel using equipment, and chemicals will be bunded in accordance with Australian Standard 1940 – 2004; The Storage and Handling of Flammable and Combustible Liquids. |
| The maintenance and cleaning of vehicles and other equipment or plant will be carried out in areas from where the resultant contaminants cannot be released into any waters. |
| Wastewater removed from site will be managed by a contractor licensed to carry and handle water. |
| Where applicable maintenance of roads, drains, bund walls, contour and diversion banks to occur. All drainage structures will be maintained for the life of the development. |
| Disturbed land will be rehabilitated to pre-operational quality or better, to minimise sediment erosion. |
| During rehabilitation, diversion banks and ripping along the contour will be completed to prevent the concentration and momentum of water flow as required. |

<p>| Soils |
| The erosion and sediment control measures are proposed as follows: |
| Any displaced soil gathered during operations will be stockpiled within the compound. This soil is to be used as backfill at the conclusion of drilling operations. |
| Maintain existing ground cover where possible. |
| Stabilise entry/exit points to the work area or any high traffic areas. |
| Install sediment fence at downstream limit of disturbance area. |
| Rehabilitate the disturbed area upon completion of required activities. |
| The following mitigation measures are proposed to reduce the risk of soil contamination: |
| Provide a spill kit for clean up spills of diesel, lubricants, oil etc. |
| Immediately clean up any spills or leaks. |</p>
<table>
<thead>
<tr>
<th>Potential Impact</th>
<th>Proposed Mitigation Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily pre-start inspection of plant and equipment to identify any maintenance requirements.</td>
</tr>
<tr>
<td></td>
<td>Store, handle, use and dispose of all potential contaminants in accordance with the MSDS.</td>
</tr>
<tr>
<td></td>
<td>Remove all wastes (other than drill cuttings and sump fluid) from the site as required.</td>
</tr>
<tr>
<td></td>
<td>Containment of drilling fluids in sumps or above-ground tanks.</td>
</tr>
<tr>
<td></td>
<td>Minimise on-site storage of fuel and lubricants.</td>
</tr>
<tr>
<td></td>
<td>Adequate maintenance of tanks or sumps.</td>
</tr>
<tr>
<td></td>
<td>Ensure tanks or sumps have overflow capacity in case of heavy rain.</td>
</tr>
<tr>
<td></td>
<td>Any soil that becomes contaminated through contact with drilling fluids, fuels, or lubricants will be removed from the site and disposed of at an appropriate licensed disposal facility.</td>
</tr>
</tbody>
</table>

**Contaminated Land**
Refer to measures for Soils, Chemical & Hazardous Substances and Waste Minimisation.

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

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

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

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

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

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

**Land Use**
The loss of the use of the agricultural land will be mitigated through rehabilitation following completion of the temporary activities.
5.18 Clause 228 Guidelines

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

Table 5-4 Clause 228 Guidelines

<table>
<thead>
<tr>
<th>Factor</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any environmental impact on the community</td>
<td>Short term negative. The nearest residential dwelling is just over 1km from the site to the north west. The closest community is Spring Ridge which is approximately 12km to the south of the site. Curlewis is approximately 18km to the north and Breeza is approximately 20km to the east of the site. Minor short term impacts such as increased local traffic would be experienced. Receptors closer to the works would also have potential dust effects. Safeguards proposed in Section 5 and Table 5-2 would minimise these impacts.</td>
</tr>
<tr>
<td>Any transformation of a locality</td>
<td>Short term negative. There would be localised and non-permanent visual impact on the immediate vicinity of the hole for the duration of the programme. Safeguards proposed in Section 5 and Table 5-2 would minimise these impacts.</td>
</tr>
<tr>
<td>Any environmental impact on the ecosystems of the locality</td>
<td>Minor negative. Some temporary disruption to the ecosystem will occur during site operations, however these are minor acceptable impacts and can be appropriately managed.</td>
</tr>
<tr>
<td>Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality</td>
<td>Nil. During drilling there may be a reduction in these values due to affecting visual amenity. Given the short-term nature of activities and the safeguards/mitigation detailed in Section 5 and Table 5-2 the potential for a reduction is considered negligible.</td>
</tr>
<tr>
<td>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</td>
<td>Nil. 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 proposed well lease.</td>
</tr>
<tr>
<td>Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)</td>
<td>Short term negative. There will be minimal impacts on fauna habitat and mitigation measures are identified. Refer Section 5.2 for further details.</td>
</tr>
<tr>
<td>Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air</td>
<td>Nil. 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.</td>
</tr>
<tr>
<td>Any long-term effects on the environment</td>
<td>Nil. The proposal would have no long-term effects on the environment. Rehabilitation of the well lease will occur.</td>
</tr>
<tr>
<td>Any degradation of the quality of the environment</td>
<td>Minor short term negative. There is potential for minor short term environmental degradation due to visual, noise or dust impacts. Safeguards proposed in Section 5 and Table 5-2 would minimise these impacts.</td>
</tr>
<tr>
<td>Any risk to the safety of the environment</td>
<td>Minor short term negative. The proposal may result in short term potential risks to the safety of the environment due to incidents and spills. The likelihood and consequence of an incident occurring would be reduced through the application of Santos’s EHSMS Standards and mitigation</td>
</tr>
</tbody>
</table>
## Review of Environmental Factors

**Sicamous 1 Chip Hole – PEL 1, Gunnedah Basin**

### Any reduction in the range of beneficial uses of the environment

**Impact:** Nil.<br> The footprint of activities for the proposal would not result in any reduction in the range of beneficial use of the environment.

### Any pollution of the environment

**Impact:** Nil.<br> 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.

### Any environmental problems associated with the disposal of waste

**Impact:** Nil.<br> Drill cuttings would be allowed to dry onsite and disposed of at an appropriate licensed facility. Any other waste generated by the activities will be collected and removed from site for disposal at approved landfill sites. Given the short term of the propose activity waste production will be minimal.

### Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply

**Impact:** Nil.<br> Resources required for the proposal are not in limited supply in the area.
6.0 Conclusions

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

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

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

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

- Ecology;
- Aboriginal heritage; and
- Noise.

Consideration has also been given to a broader range of environmental impacts, including air, surface water, soils, chemical and hazardous substances management, contaminated land, waste minimisation and management, natural resources, local community and neighbouring properties, visual impacts, land use and cumulative environmental effects. In particular, investigations have been made in relation to flooding impacts and likelihood at Goran Lake.

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

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


Namoi Catchment Management Authority – website www.namoi.cma.nsw.gov.au
Appendix A

Ecological Assessment

prepared by RPS
Ecological Assessment

Sicamous Chip Hole – PEL 1, Gunnedah Basin

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Report Number: PR107106-2_Sicamous EA
Version / Date: Final, Rev 0 / August 2011
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In preparing this report we have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

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Document Status

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<th>Meaning</th>
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<tr>
<td>AoS</td>
<td>Assessment of Significance</td>
</tr>
<tr>
<td>BoM</td>
<td>Bureau of Meteorology</td>
</tr>
<tr>
<td>CEEC</td>
<td>Critically Endangered Ecological Community</td>
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<td>CMA</td>
<td>Catchment Management Authority</td>
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<td>DECCW</td>
<td>NSW Department of Environment, Climate Change and Water</td>
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<td>EA</td>
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<td>Commonwealth Environment Protection and Biodiversity Conservation Act 1999</td>
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<td>FM Act</td>
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<td>ha</td>
<td>hectare</td>
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<td>KTP</td>
<td>Key Threatening Process</td>
</tr>
<tr>
<td>LGA</td>
<td>Local Government Area</td>
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<td>Locality</td>
<td>Lands within 10km of the study area</td>
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<td>MNES</td>
<td>Matters of National Environmental Significance</td>
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<td>NES</td>
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<td>NPWS</td>
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<td>State Environmental Planning Policy 44 “Koala Habitat Protection”</td>
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<td>SEWPaC</td>
<td>Department of Sustainability, Environment, Water, Population and Communities</td>
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<tr>
<td>Sp</td>
<td>Singular Species</td>
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<tr>
<td>Spp</td>
<td>Multiple Species</td>
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<tr>
<td>Ssp. or subsp.</td>
<td>Subspecies</td>
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<td>Area directly associated with the proposed activities</td>
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<tr>
<td>TSC Act</td>
<td>NSW Threatened Species Conservation Act 1995</td>
</tr>
</tbody>
</table>
I.0  Introduction

I.1  Background

Santos QNT Pty Ltd (Santos) as Operator for and on behalf of the Titleholders of PEL 1, is investigating opportunities for activities associated with Coal Seam Gas exploration currently underway in the Gunnedah Basin. RPS was engaged to undertake an ecological pre-clearance assessment of a portion of Lot 114 on DP755480 to identify ecological constraints, potential impacts and mitigation measures associated with the development of a chip hole referred to as Sicamous 1, located within PEL 1 (Figure 1.1).

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

I.2  Site Particulars

I.2.1  Regional Location

The study area is located approximately 20km south west of Curlewis, in the Brigalow Belt South IBRA Bioregion and Namoi Catchment Management Authority region (Liverpool Plains sub-region). The study area is within the Gunnedah Shire Council Local Government Area (LGA).

The study area is located to the east of Lake Goran, a nationally Important Wetland (NSW005), mapped by the Office of Environment and Heritage (OEH) as a Freshwater Wetland. The study area is approximately 200m from the highest level of the lake, however the lake is ephemeral in nature, with water levels fluctuating significantly throughout the year. Goran Lake is approximately 296.4m Australian Height Datum (AHD) at full capacity, while the study area is approximately 300m AHD. Doona State Forest is located approximately south-east of the site.

I.2.2  Study Area Description

The study area is limited to approximately 25ha area surrounding the proposed chip hole lease, and the proposed access tracks (Figure 1.1). The majority of the study area is currently used for cattle and sheep grazing, and has been historically cleared of native vegetation communities. However, isolated stands of vegetation occur across the study area. The site has been recently disturbed by bushfire, including the proposed chip hole lease.

I.2.3  Topography

The topography of the study area is gentle. Elevation is approximately 300m Australian Height Datum (AHD) and land falls towards Lake Goran, located to the west of the site.
1.3 Description of the Proposed Activities

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

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

In summary, the process involves:

- Preparation of lease access tracks, utilising and improving existing access tracks and construction of short section of new track;
- Preparation of a level drill pad (also referred to as “well lease area”);
- Placement of a drilling rig and ancillary equipment at the well lease;
- Drilling of the well;
- Collection and analysis of drill cuttings (as required);
- Conduct well testing and wireline logging (as required);
- Plugging and abandonment of the well;
- Removal of equipment and imported materials from the site; and
- Full rehabilitation of the site in line with legislative and landholder requirements.

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

1.3.1 Site Preparation & Equipment

Various works will be required in order to prepare the site for the proposed drilling, including preparation of the well lease, construction of approximately 50m additional track, as well as positioning the drill rig and associated temporary buildings and equipment on the site. The major equipment used on site will be a drilling rig and associated temporary buildings. These works are summarised further in this section. Figure 1.2 illustrates the proposed site layout for the well lease and access track.

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

<table>
<thead>
<tr>
<th>Area of Disturbance</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sicamous 1 80m X 60m with an overall area of disturbance of 4,800m².</td>
<td>Pad level will be created with cut to fill a pad level of approximately RL300AHD.</td>
</tr>
<tr>
<td>Additional Track 6m x ~50m, with an overall area of disturbance of approx 300m²</td>
<td>To be topped with approximately 150mm gravel to provide all weather access.</td>
</tr>
</tbody>
</table>

Further detail about the chip hole design is provided in Appendix D of the REF.

Well Lease Construction

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

Access track Improvements and Construction

- There is an existing track which provides access to the location. Upgrading of this track with gravel will be required, however no widening is necessary.
- The following is a list of the detailed works involved.
- The existing track will be top dressed with 100mm road base.
- Track is to be top dressed to allow wet weather access.
- Two cattle ramps and two sets of double gates and end assemblies to be installed in two locations along the access track.

Drill Rig Positioning & Operation

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

1.3.2 Drilling Activities

The well will have a specific design ensuring compliance with relevant legislation. A nominal 10-3/4" (273mm) cemented conductor is to be installed by the lease builder to approximately 6m below ground level. The surface hole of 8 1/2" (216mm) will be rotary drilled to approximately 150mRT, where a 7" (178mm) steel surface casing will be landed and pressure cemented in place with cement to surface. The main hole of diameter 6-1/8" (156mm) will be drilled from the 7" (178mm) casing shoe to well total depth planned to be 20m into the Boggabri Volcanics at approximately 590mRT based on the pre-drill geological prognosis. DSTs or equivalent downhole evaluations may be conducted on penetration over selected Late and Early Permian Coals with testing to be performed in accordance with legislative requirements.

The closest offset wells to the proposed activities are Calala 1 (9km) and Glasserton 1 (11km).

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

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

1.3.3 Abandonment and Rehabilitation

The well will be cemented, plugged and abandoned in accordance with DTIRIS requirements and rehabilitated following completion of activities within the allowed regulatory timeframe. A steel identification plate installed near the top of the hole > 1 metres below the surface.

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

Revegetation & rehabilitation will be undertaken within the required regulatory timeframe. All improvement works to private tracks will be retained for the benefit of the landholder.
1.3.4 Duration

Drilling activities are temporary and will not have any long-term impact on the visual amenity of the area. The drilling of the well is expected to occur over a 40 day period not including lease build, or site rehabilitation. There will be 14 days of lease construction activities prior to drilling the well. Rehabilitation activities of 30 days following the drilling of the well will be additional to this period.

This equates to a total of approximately 54 days of construction and drilling and 30 days of rehabilitation, as outlined in Table 1.3.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Expected Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lease Build</td>
<td>14 days</td>
</tr>
<tr>
<td>Drilling</td>
<td>40 days</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>30 days</td>
</tr>
</tbody>
</table>

1.3.5 Staff & Hours of Operation

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

The hours of operation during the drilling and work over will be on a 12 hour a day basis as negotiated with the landholder. Personnel movements to and from site will be minimised outside of a single shift change per day but may be necessary due to emergency situations or specific activities (e.g. crews and service companies entering and leaving site to conduct specific activities).

1.3.6 Chemicals

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

- AMC Xtra-Sweep
- AMC Lime
- AMC Hammer Oil
- AMC Aus-Ben
- AMC Aus-Gel
- AMC Aus-Plug
- Barite
- Mud Flush III
- Guar gum, propoxylated
- Fly Ash – Eraring
- Flocele 3/8”
- AMC EP Bit Lube
- Econolite Additive
- Rheolube
- AMC CR-650
- Cement – Standard – Class A
- CFR-3
- CAL-Seal 60
- Calcium Chloride – Flake
- Bentonite
- AMC Superfoam
1.3.7 Justification of Activity

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

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

1.4 Scope of the Study

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

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

A desktop assessment of the proposed chip hole lease was conducted prior to completing a pre-clearance assessment on the 18 July, 2011. This assessment details the findings of the background review and pre-clearance survey. Additionally, Commonwealth, state and local legislation relevant to the proposal have been addressed in this assessment.
1.5 Licensing and Certification

Research was conducted under the NSW National Parks and Wildlife Service Scientific Investigation Licence S10300 (Valid 30 November 2011).
Figure 1.1 - Aerial Photograph and Location

Sicamous

Legend

Site Boundary

0 100 200 300 Meters

Santos QNT Pty Ltd

Project Manager: BD
Compiled by: TL
Map Projection: MGAz56
Map Datum: GDA94
File Reference: PR107672.mxd

©2009 Google
Image ©2010 DigitalGlobe

Title

Figure 1.1 - Aerial Photograph and Location

Sicamous
Figure 1.2 - Chip Hole Lease Layout
Sicamous
2.0 **Legislative Context**

The following legislation is likely to be applicable to the site (from an environmental perspective) and may require further detailed consideration during the approval process.

2.1 **Commonwealth Legislation**

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

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

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

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

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

### 2.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (NSW) (EP& A Act) regulates development carried out in New South Wales. The carrying out of development is regulated under either Part 3A (this has been repealed and is being replaced by a new system), Part 4 or Part 5 of the EP&A Act.

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

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

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

**Determining Authorities and the REF**

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

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

The determining authorities are required to consider whether the proposed activity is likely to significantly affect the environment or threatened species, populations or ecological communities, or their habitats to determine whether an EIS or SIS is required. In deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities or their habitats, section 5A of the EP&A Act requires the following factors to be taken into account (the "seven part" test of significance)
(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

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

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
   - (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
   - (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

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

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

This EA has been prepared to assist the determining authorities in meeting their obligations under the EP&A Act. In particular, the "seven part" test has been applied to the proposed activities where required (Appendix C).

Gunnedah Shire Local Environmental Plan

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

(a) to protect the use and efficiency of prime agricultural land while permitting appropriate development subject to suitable subdivision controls,
(b) to permit other forms of development which are ancillary to rural land uses or that, as a result of their nature, require siting outside the urban area,

(c) to avoid further fragmentation and alienation of useable rural land,

(d) to retain the low density nature of settlement within the rural areas and ensure that any future development does not create unreasonable demands on the existing infrastructure or available services,

(e) to provide for the requirements of the rural community,

(f) to maintain safety and convenience along main roads by discouraging uses that are likely to generate traffic volumes which disrupt traffic flow,

(g) to ensure that the existing level of scenic amenity is maintained by requiring development to have regard for significant ridgelines and hilltops.

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

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

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

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

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

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

Core koala habitat is defined as:

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

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

### 2.2.2 Threatened Species Conservation Act 1995

The objects of the *Threatened Species Conservation 1995* (NSW) (TSC Act) include:
To conserve biological diversity and promote ecologically sustainable development;

Prevent the extinction and promote the recovery of threatened species, populations and ecological communities;

To protect the critical habitat of those threatened species, populations and ecological communities that are endangered; and

To ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed.

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

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

As discussed in Sections 4.2.4, one EEC and one threatened species listed under the TSC Act are relevant to the proposed activities, and has thus undergone the seven-part test to determine whether significant impacts to these species are likely.

2.2.3 National Parks and Wildlife Act

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

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

2.2.4 Key Threatening Processes

A key threatening process is defined under the TSC Act as ‘a process that threatens, or that may threaten, the survival or evolutionary development of a species, population or ecological community. Threatening processes that adversely affect threatened species, populations or ecological communities, or possibly cause others that are not currently threatened; to become threatened may be eligible for listing as a key threatening process (KTP).
As discussed in **Section 5.4**, KTPs relevant to the proposed activities include those listed on the TSC Act and EPBC Act and include the following:

- Invasion of native plant communities by exotic perennial grasses;
- Clearing of native vegetation;
- Loss of hollow bearing trees; and
- Loss of dead trees and dead wood.

### 2.2.5 **Native Vegetation Act 2003**

The *Native Vegetation Act 2003* (NV Act) sets a framework for:

- Encouragement of revegetation and rehabilitation of land with appropriate native vegetation;
- Providing incentives for landholders to undertake management of native vegetation on their properties; and
- An end to broad scale clearing, unless it improves or maintains the environment.

The NV Act provides three categories of native vegetation including regrowth, protected regrowth and remnant vegetation with clear definitions.

The NV Act provides greater flexibility and incentives for landholders to manage native vegetation sustainably. The Act gives effect to the Government's commitment to ending broad scale clearing unless it improves or maintains environmental outcomes.

Under section 25(g), the NV Act does not apply to any clearing that is part of an activity carried out by a determining authority within the meaning of Part 5 of the EP&A Act where the determining authority has complied with Part 5. Under section 25(m), the NV Act does not apply to any clearing authorised under the *Petroleum (Onshore) Act 1991* (NSW).

### 2.2.6 **Noxious Weeds Act 1993**

The *Noxious Weeds Act 1993* (NW Act) is a NSW government instrument outlining the definition, declaration, and control of noxious weeds throughout the State. Local government bodies have the responsibility to ensure that the Act is complied with within their boundaries.

For a plant to be declared a Noxious Weed it must be considered to pose a serious threat to humans, agriculture and/or the environment. There must also be consideration given to the feasibility of control and enforcement of those methods. Plants are declared noxious by order of the Minister for Agriculture.

Landowners or occupiers have obligations under the NW Act to control any declared weed on their property. Council is required to conduct inspections of private properties to check compliance with the NW Act and Noxious Weed Officers have the authority to issue control notices for any breach.
3.0  Methodology

3.1  Desktop Assessment

A desktop assessment was undertaken to identify potential development constraints as well as significant ecosystems and species that may potentially occur in the study area. The following databases and maps were reviewed:

- EPBC Protected Matters Search Tool (Department of Sustainability, Environment, Water, Population and Community (DSEWPaC), 2011) (Appendix A);
- Review of threatened fauna and flora records contained in the Office of Environment and Heritage (OEH) Atlas of NSW Wildlife for the Curlewis Map Sheet, as well as the Liverpool Plains sub-catchment listing;
- National Vegetation Information Systems mapping; and
- Aerial photography.

3.2  Field Assessment

A site inspection was carried out on 18th July 2011 to:

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

Surveys of the study area consisted of a threatened flora species search, a vegetation survey and a flora and fauna habitat assessment. Habitat assessments included identifying and describing the commonly occurring and listed terrestrial species and communities known or likely to be present in the study area, and assess which species or communities may be affected by the proposed activities. Targeted searched for evidence of koala were also undertaken.

The threatened species search targeted threatened species listed within the EPBC Protected Matters search and within the Atlas of NSW Wildlife database (Curlewis Mapsheet and Liverpool Plains sub-region). The flora survey consisted of a random meander, and general threatened flora searches. This method generated a flora species list for and a description of the dominant flora species for the study area.
3.3 Survey Limitations

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

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

4.1 Literature Review and Database Search Results

4.1.1 Environmental Protection and Biodiversity Conservation Act 1999

A search using the EPBC Act protected matters search tool identified ten threatened fauna species, comprising four birds, three mammals (including two bats), one reptile, one frog and one fish, and eight threatened flora species listed under the EPBC Act that are predicted to occur within the locality of the study area. In addition, nine migratory bird species were identified as predicted to occur within the locality of the study area. Five Threatened Ecological Communities (TECs) listed under the EPBC Act are also predicted to occur within the locality of the study area:

- Grey Box (Eucalyptus microcarpa) grassy woodlands and derived native grasslands of south-eastern Australia;
- Weeping Myall Woodlands;
- Natural Grasslands on Basalt and Fine-textured Alluvial Plains of Northern New South Wales and Southern Queensland; and
- White Box-Yellow Box-Blakely’s Red Gum grassy woodland and derived native grassland.
- Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions.

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

No World Heritage properties, National Heritage properties, Commonwealth marine environments or Ramsar Wetlands occur in the study area or would be affected by the activity. A full list of threatened and migratory species obtained from the protected matters search tool is available in Table 5.1 for flora and fauna species, and Table 5.2 for migratory species. Each table describes the conservation status, habitat requirements and likelihood of occurrence of each listing. A review of the specific habitat requirements of these species, and the habitat present within the study area and its surrounds allowed a number of these species and/or EECs to be eliminated as having nil, or low likelihood of occurrence in the study area.

4.1.2 Threatened Species Conservation Act

The results of the DECCW wildlife atlas database search and Curlewis map sheet review revealed four threatened flora species and 40 threatened fauna species previously recorded in the area.

In addition, nine Endangered Ecological Communities (EEC) listed within the NSW TSC Act are known in the Liverpool Plains (Part B) sub-region of the Namoi Catchment Management Authority region, including:

- Artesian Springs Ecological Community;
- Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South bioregion;
- Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions;
- Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions;
- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions;
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions;
- Native Vegetation on Cracking Clay Soils of the Liverpool Plains; (one potential site may be this EEC)
- Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions; and
- White Box Yellow Box Blakely’s Red Gum Woodland.

A full list of threatened species obtained from the DECCW database search is available in Table 5.1. The table describes the conservation status, habitat requirements and likelihood of occurrence of each listing. A review of the specific habitat requirements of these species, and the habitat present within the study area and its surrounds allowed a number of these species and/or EECs to be eliminated as having nil, or low likelihood of occurrence in the study area.

4.2 Flora Survey Results

4.2.1 Vegetation Communities

Two vegetation communities were delineated within the study area. These communities were:

- White Box Woodland; and
- Native Grassland.

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

**Description:** This vegetation community occurs across the eastern portion of the study area. This community is comprised of moderately sized, well spaced trees, with no sub-canopy and a very sparse shrub layer. A dense grassy ground layer is present (Plate 4.1).

**Canopy Layer:** 14 to 16 m – a patchy 10-15% projected foliage cover (PFC). Dominated by White Box.

Shrub Layer: 0.5m to 1m – sparse cover. Species include Small-leaved Cotton Bush (*Maireana microphylla*), African Boxthorn (*Lycium ferocissimum*), and Prickly Pear (*Opuntia stricta*).

**Ground Layer:** 0.1 to 1.0 m – variable 70 to 80 % native ground cover. Dominant species include Rough Speargrass (*Austrostipa scabra*), Plains Grass (*Austrostipa aristiglumis*), Shepherds Purse (*Capsella bursapastoris*), and Tall Fleabane (*Conyza sumatrensis*).

**Condition:** This vegetation community occupies the eastern extent of the study area (Figure 4.1). This community is regularly grazed and has been selectively logged, and is in a moderately disturbed condition as a result. Additionally, portions of this community have recently been subjected to bushfire, and are currently void of shrubs and ground cover, but have an intact canopy layer.

**Classification:** Despite the disturbed condition of this community, the floristic structure and character corresponds with the Endangered Ecological Community (EEC) known as White Box - Yellow Box - Blakely’s Red Gum Woodland which is listed within the schedules of the TSC Act. Refer to Section 4.2.4.
**Native Grassland**

*Plate 4.2: Representative Native Grassland*

*Plate 4.3: Current Condition of Chip Hole Vegetation*

**Description:** This vegetation community occurs across the study area, including within the chip hole lease. It is characterised by a dense grassy ground layer, with no shrub or canopy vegetation. While
portions of this community have recently been disturbed by wildfire, remaining areas are considered to be representative of the pre-fire condition.

**Canopy Layer:** Absent.

**Shrub Layer:** Absent.

**Ground Layer:** 0.1 to 1.0 m – variable 60 to 75 % native ground cover. Dominant species include Rough Speargrass, Plains Grass, Shepherds Purse, Tall Fleabane, Saffron Thistle, and Galvanized Burr (*Sclerolaena birchii*).

**Condition:** This vegetation community occurs across the study area. It is regularly grazed, and has been cleared of canopy and shrub vegetation, and is therefore highly disturbed. Additionally, a large portion if this community has recently been burnt due to wildfire, resulting in no ground cover vegetation. Emergent species in this area include Galvanised Burr and Prickly Pear. This community is generally in poor condition.

**Classification:** Despite the disturbed condition of this community, the floristic structure of the grassland corresponds with the Endangered Ecological Community (EEC) known as White Box - Yellow Box - Blakely’s Red Gum Woodland which is listed within the schedules of the TSC Act.

An assessment of ground cover composition was conducted (**Table 4.1**) within grassland to verify the classification of this community. Given the current condition of the chip hole lease, the assessment was conducted in an area of grassland considered to be representative of the pre-fire condition of the chip hole location. The assessment indicated that the site is dominated by native grasses (averaging 67 %) (**Table 4.1**). Further justification for the classification of this community is provided in **Section 4.2.4**.

### Table 4.1: Results of Ground Cover Composition Assessment

<table>
<thead>
<tr>
<th>Quadrature</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native perennial grass (%)</td>
<td>65</td>
<td>60</td>
<td>75</td>
<td>66.67</td>
</tr>
<tr>
<td>Native herbs and forbs (%)</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>6.67</td>
</tr>
<tr>
<td>Introduced grasses (%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Introduced herbs and shrubs (%)</td>
<td>15</td>
<td>30</td>
<td>10</td>
<td>18.33</td>
</tr>
<tr>
<td>Litter (%)</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Bare ground (%)</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Rock (%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### 4.2.2 Weeds

Two listed noxious weeds were identified on site, namely Prickly Pear and African Boxt horn. Under the provisions of the *Noxious Weeds Act 1993*, Prickly Pears (except *Opuntia ficus-indica*) and African Boxt horn are classed as Class 4 weeds. This means that the growth and spread of the plant must be controlled according to the measure specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed.
4.2.3 Significant Flora Species

Using the EPBC Act Protected Matters Search Tool (Appendix A), eight threatened flora species listed under the EPBC Act were identified as potentially occurring in the locality (10km buffer). Eight threatened species listed under the TSC Act were identified as known to be occurring in the study area, based on the Liverpool Plains (Part B) CMA-subregion TSC Act Search Tool. The likelihood of occurrence of these flora species was assessed based on broad habitat type present within the proposed chip hole lease, as well as species distribution. The outcomes of the likelihood of occurrence assessment are included in Table 5.1.

4.2.4 Threatened Ecological Communities Assessment

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

For the purposes of this assessment, the grassland to the immediate south of the chip hole lease was assessed. This is considered to be representative of the pre-fire condition of the chip hole lease, given that it is contiguous with vegetation across the study area. Despite the current highly disturbed state of the grassland within the chip hole lease, it is considered to be an EEC under the TSC Act, as outlined below. It is not considered to be a TEC under the EPBC Act.

TSC Act Assessment

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

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

Identification guidelines have been provided for this community (NPWS 2002). The vegetation in the subject site has been assessed against these guidelines in Table 4.2.
### Table 4.2: TSC Act Box Gum Woodland Listing Criteria

<table>
<thead>
<tr>
<th>Box Gum Woodland</th>
<th>NPWS Comment</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The subject site is in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands or NSW South Western Slopes Bioregions. Proceed to 2.</td>
<td></td>
<td>The subject site is located within the Nandewar Bioregion.</td>
</tr>
<tr>
<td>1*. The site is outside of the above bioregions.</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>2. There are no native species in the understorey, and the subject site is unlikely to respond to assisted natural regeneration</td>
<td></td>
<td>The subject site is not Box Gum Woodland.</td>
</tr>
<tr>
<td>2* The subject site is otherwise. Proceed to 3.</td>
<td></td>
<td>The understorey, whilst comprising up to 30% weed species, this community is dominated by native grasses.</td>
</tr>
<tr>
<td>3. The subject site has trees. Proceed to 4.</td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>3* The subject site is treeless, but is likely to have supported White Box, Yellow Box or Blakely’s Red Gum prior to clearing.</td>
<td></td>
<td>White Box occurs to the north and east of the study area. It is likely that the chip hole lease previously supported this species.</td>
</tr>
<tr>
<td>4. White Box, Yellow Box or Blakely’s Red Gum, or a combination of these species, are or were present. Proceed to 5.</td>
<td></td>
<td>White Box occurs to the north and east of the study area, and are likely to have previously occurred across the site.</td>
</tr>
<tr>
<td>4* White Box, Yellow Box or Blakely’s Red Gum have never been present.</td>
<td>The subject site is not Box Gum Woodland.</td>
<td>N/A</td>
</tr>
<tr>
<td>5. The subject site is predominantly grassy.</td>
<td>The subject site is Box Gum Woodland.</td>
<td>Native grasses are present.</td>
</tr>
<tr>
<td>5* The understorey of the subject site is dominated by shrubs excluding pioneer species.</td>
<td></td>
<td>N/A</td>
</tr>
</tbody>
</table>

The results of the field survey determined that the chip hole lease and adjacent areas of the study area do fit the NSW Scientific Committee Final Determination of this EEC. It is likely that the chip hole lease previously supported White Box, given the presence of this species within the study area. Additionally, it is likely that the chip hole lease supports native species listed in the determination, given the species composition of adjacent areas. The chip hole lease is therefore considered to be White Box – Yellow Box – Blakely’s Red Gum Woodland.
**EPBC Assessment**

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

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

While there are no canopy trees within the chip hole lease, surrounding woodland vegetation includes White Box. It is likely that these species previously occurred within the proposed chip hole lease.

*Does the patch have a predominantly native understorey?*

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

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

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

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

The defined patch is greater than 0.1ha.

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

Within the defined patch, there are not 12 or more native understorey species present, excluding grasses. The patch does not meet this criteria.

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

The patch has been delimited at a greater size than 2ha.

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

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

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

4.3 Habitat Assessment

4.3.1 Fauna Habitats of the Study Area

Mature Eucalypt trees with large hollows are common throughout the study area. These hollows range from small to large in size and provide breeding habitat for numerous native birds, mammals and reptiles. The canopy species across the property are comprised of White Box, a listed Koala food tree species.

Large tracts of the study area are comprised of native grassland. While the groundcover is structurally simple, it is likely to provide habitat for generalist species, including foraging opportunities for native reptiles and birds.

Within the proposed chip hole lease, no canopy trees occur. Furthermore, due to recent fire, the ground cover and shrub layer have been removed. This area is therefore considered to provide minimal habitat resources for native fauna.

4.3.2 Fauna Observations

Fauna observed within the study area were limited to opportunistic sightings during flora and habitat surveys. Several common native bird species were observed in the study area, including Australian Magpie (Cracticus tibicen), Brown Quail (Coturnix ypsilophora), Laughing Kookaburra (Dacelo novaeguineae), Red Rump Parrot (Psephotus haematonotus) and White-faced Heron (Egretta novaehollandiae). Potential European Rabbit (Oryctolagus cuniculus) scats were also observed on the site. Additionally, Koala scats were observed beneath White Box trees.

4.3.3 Significant Fauna Species

Ten threatened fauna species listed under the EPBC Act were identified as potentially occurring in the site locale (10km buffer) using the EPBC Protected Matters Search Tool (Appendix A). Forty threatened species listed under the TSC Act were identified as known to be occurring in the study area, based on the Atlas of NSW Wildlife. The likelihood of occurrence of these species was assessed, based on broad habitat type within the chip hole lease, as well as species distribution, outlined in Table 5.1.

The assessment identified that the site provides potential habitat for a range of threatened fauna species. Additionally, Koala scats were observed on site.

Twelve migratory species were identified as potentially occurring in the site locale using the EPBC Protected Matters Search Tool. The majority of these species are considered as potential overfly species,
however the study area does not provide suitable habitat resources to support these species. It is considered possible that one migratory species, Cattle Egret (*Adea ibis*), potentially utilises the site.
Legend

Vegetation Type

- Grazing Land
- White Box Woodland
- Site Boundary

Figure 3.1 - Vegetation Communities

Sicamous
5.0 Environmental Impact Assessment

5.1 Threatened Flora, Fauna and Ecological Communities

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

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

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

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

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

‘Potential for Impact’ – Through consideration of the likely level / significance of impacts to each species / community / population that would result from the proposed activities, taking into account both short and long-term impacts, a decision has been made whether further assessment is required. This assessment is largely based on the chance of occurrence of each species / community with due recognition to other parameters such as home range, habitat use, connectivity etc. It also considers the scope of the proposed activities.
Table 5.1: Likelihood of Occurrence of Threatened Species, Populations and Ecological Communities within the Study Area

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>TSC Act Status</th>
<th>EPBC Act Status</th>
<th>Habitat</th>
<th>Likelihood of Occurrence</th>
<th>Likely Level of Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flora</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Cadellia pentastylis</em></td>
<td>Ooline</td>
<td>V</td>
<td>V</td>
<td>Forms a closed or open canopy mixing with Eucalypt and Cypress Pine species with a typical soil profile of sandy loam surface layer, grading from a light clay to medium clay with depth.</td>
<td>Unlikely. Targeted searches for this species were undertaken, however the species was not observed within the study area.</td>
<td>Marginal habitat is present in the study area, however the species was not observed within the study area and thus is unlikely to be affected by the proposed activities. Therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Dichanthium setosum</em></td>
<td>Bluegrass</td>
<td>V</td>
<td>V</td>
<td>Found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture on heavy basaltic black soils and stony red-brown hard setting loam with clay subsoil.</td>
<td>Possible. Suitable habitat occurs within the study area. Targeted surveys could not be conducted due to the seasonal timing of the surveys.</td>
<td>Marginal habitat is present in the study area and although it is possible the species may occur within the study area, It is unlikely to be affected by the proposed activities, given the temporary disturbances associated with the proposal. Therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Digitaria porrecta</em></td>
<td>Finger Panic Grass</td>
<td>E</td>
<td>E</td>
<td>Occurs in grasslands and in undulating woodlands and open forests with an underlying basaltic geology.</td>
<td>Possible. Suitable habitat occurs within the study area. Targeted surveys could not be conducted due to the seasonal timing of the surveys.</td>
<td>Marginal habitat is present in the study area and although it is possible the species may occur within the study area, It is unlikely to be affected by the proposed activities, given the temporary disturbances</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
<td>Likely Level of Impact</td>
</tr>
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<td>---------------------------------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Philotheca ericifolia</td>
<td>-</td>
<td>V</td>
<td>V</td>
<td>Grows mostly in dry sclerophyll forest and heath on damp sandy flats and gullies.</td>
<td>Unlikely, due to unsuitable habitat. The site is not comprised of sandy flats or gullies.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat on site, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Prasophyllum sp. Wybong</td>
<td>A Leek-orchid</td>
<td>-</td>
<td>CE</td>
<td>Generally found in shrubby and grassy habitats in dry to wet soil. It is known to occur in open Eucalypt woodland and grassland.</td>
<td>Unlikely due to highly disturbed nature of the study area.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of habitat on site, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Pterostylis cobarensis</td>
<td>Cobar Greenhood Orchid</td>
<td>V</td>
<td>V</td>
<td>Found in Eucalypt woodlands, open mallee or Callitris shrublands on low or stony ridges and slopes in skeletal sandy-loam soils.</td>
<td>Surveys did not record this species within the study area. Unlikely to occur within the chip hole lease due to lack of suitable trees, as well as highly disturbed nature of the site.</td>
<td>Considered unlikely to be adversely affected by the proposed activities. Detailed flora surveys were conducted within the study area, and no individuals were observed. The proposed activities will not result in the removal of this species.</td>
</tr>
<tr>
<td>Rulingia procumbens</td>
<td>-</td>
<td>V</td>
<td>V</td>
<td>Grows in sandy sites, often along roadsides and is associated with Eucalyptus dealbata and Eucalyptus</td>
<td>Surveys did not record this species within the study area. Unlikely to occur within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities as no individuals were observed.</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
<td>Likely Level of Impact</td>
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</tr>
<tr>
<td><strong>Swainsona murrayana</strong></td>
<td>Slender Darling-pea</td>
<td>V</td>
<td>V</td>
<td>Known to occur on clay-based soils in a variety of vegetation types, including Bladder Saltbush, Black Box and grassland communities on level plains, floodplains and depressions. It is often found with Maireana species.</td>
<td>Unlikely to occur due to unsuitable habitat.</td>
<td>Considered to be unlikely affected by the proposed actions, due to the lack of suitable habitat within the study area. An AoS for this species is not required.</td>
</tr>
<tr>
<td><strong>Thesium australe</strong></td>
<td>Austral Toadflax</td>
<td>V</td>
<td>V</td>
<td>Occurs in grasslands or grassy woodlands and is often found in damp subject sites in association with Kangaroo Grass.</td>
<td>Marginal habitat occurs in the study area.</td>
<td>Marginal habitat is present in the study area and although it is possible the species may occur within the study area, It is unlikely to be affected by the proposed activities, given the temporary disturbances associated with the proposal. Therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><strong>Tylophora linearis</strong></td>
<td>-</td>
<td>V</td>
<td>E</td>
<td>Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry Eucalypt and/or Callitris woodlands.</td>
<td>Marginal habitat occurs in the study area.</td>
<td>Marginal habitat is present in the study area and although it is possible the species may occur within the study area, It is unlikely to be affected by the proposed actions, due to the lack of suitable habitat within the study area. An AoS for this species is not required.</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
<td>Likely Level of Impact</td>
</tr>
<tr>
<td>---------</td>
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</tr>
</tbody>
</table>

**TSC Act and/or EPBC Act - Threatened Ecological Communities**

**TSC Act - Inland Grey Box Woodland in the Riverina; NSW South Western Slopes; Cobar Peneplain; Nandewar and Brigalow Belt South Bioregions**  
**EPBC Act - Grey Box (Eucalyptus microcarpa) grassy woodlands and derived native grasslands of south-eastern Australia**

- E  
- E

<p>| Inland Grey Box Woodland includes those woodlands in which the most characteristic tree species, <em>Eucalyptus microcarpa</em> (Inland Grey Box), is often found in association with <em>E. populnea</em> subsp. bimbil (Bimble or Poplar Box), <em>Callitris glaucophylla</em> (White Cypress Pine), <em>Brachychiton populneus</em> (Kurrajong), <em>Allocasuarina luethmannii</em> (Bullock) or <em>E. melliodora</em> (Yellow Box), and sometimes with <em>E. albens</em> (White Box). The community generally occurs as an open woodland 15–25 m tall but in some locations the overstorey may be absent as a result of past clearing or thinning, leaving only an understorey. Inland Grey Box Woodland occurs predominately within the Riverina and South West Slopes regions of NSW down |
| This ecological community was not identified in the study area. |
| Considered unlikely to be adversely affected by the proposed activities, as this ecological community does not occur in the study area. An AoS for this community is not required. |</p>
<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>TSC Act Status</th>
<th>EPBC Act Status</th>
<th>Habitat</th>
<th>Likelihood of Occurrence</th>
<th>Likely Level of Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSC Act - Myall Woodland in the Darling Riverine Plains; Brigalow Belt South; Cobar Peneplain; Murray-Darling Depression; Riverina and NSW South Western Slopes bioregions EPBC Act - Weeping Myall Woodlands</td>
<td>E</td>
<td>E</td>
<td>to the Victorian border. This community also extends across the slopes and plains in Central and Northern NSW up to the Queensland Border.</td>
<td>This ecological community is scattered across the eastern parts of the alluvial plains of the Murray-Darling river system. Typically, it occurs on red-brown earths and heavy textured grey and brown alluvial soils within a climatic belt receiving between 375 and 500 mm mean annual rainfall. The structure of the community varies from low woodland and low open woodland to low sparse woodland or open shrubland, depending on site quality and disturbance history. The tree layer grows up to a height of about 10 metres and invariably includes Acacia pendula (Weeping Myall or Boree) as one of the dominant species or the only tree species present. This EEC is known from parts of the Local Government Areas of Berrigan, Bland, Bogan, Carrathool, Conargo,</td>
<td>This ecological community was not identified in the study area.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as this ecological community does not occur in the study area. An AoS for this community is not required.</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
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<td>Habitat</td>
<td>Likelihood of Occurrence</td>
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<tr>
<td>Coolamon, Coonamble, Corowa, Forbes, Gilgandra, Griffith, Gwydir, Inverell, Jerilderee, Lachlan, Leeton, Lockhart, Moree Plains, Murray, Murrumbidgee, Narrabri, Narranderra, Narromine, Parkes, Urana, Wagga Wagga and Warren, and but may occur elsewhere in these bioregions.</td>
<td>E</td>
<td>CE</td>
<td>Native Vegetation on Cracking Clay Soils of the Liverpool Plains is mainly a native grassland community which includes a range of small forb and herb species. The main grass species include Plains Grass (<em>Austrostipa aristiglumis</em>), Queensland Bluegrass (<em>Dichanthium sericeum</em>) and Coolibah Grass (<em>Panicum queenslandicum</em>). It also contains scattered and patchy shrubs and trees, including Boree (<em>Acacia pendula</em>), Rough-barked Apple (<em>Angophora floribunda</em>), Fuzzy Box (<em>Eucalyptus conica</em>), Bimble Box (<em>E. populnea</em>) and Yellow Box (<em>E. melliodora</em>). In wetter locations rushes and sedges are common. This community is located around Coonabarabran, Gunnedah, Murrurundi, Narrabri, Tamworth and Quirindi, on the</td>
<td>This ecological community was not identified in the study area. Additionally, the soils within the study area are not considered to be cracking clay soils, or alluvial plains.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as this ecological community does not occur in the study area. An AoS for this community is not required.</td>
<td></td>
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<tr>
<td>TSC Act - White Box Yellow Box Blakely's Red Gum Woodland</td>
<td></td>
<td>E</td>
<td>CE</td>
<td>White Box Yellow Box Blakely's Red Gum Woodland (commonly referred to as Box-Gum Woodland) is an open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: White Box <em>Eucalyptus albens</em>, Yellow Box <em>E. melliodora</em> and Blakely's Red Gum <em>E. blakelyi</em>. Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. Box-Gum Woodland is found from the Queensland border in the north, to the Victorian border in the south. It occurs in the tablelands and western slopes of NSW.</td>
<td>TSC Act – this vegetation community is known to occur across the study area. EPBC Act – this vegetation community does not occur within the study area.</td>
<td>The TSC Act listed ecological community was observed within study area. However the proposed activities may only incur minimal impacts. The chip hole lease has been selected to avoid the TSC listed ecological communities as much as possible. No trees will be removed, and the well lease has been located within a fire damaged portion of the community. A 7-part test of significance (TSC Act) and an AoS (EPBC Act) has been applied to this species in Appendix C.</td>
</tr>
<tr>
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<tr>
<td>Artesian Springs Ecological Community</td>
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<td>E</td>
<td>E</td>
<td>Naturally restricted to the artesian springs of the Great Artesian Basin in north-western NSW. The springs occur where artesian water emerges at the surface through fault-lines in the overlying rock and produce mounds from the salts and sediments as the water evaporates. The vegetation within the community frequently consists of sedges or similar vegetation, however, trees and shrubs may be adjacent to the springs or nearby. Occurs at the edges of the Great Artesian Basin. Mostly found in Queensland and South Australia, however, a few occur in the Mulga Lands, Darling Riverine Plains and Cobar Peneplain Bioregions of New South Wales.</td>
<td>This ecological community was not identified in the study area.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as this ecological community does not occur in the study area. An AoS for this community is not required.</td>
</tr>
<tr>
<td>Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South bioregion</td>
<td></td>
<td>E</td>
<td>-</td>
<td>The Ooline community is an unusual and distinctive forest community with the canopy dominated by the tree Ooline (Cadellia pentastylis). Other canopy species include White Box (Eucalyptus albens), Ironbarks (E. bayeriana and E. melanophloia), Dirty Gum (E. chloroclada), Narrow-leaved Grey Box (E. piligaensis), Green Mallee (E. viridis) and White Cypress Pine (Callitris glaucocephylla). The understorey is made up of a range of shrubs such as Wattles and grasses.</td>
<td>This ecological community was not identified in the study area.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as this ecological community does not occur in the study area. An AoS for this community is not required.</td>
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<tr>
<td>Carbeen Open Forest community in the Darling Riverine Plains and Brigalow Belt South Bioregions</td>
<td>E</td>
<td>-</td>
<td>Extensively cleared and now known from only seven main locations on the North West Slopes in NSW, between Narrabri and the Queensland border, and also in Queensland.</td>
<td>This ecological community was not identified in the study area.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as this ecological community does not occur in the study area. An AoS for this community is not required.</td>
<td></td>
</tr>
<tr>
<td>Fuzzy Box Woodland on alluvial soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions</td>
<td>E</td>
<td>-</td>
<td>Tall woodland or open forest dominated by Fuzzy Box Eucalyptus conica, often with Grey Box Eucalyptus microcarpa, Yellow Box Eucalyptus melliodora, or Kurrajong Brachychiton populneus. Buloke Allocasuarina leuhrmannii is common in places. Shrubs are generally sparse, and the groundcover moderately dense, although this will vary with season. Alluvial soils of the South West Slopes, Brigalow Belt South and Darling Riverine Plains.</td>
<td>This ecological community was not identified in the study area.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as this ecological community does not occur in the study area. An AoS for this community is not required.</td>
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<tr>
<td>Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions</td>
<td></td>
<td>E</td>
<td>CE</td>
<td>Plains Bioregions. Mainly in the Dubbo-Narromine- Parkes-Forbes area. Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions</td>
<td>Likely Level of Impact</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as this ecological community does not occur in the study area. An AoS for this community is not required.</td>
</tr>
</tbody>
</table>

Fish

| Maccullochella peelii peelii | Murray Cod | - | V | Found in clear rocky streams to slow flowing, turbid rivers and billabongs. Usually found near large rocks, snags, overhanging vegetation and other woody structures. | Habitat in the study area is not suitable to support this species. | Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area. Therefore AoS for this species is not required. |
### Species

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<tr>
<td><strong>Amphibians</strong></td>
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<tr>
<td><em>Litoria booroolongensis</em></td>
<td>Booroolong Frog</td>
<td>E</td>
<td>E</td>
<td>Found along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses.</td>
<td>Habitat in the study area is not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.</td>
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<tr>
<td><strong>Reptiles</strong></td>
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<tr>
<td><em>Aprasia parapulchella</em></td>
<td>Pink-tailed Legless Lizard / Pink-tailed Worm-lizard</td>
<td>V</td>
<td>V</td>
<td>Inhabits sloping, open woodland areas with predominantly native grassy ground layers, particularly those dominated by Kangaroo Grass (<em>Themeda australis</em>). Habitat is typically well-drained, with rocky outcrops or scattered, partially-buried rocks.</td>
<td>Marginal habitat occurs in the open woodland adjacent to the study area; however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Hoplocephalus bitorquatus</em></td>
<td>Pale-headed Snake</td>
<td>V</td>
<td>-</td>
<td>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.</td>
<td>Marginal habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Underwoodisaurus sphyrurus</em></td>
<td>Border Thick-tailed Gecko</td>
<td>V</td>
<td>V</td>
<td>Favours forest and woodland areas on steep rocky or scree slopes, with boulders, rock slabs,</td>
<td>Habitat in the study area is not suitable to support this species, due to lack of</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to</td>
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</table>
### Birds

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<tr>
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<tbody>
<tr>
<td><strong>Anthochaera phrygia</strong></td>
<td>Regent Honeyeater</td>
<td>E</td>
<td>E</td>
<td>Dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Coastal lowland forests of swamp mahogany E. robusta and spotted gum Corymbia citriodora may also be important, particularly during years of drought in inland regions.</td>
<td>Suitable habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity, given that no canopy vegetation will be cleared. Therefore, AoS for this species is not required.</td>
</tr>
<tr>
<td><strong>Burhinus grallarius</strong></td>
<td>Bush Stone-curlew</td>
<td>E</td>
<td>-</td>
<td>The Bush Stone-curlew is widespread in northern and north eastern Australia (Birds Australia, 2010; NPWS, 2000). In NSW, this species is rare east of the Great Dividing Range, with the exception of isolated populations along the north coast (NPWS, 2000). Bush Stone-curlews occur in sparsely grassed, lightly timbered open forest or woodland (Birds Australia, 2010). Preferred habitat is often associated with water courses and woodlands of casuarinas, eucalyptus, and acacia, however dry open grassland and cropland adjacent to woodland is also known to be</td>
<td>Marginal habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.</td>
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<tr>
<td><em>Calyptorhynchus lathami</em></td>
<td>Glossy Black-Cockatoo</td>
<td>V</td>
<td>-</td>
<td>She-oaks, in forests, woodlands, timbered watercourses, in eucalypt and native cypress, brigalow scrub.</td>
<td>While hollow bearing trees in adjacent woodlands provide suitable sheltering resources, the study area is considered to be marginal habitat, due to lack of preferred feed trees.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as no canopy vegetation or preferred food trees are to be cleared. Therefore, AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Circus assimilis</em></td>
<td>Spotted Harrier</td>
<td>V</td>
<td>-</td>
<td>Grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. Most commonly found in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.</td>
<td>Suitable breeding habitat occurs in the open woodland adjacent to the study area. The chip hole lease provides suitable foraging habitat.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as no breeding habitat is to be disturbed. Limited foraging habitat will be disturbed only. Therefore, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Climacteris picumnus</em></td>
<td>Brown Treecreeper</td>
<td>V</td>
<td>-</td>
<td>Found in Eucalypt woodlands</td>
<td>Suitable habitat occurs in the Eucalypt woodland</td>
<td>Considered unlikely to be adversely affected by the proposed activities. Therefore, AoS for this species is not required.</td>
</tr>
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<tr>
<td>Daphoenositta chrysoptera</td>
<td>Varied Sittella</td>
<td>V</td>
<td>-</td>
<td>and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked Eucalypts, usually with a grassy understorey.</td>
<td>the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. Additionally, no tree clearing is required. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.</td>
</tr>
<tr>
<td>Glossopsitta pusilla</td>
<td>Little Lorikeet</td>
<td>V</td>
<td>-</td>
<td>Eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.</td>
<td>Suitable habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. Additionally</td>
</tr>
<tr>
<td>Grantiella picta</td>
<td>Painted Honeyeater</td>
<td>V</td>
<td>-</td>
<td>Forages primarily in the canopy of open Eucalypt forest and woodland. Riparian habitats are particularly used, due to higher soil fertility. Also found in isolated flowering trees in open country, e.g. paddocks and roadside remnants.</td>
<td>Suitable habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. Additionally</td>
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<td></td>
<td>May occur in Woodland adjacent to the chip hole lease, however the chip hole lease does not provide suitable habitat resources.</td>
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</table>

Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. Additionally, no tree clearing is required. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.
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<tr>
<td><em>Hamirostra melanosternon</em></td>
<td>Black-breasted Buzzard</td>
<td>V</td>
<td>-</td>
<td>Lives in a range of habitats, especially along timbered watercourses which is the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands.</td>
<td>Suitable breeding habitat occurs in the open woodland adjacent to the study area. The chip hole lease provides suitable foraging habitat.</td>
<td>Considered unlikely to be adversely affected by the proposed activities, as no breeding habitat is to be disturbed. Limited foraging habitat will be disturbed only. Therefore, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Hieraaetus morphnoides</em></td>
<td>Little Eagle</td>
<td>V</td>
<td>-</td>
<td>Open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands are also used.</td>
<td>May occur in Woodland adjacent to the chip hole lease, as an overfly species, however the chip hole lease does not provide suitable habitat resources.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Lathamus discolor</em></td>
<td>Swift Parrot</td>
<td>E</td>
<td>E</td>
<td>Migrates to south-east Australia between March and October. Occurs in areas where Eucalypts are flowering profusely or where there are abundant lerp infestations.</td>
<td>Marginal habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. Additionally, no canopy trees will be disturbed. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Lophoictinia isura</em></td>
<td>Square-tailed Kite</td>
<td>V</td>
<td>-</td>
<td>Found in a variety of habitats including dry woodlands and</td>
<td>Suitable habitat occurs in the open woodland</td>
<td>Considered unlikely to be adversely affected by the proposed activities.</td>
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<tr>
<td>Melanodryas cucullata</td>
<td>Hooded Robin</td>
<td>V</td>
<td>-</td>
<td>open forests. Shows a particular preference for timbered watercourses.</td>
<td>adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>proposed activities due to the lack of suitable habitat within the chip hole lease. Additionally, no canopy trees will be disturbed. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.</td>
</tr>
<tr>
<td>Melithreptus gularis gularis (eastern subspecies)</td>
<td>Black-chinned Honeyeater</td>
<td>V</td>
<td>-</td>
<td>Prefers lightly wooded country and structurally diverse habitats, usually open Eucalypt woodland, Acacia scrub and mallee, often in or near clearings or open areas.</td>
<td>Marginal habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. Additionally, no canopy trees will be disturbed. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.</td>
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Marginal habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.
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<tbody>
<tr>
<td>Neophema pulchella</td>
<td>Turquoise Parrot</td>
<td>V</td>
<td>-</td>
<td>Lives on edges of Eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.</td>
<td>Marginal habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. Additionally, no canopy trees will be disturbed. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.</td>
</tr>
<tr>
<td>Ninox connivens</td>
<td>Barking Owl</td>
<td>V</td>
<td>-</td>
<td>Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. Roosts in shaded portions of tree canopies, with tall midstorey species, such as Acacia and Casuarina species.</td>
<td>Suitable habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.</td>
</tr>
<tr>
<td>Polytelis swainsonii</td>
<td>Superb Parrot</td>
<td>V</td>
<td>V</td>
<td>Found in Box-Gum, Box-Cypress-pine and Boree woodlands and River Red Gum forest. Nests in small colonies in the hollows of large trees, mainly in tall riparian River Red Gum forest or woodland.</td>
<td>Suitable habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.</td>
</tr>
<tr>
<td>Pomatostomus temporalis</td>
<td>Grey-crowned Babbler</td>
<td>V</td>
<td>-</td>
<td>Inhabits open Box-Gum woodlands on the slopes, Box-Cypress-Pine and Boree forest.</td>
<td>Suitable habitat occurs in the open woodland</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
<td>Likely Level of Impact</td>
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<td>subspecies)</td>
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</tr>
<tr>
<td>Pyrrholaemus saggitatus</td>
<td>Speckled Warbler</td>
<td>V</td>
<td>-</td>
<td>Lives in a wide range of Eucalypt dominated communities that have a grassy understorey and often on rocky ridges or in gullies.</td>
<td>Marginal habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. Additionally, no canopy trees will be disturbed while suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required.</td>
</tr>
<tr>
<td>Rostratula australis</td>
<td>Australian Painted Snipe</td>
<td>E</td>
<td>V</td>
<td>Inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans.</td>
<td>Habitat in the study area is not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area. Additionally, no canopy trees will be disturbed therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Stagonopleura guttata</td>
<td>Diamond Firetail</td>
<td>V</td>
<td>-</td>
<td>Found in grassy eucalypt woodlands, including Box-Gum woodlands and Snow Gum woodlands. Often found in</td>
<td>Suitable habitat occurs in the open woodland adjacent to the study area, however no suitable</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat.</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
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</tr>
<tr>
<td>Stictonetta naevosa</td>
<td>Freckled Duck</td>
<td>V</td>
<td>-</td>
<td>Primarily occurs in south-eastern and south-western Australia (Pizzey and Knight, 2007), however the species occasionally occurs in coastal NSW and Victoria, particularly during drought. Breeds in large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system. Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. May also utilise lakes, reservoirs, farm dams and sewage ponds (DEC, 2007). During drier times, the Freckled Duck moves to more permanent waters such as lakes, reservoirs, farm dams and sewerage ponds (Pizzey and Knight, 2007).</td>
<td>Habitat in the study area is not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area. Additionally, no canopy trees will be disturbed Therefore AoS for this species is not required</td>
</tr>
<tr>
<td>Tyto novaehollandiae</td>
<td>Masked Owl</td>
<td>V</td>
<td>-</td>
<td>Roosts and breeds in moist Eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Lives in dry Eucalypt forests and woodlands.</td>
<td>Marginal habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. While suitable habitat occurs in adjacent areas, it</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
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<td><strong>Mammals</strong></td>
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<tr>
<td><em>Bettongia penicillata penicillata</em></td>
<td>Brush-tailed Bettong (South-East Mainland)</td>
<td>EX</td>
<td>-</td>
<td>The Brush-tailed Bettong (south-east mainland) was associated with grassland, heath and sclerophyll woodland (AMMSG 1996). Other accounts record the subspecies from open eucalypt forest with low woody scrub, tussock grass and occasional bare patches (Flannery 1990a).</td>
<td>Extinct</td>
<td>is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required</td>
</tr>
<tr>
<td><em>Chalinolobus dwyeri</em></td>
<td>Large-eared Pied Bat</td>
<td>V</td>
<td>V</td>
<td>Roosts in caves, crevices in cliffs, old mine workings and disused Fairy Martin (<em>Hirundo ariel</em>) nests, frequenting dry open forest and woodland close to these features.</td>
<td></td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required</td>
</tr>
<tr>
<td><em>Chalinolobus picatus</em></td>
<td>Little Pied Bat</td>
<td>V</td>
<td>-</td>
<td>Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee and Bimble box. Roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings.</td>
<td>Marginal habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required</td>
</tr>
<tr>
<td><em>Conilurus albipes</em></td>
<td>White-footed Tree-rat</td>
<td>E</td>
<td>EX</td>
<td>Eucalypt forest, woodland and grassy ecosystems.</td>
<td>Extinct</td>
<td>N/A</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
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<tr>
<td><em>Dasyurus geoffroii</em></td>
<td>Western Quoll</td>
<td>E</td>
<td>V</td>
<td>Most kinds of wooded habitat including eucalypt forest, dry woodland and mallee shrubland.</td>
<td>Marginal habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required</td>
</tr>
<tr>
<td><em>Dasyurus maculatus</em></td>
<td>Spotted-tail Quoll</td>
<td>V</td>
<td>E</td>
<td>Recorded in a wide range of habitat types including dry and moist sclerophyll forests and woodlands, rainforest, coastal heathland, and riparian forest. Found in shelters and dens in small caves, fallen logs with large hollows and tree hollows.</td>
<td>The study area does not provide suitable habitat resources for this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. Therefore, AoS for this species is not required</td>
</tr>
<tr>
<td><em>Lagorchestes leporides</em></td>
<td>Eastern Hare-wallaby</td>
<td>E</td>
<td>EX</td>
<td>Little is known about this species, but it appears to have inhabited open grassland plains.</td>
<td>Extinct</td>
<td>N/A</td>
</tr>
<tr>
<td><em>Macropus dorsalis</em></td>
<td>Black-striped Wallaby</td>
<td>E</td>
<td>-</td>
<td>Preferred habitat is characterised by dense woody or shrubby vegetation that must occur near a more open, grassy area to provide suitable habitat.</td>
<td>Marginal habitat occurs in the open woodland adjacent to the study area. Additionally, the native grasslands provide suitable foraging habitat.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the minimal disturbances proposed. Therefore, AoS for this species is not required</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
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</tr>
<tr>
<td><em>Nyctophilus timoriensis</em></td>
<td>Greater Long-eared Bat</td>
<td>V</td>
<td>V</td>
<td>Commonly roosts in crevices, hollows and under loose bark in Box / Ironbark / Cypress Pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland.</td>
<td>Marginal habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Additionally, no trees will be cleared as part of the application. Therefore, AoS for this species is not required</td>
</tr>
<tr>
<td><em>Onychogalea fraenata</em></td>
<td>Bridled Nailtail Wallaby</td>
<td>E</td>
<td>E</td>
<td>Preferred habitat is a narrow band of transitional vegetation that separates dense Acacia scrub from open grassy Eucalypt woodland.</td>
<td>Habitat in the study area is not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required</td>
</tr>
<tr>
<td><em>Perameles bougainville fasciata</em> (mainland)</td>
<td>Western Barred Bandicoot</td>
<td>E</td>
<td>EX</td>
<td>Inhabited a variety of landscapes and vegetation types, including Saltbush covered Nullarbor Plain, woodlands on sand ridges, Bluebush plains, Desert Acacia, shrublands and heath.</td>
<td>Extinct</td>
<td>N/A</td>
</tr>
<tr>
<td><em>Petaurus norfolcensis</em></td>
<td>Squirrel Glider</td>
<td>V</td>
<td>-</td>
<td>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.</td>
<td>Habitat in the study area is not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area. Additionally, no trees will be cleared. Therefore AoS for this species is not required</td>
</tr>
<tr>
<td><em>Petrogale penicillata</em></td>
<td>Brush-tailed Rock-</td>
<td>E</td>
<td>V</td>
<td>Occupies rocky escarpments,</td>
<td>Habitat in the study area is not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area. Additionally, no trees will be cleared. Therefore AoS for this species is not required</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
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<tr>
<td>wallaby</td>
<td></td>
<td></td>
<td></td>
<td>outcrops and cliffs with a preference for complex structures with fissures, caves and ledges.</td>
<td>not suitable to support this species.</td>
<td>adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required</td>
</tr>
<tr>
<td>Phascolarctos cinereus</td>
<td>Koala</td>
<td>V</td>
<td></td>
<td>Inhabits Eucalypt woodlands and forests, spending most of their time in trees. Feeds on the foliage of more than 70 Eucalypt and 30 non-Eucalypt species.</td>
<td>Suitable habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease. Koala scats were observed under White Box within the study area.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity, given that no canopy species will be removed. However, as this species was recorded on site, an AoS has been prepared for this species, and is included in Appendix C.</td>
</tr>
<tr>
<td>Pseudomys australis</td>
<td>Plains Rat</td>
<td>E</td>
<td>V</td>
<td>Primarily found in stone-covered plains and slopes with boulders, small stones and gilgais. Associated vegetation is predominantly chenopod as well as ephemeral plants.</td>
<td>Habitat in the study area is not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required</td>
</tr>
<tr>
<td>Pseudomys gouldii</td>
<td>Gould's Mouse</td>
<td>E</td>
<td>EX</td>
<td>It is a poorly known species. Animals are reported to have preferred sandhills and plains, and to make burrows under bushes in loose soil (Dixon 2008).</td>
<td>Extinct</td>
<td>N/A</td>
</tr>
<tr>
<td>Rattus villosissimus</td>
<td>Long-haired Rat</td>
<td>V</td>
<td></td>
<td>Sustained in mesic, densely vegetated sites. During plagues</td>
<td>Marginal habitat occurs in the open woodland</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the study area, therefore AoS for this species is not required</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>TSC Act Status</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
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</tr>
<tr>
<td>Saccolaimus flaviventris</td>
<td>Yellow-bellied Sheathtail-bat</td>
<td>V</td>
<td>-</td>
<td>Roosts in tree hollows and buildings. If there are no trees, they are known to occupy mammal burrows.</td>
<td>Marginal habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required</td>
</tr>
<tr>
<td>Vespadelusroughtoni</td>
<td>Eastern Cave Bat</td>
<td>V</td>
<td>B</td>
<td>Usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings</td>
<td>Marginal habitat occurs in the open woodland adjacent to the study area, however no suitable habitat occurs within the chip hole lease. No suitable roosts were observed.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the lack of suitable habitat within the chip hole lease. While suitable habitat occurs in adjacent areas, it is unlikely to be impacted by the proposed activity. Therefore, AoS for this species is not required</td>
</tr>
</tbody>
</table>

Sources: EPBC Act and TSC Act.
Note: This table excludes migratory species.
### Table 5.2: Likelihood of Occurrence of Migratory Fauna Species in the Study Area

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>EPBC Act Status</th>
<th>Habitat</th>
<th>Likelihood of Occurrence</th>
<th>Likely Level of Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Apus pacificus</em></td>
<td>Fork-tailed Swift</td>
<td>M</td>
<td>Aerial over open country, from semi-desserts to coasts, islands and sometimes over forests and cities.</td>
<td>Suitable foraging resources in woodland habitats, but may only occur rarely as a vagrant</td>
<td>The proposed activities will result in minimal impact on this species’ habitat. Construction activities will have a minimal impact on suitable habitat and suitable habitat will be retained across the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Ardea alba</em></td>
<td>Great Egret</td>
<td>M</td>
<td>Prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands.</td>
<td>Habitats in the study area are not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the low likelihood of the species occurring on the site, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Ardea ibis</em></td>
<td>Cattle Egret</td>
<td>M</td>
<td>Found in grasslands, woodlands, wetlands, pastures and croplands, especially where drainage is poor.</td>
<td>The grazing habitats provide suitable foraging resources for this species.</td>
<td>The proposed activities will result in minimal temporary impact on this species’ habitat. Construction activities will have a minimal impact on suitable habitat, however suitable habitat will be retained across the study area. Additionally, habitat will be re-instated following decommissioning. Therefore AoS for this species is not required.</td>
</tr>
<tr>
<td><em>Gallinago hardwickii</em></td>
<td>Latham's Snipe</td>
<td>M</td>
<td>Soft wet ground or shallow water with tussocks with other green or</td>
<td>Habitats in the study area are not suitable to support this</td>
<td>Considered unlikely to be adversely affected by the</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
<td>Likely Level of Impact</td>
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</tr>
<tr>
<td>Haliaeetus leucogaster</td>
<td>White-bellied Sea-Eagle</td>
<td>M</td>
<td>Habitat characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest (including rainforest) and even urban areas.</td>
<td>Suitable foraging resources in woodland habitats, but may only occur rarely as a vagrant</td>
<td>The proposed activities will result in minimal impact on this species’ habitat. Construction activities will have a minimal impact on suitable habitat and suitable habitat will be retained across the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Hirundapus caudacutus</td>
<td>White-throated Needletail</td>
<td>M</td>
<td>Almost exclusively aerial most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy.</td>
<td>Suitable foraging resources in woodland habitats, but may only occur rarely as a vagrant</td>
<td>The proposed activities will result in minimal impact on this species’ habitat. Construction activities will have a minimal impact on suitable habitat and suitable habitat will be retained across the study area, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Lathamus discolor</td>
<td>Swift Parrot</td>
<td>M,E</td>
<td>Migrates to south-east Australia between March and October. Occurs in areas where Eucalypts are flowering profusely or where there are abundant lerp infestations</td>
<td>Habitats in the study area are not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the low likelihood of the species occurring on the site, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Merops ornatus</td>
<td>Rainbow Bee-eater</td>
<td>M</td>
<td>Occurs mainly in open forests and</td>
<td>Suitable foraging resources</td>
<td>The proposed activities will</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>EPBC Act Status</td>
<td>Habitat</td>
<td>Likelihood of Occurrence</td>
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</tr>
<tr>
<td>Rostratula benghalensis s. lat.</td>
<td>Painted Snipe</td>
<td>M</td>
<td>Inhabits inland and coastal shallow freshwater wetlands, occurring in both ephemeral and permanent wetlands, particularly where there is grass. Individuals have been spotted in artificial dams, sewage ponds and waterlogged grasslands.</td>
<td>Habitats in the study area are not suitable to support this species.</td>
<td>Considered unlikely to be adversely affected by the proposed activities due to the low likelihood of the species occurring on the site, therefore AoS for this species is not required.</td>
</tr>
<tr>
<td>Anthochaera phrygia</td>
<td>Regent Honeyeater</td>
<td>M</td>
<td>Dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Coastal lowland forests of swamp mahogany E. robusta and spotted gum Corymbia citriodora may also be important, particularly during years of drought in inland regions.</td>
<td>Suitable foraging resources in woodland habitats, but may only occur rarely as a vagrant</td>
<td>The proposed activities will result in minimal impact on this species’ habitat. Construction activities will have a minimal impact on suitable habitat and suitable habitat will be retained across the study area, therefore AoS for this species is not required.</td>
</tr>
</tbody>
</table>

**Sources:** EPBC Act and TSC Act.

**Key:** CE: Critically Endangered, M: Migratory, Bold: Recorded- known to occur.
5.2 Impact Assessment under the TSC Act

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

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

5.3 Impact Assessment under the EPBC Act

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

World Heritage areas:

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

Wetlands protected by international treaty (the Ramsar convention):

The proposed activities are not upstream or in an area where there is any form of Ramsar Wetlands.

Nationally listed threatened species, migratory species and ecological communities:

After utilising the EPBC Protected Matters Search Tool (10km Buffer) twelve migratory species, ten threatened fauna species, eight threatened flora species and five ecological communities were identified as potentially occurring in the site locale. Table 4.1 and Table 4.2 outline that the proposed activity is unlikely to have a significant impact on these species. As such, an assessment under the EPBC Act Policy Statement 1.1 - Significant Impact Guidelines Matters of National Environmental Significance (DEWHA, 2009) is not considered necessary.

5.4 Key Threatening Processes Relevant to Proposed Activities

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

<table>
<thead>
<tr>
<th>Key Threatening Process</th>
<th>Relevance to Proposed Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invasion of native plant communities by exotic perennial grasses</td>
<td>The site has been disturbed by exotic perennial grasses, however there exists the potential for the invasion of additional weed species.</td>
</tr>
<tr>
<td>Clearing of native vegetation</td>
<td>The chip hole has been sited in a heavily disturbed area to avoid the need for unnecessary vegetation clearing. Prior to wildfire, the chip hole lease was comprised of ground covers only. No canopy vegetation will be removed.</td>
</tr>
<tr>
<td>Loss of hollow-bearing trees</td>
<td>No hollow bearing trees will be removed as part of this activity.</td>
</tr>
<tr>
<td>Removal of dead trees and dead wood</td>
<td>No dead ‘stag’ trees will be removed from the study area.</td>
</tr>
<tr>
<td>Infection of native plants by <em>Phytophthora cinnamomi</em></td>
<td>There exists the potential for the importation of this pathogen on unclean vehicles and plant machinery. It is recommended that all vehicles be cleaned of foreign soil from other sites to ensure that this pathogen is not introduced.</td>
</tr>
</tbody>
</table>

5.5 Koala SEPP 44

Gunnedah LGA is listed in the *State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44), Schedule 1 as an LGA where this policy applies. Schedule 2 of SEPP 44 lists 10 tree species that are considered indicators of ‘Potential Koala Habitat’. The presence of any of the species listed on a site proposed for development triggers the requirement for an assessment for ‘Potential Koala Habitat’. SEPP 44 defines potential Koala Habitat as:

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

While White Box is present across the property, and constitutes 15% of the total number of trees in the upper canopy, the proposed chip hole lease does not include any canopy trees. The proposed chip hole lease is therefore not considered to provide potential Koala habitat. The proposed activity will not result in the removal or interference of canopy trees.

5.6 Discussion of Impacts

The potential impacts associated with the proposed activities are short-term and temporary. The proposed chip hole lease is located within an area that has been heavily disturbed by fire, and was previously likely to be comprised of disturbed native grassland. This area is in poor ecological condition, and of little habitat value due to the high levels of disturbance. As such, impacts are considered to be negligible.

The proposed chip hole lease is located to the east of Lake Goran. The chip hole lease is approximately 200m from the highest level of the lake, which reaches 296.4m AHD when at capacity. The chip hole lease is approximately 300m AHD. The potential impacts on the water quality of the lake are expected to be minimal, given the lengthy distance, particularly at times of low water level. Additionally, indirect impacts such as noise, dust emissions, and traffic movements are not anticipated to impact upon the lake.
Site access will predominantly be via existing farm tracks, with an additionally 300m² of new access track required. No clearing of native vegetation is required, as the new access track is located within an area that has been cleared of native vegetation due to wildfire.

### 5.6.1 Potential Impacts

The proposed lease is located within a grazing pasture, and is currently void of vegetation due to wildfire. While the chip hole lease is currently cleared of vegetation, it is likely to have previously supported White Box, as well as native grasses. As such, it is likely that the chip hole lease is considered to be White Box-Yellow Box-Blakely’s Red Gum grassy woodland, as listed under the TSC Act. The proposed well lease location will result in disturbances to this area, namely top soil removal, and removal of regenerating vegetation.

The proposed access track is predominantly located along existing access tracks, however impacts associated with the use of the access track include potential edge effects to native grassland communities adjacent to the access track. No canopy trees are located adjacent to the access track. Additionally, 300m² of additional access track requires construction immediately adjacent to the chip hole lease. This will not result in the clearing of native vegetation, as this area is currently void of vegetation due to a recent wildfire.

The proposed activity is not considered to have a significant impact on the TEC, as it will result in limited disturbance to ground cover vegetation only. No canopy vegetation is located within the well lease or adjacent to the access track.

The proposed activity is considered to have minimal impacts on fauna habitat, as no canopy trees or structurally diverse vegetation will be cleared as part of construction.

Potential indirect ecological impacts associated with the proposed activity include dust generation, soil erosion, weed invasion, and transportation of weeds off site. Impacts are considered to be minimal.

### 5.6.2 Overview of Identifying Potential Impacts

The assessment of potential ecological impacts revealed the following:

- Potential short-term impacts;
- Introduction and spread of weeds and feral pest species; and
- Noise.

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

**Potential Short-term Impacts**

Temporary short-term impacts will be associated with the establishment and operation of the chip hole lease site. There will be no long term impacts.
The proposed rehabilitation of the chip hole lease site and access track will reinstate a native ground cover. Given the poor state of vegetation within the chip hole lease, re-instatement of vegetation will improve the ecological condition from the current condition. Rehabilitation will be completed within 6 months of decommissioning.

In consideration of site rehabilitation activities that are to occur at the chip hole site once decommissioning has occurred, it is unlikely that there will be any long-term impacts associated with the proposed activities.

**Introduction of Weeds and Feral Pest Species**

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

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

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

**Noise**

Noise pollution as a result of vehicles, machinery and drilling may deter native fauna from utilising the surrounding habitat. The proposed activities could affect the migration and dispersal ability of native fauna particularly in relation to noise and vehicular movements.
6.0 Impact Mitigation and Management

6.1 Introduction

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

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

6.2 Avoid

The chip hole lease has been located within an area that is currently void of native vegetation to avoid unnecessary vegetation clearing. This area is considered to be of low ecological value, given the lack of vegetation and fauna habitat resources. The chip hole lease has been sited to avoid nearby woodland vegetation that is considered to provide habitat resources for a range of native fauna.

The access track has been predominantly located along an existing track to avoid unnecessary vegetation clearing. Where new access track is required, it has been located within areas that are currently void of native vegetation.

6.3 Minimise

The disturbance area will be minimised to reduce unnecessary clearing and earthworks. Additionally, the disturbance area will be appropriately fenced to ensure machinery is limited to the designated disturbance area. Vehicle speeds will be limited to reduce dust generation. Where access tracks are required, they will be located within areas that are void of native vegetation.

Weed management procedures will be implemented to prevent the spread of weeds both on and off site. Where vehicles and machinery are moving between the site and weed free areas, wash down procedures will be implemented.

6.4 Mitigate

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

Mitigation measures will be implemented to ensure potential impacts on native fauna are minimised. Mitigation measures will include reduced speed limits, dust control, and fencing as required.
Following construction of the chip hole, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Given that the site was used for grazing prior to wildfire, it will be re-instated to a natural grassland to provide site stability.

6.5 Offset

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

Santos is proposing to construct an exploration chip hole, known as Sicamous within PEL 1, Gunnedah Basin. The proposed well lease is located within an agricultural property which is has been disturbed due to historical land management practices, and more recently, by wildfire.

While TSC Act listed White Box - Yellow Box - Blakely's Red Gum Woodland is known to occur across the property, the proposed chip hole lease has been located within an area that has recently been subject to wildfire. As it is likely that this area was comprised of native grasses prior to the wildfire, and historically supported White Box, this area is considered to be the TSC Act listed White Box – Yellow Box – Blakely's Red Gum Woodland. However, the proposed chip hole location has been selected to avoid the need for unnecessary clearing.

Access to the chip hole lease is predominantly along existing access tracks. No widening of the existing track will be required, however approximately 300m² of new access track will require construction. This has been located within an area that is currently void of native vegetation due to a recent wildfire. As such, minimal disturbances are expected to arise from the access track.

The proposed well lease has been selected and designed in accordance with the ‘avoid – minimise – mitigate – offset’ hierarchy to minimise impacts upon the White Box - Yellow Box - Blakely's Red Gum Woodland. The proposed well lease and new access track are highly disturbed, and predominantly cleared of vegetation. No canopy vegetation, or native understory species occur within the proposed lease or within the new access track disturbance area.

No threatened flora species listed under the TSC Act and/or EPBC Act were identified as occurring within the well lease. Two Class 4 noxious weeds, Prickly Pear and African Boxthorn, were recorded in the study area during the pre-clearance survey.

The adjacent woodland community is considered to provide potential suitable marginal habitat to support several listed threatened species. Additionally, Koala scats were observed in nearby woodland. However, the proposed well lease does not comprise suitable habitat resources to support these listed species.

The potential direct and indirect impacts that may be associated with the proposal are considered to be minimal. A range of mitigation and management measures have been identified, to minimise potential indirect ecological impacts. No significant impact on the White Box - Yellow Box - Blakely's Red Gum Woodland EEC will occur as a result of the proposed activity.
8.0 References


EPBC Act Protected Matters Report: Coordinates

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

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

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

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

Report created: 04/05/11 10:55:34

Summary
Details
Matters of NES
Other matters protected by the EPBC Act
Extra Information
Caveat
Acknowledgements

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

Coordinates
Buffer: 10Km
Summary

Matters of National Environmental Significance

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

| World Heritage Properties: | None |
| National Heritage Places: | None |
| Wetlands of International Significance (Ramsar Wetlands): | None |
| Great Barrier Reef Marine Park: | None |
| Commonwealth Marine Areas: | None |
| Threatened Ecological Communities: | 4 |
| Threatened Species: | 17 |
| Migratory Species: | 11 |

Other Matters Protected by the EPBC Act

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

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

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

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

| Commonwealth Lands: | None |
| Commonwealth Heritage Places: | None |
| Listed Marine Species: | 9 |
Whales and Other Cetaceans: None
Critical Habitats: None
Commonwealth Reserves: None

Report Summary for Extra Information

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

Place on the RNE: None
State and Territory Reserves: None
Regional Forest Agreements: None
Invasive Species: 10
Nationally Important Wetlands: 1

Details

Matters of National Environmental Significance

Threatened Ecological Communities

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

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

Threatened Species

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Type of Presence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthochaera phrygia</td>
<td>Endangered</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Lathamus discolor</td>
<td>Endangered</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Swift Parrot [744]</td>
<td>Endangered</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Polytelis swainsonii</td>
<td>Endangered</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Superb Parrot [738]</td>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Rostratula australis</td>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Australian Painted Snipe [77037]</td>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
</tr>
</tbody>
</table>
### FISH

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maccullochella peelii peelii</td>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Murray Cod, Cod, Goodoo [68443]</td>
<td></td>
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</tr>
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</table>

### FROGS

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Litoria boorooolongensis</td>
<td>Endangered</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Booroolong Frog [1844]</td>
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<td></td>
</tr>
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</table>

### MAMMALS

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chalinolobus dwyeri</td>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Large-eared Pied Bat, Large Pied Bat [183]</td>
<td></td>
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</tbody>
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<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dasyurus maculatus maculatus (SE mainland population)</td>
<td>Endangered</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nyctophilus timoriensis (South-eastern form)</td>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Greater Long-eared Bat, South-eastern Long-eared Bat [66888]</td>
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### PLANTS

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<tbody>
<tr>
<td>Digitaria porrecta</td>
<td>Endangered</td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Finger Panic Grass [12768]</td>
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<thead>
<tr>
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<th>Notes</th>
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<tbody>
<tr>
<td>Philotheca ericifolia</td>
<td>Vulnerable</td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>[64942]</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]</td>
<td>Critically Endangered</td>
<td>Species or species habitat may occur within area</td>
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</table>

<table>
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<th>Name</th>
<th>Status</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pterostylis cobarensis</td>
<td>Vulnerable</td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Cobar Greenhood Orchid [12993]</td>
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</tbody>
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<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Swainsona murrayana</td>
<td>Vulnerable</td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]</td>
<td></td>
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<table>
<thead>
<tr>
<th>Name</th>
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<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>Thesium australe</td>
<td>Vulnerable</td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Austral Toadflax, Toadflax [15202]</td>
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<thead>
<tr>
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<tbody>
<tr>
<td>Tylophora linearis</td>
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### REPTILES

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<td>Underwoodisaurus sphyrurus</td>
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<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Border Thick-tailed Gecko [1660]</td>
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</table>

### Migratory Species

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migratory Marine Birds</td>
<td></td>
<td>[ Resource Information ]</td>
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</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apus pacificus</td>
<td></td>
<td>Fork-tailed Swift [678] Species or species habitat may occur within area</td>
</tr>
</tbody>
</table>
### Migratory Terrestrial Species

- **Hirundapus caudacutus**
  - White-throated Needletail [682]
  - Species or species habitat may occur within area

- **Merops ornatus**
  - Rainbow Bee-eater [670]
  - Species or species habitat may occur within area

- **Haliaeetus leucogaster**
  - White-bellied Sea-Eagle [943]
  - Species or species habitat likely to occur within area

### Migratory Wetlands Species

- **Ardea alba**
  - Great Egret, White Egret [59541]
  - Species or species habitat may occur within area

- **Ardea ibis**
  - Cattle Egret [59542]
  - Species or species habitat may occur within area

- **Gallinago hardwickii**
  - Latham's Snipe, Japanese Snipe [863]
  - Species or species habitat may occur within area

### Other Matters Protected by the EPBC Act

#### Listed Marine Species

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Type of Presence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Birds</strong></td>
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</tr>
<tr>
<td><em>Apus pacificus</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fork-tailed Swift [678]</td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td><em>Ardea alba</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Great Egret, White Egret [59541]</td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td><em>Ardea ibis</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattle Egret [59542]</td>
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Extra Information

Invasive Species

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

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<td>Felis catus</td>
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<td>Vulpes vulpes</td>
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<td>Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]</td>
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<td>Rubus fruticosus aggregate</td>
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<td>Blackberry, European Blackberry [68406]</td>
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</table>

Nationally Important Wetlands

Lake Goran, NSW

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It
holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

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

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:
- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:
- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:
- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

150.27 -31.28472

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.
Appendix B

Site Flora Species List

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<tr>
<th>Family Name</th>
<th>Scientific Name</th>
<th>Common Name</th>
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<tr>
<td>ASTERACEAE</td>
<td>Carthamus lanatus*</td>
<td>Saffron Thistle</td>
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<tr>
<td>ASTERACEAE</td>
<td>Conyza sumatrensis*</td>
<td>Tall Fleabane</td>
</tr>
<tr>
<td>BRASSICACEAE</td>
<td>Capsella bursa-pastoris*</td>
<td>Shepherds purse</td>
</tr>
<tr>
<td>CACTACEAE</td>
<td>Opuntia stricta*</td>
<td>Prickly Pear</td>
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<tr>
<td>CHENOPODIACEAE</td>
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<td>Small-leaf Cotton Bush</td>
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<td>Galvanized Burr</td>
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<td>Sclerolaena muricata</td>
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<td>Austrostipa aristiglumis</td>
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<td>Austrostipa scabra</td>
<td>Rough Speargrass</td>
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<tr>
<td>SOLANACEAE</td>
<td>Lycium ferocissimum*</td>
<td>African Boxthorn</td>
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* denotes introduced species
Appendix C

7-Part Test

Approach

Part 1, Section 5A of the EP&A Act lists seven factors that must be taken into account in the determination of the significance of potential impacts of proposed activities on ‘threatened species, populations or ecological communities or their habitats’ (threatened biota) listed under the TSC Act. The so-called ‘7-part test’ is used to determine whether proposed activities are ‘likely’ to impose ‘a significant effect’ on threatened biota and thus whether a Species Impact Statement (SIS) is required to be produced.

The significance of the impacts on White Box Yellow Box Blakely’s Red Gum Woodland, and Koala has been assessed.

White Box Yellow Box Blakely’s Red Gum Woodland

White Box Yellow Box Blakely’s Red Gum Woodland is found on relatively fertile soils on the tablelands and western slopes of NSW and generally occurs between the 400 and 800 mm isohyets extending from the western slopes, at an altitude of c. 170m to c. 1200 m, on the northern tablelands. The community occurs within the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions.

7-Part Test Criteria

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

Not applicable.

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

Not applicable.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Approximately .48ha of this EEC is likely to be removed as a result of the proposed activities, however, this area is cleared of native vegetation due to recent wildfire. While this area is considered to qualify as an EEC on the basis of previously supporting White Box prior to historical land clearing, the proposed activity is not considered to have an adverse impact on this community, given the current highly disturbed condition of the site. The study area and locality contain higher quality intact areas of this EEC, and the native grassland contiguous with adjacent areas will be re-instated following construction. As such the proposal will not significantly impact on this EEC to the point of local extinction.

(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

The proposed activities will cause the removal of a relatively small proportion of this EEC, that is currently seed bank only. The proposed activities are unlikely to adversely impact the EEC in areas adjacent to the well lease.

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

(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed activity will remove approximately 0.48ha of Box Gum Woodland EEC. However, the disturbance area is currently void of native vegetation, due to recent wildfire and historical canopy clearing. Adjacent areas are unlikely to be modified as a result of the proposed activity.

(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The proposed well lease and access track are currently void of native vegetation due to wildfire. It is not considered to be contributing to a movement corridor. No areas of adjacent EEC habitat are likely to become fragmented or isolated as a result of the proposed activity.

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The area of this EEC to be removed is limited in extent and subject to ongoing disturbances associated with wildfire, weed invasion and periodic livestock grazing. This area is relatively small, and highly disturbed, in contrast to similar habitats across the property that are also the EEC, where the species composition maybe greater and less structurally modified, and as such maybe a better representation of this EEC. However this patch of EEC is likely to be improved in contrast to its current condition, species composition and structural diversity as part of the decommissioning rehabilitation program. The habitat to be removed or modified is not likely to be important for the long-term survival of the community.

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

No critical habitat is registered for this EEC.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

The OEH (2010) has prepared a (draft) national recovery plan for this EEC. The primary objective of the recovery plan is to minimise the risk of extinction of this EEC through:

- Achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;
- Increasing protection of sites in good condition;
- Increasing landscape functionality of the ecological community through management and restoration of degraded sites;
- Increasing transitional areas around remnants and linkages between remnants; and
- Bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.

Only a very small proportion of this EEC would be disturbed, which is already in a highly degraded state. The un-impacted EEC adjacent to the well lease and access tracks will be protected and some weed control will occur in and around the proposed well lease and access tracks where vegetation clearing is likely to take place.

Rehabilitation with native grasses will occur within the well lease and access track following decommissioning.

Agricultural land use prevents any opportunities to provide linkages between isolated patches of this EEC.

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

There are currently 35 key threatening processes (KTP’s) listed under the TSC Act. The most relevant ones to this proposed activities and White Box Yellow Box Blakely’s Red Gum Woodland are the invasion of native plant communities by exotic perennial grasses and the clearing of native vegetation, which are listed as KTPs under TSC and EPBC Acts.

Invasion of native plant communities by exotic perennial grasses – It is unlikely that the proposed activity will result in exotic perennial weed invasion, given that weed management measures will be implemented. The proposed activity should not result in the operation of, or increase the impact of the invasion of exotic perennial weeds into those areas not impacted by the proposed activities in adjacent areas.

Clearing of native vegetation - The proposed activities will not result in the clearing of native vegetation, given the location within an area that has been subject to wildfire.
Conclusion

Based on the consideration of the above factors, the proposed activities are not likely to significantly affect the listed threatened ecological community White Box Yellow Box Blakely's Red Gum Woodland or its habitats.
Koala (*Phascolarctos cinereus*)

The Koala is widespread, found in sclerophyll forest and woodland on foothills and plains on both sides of the Great Dividing Range from about Chillagoe in northern Queensland to Mount Lofty Ranges in South Australia. The distribution extends inland to Desert Uplands of central Queensland and along riverine forests in central NSW and north-central Victoria. Koalas are arboreal, agile climbers and spend most of their time in trees. They are inactive for 20 hours per day. Koalas feed on the foliage of more than 70 Eucalypt and 30 non-Eucalypt species.

7-Part Test Criteria

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

The proposed activities are unlikely to have an adverse effect on the life cycle of the Koala. While evidence of Koala usage was observed in woodland vegetation within the study area, no canopy trees are located within or adjacent to the chip hole lease. Subsequently, it is unlikely that Koala will be affected by the proposed activities.

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

Not applicable.

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

(i) *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction,* or

(ii) *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

Not applicable.

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

(i) *The extent to which habitat is likely to be removed or modified as a result of the action proposed,* and

The proposed activity will result in the temporary disturbance of approximately .48 hectares of highly disturbed grassland vegetation. The proposed activity will not result in the removal of canopy species. Furthermore, suitable koala habitat located within the study area will not be disturbed.
(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

The proposed chip hole lease is currently void of native vegetation, and does not comprise Koala food trees. The disturbance of this area will not result in the fragmentation or isolation of nearly Koala habitat areas.

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Evidence of Koala usage was observed under several Eucalypt trees in the study area, however no canopy trees occur within the chip hole lease. Therefore the highly disturbed grassland to be removed or modified is not likely to be important for the long-term survival of the Koala, as it does not provide an important habitat resource for the Koala.

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

The vegetation within the chip hole lease is not considered to provide critical habitat for the Koala, as it is lacking canopy vegetation. The proposed activities are not anticipated to have an impact on any existing Koala populations.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

The OEH (2008) has prepared an Approved Recovery Plan for the Koala. The primary objective of the recovery plan is to minimise the risk of extinction of this species. Specific objectives include:

- To conserve Koalas in their existing habitat;
- To rehabilitate and restore Koala habitat and populations;
- To develop a better understanding of the conservation biology of Koalas;
- To ensure that the community has access to factual information about the distribution, conservation and management of Koalas at a national, state and local scale;
- To manage captive, sick or injured Koalas and orphaned wild Koalas to ensure consistent and high standards of care;
- To manage overbrowsing to prevent both Koala starvation and ecosystem damage in discrete patches of habitat; and
- To coordinate, promote the implementation, and monitor the effectiveness of the NSW Koala Recovery Plan across NSW.

The proposed activities will result in the temporary disturbance of approximately 0.48ha of highly disturbed grassland habitat. There are no existing canopy trees within the chip hole lease that require clearing. Furthermore, mitigation measures such as fencing will be implemented as part of construction works as required. Koalas are unlikely to be affected by the proposed activities.
g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

There are currently 35 key threatening processes (KTP’s) listed under the TSC Act. The most relevant KTP to this activity is the clearing of native vegetation, which is listed as a KTP under TSC and EPBC Acts.

Clearing of native vegetation - The proposed activities will result in the temporary disturbance of approximately 4.2 hectares of grassland, including an existing rubbish pit. The loss of grassland is unavoidable in light of the objectives of the proposed activities, however is unlikely to result in impacts upon Koalas, particularly given that no canopy vegetation is to be removed.

Conclusion

Based on the consideration of the above factors, the proposed activities are not likely to significantly affect the listed Vulnerable Koala or its habitats.
Appendix B

Aboriginal Heritage Due Diligence Report

prepared by RPS
Aboriginal Heritage
Due Diligence Report

Sicamous I Core hole
Near Lake Goran, NSW

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Version/Date: Final August 2011

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Executive Summary

RPS has been engaged by Santos (QNT) Pty Ltd (Santos) to prepare an Aboriginal Heritage Due Diligence Report for a core hole named Sicamous 1 near Lake Goran, NSW. The purpose of a due diligence report is to demonstrate that reasonable and practicable measures were taken to prevent harm to Aboriginal objects or places.

The Project Area is located near Lake Goran in the Gunnedah Local Government Area (LGA). It is located approximately 28 km south west of the town of Gunnedah, and comprises a privately owned, cleared field situated approximately 5km east of the eastern margin of Lake Goran and approximately 1 km south of the Breeza State Forest. Santos proposes that a single core hole be drilled in the Project Area for the purposes of coal seam gas exploration.

As part of this project, RPS undertook a desktop review of environmental data, previously registered sites and previous archaeological investigations in the vicinity of the Project Area. A total of 19 sites were registered on the Office of Heritage and Environment (OEH) Aboriginal Heritage Information Management System (AHIMS) database within 10km of the proposed location of the core hole. The majority of registered sites were modified trees.

A site inspection of the proposed location of the core hole was also conducted in March 2011. No Aboriginal sites were identified, nor any areas of archaeological sensitivity within the vicinity of Sicamous 1. As a result of the desktop study and the search results of the AHIMS database and associated archaeological reports, environmental data and the site inspection, it was concluded that there were no archaeological constraints to the drilling of the core hole at the proposed location and the following recommendations were made.

Recommendation 1
Vehicle access is to remain within existing tracks where possible in order to minimise potential impacts on surrounding vegetation and reduce erosion.

Recommendation 2
All relevant Santos Ltd staff and subcontractors should be made aware of their statutory obligations for heritage under NSW NPW Act (1974) and the NSW Heritage Act (1977), which may be implemented as a heritage induction.

Recommendation 3
If Aboriginal site/s are identified in the Project Area during works, then all works in the area should cease, the area cordoned off and contact made with OEH Enviroline 131 555, a suitably qualified archaeologist and the relevant Aboriginal stakeholders, so that it can be adequately assessed and managed.

Recommendation 4
In the event that skeletal remains are uncovered, work must cease immediately in that area and the proponent, Santos Limited, will need to contact the NSW Police Coroner to determine if the material is of Aboriginal origin. If determined to be Aboriginal, Santos Limited must then contact...
OEH Enviroline 131 555 and relevant Aboriginal stakeholders in order to determine an action plan for the management of the skeletal remains prior to works re-commencing.

**Recommendation 5**

If, during the course of development works, significant European cultural heritage material is uncovered, work should cease in that area immediately. OEH should be notified and works only recommence when an appropriate and approved management strategy instigated.
## Terms & Abbreviations

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<td>AHIMS</td>
<td>Aboriginal Heritage Information Management System</td>
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<td>Office of Environment and Heritage</td>
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<td>PAD</td>
<td>Potential Archaeological Deposit</td>
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Tables

Table 2-1: Summary of AHIMS Results

Plates

Plate 1: View of the location of the Project Area with core hole site (white post in upper right background) 18
Plate 2: Detail of core hole location 18
Plate 3: View from Project Area to south - tree in middle background represents seasonal high water mark of Lake Goran 19
Plate 4: View to the south east of the Project Area 19
Plate 5: View to the north from the Project Area 20
Plate 6: View to west from the Project Area 20

Appendices

APPENDIX 1
Legislative Requirements

APPENDIX 2
AHIMS Results
1 Introduction

RPS was engaged by Santos (QNT) Pty Ltd (Santos) to prepare an Aboriginal Heritage Due Diligence Report for a core hole named Sicamous 1 near Lake Goran, NSW. The purpose of a due diligence report is to demonstrate that reasonable and practicable measures were taken to prevent harm to an Aboriginal object or place. This report has considered the relevant environmental and archaeological information, landforms, disturbances and the nature of the proposed activity in addition to formulating appropriate recommendations.

1.1 The Project Area

The Project Area is located near Lake Goran in the Gunnedah Local Government Area (LGA). It is located approximately 28 km south west of the town of Gunnedah, and comprises a privately owned field approximately 5km east of the eastern margin of Lake Goran (Figure 1-1).

1.2 Proposed Works

Santos is a major Australian oil and gas exploration and production company, with interests both in Australia and overseas. It is the holder of Petroleum Exploration Licence 1 (PEL 1) which covers the Project Area. It is proposed that a single core hole be drilled in the Project Area for the purposes of coal seam gas exploration.

1.3 Legislative Context

The following overview of the legal framework is provided solely for information purposes for the client; it should not be interpreted as legal advice. RPS will not be liable for any actions taken by any person, body or group as a result of this general overview, and recommends that specific legal advice be obtained from a qualified legal practitioner prior to any action being taken as a result of the summary below.

1.3.1 National Parks & Wildlife Act (1974, as amended)

Aboriginal heritage (places, sites and objects) within NSW are protected by the National Parks and Wildlife Act 1974, (as amended). Although there are other Acts protecting and managing cultural heritage in New South Wales (see Appendix 1), the due diligence procedure is only available to projects applicable under this Act.

The NSW Government is working towards stand alone legislation to protect Aboriginal cultural heritage which will be a significant reform for NSW. The first stage of this work has been completed and includes significant changes to the primary state legislation relating to Aboriginal cultural heritage in NSW, the National Parks and Wildlife Act 1974 (NPW Act). The legislation is now overseen by the Office of Environment and Heritage (OEH) (formerly DECCW) as part of the NSW Department of Premier and Cabinet.
Changes to the NPW Act were made effective on 1 October 2010 and include:

- increased penalties for Aboriginal heritage offences, in some cases from $22,000 up to $1.1 million in the case of companies who do not comply with the legislation;
- ensuring companies or individuals cannot claim ‘no knowledge’ in cases of serious harm to Aboriginal heritage places and objects by creating new strict liability offences under the Act;
- introducing remediation provisions to ensure people who illegally harm significant Aboriginal sites are forced to repair the damage, without need for a court order;
- unification of Aboriginal heritage permits into a single, more flexible permit; and
- strengthened offences around breaches of Aboriginal heritage permit conditions.

Along with new offences summarised above, there are new defences that have been introduced which will apply where a person harms an Aboriginal object without knowing what it was and without a permit from OEH. One of these defences is the ‘due diligence’ defence (s87(2)), which states that if a person or company has exercised due diligence to ascertain that no Aboriginal object was likely to be harmed as a result of the activities proposed for the site, then liability from prosecution under the NPW Act 1974 will be removed or mitigated if it transpires that an object was harmed. As a consequence of this provision, OEH released a publication entitled *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. This publication sets out a minimum benchmark for acceptable due diligence investigations to be followed. These investigations include:

- the carrying out of a search of the Aboriginal Heritage Information Management System (AHIMS) database to ensure there are no registered sites within the Project Area;
- a review of previous archaeological investigations in the Project Area; and
- an assessment of the relevant landscape features and visual inspection to determine whether there are Aboriginal objects present within the Project Area or that they are likely.

One of the benefits of the due diligence provisions are that they provide a simplified process for investigating the Aboriginal archaeological context of an area without the need for an Aboriginal Heritage Impact Permit (AHIP). Aboriginal consultation is also not required for an investigation under due diligence. However, if the due diligence investigation shows that the activities proposed for the area are likely to harm objects or likely objects within the landscape, then an AHIP will be required with full consultation.

Further details on the relevant legislative Acts are provided in Appendix 1.

1.4 Aboriginal Community Consultation

As mentioned above, due diligence inspection relates to the physical identification of Aboriginal objects. Community consultation is only required once Aboriginal objects have
been detected and an AHIP is deemed necessary. Section 5.2 of the 2010 Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW specifically states that:

‘Consultation with the Aboriginal community is not a formal requirement of the due diligence process’ (DECCW 2010:3)

1.5 Authorship and Acknowledgements

This report was prepared by Deborah Farina, Archaeologist, with assistance from Ali Byrne, Graduate Archaeologist and reviewed by Gillian Goode, Senior Archaeologist, all of RPS.
2 Environmental and Heritage Context

Aboriginal heritage due diligence requires that available knowledge and information is considered. The purpose of reviewing the relevant environmental and heritage information is to assist in identifying whether Aboriginal sites or places are present within the Project Area.

2.1 Local Environment

An understanding of environmental context is important for the predictive modelling of Aboriginal sites, as well as for their interpretation. The local environment provided natural resources for Aboriginal people, such as, stone (for manufacturing stone tools), food and medicines, wood and bark (for implements such as shields, spears, canoes, bowls, shelters, amongst others), as well as, areas for camping and other activities. The nature of Aboriginal occupation and resource procurement is related to the local environment and it therefore needs to be considered as part of the cultural heritage assessment process.

2.2 Geology and soils

The Project Area is located within the Gunnedah Basin, which extends from Belatta in the north (approximately 40 km north of Narrabri) to the Liverpool Ranges in the south. The Gunnedah basin was formed in the late Carboniferous to early Permian and covers an area of 15,000 km².

The dominant geology of the Project Area is quaternary alluvium which is common in areas of inundation (Banks 1995:3). It chiefly comprises clay, silt, sand and gravel. There are also small areas of basalt and dolerite which form part of the Jurassic Garrawilla Volcanics. The Triassic Digby Beds of the Narrabeen Group include the Digby Conglomerate, comprising two formations, one predominantly quartzose and quartz lithic sandstone, silty sandstone and mudstone, and the other made up of polymictic conglomerate, lithic and quartz lithic sandstone and mudstone.

The soils of the Liverpool Plains area are rich, alluvial soils. They are thought to be one of the most productive and resilient soils in the country, as evidenced by the extensive agricultural industries dominating land use in the region. There are four major soil landscapes within the vicinity of the Project Area: the Booloocooroo, Goran Lake, Lochaber and Leslie’s Road.

The Project Area is predominantly within the Booloocooroo soil landscape which has very deep (>150cm) red-brown earths, red earths, red podzolic soils, black duplex soils and brown clays. These A and B horizon duplex soils are moderately permeable hardsetting and earthy (Banks 1995:85).

The Leslies Road soil landscape is located adjacent to the Project Area and is described as predominantly grey clays with black earths and brown clays. It is chiefly found in the
Goran Basin and Mullaley Hills. Due its periodic waterlogging it is a water erosion and salinity hazard, with low wet-bearing strength (Banks 1995:97).

The other two soil landscapes, Goran Lake and Lochaber, occur nearby in small concentrations. Goran Lake is a lacustrine landscape, with associated lunettes and beaches which form undulating to rolling rises on the lake margins. The grey clay soils are predominantly very deep (>300cm) with a probable depth of Quaternary alluvium across the lake of 40m to >100m. Lochaber is described as an aeolian landscape of moderately deep (<100cm) grey clays, with moderately deep black earths occurring on the youngest lunettes and brown clays occurring in patches across the landscape (Banks 1995:148, 157).

2.3 Topography and hydrology

The Project Area is situated on the Liverpool Plains in north western New South Wales. The Breeza topographic map (89352N) shows the Project Area to be on flat to gently undulating land, within 1.5km of the high water mark of Goran Lake. Slopes are generally 0-3% with local relief at <3m.

The closest water source is Goran Lake, a natural ephemeral lake with associated lunettes and beaches on the lake margins with its high water mark located approximately 1.5km to the east of the proposed core hole. Other nearby permanent water courses include the Mooki River, located approximately 15km to the east, and Cox’s Creek approximately 33km to the west. The Namoi River is slightly north of Gunnedah, approximately 30km to the north, and a series of creeks and gullies are located approximately 15km to the south.

Flooding is therefore an issue for much of the Gunnedah Shire, particularly at times when water levels of both the Namoi and Mooki Rivers are high. Flooding is irregular, with floods having been recorded in every month of the year. More severe floods have however been recorded in the months of January, February, June and July, which also generally coincides with the hottest and coldest months in the year (Shire of Gunnedah 2009:6).

2.4 Flora and fauna

Vegetation in the vicinity of the Project Area is currently cleared grassland and the area is chiefly used for agricultural purposes. However in its natural state, the Gunnedah area is likely to have comprised dry sclerophyll forests and tall or savannah Woodland, containing species such as *Eucalyptus albens* (white box), *E. populnea* (bimble box), *E. camaldulensis* (river red gum), *E. pilligaensis* (pilliga box), *Acacia pendula* (myall), *Geijera parviflora* (wilga), *Angaphora floribunda* (rough-barked apple), *Heterodendron oleifolium* (rosewood) and *Casuarina cristata* (belah) (Banks 1995:84).

These vegetation communities often supported extensive faunal resources such as koala, kangaroo (red and grey), dingoes, possums, echidna and a variety of birds, lizards and
bats (O'Rourke 2005:30-32). Due to its visible and relatively high koala population, Gunnedah promotes itself as the “Koala capital of the world” (Shire of Gunnedah 2009:2).

The threatened species list for the Gunnedah area lists 71 species of flora and fauna considered as vulnerable or endangered. Most of the threatened species on the list are birds, possibly due to the large-scale clearance of vegetation from agriculture and mining (Department of Environment and Climate Change undated).

2.5 Climate

The climate in the Gunnedah area is within the mild temperate climate zone, characterised by warm, wet summers and cool to cold dry winters. The warmest months are December to February, with January recording the highest average maximum temperate at 31.9°C. The coolest months are June and July, with July recording the lowest average minimum temperate at 4.7°C (BOM, 2011).

Rainfall is highest during the summer months, with January recording the highest average monthly rainfall at 84.9 mm. July records the lowest average monthly rainfall at 35.8 mm.

2.6 Aboriginal Heritage Information Management System (AHIMS)

A search was undertaken on 10 August 2011 of the AHIMS register (Table 2-1 and Figure 2-1). The search results indicated that there are 19 previously recorded Aboriginal sites within a 10 km radius of the Project Area.

Table 2-1: Summary of AHIMS Results

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified/scarred trees</td>
<td>12</td>
<td>63.16%</td>
</tr>
<tr>
<td>Artefact scatter</td>
<td>5</td>
<td>26.32%</td>
</tr>
<tr>
<td>Axe grinding groove</td>
<td>1</td>
<td>5.26%</td>
</tr>
<tr>
<td>Aboriginal resource &amp; gathering</td>
<td>1</td>
<td>5.26%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>19</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

As can be seen from Table 2-1, modified/carved trees are the dominant site type within the vicinity of the Project Area, followed by artefact scatters and smaller quantities of axe grinding grooves and Aboriginal resource & gathering sites. The density of artefacts in the scatters is small, with three being the highest number recorded at any one site.

As can be seen from Figure 2-1, very few of these sites are located within the vicinity of the Project Area.
2.7 Historic Records of Aboriginal Occupation

It is important to acknowledge that early historical documents were produced for a number of reasons and thus may contain inaccuracies and/or bias in their reporting of events or other aspects of Aboriginal culture (L'Oste Brown 1998). Nonetheless, some historical documents provide important information and insights into local Aboriginal customs and material culture at the time of non-Indigenous settlement and occupation of region. For example, in the late 19th century, Police Sgt P J Ewing of Gunnedah recorded the memoirs of “Old” Joe Bungaree, an Aboriginal living in Gunnedah at the time. The “Ewing papers” offer a valuable insight to the life of one of the Kamilaroi’s greatest leaders, known as “Red Kangaroo”, as well as pre contact information regarding the Kamilaroi (O'Rourke 2005).

2.7.1 Pre contact

The Gunnedah area was home to the Kamilaroi/Gamilaraay people, whose country included land around the Barwon, Gwydir and Namoi Rivers. Their country extended to the Great Dividing Range in the east, west to Walgett, north to Nindigully, Queensland and south to the Goulburn River north of Mudgee (Tindale 1974).

It is estimated that there were approximately 10,000 Kamilaroi-speaking people in the region prior to European contact (O'Rourke 2005:34). The population would have been made up of approximately 50-60 smaller groups, who would also have been made up of even smaller familial groups or clans. By 1851, the Aboriginal population across the Liverpool Plain estimated by the Aborigines Commission Report as “about 1,000” (O'Rourke 2005:83).

Ethnographic data provided by “Old” Joe Bungaree state that men were dressed in “girdles” made of woven animal hair and carried tools with them, either for hunting or for war. These included spears, woomeras, shields, boomerangs, waddies, nulla-nullas and tomahawks. Women carried yam sticks, hardwood sticks approximately 1.5m long, used to dig for roots and tubers. They would also carry large woven bags called “game packs” and small plaited bags known as “dilly bags”. The dilly bag contained small necessities, such as needles of fish bone, kangaroo or emu bone, wood, sewing threads of hair, bark, animal sinew, tying cords of animal hide, flint knives, tinder, clay balls (wetted for dressing wounds) and grinding stones (O'Rourke 2005:114-115).

Kamilaroi names were generally tripartite, with one being a “section” name, one a matri-clan or totem name, and a personal name. For example, the hero warrior “Red Kangaroo” was partially named in Kamilaroi Gambu Gannuuru – Gambu being his section name, inherited from his maternal grandmother, Gannuuru meaning “red kangaroo” being his totem name inherited from his mother and his personal name which is now lost, but would have been acquired or ascribed to him when he was a baby. His kin, both actual and assigned, would likely have called him “brother”, “uncle” or “cousin”, whilst others outside of his kin would have refer to him neutrally as “Gambu” or “Gannuuru” (O'Rourke 2005:115-116).
Gambu Gannuuru (Red Kangaroo in English) was one of the great warriors of the Gunnedah people. He was variously referred to as a “chief”, a “war chief” or “head man”. It is believed he lived before the time of the “great flood”, which was thought to have occurred around 1750. He was described as being exceptionally tall and broad, with a loud, booming voice. Shortly after being initiated when he was around 15 or 16 years old, he killed two Narrabri raiders. At the age of 17, he led a raiding party to Coonabarabran and captured two wives named Naroo and Nareen. He became a leader at around the age of 19 after fighting the existing leader to the death, killing him with a special “V” shaped shield. As well as being a fierce warrior, he was a strong dancer, being described whilst a teenager as “the strongest dancer and the most active of all” (O'Rourke, 2005:154).

In his prime, Gambu Gannuuru is said to have led wars against the Barraba-Bingara (the “Walleri or Gwydir blacks”), Bundarra, Coonabarabran, Goonoo Goonoo, Kingstown, Manilla, Narrabri, Quirindi, Terry Hie Hie and Walgett groups. However, by the time he was 40, he had negotiated peace with the Goonoo Goonoo and Manilla people, combining the forces to defeat the Kingstown-Bundarra people. Gambu Gannuuru defeated the Kingstown-Bundarra leader, Kibbi, with a spear (O'Rourke, 2005:155).

The Gunnedah people enjoyed an era of strength and prosperity at this time, with Gambu Gannuuru even leading the combined groups on a raid to New England. He is said to have died approximately “twenty moons before the great flood”, which has been estimated at around 1745 (O'Rourke, 2005:155). He was said to have been buried in a seated position under a mound, with a carved tree marking his grave, near the present day Abbott Street, Gunnedah (O'Rourke, 2005).

2.7.2 Post contact

It is thought that the area was named “Gunnedah” from the Kamilaroi meaning “place of white stones”. “Old” Joe Bungaree, one of the last full-blooded Kamilaroi men in the Gunnedah area, said that it was so named because of the white stones that were found in the soil in the area. A cattle station run by the employees of Jack Johnson was named Gunnedah in around 1835, and the area around it became known as such between then and 1848. A township grew around a place called “Johnson’s Woolshed”, but its post office was not named “Gunnedah” until 1859 (O'Rourke 2005:42) (Oxley 1820)

John Oxley in 1818 was the first European to explore the Liverpool Plains. He named the area the “Liverpool Plains” after Lord Liverpool, describing it as “beautiful and fertile”. Oxley notes that three native fires were observed, stating that the Liverpool Plains generally appeared to be “thinly inhabited” (Oxley 1820).

European settlers began arriving in the area in the 1830s. Initially, relations between the Kamilaroi and Europeans were cordial. However, competition for resources and lack of communication between the two groups led to conflict on both sides. As most pastoral runs were situated on watercourses, Aboriginal groups gradually moved from traditional watering places. Cattle were often speared in retaliation and additional conflicts arose
when male relatives sought revenge for their wives being “borrowed” by the colonists which resulted in ongoing clashes between pastoralists and the Aboriginal groups (O'Rourke 2005:61).

It was considered that the real decimation of the Kamilaroi was caused by disease, in particular, smallpox, tuberculosis, measles and influenza. Other effects of disease included malnutrition and low birth rates due to alcoholism and venereal diseases. In 1789 a smallpox epidemic swept through the colony and is thought to have claimed the lives of at least a third of the Aboriginal population of New South Wales. In 1830-31, another smallpox outbreak was noted in the Namoi Valley killing many Kamilaroi, including the leader of the Boggabri people (O'Rourke 2005:67).

A mound was excavated towards the end of the 19th Century that may have been the grave of Gambu Gunnuuru and the area was known locally to be an Aboriginal burial ground.

According to recent census data, there are 978 (7.6%) Aboriginal people living in the Gunnedah Shire. Approximately half are resident in Gunnedah town, and the remainder in other parts of the shire. One village in the south of the Shire, Walhollow, is an Aboriginal community settlement with an established school, shop, administrative office and health clinic (Shire of Gunnedah 2009:18).

2.8 Regional Archaeological Literature Review

Griffiths, T (1993). An Investigation of Fibre Optic Cable Route from Wandoba Exchange to Red Bob’s Exchange, South of Gunnedah

This investigation was conducted on behalf of Telecom Australia ahead of the proposed installation of fibre optic cable between the Wandoba Exchange and Red Bob’s exchange, a distance of approximately 12 km, and approximately 5 km to the west of Lake Goran. Portions of that survey lie to the immediate west of the current Project Area.

The survey transects generally followed road easements of Wandoba Road, and Red Bob’s Road. Some of the route crossed ploughed fields. Ground visibility was described as very good.

A total of four sites along the Red Bob’s Road transect were identified. The sites were all scarred trees and all of the scars were consistent with those made for coolamons. Three of the trees were yellow box, whilst one was a grey gum. All four were identified within 30m of the easement. Scarred trees 1 and 2 were designated “Probable” scarred trees, whilst scarred trees 3 and 4 were designated “Definite”.

As all of the trees were outside of the impact zone for the cable route, no further action was recommended. All trees were marked with orange tape to facilitate identification of the trees during the installation of the fibre optic cable. It was recommended that the sites be monitored during installation to ensure the trees would not be damaged.

This investigation was conducted on behalf of the Namoi Mining Pty Limited, ahead of a proposed mining program at the “Sunnyside” property, approximately 15 km west of Gunnedah. The project entailed the construction of a coal transport route through several properties to the Oxley Highway. The scope of works included identifying any constraints to an open cut mining facility. The study area totalled approximately 231 hectares.

A pedestrian survey was conducted in conjunction with representatives of local Aboriginal groups by walking transects across the project area. It was observed that the northern floodplain area was under new pasture inhibiting visibility; consequently it was decided to inspect the edges of the pasture where some exposure still existed. A total of four sites were identified, comprising an axe grinding groove, two isolated finds and an artefact scatter. The sites were identified on the slopes, saddle and ridge of the hills within the study area. It was concluded that the predictive model supported the outcomes of the survey.

All of the sites fell outside of the impact zone of the proposed works. However, it was recommended that as the axe grinding groove may still be indirectly impacted by mining activities, either by fly rock (from blasting) or vibration, that in addition to protecting the surface of the axe grinding grooves with hay bales, that a geotechnical expert be consulted to investigate the potential for damage to the grooves by any blasting.

RPS (2010). Cultural Heritage Survey and Assessment: Rocglen Mine Extension Project

This investigation was conducted on behalf of Whitehaven Coal Ltd ahead of a proposed extension of the Rocglen Mine. The project area comprised 460ha, and was located approximately 25km north of Gunnedah. The investigation consisted of indigenous and European heritage.

A pedestrian survey was conducted in conjunction with representatives of local Aboriginal groups by walking transects across the project area. A total of three sites were identified as a result of the survey, comprising an isolated find and two artefact scatters. Of the artefact scatters, one contained three flaked pieces of mudstone, chert and grey silcrete, whilst the other scatter contained two flaked pieces of greenstone and chert. The isolated find was a chalcedony flake with a banded quartz vein. No European heritage items were identified. In addition, it was noted that a survey by Appleton in 2007 of an adjacent block identified two scarred trees that were relatively undisturbed and in good condition. No scarred trees were observed during this survey.

Both artefact scatters were considered to be in a highly disturbed context, and not in situ. It was therefore recommended that archaeological excavations not take place at these sites, despite having been recommended by one Aboriginal community group. It was noted that the isolated find was located at the base of a tree, and it was acknowledged that the artefact may have been pushed to the surface by the tree roots. Therefore, it was suggested that OEH (then DECCW) may recommend subsurface investigations at this site in support of the Aboriginal group.
It was concluded that previous environmental and archaeological investigations together with the survey results suggested that the area had been used for camping and resource gathering.

2.9 Synthesis of Environmental and Archaeological Context

A review of environmental context suggests that the Project Area would have been a suitable place for habitation by Aboriginal groups. This is borne out by its rich soil, allowing diverse plant and animal life, abundant water supplies and geology in the form of mudstone and basalt providing suitable raw materials for the manufacture of stone tools to harness and exploit those resources.

However, this is not borne out by the relatively low number of registered sites within the vicinity of the Project Area. This apparent bias may be explained by the destructive nature of the agricultural pursuits dominating the landscape since European contact, or it may simply be a case of inadequate archaeological investigations having been conducted in the area. However, it could also be that other areas nearby were more favourable habitation sites, with the area in the vicinity of the Project Area limited to short-term or transitory habitation.

A review of previous archaeological investigations showed a consistency between the sites identified regionally and those identified locally. Scarred trees were the dominant site type both regionally and locally. However, potential for carved or scarred trees depends on the retention of suitable mature age trees in a disturbed landscape and may have been affected in the Project Area by previous land clearing associated with surrounding development. The varied effects of erosion and vegetation growth could have displaced artefacts and affected the potential for evidence of other site types in the area. These factors may affect site integrity and reduce the possibility for in situ cultural material to be identified or located.
3 Site Visit and Field Results

The site visit was undertaken to comply with due diligence requirement that a visual inspection of the Project Area be conducted. The results of the site visit are reported below.

3.1 Field Results

An archaeological due diligence site inspection was undertaken by Stephen Coghill, Indigenous Affairs Advisor, on 31 March 2011. Conditions were clear and sunny, with no wind apparent. Access to the site was along existing farm tracks and crossing through several gate ways. No vegetation was required to be removed along the access tracks. The nearest permanent water source was the Mooki River, approximately 15 km to the east, although the ephemeral Lake Goran was located 1-2 km to the west.

Sicamous 1 presented as a single flat landscape unit with no discernable features (Plate 1). All vegetation had been cleared consistent with agricultural use. The proposed core hole Sicamous 1 was located in a cleared open paddock, surrounded by other cleared open paddocks (Plate 2). Some native grasses were apparent offering a sparse coverage of the ground surface. Consequently ground visibility was excellent for visual identification of potential Aboriginal material. Whilst exposures may have represented 5-10% of the overall location, visibility was excellent at better than 70%. No Aboriginal cultural heritage material was observed.

A small area to the east of the core hole site was made up of native regrowth vegetation. It was considered there was a slight possibility that older trees could be present within this area, however, none were observed during the due diligence inspection. Regardless, this area was located at a sufficient distance from the impact area of the core hole and would therefore not be affected by the proposed works (Plate 3).

3.2 Conclusion of Field Results

Given that there were no mature trees, no stone outcropping, no overhangs or rocky shelters, no sandstone nor any other discernible landform feature or environmental resource suitable for Aboriginal exploitation or occupation, it is considered highly unlikely that the proposed drilling works at Sicamous 1 core hole would harm Aboriginal cultural heritage or material items. The archaeological field survey identified no Aboriginal material at risk of impact from the proposed works.

An area exceeding the core hole footprint was assessed for the purposes of due diligence and included areas likely to undergo modification during drilling works, proposed access routes to the drill locations and turning circles for vehicles.

The proposed core hole was not situated close to known cultural heritage sites. There was no evidence of any Aboriginal artefacts at the core hole location or along the
proposed core hole access track; therefore it is considered that there is no impediment for
work for the proposed drilling programme to proceed at the proposed core hole locations
investigated in this report.

The proposed core hole was positioned in a highly modified landform. As such, any core
hole works undertaken in this location meets the low impact activity criteria under the
National Parks & Wildlife Regulations 2009 and described in Section 7.5 of the NSW
DECCW 2010 Due Diligence Code of Practice for the protection of Aboriginal Objects in
NSW.

No Aboriginal or European Cultural Heritage sites were identified at the core hole location
inspected during the course of the archaeological survey. As such no archaeological
constraints apply to the proposed drilling within the bounds of the drilling footprints at the
core hole location.
4 Conclusions and Recommendations

This report has considered the available environmental and archaeological information for the Project Area, the land condition, as well as, the nature of the proposed activities. No Aboriginal sites were identified at the core hole location inspected during the course of the archaeological survey. As such no archaeological constraints apply to the proposed drilling within the bounds of the drilling footprints at the core hole location. The following management recommendations have been formulated with consideration to all available information.

Recommendation 1
Vehicle access is to remain within existing tracks where possible in order to minimise potential impacts on surrounding vegetation and reduce erosion.

Recommendation 2
All relevant Santos staff and subcontractors should be made aware of their statutory obligations for heritage under NSW NPW Act (1974) and the NSW Heritage Act (1977), which may be implemented as a heritage induction.

Recommendation 3
If Aboriginal site/s are identified in the Project Area during works, then all works in the area should cease, the area cordoned off and contact made with OEH Enviroline 131 555, a suitably qualified archaeologist and the relevant Aboriginal stakeholders, so that it can be adequately assessed and managed.

Recommendation 4
In the event that skeletal remains are uncovered, work must cease immediately in that area and the proponent, Santos, will need to contact the NSW Police Coroner to determine if the material is of Aboriginal origin. If determined to be Aboriginal, Santos Limited must then contact OEH Enviroline 131 555 and relevant Aboriginal stakeholders in order to determine an action plan for the management of the skeletal remains prior to works re-commencing.

Recommendation 5
If, during the course of development works, significant European cultural heritage material is uncovered, work should cease in that area immediately. OEH should be notified and works only recommence when an appropriate and approved management strategy instigated.
5 References


Plate 1: View of the location of the Project Area with core hole site (white post in upper right background)

Plate 2: Detail of core hole location
Plate 3: View from Project Area to south - tree in middle background represents seasonal high water mark of Lake Goran

Plate 4: View to the south east of the Project Area
Plate 5: View to the north from the Project Area

Plate 6: View to west from the Project Area
Appendix I

Legislative Requirements
Summary of Statutory Controls

The following overview of the legal framework is provided solely for information purposes for the client, it should not be interpreted as legal advice. RPS will not be liable for any actions taken by any person, body or group as a result of this general overview, and recommend that specific legal advice be obtained from a qualified legal practitioner prior to any action being taken as a result of the summary below.

COMMONWEALTH

Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (ATSIHIP Act Amendment 2006)
The purpose of this Act is to preserve and protect all heritage places of particular significance to Aboriginal and Torres Strait Islander people. This Act applies to all sites and objects across Australia and in Australian waters (s4).

It would appear that the intention of this Act is to provide national baseline protection for Aboriginal places and objects where Stage legislation is absent. It is not to exclude or limit State laws (s7(1)). Should State legislation cover a matter already covered in the Commonwealth legislation, and a person contravenes that matter, that person may be prosecuted under either Act, but not both (s7(3)).

The Act provides for the preservation and protection of all Aboriginal objects and places from injury and/or desecration. A place is construed to be injured or desecrated if it is not treated consistently with the manner of Aboriginal tradition or is or likely to be adversely affected (s3).

The Australian Heritage Commission Act 1975
The Australian Heritage Commission Act (1975) established the Australian Heritage Commission which assesses places to be included in the National Estate and maintains a register of those places. Places maintained in the register are those which are significant in terms of their association with particular community or social groups and they may be included for social, cultural or spiritual reasons. The Act does not include specific protective clauses.

STATE

It is incumbent on any land manager to adhere to state legislative requirements that protect Aboriginal Cultural heritage. The relevant legislation is NSW includes but is not limited to the summary below.

National Parks and Wildlife Act 1974 (NPW ACT)
The NPW Act provides statutory protection for all Aboriginal heritage, places and objects (not being a handicraft made for sale), with penalties levied for breaches of the Act. This legislation is overseen by the Office of Environment and Heritage (OEH), and specifically the Director-General of OEH. Part 6 of this Act is the relevant part concerned with Aboriginal objects and places, with Section 86 and Section 90 being the most pertinent. In 2010, this Act was substantially amended, particularly with respect to Aboriginal cultural heritage requirements. Relevant sections include:

Section 86
This section now lists four major offences:

(1) A person must not harm or desecrate an object that the person knows is an Aboriginal object;
(2) A person must not harm and Aboriginal object;
(3) For the purposes of s86, “circumstances of aggravation” include:
   (a) The offence being committed during the course of a commercial activity; or
   (b) That the offence was the second or subsequent offence committed by the person;
(4) A person must not harm or desecrate an Aboriginal place.

Offences under s86 (2) and (4) are now strict liability offences, i.e., knowledge that the object or place harmed was an Aboriginal object or place needs to be proven, however, a defence of honest and reasonable mistake applies. Penalties for all offences under Part 6 of this Act have also been substantially increased, depending on the nature and severity of the offence.

Section 87
This section now provides defences to the offences of s86. These defences chiefly consist of having an appropriate Aboriginal Heritage Impact Permit (AHIP), not contravening the conditions of the AHIP or demonstrating that due diligence was exercised prior to the alleged offence.

Section 87A & 87B
These sections provide exemptions from the operation of s86; Section 87A for authorities such as the Rural Fire Service, State Emergency Services and officers of the National Parks & Wildlife Service in the performance of their duties, and s87B for Aboriginal people performing traditional activities.
Section 89A
If a person knows of the location of an Aboriginal object or place that has not been previously registered and does not advise the Director-General of that object or place within a reasonable period of time, then that person is guilty of an offence under this Section of the Act.

Section 90
This section authorises the Director-General to issue an AHIP.

Section 90A-90R
These sections govern the requirements relating to applying for an AHIP. In addition to the amendments to the Act, OEH have issued three new policy documents clarifying OEH requirements with regards to Aboriginal archaeological investigations: Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010, Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW and Code of Practice for Archaeological Investigations in NSW. The Consultation Requirements formalise the consultation with Aboriginal community groups into four main stages, and includes details regarding the parties required to be consulted, advertisements inviting Aboriginal community groups to participate in the consultation process, requirements regarding the provision of methodologies, draft and final reports to the Aboriginal stakeholders and timetables for the four stages. The Due Diligence Code of Practice sets out the minimum requirements for investigation, with particular regard as to whether an AHIP is required. The Code of Practice for Archaeological Investigation sets out the minimum requirements for archaeological investigation of Aboriginal sites.

Aboriginal Heritage Impact Permits (AHIP)
OEH encourages consultation with relevant Aboriginal stakeholders for all Aboriginal Heritage Assessments. However, if an Aboriginal Heritage Impact Permit (AHIP) is required for an Aboriginal site, then specific OEH guidelines are triggered for Aboriginal consultation.

Aboriginal Cultural Heritage Consultation Requirements for Proponents
In 2010, the Aboriginal Cultural Heritage Consultation Requirements for Proponents (ACHCRs) were issued by OEH (12th April 2010). These consultation requirements replace the previously issued Interim Community Consultation Requirements (ICCR) for Applicants (Dec 2004). These guidelines apply to all AHIP applications prepared after 12th April 2010. For projects commenced prior to 12th April 2010, transitional arrangements have been stipulated in a supporting document, Questions and Answers 2: Transitional Arrangements.

The ACHCRs 2010, include a four stage Aboriginal consultation process and stipulate specific timeframes for each state. Stage 1 requires that Aboriginal people who hold cultural information are identified, notified and invited to register an expression of interest in the assessment. Stage 1 includes the identification of Aboriginal people who may have an interest in the Project Area and hold information relevant to determining the cultural significance of Aboriginal objects or places. This identification process should draw on reasonable sources of information including: the relevant OEH EPRG regional office, the relevant Local Aboriginal Land Council(s), the Registrar of Aboriginal Owners, Aboriginal Land Rights Act (1983), the Native Title Tribunal, Native Title Services Corporation Limited, the relevant local council(s), and the relevant catchment management authority. The identification process should also include an advertisement placed in
a local newspaper circulating in the general location of the Project Area. Aboriginal organisations and/or individuals identified should be notified of the project and invited to register an expression of interest (EoI) for Aboriginal consultation. Once a list of Aboriginal stakeholders has been compiled from the EoIs, they need to be consulted in accordance with ACHCRs Stages 2, 3 and 4.

For projects commenced before the 12th April 2010, Section 1 (Q1) of the transitional arrangements indicates that if Aboriginal consultation was commenced prior to the 12th April 2010 (including advertising and notification of stakeholders) then consultation is to be continued under the previous ICCR guidelines.

*Interim Community Consultation Requirements (ICCR) for Applicants* (Dec 2004) required a three stage process of which timeframes were stipulated for specific components. Stage 1 required the notification and registration of interests. Notification included an advertisement in a local print media, in addition to contacting the Local Aboriginal Land Council(s), the registrar of Aboriginal Owners, Native Title Services, local council(s) and the Department of Environment and Conservation. Stage 1 also required the invitation for expressions of interest (EoI) to be sent to interested Aboriginal parties and an Aboriginal stakeholder list compiled. Stage 2 required the preparation of an assessment design to be sent to the Aboriginal stakeholders for comment and review. Stage 3 required that the assessment report be provided to registered Aboriginal stakeholders for review and comment.

**Environmental Planning & Assessment Act 1979 (EP&A Act)**

This Act regulates a system of environmental planning and assessment for New South Wales. Land use planning requires that environmental impacts are considered, including the impact on cultural heritage and specifically Aboriginal heritage. Within the *EP&A Act*, Parts 3, 4 and 5 relate to Aboriginal heritage.

Part 3 regulates the preparation of planning policies and plans. Part 4 governs the manner in which consent authorities determine development applications and outlines those that require an environmental impact statement. Part 5 regulates government agencies that act as determining authorities for activities conducted by that agency or by authority from the agency. The National Parks & Wildlife Service is a Part 5 authority under the *EP&A Act*.

In brief, the *NPW Act* provides protection for Aboriginal objects or places, while the *EP&A Act* ensures that Aboriginal cultural heritage is properly assessed in land use planning and development.

**The Heritage Act 1977**

This Act protects the natural and cultural history of NSW with emphasis on non-indigenous cultural heritage through protection provisions and the establishment of a Heritage Council. Although Aboriginal heritage sites and objects are primarily protected by the *National Parks & Wildlife Act* (1974, as amended), if an Aboriginal site, object or place is of great significance, it may be protected by a heritage order issued by the Minister subject to advice by the Heritage Council.
Other legislation of relevance to Aboriginal cultural heritage in NSW includes the *NSW Local Government Act (1993)*. Local Environment Plans also contain provisions relating to indigenous heritage and development conditions of consent.
Appendix 2

AHIMS Results
### Extensive search - Site list report

**Note:** This Excel report shows the sites found in AHIMS on the 11/08/2011. If this date is not the same as the original date of the Search Results letter obtained during the Basic Search, then the search results might be different. The PDF version of this report will always coincide with the Basic Search Results letter.

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This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.
Appendix C

Santos Drill Rig Noise Assessment

prepared by Heggies (now SLR)
Santos Drill Rig
Noise Assessment

PREPARED FOR

URS
Level 14, 240 Queen Street
Brisbane Qld 4000

29 APRIL 2009
Santos Drill Rig
Noise Assessment

PREPARED BY:
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This document has been prepared in accordance with the requirements of that System.

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Heggies Pty Ltd
Report Number 20-2014-R3
Revision 2
Santos Drill Rig
Noise Assessment
URS
(20-2014-R3R2.doc) 29 April 2009
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1 INTRODUCTION

Heggies Pty Ltd (Heggies) has been engaged by URS Australia Pty Ltd (URS) on behalf of Santos Ltd (Santos) to undertake noise and lighting assessments for the drill rigs operating in the Gunnedah Basin.

This report presents the results from:

- Ambient noise monitoring conducted at Wisemans 1 and Stoney Creek 1 which are located on the Gunnedah Basin, New South Wales. The two (2) monitoring locations are representative of flat/open plains (Wisemans 1) and woodlands (Stoney Creek 1). Both attended and unattended noise measurements have been performed in order to accurately document the existing background noise environment.
- Based on the existing background noise environment the appropriate noise criteria have been determined.
- Attended noise measurements have been performed to determine sound power levels (SWL) for the dominant noise sources during operation of drill rigs McD 29, McD 33, MDC 105 and Atlas Rig 1.
- Noise emission predictions including noise contour plots and offset distances at which the noise criteria is predicted to be achieved using the calculated SWLs for the drill rigs.

2 TECHNICAL NOISE INFORMATION

2.1 Standard Noise Indices

This report makes reference to certain noise level descriptors, in particular the LA90, LAeq, LA10 and LAmx noise levels.

The LAeq is essentially the average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound over the same measurement period.

The LA90 noise level is the A-weighted sound pressure level exceeded 90% of a given measurement period and is representative of the average minimum background sound level (in the absence of the source under consideration), or simply the “background” level.

The LA10 is the A-weighted sound pressure level exceeded 10% of a given measurement period.

The LAmx noise level is the maximum A-weighted noise level associated with site activity.

The LAmx,adj T noise level is the average of the maximum noise levels during time period T adjusted for tonality and impulsiveness.

The relationship between the LAeq and the LA90 is in general less than 1 dBA for steady state noise sources (ie generators and normal drilling operation).
2.2 Typical Noise Levels

Table 1 presents examples of typical noise levels

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<tr>
<td>40</td>
<td>Inside private office</td>
<td>Quiet to</td>
</tr>
<tr>
<td>30</td>
<td>Inside bedroom</td>
<td>Very quiet</td>
</tr>
<tr>
<td>20</td>
<td>Unoccupied recording studio</td>
<td>Almost silent</td>
</tr>
</tbody>
</table>

2.3 A-Weighting or dBA Noise Levels

The overall level of a sound is usually expressed in terms of dBA, as is the case in Australian Standard AS 1055 Acoustics – Description and measurement of environmental noise, which is measured using the “A-weighting” filter incorporated in sound level meters. These filters have a frequency response corresponding approximately to that of human hearing. People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound.

Different sources having the same dBA level generally sound about equally as loud, although the perceived loudness can also be affected by the character of the sound (e.g., the loudness of human speech and a distant motorbike may be perceived differently, although they are of the same dBA level).

2.4 Sensitivity of People to Noise Level Changes

A change of up to 3 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness.
3 DETERMINING EXISTING AMBIENT NOISE LEVELS

In order to characterise the existing noise environment, long-term unattended ambient noise monitoring was undertaken from 9 March to 23 March at two (2) locations typical of the terrain in the Murrurundi/Gunnedah of NSW. These noise monitoring locations were located in areas with the following type of terrain:

- Wisemans 1 – flat/open plains; and
- Stoney Creek 1 – woodlands.

The noise monitoring locations are shown in Figure 1.

**Figure 1 Ambient Noise Monitoring Locations on the Gunnedah Basin**

Table 2 summarises the noise monitoring location details.
<table>
<thead>
<tr>
<th>Noise monitoring Location</th>
<th>Comments</th>
<th>Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wisemans 1</td>
<td>Logger located next to a sorghum field and a paddock with cattle to the side.</td>
<td></td>
</tr>
<tr>
<td>Stoney Creek 1</td>
<td>Logger located in an unused paddock. With cattle paddock to the side.</td>
<td></td>
</tr>
</tbody>
</table>

Attended noise measurements were also conducted at the site to confirm background noise levels and to observe typical noise sources associated with the ambient noise environment during the daytime, evening and night-time periods. The attended noise measurements were conducted for one 15 minute period during each of the day (7.00 am to 6.00 pm), evening (6.00 pm to 10.00 pm) and night (10.00 pm to 7.00 am) time periods at both Wisemans 1 and Stoney Creek 1 (ie six 15 minute attended noise measurements were undertaken). The attended noise measurements were conducted on the 9, 10 and 23 March 2009.

15-minute weather data over the noise monitoring period was sourced via a remote weather station setup near the unattended logger at Wisemans 1. The weather conditions on 9 to 11 March were windy (above 5 m/s) and these days have been excluded from the measurements results. For the monitoring period 12 to 21 March the weather conditions were generally fine, with temperatures ranging from 15°C to 30°C, with calm to moderate breezes (below 5 m/s) blowing generally from the south, east and west. Some minor rainfall was recorded during the monitoring period these periods have been excluded from the measurement results. The weather conditions during the remainder of the monitoring period are considered to be suitable for background noise measurements.
Graphs showing the statistical noise levels and weather data measured at Wisemans 1 and Stoney Creek 1 over the whole monitoring period are presented in Appendix A and Appendix B for each 24-hour period. The graphs show various statistical noise levels, including the background (L₉₀) noise level.

3.1 Instrumentation

The long term unattended monitoring was undertaken using two (2) Acoustic Research Laboratories (ARL) EL-316 Environmental Noise Loggers programmed to record various statistical noise levels including the background (L₉₀) noise level. The logger was checked for calibration before and after the survey with a Rion NC-73 Sound Level Calibrator and no significant drift (greater than 0.5 dBA) in calibration was detected.

ARL EL-316 Noise Loggers are NATA certified Type 1 meters. It is common practice to use Type 1 (or 2) noise loggers for measuring background noise levels. The noise floor of EL-316 loggers is around 19 dBA.

Attended measurements were undertaken using a SVAN 948 Sound Level Meter. This unit is a Type 1 Sound Level Meter. The SVAN was checked for calibration before and after each set of noise measurements using a Rion NC-73 Sound Level Calibrator and no significant drift in calibration signal level was observed.

All items of acoustic instrumentation employed during the noise monitoring were set to ‘Fast’ response in accordance with the relevant Australian Standards. All items of acoustic instrumentation employed during the noise measurement surveys were designed to comply with AS 1259.2 Sound Level Meters and carry current calibration certificates.

3.2 Noise Monitoring Results

3.2.1 Unattended Noise Monitoring

The unattended ambient noise measurements were used to determine the “Rating Background Level” (RBL) for the daytime (7.00 am to 6.00 pm), evening (6.00 pm to 10.00 pm) and night-time (10.00 pm to 7.00 am) periods at Wisemans 1 and Stoney Creek 1. The RBL is the median of the 90th percentile of the background (L₉₀) noise levels in each assessment period (day, evening and night) over the duration of the monitoring period.

For the purpose of determining the applicable noise criteria the New South Wales (NSW) ‘Industrial Noise Policy’ (INP) states that where a rating background noise level of less than 30 dBA is measured, the rating background noise level is set to the threshold level of 30 dBA.

<table>
<thead>
<tr>
<th>Monitoring Location</th>
<th>Rating Background Level (dBA)</th>
<th>Day¹</th>
<th>Evening¹</th>
<th>Night¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wisemans 1</td>
<td>(27) 30²</td>
<td>32</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Stoney Creek 1</td>
<td>(26) 30²</td>
<td>34</td>
<td>(23) 30²</td>
<td></td>
</tr>
</tbody>
</table>

Note 1: Daytime: 0700 to 1800 hours (Monday to Saturday), or 0800 to 1800 hours (Sundays and public holidays). Evening: 1800 to 2200 hours. Night-time: the remaining periods

Note 2: Numbers within brackets are the actual measured RBL’s. Where the rating background level is less than 30 dBA, it is set to 30 dBA.

The elevated ambient noise levels in the evening and night-time at Wisemans 1 and in the evening at Stoney Creek 1 are due to noise from insects which are typical of the ambient noise environment during the summer season.
3.2.2 Attended Ambient Noise Measurements

Attended measurements were undertaken in order to confirm background noise levels and to observe typical noise sources associated with the ambient noise environment. The results of these measurements are summarised in Table 4.

Table 4: Attended Measurement Results – Day, Evening and Night-Time Periods

<table>
<thead>
<tr>
<th>Monitoring Location</th>
<th>Date</th>
<th>Time (end of 15 min period)</th>
<th>Measured Noise Level (dBA)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wisemans 1</td>
<td>9/03/09</td>
<td>5:25pm</td>
<td>42 46 49</td>
<td>Wind speed above 5 m/s. Wind generated noise in grass, trees and sorghum dominant. Noise from insects present, but lower than wind generated noise.</td>
</tr>
<tr>
<td></td>
<td>10/03/09</td>
<td>2:45pm</td>
<td>37 44 46</td>
<td>Wind speed approximately 5 m/s. Wind generated noise in grass and sorghum dominant. Some occasional bird noise.</td>
</tr>
<tr>
<td></td>
<td>10/03/09</td>
<td>7:05pm</td>
<td>43 48 51</td>
<td>Windy and gusty above 5 m/s. Wind generated noise in grass, trees and sorghum dominant. Noise from insects present, but lower than wind generated noise.</td>
</tr>
<tr>
<td></td>
<td>10/03/09</td>
<td>11:20pm</td>
<td>33 37 38</td>
<td>Light breeze, wind speed less than 5 m/s. Insect noise dominant.</td>
</tr>
<tr>
<td>Stoney Creek 1</td>
<td>9/03/09</td>
<td>8:25pm</td>
<td>38 44 46</td>
<td>Wind speed approximately 5 m/s (wind gusts of above 5 m/s). Wind generated noise in grass and trees dominant. Some occasional insect noise.</td>
</tr>
<tr>
<td></td>
<td>23/03/09</td>
<td>4:30pm</td>
<td>26 38 41</td>
<td>In general wind speed of much less than 5 m/s (wind gust of approximately 5 m/s). Bird chipping and occasional insect dominant noise source. 2 car passbys generated less than 35 dBA.</td>
</tr>
<tr>
<td></td>
<td>24/03/09</td>
<td>0:45am</td>
<td>23 36 30</td>
<td>No wind. Distant Insect noise dominant. Car passby.</td>
</tr>
</tbody>
</table>

1. The LA90 is the noise level exceeded for 90% of the sample period. This noise level is described as the background level.
2. The LAeq is the A-weighted equivalent noise level. It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.
3. The LA10 is the noise level exceeded for 10% of the sample period. This is commonly referred to as the average maximum noise level.

Note: Daytime: 7.00am to 6.00pm (Monday to Saturday), or 8.00am to 6.00pm (Sundays and public holidays). Evening: 6.00pm to 10.00pm. Night-time: 10.00pm to 7.00am.

The attended measurements and observations summarised in Table 4 shows that, in the absence of wind noise, insects and birds noise dominates the ambient noise environment at both Wisemans 1 and Stoney Creek 1.
3.3 Predicted Ambient Noise Levels for the Winter Period

The most significant seasonal influence on noise levels is due to the presence (or otherwise) of insect noise (usually most prevalent during the summer months) and from the prevailing weather conditions. On review of the measured RBLs in Table 3, the statistical noise plots (Appendix A and Appendix B), the 1/3 octave attended measurements and operator notes in Table 4, the measured RBLs have been adjusted to predict the likely ambient noise level for the winter period (excluding insect noise). The predicted RBLs for the winter season are shown in Table 5.

<table>
<thead>
<tr>
<th>Monitoring Location</th>
<th>Rating Background Level (dBA)</th>
<th>Day¹</th>
<th>Evening¹</th>
<th>Night¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wisemans 1</td>
<td></td>
<td>(27) 30²</td>
<td>(27) 30²</td>
<td>(28) 30²</td>
</tr>
<tr>
<td>Stoney Creek 1</td>
<td></td>
<td>(26) 30²</td>
<td>(26) 30²</td>
<td>(23) 30²</td>
</tr>
</tbody>
</table>

Note 1: Daytime: 0700 to 1800 hours (Monday to Saturday), or 0800 to 1800 hours (Sundays and public holidays). Evening: 1800 to 2200 hours. Night-time: the remaining periods.

Note 2: Where the rating background level is less than 30 dBA, it is set to 30 dBA.

4 NOISE CRITERIA

The New South Wales (NSW) ‘Industrial Noise Policy’ (INP) outlines industrial noise criteria in two categories, an intrusive criterion and an amenity criterion. These criteria will be used in assessing the noise impacts associated with the operating drill rigs and are summarised below.

4.1 Intrusive Criterion

$LA_{eq(15\ min)}$ should not exceed the RBL by more than 5 dBA. Table 6 presents a summary of the time specific intrusive criteria, based on the RBL’s in Table 3.

<table>
<thead>
<tr>
<th>Background Noise Monitoring Location</th>
<th>Day¹ $LA_{eq(15\ min)}$ (dBA)</th>
<th>Evening¹ $LA_{eq(15\ min)}$ (dBA)</th>
<th>Night¹ $LA_{eq(15\ min)}$ (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wisemans 1</td>
<td>35</td>
<td>37</td>
<td>38</td>
</tr>
<tr>
<td>Stoney Creek 1</td>
<td>35</td>
<td>39</td>
<td>35</td>
</tr>
</tbody>
</table>

Note 1: Daytime: 0700 to 1800 hours (Monday to Saturday), or 0800 to 1800 hours (Sundays and public holidays). Evening: 1800 to 2200 hours. Night-time: the remaining periods.
4.2 Amenity Criteria

Table 7 Summary of Relevant Amenity Criteria

<table>
<thead>
<tr>
<th>Type of Receiver</th>
<th>Indicative Noise Amenity Area</th>
<th>Time of Day</th>
<th>Recommended LAeq Noise Level, dBA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Acceptable</td>
</tr>
<tr>
<td>Residence</td>
<td>Rural</td>
<td>Day</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evening</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Night</td>
<td>40</td>
</tr>
<tr>
<td>Suburban</td>
<td></td>
<td>Day</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evening</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Night</td>
<td>40</td>
</tr>
</tbody>
</table>

Note 1: Sourced from Table 2.1 in the NSW INP
Note 2: Daytime: 0700 to 1800 hours (Monday to Saturday), or 0800 to 1800 hours (Sundays and public holidays). Evening: 1800 to 2200 hours. Night-time: the remaining periods.

The noise criteria in Table 6 and Table 7, shows that the intrusive noise criterion is the limiting criterion and will represent the operational noise criterion for this project. The limiting intrusive noise criterion for the project is 35 dBA LAeq(15 minute) for both open/flat plains and woodland terrain areas.

4.3 Accounting for Annoying Noise Characteristics

The INP refers to ‘Modifying factor’ adjustments. ‘Modifying factor’ adjustments should be applied if the noise characteristics include:

- Tonal noise
- Low-frequency noise
- Impulsive noise
- Intermittent noise

Low frequency noise was observed during the site visits to the investigated drill rigs. The noise emission from these drill rigs has therefore been assessed against the relevant noise criterion, applying the low frequency ‘modifying factor’ adjustments where appropriate.

‘Modifying factor’ adjustments are applied for low frequency noise when the difference between the C-weighted level and the A-weighted level is more than 15 dB. If the noise is of low frequency character (ie dBC-dBA >15 dB) a penalty of 5 dB is to be added to the measured/predicted noise level before comparison with the applicable intrusive or amenity criteria. This is equivalent to reducing the noise criteria (which has been done for this assessment to allow for a simple presentation of the measured/predicted noise levels).

5 ATTENDED SOURCE NOISE MEASUREMENTS

Attended near-field source noise measurements at two (2) drill rigs operating in the Gunnedah Basin and two (2) drill rigs operating in the Roma/Fairview area have been performed to determine sound power levels (SWL) for noise prediction purposes. Where possible individual noise sources (ie drill rig, drill rig engine exhaust, generators, pumps) have been identified and the noise emission from these individual plant items were measured.
The attended noise measurements were carried out with a SVAN 948 Type 1 Sound Level Meter (S/N 8895) that was checked for calibration before the measurement using a Rion NC 73 Calibrator. The Sound Level Meter was designed to comply with the requirements of AS IEC 61672.1 2004 *Electroacoustics - Sound Level Meters* and carried a current manufacturer calibration certificate.

A nominal site plan for the drill rigs is shown in Figure 2. The orientation and indicated directions shown on Figure 2 have been used for presentation of the determined SWLs and predicted noise emission levels.

**Figure 2  Typical Drill Site Plan**

5.1 Drill Rig McD 33

Attended near-field source noise measurements were performed for the drill rig McD 33 at Drill Site Maroo 1 on 10 March 2009 and Drill Site Slacksmith 1 on 24 March 2009. The determined SWLs are presented in Table 8.

**Table 8  Determined SWL for Plant Items at Drill Rig McD 33**

<table>
<thead>
<tr>
<th>Plant Item</th>
<th>Operation</th>
<th>SWL dBA</th>
<th>Direction of Noise Emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drill engine exhaust dominant source (RPM 750)</td>
<td>Drillstring testing operation</td>
<td>105</td>
<td>Main source emission to the sides of the drill rig trailer with engine</td>
</tr>
<tr>
<td>Drill engine exhaust dominant source (RPM 1700)</td>
<td>High RPM with no load</td>
<td>110</td>
<td>Main source emission to the sides of the drill rig trailer with engine</td>
</tr>
</tbody>
</table>
5.2 Drill Rig McD 29

Attended near-field source noise measurements were performed for the drill rig McD 29 at Drill Site Glasserton 1 on 24 March 2009. The determined SWLs are presented in Table 9.

Table 9 Determined SWL for Plant Items at Drill Rig McD 29

<table>
<thead>
<tr>
<th>Plant Item</th>
<th>Operation</th>
<th>SWL dBA</th>
<th>Direction of Noise Emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drill engine exhaust dominant source (RPM 800)</td>
<td>Core drilling operation</td>
<td>111</td>
<td>Main source emission to the front of the drill hole</td>
</tr>
<tr>
<td>Generator QAS20</td>
<td>Normal operation</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Generator Genelite P14E25</td>
<td>Normal operation</td>
<td>84</td>
<td></td>
</tr>
</tbody>
</table>

5.3 Drill Rig MDC 105

Attended near-field source noise measurements were performed for the drill rig MDC 105 at Drill Site Blythe Down 1 in Roma on 6 April 2009. The determined SWLs are presented in Table 10.

Table 10 Determined SWL for Plant Items at Drill Rig MDC 105

<table>
<thead>
<tr>
<th>Plant Item</th>
<th>Operation</th>
<th>SWL dBA</th>
<th>Direction of Noise Emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drill engine exhaust dominant source</td>
<td>Core drilling operation</td>
<td>108</td>
<td>Main source emission to the sides of the drill rig trailer with engine</td>
</tr>
<tr>
<td>Mud Pump PEQ 179</td>
<td>Normal operation</td>
<td>111</td>
<td></td>
</tr>
<tr>
<td>Generator Allight P14E2S</td>
<td>Normal operation</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>Generator Allight P11E2S</td>
<td>Normal operation</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Light Tower Diesel generator</td>
<td>Normal operation</td>
<td>104</td>
<td>Main source emission from engine exhaust, normally perpendicularly to the direction of light.</td>
</tr>
</tbody>
</table>

5.4 Drill Rig Atlas 1

Attended near-field source noise measurements were performed for the drill rig Atlas 1 at Drill Site Fairview 83_OB3 on 7 April 2009. The determined SWLs are presented in Table 11.
Table 11 Determined SWL for Plant Items at Drill Rig Atlas 1

<table>
<thead>
<tr>
<th>Plant Item</th>
<th>Operation</th>
<th>SWL dBA</th>
<th>Direction of Noise Emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drill engine exhaust dominant source</td>
<td>Core drilling operation</td>
<td>111</td>
<td>Main source emission to the sides and back of the drill rig trailer with engine</td>
</tr>
<tr>
<td>Mud Pump (pump PZ7 and motor Caterpillar 3408)</td>
<td>Normal operation</td>
<td>113</td>
<td></td>
</tr>
<tr>
<td>Rig Generator Allight P275HE2</td>
<td>Normal operation</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>Generator Allight P30E1</td>
<td>Normal operation</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>Sykes Pump</td>
<td>Normal operation</td>
<td>101</td>
<td></td>
</tr>
<tr>
<td>Light Tower Diesel generator</td>
<td>Normal operation</td>
<td>98</td>
<td>Main source emission from engine exhaust, normally perpendicularly to the direction of light.</td>
</tr>
</tbody>
</table>

6 NOISE PREDICTIONS/ ASSESSMENT

All noise predictions for this project have been carried out utilising the CONCAWE prediction methodology within SoundPLAN. The CONCAWE prediction method is specially designed for large industrial facilities and incorporates the influence of distance attenuation, ground absorption, air absorption and shielding attenuation, as well as meteorological conditions, including wind effects.

Noise levels have been calculated for both neutral and “worst case” weather conditions. The “worst case” weather conditions used to assess the effect of adverse meteorological conditions on noise propagation is shown in Table 12 below. The parameters in Table 12 are considered typical of neutral and “worst case” weather in regards to noise propagation.

Table 12 Weather Conditions – Neutral and “Worst Case”

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Neutral Weather</th>
<th>“Worst Case” Weather</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>10°C</td>
<td>10°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>70%</td>
<td>90%</td>
</tr>
<tr>
<td>Pasquill Stability Category</td>
<td>D</td>
<td>F (simulates temperature inversion conditions)</td>
</tr>
<tr>
<td>Wind Speed</td>
<td>0 m/s</td>
<td>2 m/s (source to receiver)</td>
</tr>
</tbody>
</table>

The determined SWLs, location of noise sources and the directivities (noise emission in different directions) in Section 5 have been used to predict noise emission levels at various offset distances for each of the operational drill rigs. The predictions include noise emissions from the diesel generators in the light towers which would be operating if night works were being undertaken.

6.1 Drill Rig McD 29 and McD 33

Noise contour plots for the different drill rig operations, modelled for neutral and “worst case” weather conditions, are presented in Appendix C for the 2 existing drill rigs (ie McD 29 and McD 33) operating in the Gunnedah area. The predicted noise emissions in Table 13 and the offset distances at which the noise criteria are predicted to be achieved (shown in Table 14) assume propagation over flat, soft ground (ie open grassland) to a typical receiver.
Table 13  Predicted Noise Levels at Various Offset Distances – Drill Rig McD 29 and McD 33

<table>
<thead>
<tr>
<th>Drill Rig and Operation</th>
<th>Weather Condition</th>
<th>Direction</th>
<th>Predicted Noise Level at Buffer Distance (LAeq dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>50m</td>
</tr>
<tr>
<td>Drillstring testing operation McD 33</td>
<td>Neutral</td>
<td>Front</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Back</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>60</td>
</tr>
<tr>
<td>Drillstring testing operation McD 33</td>
<td>Worst Case</td>
<td>Front</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Back</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>60</td>
</tr>
<tr>
<td>Core drilling operation McD 29</td>
<td>Neutral</td>
<td>Front</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Back</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>62</td>
</tr>
<tr>
<td>Core drilling operation McD 29</td>
<td>Worst Case</td>
<td>Front</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Back</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>62</td>
</tr>
<tr>
<td>Open hole drilling operation McD 33</td>
<td>Neutral</td>
<td>Front</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Back</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>64</td>
</tr>
<tr>
<td>Open hole drilling operation McD 33</td>
<td>Worst Case</td>
<td>Front</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Back</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>65</td>
</tr>
</tbody>
</table>

It is noted that the predicted noise levels at distances greater than 1,000m would be similar to, or below, background noise levels observed in rural areas of the Gunnedah Basin.

The character of the noise source has been considered when assessing the relevant intrusive noise criteria. A penalty of 5 dBA has been applied to the noise criteria to account for the low frequency character of the noise source (ie the difference between C-weighted and A-weighted is more than 15 dBA as outlined in Section 4.3). A column showing the result of the low frequency assessment is shown in Table 14, the relevant intrusive noise criteria (reduced by 5 dBA where necessary) shows.

Table 14 shows the predicted offset distances in each direction for the different drilling operations. The highlighted distances are the predicted offset distance required to achieve the noise criteria for all drilling operations at drill rigs McD 29 and McD 33.
Table 14  Predicted Offset Distances to Achieve the Noise Criteria – Drill Rig McD 29 and McD 33

<table>
<thead>
<tr>
<th>Drill Rig and Operation</th>
<th>Weather Contour Map in Appendix C</th>
<th>Weather Condition</th>
<th>Low Frequency Assessment Difference (dBC – dBA)</th>
<th>Relevant Intrusive Criterion (LAeq dBA)</th>
<th>Offset Buffer Distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Front</td>
</tr>
<tr>
<td>Drillstring testing operation McD 33</td>
<td>Map 1</td>
<td>Neutral</td>
<td>22 &gt;15</td>
<td>30²</td>
<td>475</td>
</tr>
<tr>
<td>Core drilling operation McD 29</td>
<td>Map 2</td>
<td>Neutral</td>
<td>22 &gt;15</td>
<td>30²</td>
<td>975</td>
</tr>
<tr>
<td>Open hole drilling operation McD 33</td>
<td>Map 3</td>
<td>Neutral</td>
<td>22 &gt;15</td>
<td>30²</td>
<td>730</td>
</tr>
<tr>
<td>Drillstring testing operation McD 33</td>
<td>Map 4</td>
<td>Worst Case</td>
<td>21 &gt;15</td>
<td>30²</td>
<td>650</td>
</tr>
<tr>
<td>Core drilling operation McD 29</td>
<td>Map 5</td>
<td>Worst Case</td>
<td>21 &gt;15</td>
<td>30²</td>
<td>1250²</td>
</tr>
<tr>
<td>Open hole drilling operation McD 33</td>
<td>Map 6</td>
<td>Worst Case</td>
<td>19 &gt;15</td>
<td>30²</td>
<td>1100</td>
</tr>
</tbody>
</table>

Note 1:  If the difference between the C-weighted and A-weighted noise level is more than 15 dB, the intrusive noise criterion is reduced by 5 dB to account for noise of low frequency character (as outlined in Section 4.3).

Note 2: Highlighted shows the predicted distance in each direction required to achieve the noise criteria for all drilling operations at drill rigs McD 29 and McD 33 (currently operating in the Gunnedah Basin).

6.2 Drill Rig MDC 105 and Atlas 1

Noise contour plots for the different drill rig operations, modelled for neutral and “worst case” weather conditions, are presented in Appendix D for the two drill rigs, MDC 105 and Atlas 1, operating in the Roma/Fairview area. The predicted noise emissions in Table 15 and the offset distances at which the noise criteria are predicted to be achieved (shown in Table 16) assume propagation over flat, soft ground (ie open grassland) to a typical receiver.

Table 15  Predicted Noise Levels at Various Offset Distances – Drill Rig MDC 105 and Atlas 1

<table>
<thead>
<tr>
<th>Drill Rig and Operation</th>
<th>Weather Condition</th>
<th>Direction</th>
<th>Predicted Noise Level at Buffer Distance (LAeq dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>50m</td>
<td>100m</td>
</tr>
<tr>
<td>Core drilling operation MDC 105</td>
<td>Neutral</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Front</td>
<td>65</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>Left</td>
<td>67</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Back</td>
<td>64</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>Right</td>
<td>63</td>
<td>58</td>
</tr>
<tr>
<td>Drill Rig and Operation</td>
<td>Weather Condition</td>
<td>Direction</td>
<td>Predicted Noise Level at Buffer Distance (L_{Aeq} dBA)</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------</td>
<td>-----------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50m</td>
<td>100m</td>
</tr>
<tr>
<td>Core drilling operation MDC 105</td>
<td>Worst Case</td>
<td>Front</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Back</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>63</td>
</tr>
<tr>
<td>Drilling operation including the mud pump MDC 105</td>
<td>Neutral</td>
<td>Front</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Back</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>66</td>
</tr>
<tr>
<td>Drilling operation including the mud pump MDC 105</td>
<td>Worst Case</td>
<td>Front</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Back</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>67</td>
</tr>
<tr>
<td>Core drilling operation Atlas Rig 1</td>
<td>Neutral</td>
<td>Front</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Back</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>72</td>
</tr>
<tr>
<td>Core drilling operation Atlas Rig 1</td>
<td>Worst Case</td>
<td>Front</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Back</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>72</td>
</tr>
<tr>
<td>Drilling operation including the mud pump Atlas Rig 1</td>
<td>Neutral</td>
<td>Front</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Back</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>75</td>
</tr>
<tr>
<td>Drilling operation including the mud pump Atlas Rig 1</td>
<td>Worst Case</td>
<td>Front</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Back</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Right</td>
<td>75</td>
</tr>
</tbody>
</table>

It is noted that the predicted noise levels at distances greater than 1,000m to 2,000m would be similar to, or below, background noise levels observed in rural areas of the Gunnedah Basin.

The character of the noise source has been considered when assessing the relevant intrusive noise criteria. A penalty of 5 dB has been applied to the noise criteria to account for the low frequency character of the noise source (i.e., the difference between C-weighted and A-weighted is more than 15 dB as outlined in Section 4.3). A column showing the result of the low frequency assessment is shown in Table 16, the relevant intrusive noise criteria (reduced by 5 dB where necessary) shows.
Table 16 shows the predicted offset distances and directivities for the different drilling operations. The highlighted distances are the predicted offset distance required to achieve the noise criteria for all drilling operations at the two drill rigs, MCD 105 and Atlas Rig 1, currently operating in the Roma/Fairview area. Table 16 shows that Atlas Rig 1 is the noisiest of all measured drill rigs. It is also the drill rig that requires the largest drill site (in terms of area).

Table 16  Predicted Offset Distances to Achieve the Noise Criteria – Drill Rig MDC 105 and Atlas 1

<table>
<thead>
<tr>
<th>Drill Rig and Operation</th>
<th>Noise Contour Map in Appendix D</th>
<th>Weather Condition</th>
<th>Low Frequency Assessment Difference (dBC – dBA)</th>
<th>Relevant Intrusive Criterion (LEq dBA)</th>
<th>Offset Buffer Distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Front</td>
</tr>
<tr>
<td>Core drilling operation</td>
<td>Map 1</td>
<td>Neutral</td>
<td>16 &gt;15</td>
<td>30¹</td>
<td>755</td>
</tr>
<tr>
<td>MDC 105</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drilling operation</td>
<td>Map 2</td>
<td>Neutral</td>
<td>14 &lt; 15</td>
<td>35</td>
<td>660</td>
</tr>
<tr>
<td>including the mud pump</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MDC 105</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core drilling operation</td>
<td>Map 3</td>
<td>Neutral</td>
<td>10 &lt; 15</td>
<td>35</td>
<td>620</td>
</tr>
<tr>
<td>Atlas Rig 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drilling operation</td>
<td>Map 4</td>
<td>Neutral</td>
<td>9 &lt; 15</td>
<td>35</td>
<td>900</td>
</tr>
<tr>
<td>including the mud pump</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atlas Rig 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core drilling operation</td>
<td>Map 5</td>
<td>Worst Case</td>
<td>15 &gt;15</td>
<td>30¹</td>
<td>1055</td>
</tr>
<tr>
<td>MDC 105</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drilling operation</td>
<td>Map 6</td>
<td>Worst Case</td>
<td>13 &lt;15</td>
<td>35</td>
<td>950</td>
</tr>
<tr>
<td>including the mud pump</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MDC 105</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core drilling operation</td>
<td>Map 7</td>
<td>Worst Case</td>
<td>9 &lt; 15</td>
<td>35</td>
<td>840</td>
</tr>
<tr>
<td>Atlas Rig 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drilling operation</td>
<td>Map 8</td>
<td>Worst Case</td>
<td>7 &lt; 15</td>
<td>35</td>
<td>1280²</td>
</tr>
<tr>
<td>including the mud pump</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atlas Rig 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note 1: If the difference between the C-weighted and A-weighted noise level is more than 15 dB, the intrusive noise criterion is reduced by 5 dB to account for noise of low frequency character (as outlined in Section 4.3).

Note 2: Highlighted shows predicted distance in each direction required to achieve the noise criteria for all drilling operations at drill rigs MDC 105 and Atlas Rig 1 (currently operating in the Roma/Fairview area).
6.3 Noise Attenuation due to Meteorology, Topography and Vegetation

6.3.1 Meteorological Effects

As previously noted, the predicted noise level emissions in Table 13 and Table 15 are based on neutral weather and “worst case” weather conditions as presented in Table 12. The resulting change in predicted levels due to “worst case” weather is summarised in Table 17.

<table>
<thead>
<tr>
<th>Change due to adverse weather</th>
<th>50m</th>
<th>100m</th>
<th>250m</th>
<th>500m</th>
<th>1,000m</th>
<th>2,000m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase above predicted noise level for neutral weather conditions.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 17 shows that sensitive receivers located at 250m or more from a drill rig operation would experience a noticeable change in noise levels as a result of adverse weather conditions (up to distances where noise is no longer audible).

6.3.2 Topographical Effects

As previously stated, the predictions in Table 13 to Table 16 assume propagation over flat, soft ground (ie open grassland) to a typical receiver.

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

Noise attenuation due to topographical shielding typically ranges from 5 dBA if line-of-sight between the noise source and receiver location is just obscured, and up to approximately 15 dBA where the topography provides optimal shielding of the sound transmission path.

It is noted that during “worst case” weather conditions, noise attenuation due to topographical shielding would be less than that expected during “neutral” weather conditions.

6.3.3 Vegetation and Forest Effects

Dense forest vegetation increases the amount of sound absorption along the noise propagation path. For the vegetation to have an effect on the noise propagation the height of vegetation must be above 2 metres (low scrub/bush would not attenuate the noise more than normal absorbing soft ground ie grass) and dense (unable to see through the vegetation even a short distances). The increased sound absorption of typical forest vegetation is estimated to be between 0.05 to 0.1 dBA per metre of propagation distance (ie approximately 5 to 10 dBA over 100 metres in dense forest).
CONCLUSION

Background noise monitoring has been performed for two (2) locations representative of open/flat plains (Wisemans 1) and woodland (Stoney Creek 1) terrain areas respectively. The results show presence of bird and insect noise as well as wind noise in grass, sorghum and trees (low breeze less than 5 m/s).

For the purpose of determining the applicable noise criteria the NSW INP states that where a rating background noise level of less than 30 dBA is measured, the rating background noise level is set to the threshold level of 30 dBA. The limiting rating background noise level for both open/flat plains and woodland terrain areas were set to the threshold level of 30 dBA.

The noise emissions from drill rigs McD 29, McD 33 and to some extent MDC 105 were identified as having low frequency noise characteristics. The NSW INP specifies a penalty of 5 dB if the noise is of low frequency character (ie dBC – dBA > 15 dB).

Therefore the limiting intrusive noise criterion has been reduced to 30 dBA $L_{Aeq(15\text{ minute})}$ for drill rigs McD 29, McD 33 and to some extent MDC 105 for where the noise emission has been identified as having low frequency character.

The limiting intrusive noise criterion for the Atlas Rig 1 is 35 dBA $L_{Aeq(15\text{ minute})}$

Noise emission levels and offset distances at which the intrusive noise criterion is predicted to be achieved for the different drill rigs and drilling operations are presented in Table 13 to Table 16. A summary of the offset distances required to achieve the relevant intrusive noise criteria is summarised in Section 7.1 and Section 7.2.

7.1 Noise Emissions for McD 29, McD 33 and MDC 105

It was found that for the 2 drill rigs currently operating in the Gunnedah Basin, the noisiest drilling operation was the core drilling. For the core drilling the direction in front of the drill hole is emitting more noise than to the sides and backwards. For worst case weather conditions and core drilling operations, offset distances of up to 1250 metres were found to be required to achieve the relevant intrusive noise criterion.

For the current drill site layout the open hole drilling operation (including the Tulsa mud pump) radiates more noise backwards and to the sides. For worst case weather conditions and open hole drilling operations, offset distances of up to 1220 metres were found to be required to achieve the relevant intrusive noise criterion.

The MDC 105 drill rig has very similar noise emission levels to the McD 29 and McD 33. The noise emission from MDC 105 was also identified as having low frequency characteristics. However, when the mud pump was added to the noise sources the overall noise emission from MDC 105 was not identified as having low frequency characteristics. For worst case weather conditions a maximum offset distance of 1215 metres was found to be required to achieve the relevant intrusive noise criterion. The maximum noise emission was measured to the left of the drilling operations almost 200 metres more offset distance required in comparison to the other three directions.

The offset distance required in each direction to achieve the relevant intrusive noise criteria for all drilling operations at drill rig McD 29, McD 33 and MDC 105 is summarised in Table 18.
Table 18  Predicted Offset Distances to Achieve the Noise Criteria for All Drilling Operations – Drill Rig McD 29, McD 33 and MDC 105

<table>
<thead>
<tr>
<th>Drill Rig</th>
<th>Weather Condition</th>
<th>Offset Buffer Distance (m)</th>
<th>Front</th>
<th>Left</th>
<th>Back</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>McD 29 and McD 33</td>
<td>Neutral</td>
<td>975</td>
<td>790</td>
<td>820</td>
<td>800</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Worst Case</td>
<td>1250</td>
<td>1160</td>
<td>1220</td>
<td>1110</td>
<td></td>
</tr>
<tr>
<td>MDC 105</td>
<td>Neutral</td>
<td>755</td>
<td>860</td>
<td>745</td>
<td>850</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Worst Case</td>
<td>1055</td>
<td>1215</td>
<td>1055</td>
<td>1210</td>
<td></td>
</tr>
</tbody>
</table>

Note 1: See discussion in Section 6.3.1. Neutral and “Worst Case” weather conditions defined in Table 12.

For the drill rigs McD 29, McD 33 and MDC 105, an optimally placed drill site in the woodland with significant (if not dense) forest vegetation and topography obscuring line-of-sight between noise sources and the noise sensitive receiver, would result in an offset distance of approximately **600 metres** being required to achieve the relevant intrusive noise criterion (as detailed discussed below in Section 7.3).

### 7.2 Noise Emissions Atlas Rig 1

Atlas Rig 1 is the loudest of all measured drill rigs, but does not have low frequency characteristics. The maximum noise emission was measured to the sides and back of the drill rig. For worst case weather conditions and drilling operations including the mud pump, an offset distance of up to **1410 metres** was found to be required to achieve the relevant intrusive noise criterion.

The offset distance required in each direction to achieve the relevant intrusive noise criteria for all drilling operations at drill rig Mcd 29, McD 33 and MDC 105 is summarised in Table 19.

Table 19  Predicted Offset Distances to Achieve the Noise Criteria for All Drilling Operations – Atlas Rig 1

<table>
<thead>
<tr>
<th>Drill Rig</th>
<th>Weather Condition</th>
<th>Offset Buffer Distance (m)</th>
<th>Front</th>
<th>Left</th>
<th>Back</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlas Rig 1</td>
<td>Neutral</td>
<td>900</td>
<td>1010</td>
<td>1010</td>
<td>1025</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Worst Case</td>
<td>1280</td>
<td>1410</td>
<td>1410</td>
<td>1400</td>
<td></td>
</tr>
</tbody>
</table>

Note 1: See discussion in Section 6.3.1. Neutral and “Worst Case” weather conditions defined in Table 12.

For the Atlas Rig 1, an optimally placed drill site in the woodland with significant (if not dense) forest vegetation and topography obscuring line-of-sight between noise sources and the noise sensitive receiver, would result in an offset distance of approximately **700 metres** being required to achieve the relevant intrusive noise criterion (as detailed discussed below in Section 7.3).

### 7.3 Noise Attenuation due to Meteorology, Topography and Vegetation

There are several mitigation measures that can be applied to screen and direct the noise emission away from noise sensitive receivers as well as using the natural topography and vegetation to reduce the noise impacts.

With dense forest vegetation between the drill rig and the nearest noise sensitive receiver there will be increased noise propagation attenuation as outlined in Section 6.3.3. The dense forest vegetation will not only increase the attenuation, but also disrupt the steady down wind (wind from source to receiver) that is a characteristic of the adverse weather conditions. Typical dense forest vegetation in the woodlands thus has the potential to halve the required offset distances presented in Table 13 to Table 16 for worst case weather.
Furthermore using natural topographical shielding (or man-made earth mounds from the mud sumps etc) to shield the drill rigs from the nearest noise sensitive receivers has the potential to attenuate the noise emission by 5 dBA if line-of-sight between the noise source (drill rig engine exhaust typically at 3.5m height) and receiver location is just obscured, and by up to 15 dBA where the topography provides optimal blocking of the sound transmission path.

For the drill rigs McD 29, McD 33 and MDC 105, an optimally placed drill site in the woodland with significant (if not dense) forest vegetation and topography obscuring line-of-sight between noise sources and the noise sensitive receiver, would result in an offset distance of approximately **600 metres** being required to achieve the relevant intrusive noise criterion.

Atlas Rig 1 is louder and has the dominant noise source (ie the drill rig engine exhaust) located approximately 1m higher than the other three drill rigs (ie 4.5m height). Atlas Rig 1 optimally placed in the woodland with significant (if not dense) forest vegetation and topography obscuring line-of-sight between noise sources and the noise sensitive receiver would result in an offset distance of approximately **700 metres** being required to achieve the relevant intrusive noise criterion. Since the noise source is located higher than the other three drill rigs, obscuring line-of-sight between noise source and receiver will require significantly more elevation from the topography.

There are also other mitigation measures which could be incorporated closer to the noise sources (ie drill rig engine exhaust and mud pump) that would enable additional noise attenuation to be provided to the noise sensitive receiver. These noise mitigation measures may include:

- Engine exhaust silencers
- Screening of engine exhausts
UNATTENDED NOISE MONITORING AT WISEMANS – STATISTICAL NOISE PLOTS
Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Wednesday 11 March 2009

Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.3mm
Temp
Mean Wind Speed

Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Thursday 12 March 2009

Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.3mm
Temp
Mean Wind Speed
UNATTENDED NOISE MONITORING AT WISEMANS – STATISTICAL NOISE PLOTS

Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Friday 13 March 2009

Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Saturday 14 March 2009
UNATTENDED NOISE MONITORING AT WISEMANS – STATISTICAL NOISE PLOTS

**Statistical Ambient Noise Levels**

20-2014 - GLNG - Wisemans - Sunday 15 March 2009

- Excluded Data
- L1
- L10
- L90
- Leq
- Relative Humidity
- Rain >= 0.3mm
- Temp
- Mean Wind Speed

**Statistical Ambient Noise Levels**

20-2014 - GLNG - Wisemans - Monday 16 March 2009

- Excluded Data
- L1
- L10
- L90
- Leq
- Relative Humidity
- Rain >= 0.3mm
- Temp
- Mean Wind Speed
Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Tuesday 17 March 2009

Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Wednesday 18 March 2009
UNATTENDED NOISE MONITORING AT WISEMANS – STATISTICAL NOISE PLOTS

Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Thursday 19 March 2009

Statistical Ambient Noise Levels
20-2014 - GLNG - Wisemans - Friday 20 March 2009
Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Monday 9 March 2009

Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Tuesday 10 March 2009

Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.3mm
Temp
Mean Wind Speed

Sound Pressure Level (dBA)
Relative Humidity (%)

Wind Speed (km/h)
Temperature (Deg C)

Excluded Data
L1
L10
L90
Leq
Relative Humidity
Rain >= 0.3mm
Temp
Mean Wind Speed
UNATTENDED NOISE MONITORING AT STONEY CREEK 1 – STATISTICAL NOISE PLOTS

Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Wednesday 11 March 2009

Excluded Data  L1  L10  L90  Leq  Relative Humidity  Rain >= 0.3mm  Temp  Mean Wind Speed

Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Thursday 12 March 2009

Excluded Data  L1  L10  L90  Leq  Relative Humidity  Rain >= 0.3mm  Temp  Mean Wind Speed
Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Friday 13 March 2009

Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Saturday 14 March 2009
UNATTENDED NOISE MONITORING AT STONEY CREEK 1 – STATISTICAL NOISE PLOTS

Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Sunday 15 March 2009

Excluded Data  L1  L10  L90  Leq  Relative Humidity  Rain >= 0.3mm  Temp  Mean Wind Speed

![Graph showing sound pressure level (dBA) vs. time of day for Sunday 15 March 2009.]

Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Monday 16 March 2009

Excluded Data  L1  L10  L90  Leq  Relative Humidity  Rain >= 0.3mm  Temp  Mean Wind Speed

![Graph showing sound pressure level (dBA) vs. time of day for Monday 16 March 2009.]

(20-2014-R3R2.doc) Heggies Pty Ltd
Appendix B

Report 20-2014-R3

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UNATTENDED NOISE MONITORING AT STONEY CREEK 1 – STATISTICAL NOISE PLOTS

Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Tuesday 17 March 2009

Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Wednesday 18 March 2009
Statistical Ambient Noise Levels
20-2014 - GLNG - Stoney Creek 1 - Saturday 21 March 2009

Excluded Data  L1  L10  L90  Leq  Relative Humidity  Rain >= 0.3mm  Temp  Mean Wind Speed

Time of Day

Sound Pressure Level (dBA)
Relative Humidity (%)
Project specific intrusive noise criterion 30 dBA LAeq 5 dB penalty for low frequency noise has been applied.

Predictions at 1.5m above ground and assumes "Neutral" weather

Grid sections 100x100m

Legend
- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:

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Appendix C
Map 1

Predicted Noise Contours (LAeq)
Drill Rig McD 33
Drillstring testing operation
Predicted Noise Contours (LAeq)

Project specific intrusive noise criterion 30 dBA LAeq 5 dB penalty for low frequency noise has been applied.

Legend
- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

LAeq (dBA) Grid sections
- 30 < 35
- 35 < 40
- 40 < 45
- 45 < 50
- 50 < 55
- 55 < 60
- 60 < 65
- 65 < 70
- 70 <

Note:
Predictions at 1.5m above ground and assumes "Neutral" weather

Appendix C
Map 2

Predicted Noise Contours (LAeq)
Drill Rig McD 29
Core drilling operation

Table:
- Prepared: HM 2/04/09
- Checked: MC 2/04/09
- Authorised: MC 2/04/09
Project specific intrusive noise criterion 30 dBA LAeq 5 dB penalty for low frequency noise has been applied.

Note:
Predictions at 1.5m above ground and assumes "Neutral" weather.

Legend:
- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

20-2014-R3
SANTOS DRILL RIG
(LAeq) Noise Contours

Appendix C
Map 3

Predicted Noise Contours (LAeq)
Drill Rig McD 33
Open hole drilling operation

HM 2/04/09
MC 2/04/09
MC 2/04/09
MC 2/04/09
MC 2/04/09

Scale 1:8000
60 80 240 320 400 m

NOTE:

Predictions at 1.5m above ground and assumes "Neutral" weather.
Predicted Noise Contours (LAeq)

Drill Rig McD 33
Drillstring testing operation

Project specific intrusive noise criterion 30 dBA LAeq. 5 dB penalty for low frequency noise has been applied.

Note:
Predictions at 1.5m above ground and assumes "Worst Case" weather.

Appendix C
Map 4

Legend

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Scale 1:8000
0  40  80  120  160 m

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20-2014-R3
SANTOS DRILL RIG
(LAeq) Noise Contours

Appendix C
Map 4

Predicted Noise Contours (LAeq)
Predicted Noise Contours (LAEq)

Note:
Predictions at 1.5m above ground and assumes "Worst Case" weather.

Project specific intrusive noise criterion 30 dBA LAeq 5 dB penalty for low frequency noise has been applied.

Grid sections
100x100m

Legend
- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Appendix C
Map 5
Predicted Noise Contours (LAEq)
Drill Rig McD 29
Core drilling operation
Project specific intrusive noise criterion 30 dB LAeq 5 dB penalty for low frequency noise has been applied.

Legend
- Grid 100x100m
- Berm top
- Point source
- Building
- Drill Site

Grid sections
100x100m

Scale 1:11000
0 50 100 200 300 400 500 m

Note:
Predictions at 1.5m above ground and assumes “Worst Case” weather

Prepared: HM 2/04/09
Checked: MC 2/04/09
Authorised: MC 2/04/09

Appendix C
Map 6

Predicted Noise Contours (LAeq)
Drill Rig McD 33
Open hole drilling operation
Predicted Noise Contours (LAeq) of SANTOS DRILL RIG Core drilling operation

**Legend**
- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

**Note:**
- Predictions at 1.5m above ground and assumes "Neutral" weather.
- 5 dB penalty for low frequency noise has been applied.

**Project specific intrusive noise criterion:**
- 30 dBA LAeq

**Grid sections:**
- 100x100m

**Appendix D Map 1**
- Predicted Noise Contours (LAeq)
- Drill Rig MDC 105

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Note: Predictions at 1.5m above
ground and assumes
"Neutral" weather

Project specific intrusive
noise criterion 35 dBA LAeq

Legend
- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

20-2014-R3
SANTOS DRILL RIG
(LAeq) Noise Contours

Appendix D
Map 2

Predicted Noise Contours (LAeq)
Drill Rig MDC 105
Drilling operation including the mud pump

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20-2014-R3
SANTOS DRILL RIG
(LAeq) Noise Contours

Note:
Predictions at 1.5m above ground and assumes "Neutral" weather

Grid sections
100x100m

Appendix D
Map 3
Predicted Noise Contours (LAeq)
Drill Rig Atlas 1
Core drilling operation

Project specific intrusive noise criterion 35 dBA LAeq

Legend

LAeq (dBA)
30 < <= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 < <= 70
70 <

Scale 1:10000

0 50 100 200 300 400 500 m

Name
Prepared HM 17/04/09
Checked MC 17/04/09
Authorised MC 17/04/09
Predicted Noise Contours (L_{Aeq})

Drill Rig Atlas 1
Drilling operation including the mud pump

Note:
Predictions at 1.5m above ground and assumes "Neutral" weather

Legend:
- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Scale 1:12000

Grid sections 100x100m

Project specific intrusive noise criterion 35 dBA L_{Aeq}
Predicted Noise Contours (LAeq)

Drill Rig MDC 105
Core drilling operation

Appendix D
Map 5

Predicted Noise Contours (LAeq)

Project specific intrusive noise criterion 30 dBA LAeq
5 dB penalty for low frequency noise has been applied.

Legend
- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:
Predictions at 1.5m above ground and assumes "Worst case" weather
Predictions at 1.5m above ground and assumes "Worst case" weather

Scale 1:12000

Project specific intrusive noise criterion 35 dBA LAeq

Grid sections 100x100m
Predicted Noise Contours (LAeq)

Legend:
- Building
- Point source
- Berm top
- Grid 100x100m
- Drill Site

Note:
Predictions at 1.5m above ground and assumes "Worst case" weather

Scale 1:12000

Grid sections 100x100m

Project specific intrusive noise criterion 35 dBA LAeq

20-2014-R3
SANTOS DRILL RIG
(LAeq) Noise Contours

Appendix D
Map 7

Predicted Noise Contours (LAeq)
Drill Rig Atlas 1
Core drilling operation

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Note: Predictions at 1.5m above ground and assumes "Worst case" weather

Project specific intrusive noise criterion 35 dBA LAeq
Appendix D

Chip Hole Design

prepared by Santos
WELL NAME: Sicamous 1
WELL TYPE: CSG Chiphole
WELL AREA: PEL 1
RIG: Lucas Rig 13 (Drilling Only)

### TOPS & TARGETS & SCHEMATIC

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<td>71m</td>
<td>0-1/4&quot; Hole</td>
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**TARGETS:**
- Primary - Hoskissons Coal
- Secondary - Maules Creek Coal

**Well Objectives:**
- Primary - Hoskissons Coal
- Secondary - Maules Creek Coal

**Anticipated Plug & Abandon PLUGS**
- If required
- A P&A programme will be issued separately

**All depths approximate and pre-drill**
Appendix E

Environmental Management Plan

prepared by RPS
Environmental Management Plan

Sicamous Chip Hole – PEL 1, Gunnedah Basin

Prepared by:

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W: rpsgroup.com.au

Prepared for:

SANTOS QNT PTY LTD

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32 Turbot Street
BRISBANE QLD 4000

T: 07 3838 3676
F: 07 3838 3700

Report Number: 107106-2_Sicamous EMP
Version / Date: Final, Rev 0 / August 2011
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1.0 Introduction

Santos QNT Pty Ltd (Santos) as operator for and on behalf of the titleholders is proposing to drill and complete one chip hole and ancillary activities, known as Sicamous 1, in the Gunnedah Basin. The purpose of the proposed activities is to investigate the potential coal seam gas resource within Petroleum Exploration Licence No. 1 (PEL 1).

RPS was engaged to prepare this Environmental Management Plan (EMP) to accompany the Review of Environmental Factors (REF) for the proposed activities to be submitted to the Department of Industry and Investment in accordance with the Environmental Planning and Assessment Act 1979 (NSW). RPS has also prepared an ecological assessment (EA). Terms used in the REF and the EA have the same meaning in this EMP.

1.1 Description of the Action

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

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

In summary, the process involves:

- Preparation of lease access tracks, utilising and improving existing access tracks and construction of short section of new track;
- Preparation of a level drill pad (also referred to as “well lease area”);
- Placement of a drilling rig and ancillary equipment at the well lease;
- Drilling of the well;
- Collection and analysis of drill cuttings (as required);
- Conduct well testing and wireline logging (as required);
- Plugging and abandonment of the well;
- Removal of equipment and imported materials from the site; and
- Full rehabilitation of the site in line with legislative and landholder requirements.

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

### 1.1.1 Site Preparation and Equipment

Various works will be required in order to prepare the site for the proposed drilling, including preparation of the well lease, construction of approximately 50m additional track, as well as positioning the drill rig and associated temporary buildings and equipment on the site. The major equipment used on site will be a drilling rig and associated temporary buildings. These works are summarised further in this section. Figure 3.1 – 3.3 of the REF illustrate the proposed site layout for the well lease and access tracks, and the proposed erosion and sediment control measures for the well lease.

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

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

<table>
<thead>
<tr>
<th>Area of Disturbance</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sicamous 1</td>
<td>80m X 60m with an overall area of disturbance of 4,800m². Pad level will be created with cut to fill a pad level of approximately RL300AHD.</td>
</tr>
<tr>
<td>Additional Track</td>
<td>6m x ~50m, with an overall area of disturbance of approx 300m². To be topped with approximately 150mm gravel to provide all weather access.</td>
</tr>
</tbody>
</table>

#### 1.1.1.1 Access track improvements and construction

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

The following is a list of the detailed works involved.

- The existing track will be top dressed with 100mm road base.
- Track is to be top dressed to allow wet weather access.
- Two cattle ramps and two sets of double gates and end assemblies to be installed in two locations along the access track.

#### 1.1.2 Well Lease Construction

- Civil works equipment will be moved to site including bulldozer, excavator, grader, roller, water trucks, other trucks and support and light vehicles.
- Portable amenities will be located on site during construction.
- Any topsoil will be stripped and stockpiled.
- Required sumps will be excavated and lined with impermeable plastic sheeting.
- The lease area will be graded, rolled and otherwise constructed per Figure 3.1 of the REF;
- A 10-3/4” steel conductor casing will be pre-installed at approximately 6m depth by the civil works crews ahead of the rig arriving on site.

- The well lease pad will be fenced in a conventional manner consistent with the fencing on the landholder’s property.

1.1.1.3 Drill Rig Positioning & Operation

Equipment will enter/exit the site via the main access gate. Equipment will include generator units, lighting towers, site offices, stores and other various temporary buildings and equipment required for the duration of drilling. Moving and rigging up/down of equipment (i.e. installation and dismantling of rig equipment) is expected to take up to 3 days (3 per rig up, 3 per rig down).

Ancillary equipment will be required on site during the course of the drilling activities, including wireline trucks, cementing trucks and service company vehicles, these vehicles will exit and enter the site as required.

1.1.2 Drilling Activities

The well will have a specific design ensuring compliance with relevant legislation. A nominal 10-3/4” (273mm) cemented conductor is to be installed by the lease builder to approximately 6m below ground level. The surface hole of 8 1/2” (216mm) will be rotary drilled to approximately 150mRT, where a 7” (178mm) steel surface casing will be landed and pressure cemented in place with cement to surface. The main hole of diameter 6-1/8” (156mm) will be drilled from the 7” (178mm) casing shoe to well total depth planned to be 20m into the Boggabri Volcanics at approximately 590mRT based on the pre-drill geological prognosis. DSTs or equivalent downhole evaluations may be conducted on penetration over selected Late and Early Permian Coals with testing to be performed in accordance with legislative requirements.

The closest offset wells to the proposed activities are Calala 1 (9km) and Glasserton 1 (11km).

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

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

1.1.3 Abandonment and Rehabilitation

The well will be cemented, plugged and abandoned in accordance with DTIRIS requirements and rehabilitated following completion of activities within the allowed regulatory timeframe. A steel identification plate installed near the top of the hole > 1 metre below the surface.
Once the drilling and testing activities are complete, the disturbed area is proposed to be rehabilitated with appropriate mitigation measures and environmental safeguards implemented to minimise potential impacts. All rehabilitation works will be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation in accordance with the relevant statutory requirements.

Revegetation & rehabilitation will be undertaken within the required regulatory timeframe. All improvement works to private tracks will be retained for the benefit of the landholder.

### 1.1.4 Duration

Drilling activities are temporary and will not have any long-term impact on the visual amenity of the area. The drilling of the well is expected to occur over a 40 day period not including lease build, or site rehabilitation. There will be 14 days of lease construction activities prior to drilling the well. Rehabilitation activities of 30 days following the drilling of the well will be additional to this period.

This equates to a total of approximately 54 days of construction and drilling and 30 days of rehabilitation, as outlined in the table below.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Expected Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lease Build</td>
<td>14 days</td>
</tr>
<tr>
<td>Drilling</td>
<td>40 days</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>30 days</td>
</tr>
</tbody>
</table>

### 1.1.5 Staff & Hours of Operation

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

The hours of operation during the drilling and work over will be on a 12 hour a day basis as negotiated with the landholder. Personnel movements to and from site will be minimised outside of a single shift change per day but may be necessary due to emergency situations or specific activities (e.g. crews and service companies entering and leaving site to conduct specific activities).

### 1.1.6 Chemicals

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

1.2.1 Regional Location

The investigation area is located within PEL 1, which is in the Gunnedah region. PEL 1 covers a number of local government areas (LGAs), including the Gunnedah Shire Council LGA where the proposed activities are located.

A satellite image showing the site and its vicinity is shown in Figure 2.1 of the REF. The region has been used extensively for agricultural activities since the 1830s. Agricultural activities include mixed farming of sheep, cattle and grain crops with a gradually larger reliance on cattle. Coal mines are located in tenures that overlay PEL 1, however these are not within the vicinity of the proposed chip hole.

The study area is located approximately 20km south west of Curlewis, in the Brigalow Belt South IBRA Bioregion and Namoi Catchment Management Authority region (Liverpool Plains sub-region). The study area is located to the east of Lake Goran, a nationally Important Wetland (NSW005), mapped by the Office of Environment and Heritage (OEH) as a Freshwater Wetland. The study area is approximately 200m from the highest level of the lake, however the lake is ephemeral in nature, with water levels fluctuating significantly throughout the year. Goran Lake is approximately 296.4m Australian Height Datum (AHD) at full capacity, while the study area is approximately 300m AHD. Doona State Forest is located approximately south-east of the site.

The majority of the subject site is currently used for cattle and sheep grazing, and has been historically cleared of native vegetation communities. However, isolated stands of vegetation occur across the study area. The site has been recently disturbed by bushfire, including the proposed chip hole lease.

1.2.2 Topography

The topography of the subject site is flat to undulating. It is located at approximately 298m Australian Height Datum (AHD) and land rises to the north east. Lake Goran is located to the west of the site.
1.2.3 Climate

The Bureau of Meteorology (BoM) weather station most representative of the area is located at Curlewis (Wongalee), which only provides rainfall and solar data. The Gunnedah Resource Centre is the closest station with temperature statistics.

The local climate is temperate with a slight dominance of summer rainfall. The average daily maximum temperature is around 24.5°C, while the average daily minimum temperature is around 12.1°C (BoM, 2011). Long-term mean annual rainfall for the locality is 640.8 mm.

As shown in Table 1.3, based on mean temperature records the warmest month is January and the coolest months are June and July. December receives the greatest rainfall and April the least, however very little variation is evident throughout an average year.

### Table 1.3 Climate Statistics from Curlewis (Wongalee) (rainfall) & Gunnedah Resource Centre (temp) BoM Weather Stations

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

2.1.1 Purpose

This EMP has been prepared to ensure that the proposed activities are undertaken in accordance with relevant legislation, policies and guidelines. The mitigation measures outlined within this EMP are designed to ensure that the impact upon the environment are minimised, and that any impacts that do occur are managed appropriately.

2.1.2 Objectives

The objective of this EMP is to:

- Ensure cultural heritage sites are not impacted unnecessarily by land disturbance;
- Avoid sites of known scientific and natural significance;
- Minimise or where possible avoids clearance of trees and shrubs;
- Minimise risks to wildlife and stock;
- Avoid the introduction or spread of pest plants and animals and implement control measures as necessary;
- Minimise disturbance and avoid contamination to soil;
- Include erosion control measures in vulnerable locations;
- Ensure that noise and dust issues are adequately dealt with in order to minimise likely impacts upon the surrounding environments;
- Optimize (in order of most to least preferable) waste avoidance, reduction, reuse, recycling, treatment and disposal;
- Provide adequate measures in relation to bushfire protection and ignition that may affect the surrounding environments; and
- Facilitate rehabilitation and/or restoration and consider post-construction land use.

2.2 Responsibilities

Responsibility for the environmental management will be structured and be both broad-based company policy related and individually assigned. While designated individuals will be responsible for certain aspects of the construction and decommissioning activities, all staff will be responsible for environmental management to a certain extent.

The following information provides a summary of each of the defined roles.
2.2.1 **Project Manager**

During the Sicamous activities the Project Execution Manager is responsible for the overall execution of the activities and will ensure appropriate environmental management and compliance throughout the project execution activities.

2.2.2 **Drilling Contractor**

During drilling operations and within the drilling lease areas the Drilling Rig Manager is the on-site person responsible for ensuring appropriate environmental management and compliance. Overall responsibility for ensuring drilling activity environmental management and compliance falls with the Santos CSG Drilling and Completions Environmental Advisor following site approval.

2.2.3 **Civil Works Contractor**

During civil works activities the responsibility for environmental management and compliance rests with the Santos Construction Supervisor. The Site Supervisor provided by the Civil Works Contractor is responsible for any immediate actions required to ensure on-site environmental management and compliance only in the on-site absence of the Santos Construction Supervisor and is responsible for timely reporting of any issues directly to the Santos Construction Supervisor.

2.2.4 **Environmental Advisor / Auditor**

The Santos Environmental Advisor is the field-based person responsible for advising the Drilling Contractor and Civil Works and other relevant parties on the requirements of the EMP to ensure that the requirements are implemented.

Such personnel need to be appropriately qualified and undertake activities such as the following:

- Inspecting construction works on a regular basis to ensure compliance with relevant requirements;
- Maintaining a written and photographic record of the construction activities for reference;
- Identifying potential problem areas and ensuring that they are treated adequately;
- Advising all construction staff on their environmental responsibilities;
- Reporting situations of non-compliance to the Santos Project Manager;
- Ensuring sensitive areas previously identified by studies (such as threatened plants or heritage items) are flagged out and that personnel are informed of their significance; and
- Monitoring environmental performance of the construction activities.

2.2.5 **Heritage Supervisor**

The Santos Heritage Supervisor will be consulted as required. They may be required to monitor the protection of Aboriginal artefacts or European heritage. They are also required to flag items of significance for construction workers to avoid.
2.2.6 Supervising Ecologist

The Supervising Ecologist is required to monitor all vegetation clearing and pruning activities to ensure vegetation and fauna management procedures are implemented. The Supervising Ecologist is to provide advice during the site rehabilitation and monitor revegetation. They are also required to prepare or provide input into required reporting.

2.2.7 Project Liaison

The Santos Project Liaison manager is responsible for regular and ongoing communication as required to external parties. The Santos Project Liaison manager is responsible for ensuring any public complaints are effectively managed.

2.3 Procedures

Procedures need to be put in place to ensure that there are set standards and management requirements that need to be considered. This EMP outlines procedures in Construction Management and Decommissioning Management sections as to what procedures are, in relation to each environmental issue. No Operational Management phase has been developed for the site as drilling operations are considered under Construction Management.

2.4 Training and Awareness

Training and awareness is an integral part of the protection of the environment and the implementation of an EMP. A comprehensive environmental training program will encompass inductions, job specific training, and environmental awareness programs.

2.4.1 Induction

Santoş has a comprehensive, multi level induction program. All contractors and personnel will complete the Santos Level 1 induction as the basis of completing any works for the company and covers company values, policies, Environment Health and Safety Management System (EHS MS) and other core information.

The Gunnedah Level 2 induction covers EHS matters that are specific to the NSW and the local area in which the company operates, minimum standards and expectations.

The Site Level 3 is an on-site induction specific to a smaller area of work, such as a drill site or a pilot well site. Conditions and requirements for this site are covered in this induction.

2.4.2 Job Specific Training

Santoş operators and staff undertake competency based training, in line with the requirements of their role. These are assessed periodically and identified gaps addressed in a training and development plan for each individual.
All Santos personnel and contractors are required to have a working knowledge of the Santos EHS MS, site specific conditions relating to works being completed on site.

2.4.3 Environmental Awareness

Prior to a scope of work commencing on a Santos site, an ‘icebreaker’ is held with all relevant parties to the work scope. Environmental conditions associated with the works in addition to any health and safety issues are identified and discussed in detail. Toolbox meetings are held at the start of each day where these requirements are refreshed to ensure that all persons on site are aware of the requirements and have opportunity to discuss concerns in an open forum.

2.5 Communication

Regular and ongoing communication will be required to inform external parties as to the progress and success of the environmental aspects of the activity. The primary point of contact will be the appointed project liaison person. External parties are likely to include:

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

2.6 Documentation and Reporting

A record of the implementation and results of the EMP is an important tool to enable internal and external authorities to check the procedures and the monitoring results. Assessment of compliance with statutory authorities, success in achieving objectives, any environmental outcomes and their significance and the effectiveness of the EMP will be documented.

Documentation and recording is proposed to include:

- Records of induction and training attendees;
- Inspection reports;
- Non-compliance reports;
- Accident or incident reports; and
- Audit result reports.
2.7 Review and Improvement

Given the short-term nature of the proposal, a review and improvement process is not required. However, in the event of a notable environmental incident, the EMP will be updated to reflect any required changes to management practices.
3.0 Construction Management

3.1 Overview

The construction phase incorporates the following activities:

- preparation of lease access tracks utilising and improvements to existing access tracks;
- preparation of a level drill pad (also referred to as “well lease area”);
- placement of a drilling rig and ancillary equipment at the well lease;
- drilling of the well;
- collection and analysis of drill cuttings (as required); and
- conduct well testing and wireline logging (as required).

The sections below outline environmental issues and management actions to be implemented throughout the construction phase.

3.2 Vegetation Management

3.2.1 Overview

While TSC Act listed White Box - Yellow Box - Blakely’s Red Gum Woodland is known to occur across the property, the proposed chip hole lease has been located within an area that has recently been subject to wildfire. As it is likely that this area was comprised of native grasses prior to the wildfire, and historically supported White Box, this area is considered to be the TSC Act listed White Box – Yellow Box – Blakely’s Red Gum Woodland.

The access track is predominantly located along a well defined existing access track. Vegetation adjacent to the access track is comprised of native grassland. No canopy trees occur adjacent to the access track. Approximately 300m² of additional access track is required, to be constructed within an area of grassland that is currently highly disturbed due to wildfire.

3.2.2 Environmental Issues

The potential impacts associated with the proposed activities are short-term and temporary. The proposed chip hole and new access track are located within grassland vegetation that is currently highly disturbed due to recent wildfire. Given the heavily disturbed nature of the site, the proposed chip hole and associated activities are not considered to have any further impact on the subject area.

The proposed activity is considered to have minimal impacts on fauna habitat, given the highly disturbed nature of the site. Additionally, no canopy trees will be cleared as part of construction.

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

The following vegetation management measures will be implemented throughout the construction phase.

- The disturbance area will be appropriately demarcated to ensure machinery is limited to the designated disturbance area;
- All contractors will be specifically advised of designated work area. The following activities are not to occur outside of designated work areas to minimise impacts on native vegetation:
  - Vehicle movements;
  - Storage and mixing of materials
  - Vehicle parking;
  - Liquid disposal;
  - Machinery repairs and/or refueling;
  - Construction site office or shed;
  - Combustion of any material;
  - Stockpiling of soil, rubble or debris; and
  - Any filling or excavation including trenching, topsoil skimming and/or surface excavation;
- Vehicle speeds will be limited to reduce the potential of fauna strike and to reduce dust generation;
- To minimise potential impacts on adjacent grazing lands, all liquids (fuel, oil, cleaning agents, drilling liquids etc) will be stored appropriately and disposed of at suitably licensed facilities. Spill management procedures will be implemented as required. Rubbish will be collected and removed from the site. Appropriate erosion and sediment control measures will be utilised as required; and
- Following construction of the well lease, the disturbance area will be appropriately rehabilitated to meet landholder requirements. Rehabilitation will include native grasses that are representative of the existing vegetation composition of the study area.

3.3 Fauna Management

3.3.1 Overview

No canopy trees occur within the proposed chip hole area or along the access track. Furthermore, due to recent fire, the ground cover and shrub layer have been removed. This area is considered to provide minimal habitat resources for native fauna.

Mature Eucalypt trees with large hollows are common within the property. These hollows range from small to large in size and provide breeding habitat for numerous native birds, mammals and reptiles. The canopy species across the property are comprised of White Box, a listed Koala food tree species. Additionally, Koala scats were observed.
Large tracts of the study area are comprised of native grassland. While the groundcover is structurally simple, it is likely to provide habitat for generalist species, including foraging opportunities for native reptiles and birds.

### 3.3.2 Environmental Issues

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

### 3.3.3 Management Measures

The following fauna management measures to be implemented throughout the construction phase.

- Construction equipment and vehicles will be stored within designated work areas, and not within areas of adjacent habitat;
- All construction vehicles/machinery are to use the designated access tracks, and follow the speed limits; and
- No domestic pets (including dogs or cats) allowed on site during construction.

### 3.4 Aboriginal Cultural Heritage Management

#### 3.4.1 Environmental Issues

The subject site, including the lease pad and access tracks was inspected by Santos’ cultural heritage officer in July 2011. A due diligence investigation was carried out for the project area (**Appendix B of the REF**). This included a 10km x 10km search of the Office of Environment & Heritage’s (OEH’s) Aboriginal Heritage Information Management System (AHIMS) database. A total of 19 Aboriginal sites were identified, however none were identified within the vicinity of the proposed core hole location. The majority of sites recorded within a 10km radius of the project area were modified/scarred trees (63.19%). In addition, a review of environmental conditions, previous archaeological reports and a site inspection were carried out.

The site was inspected by Santos’ cultural heritage officer. No items of significance were identified, and no features likely to contain archaeological deposits were found.

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

#### 3.4.2 Management Measures

To limit any potential impact on any unknown Aboriginal sites or objects the following measures are recommended:
- Minimise impact to areas outside the area of operation through appropriate on site induction of all employees and contractors attending site;
- Vehicle access is to remain within existing tracks where possible in order to minimise potential impacts on surrounding vegetation and reduce erosion;
- Soil disturbance will be kept to a minimum;
- If works fall outside of the areas inspected for the purposes of the cultural heritage assessment or access routes are altered Santos are advised to have those areas investigated by a qualified archaeologist;
- If an Aboriginal object or site is identified at any point during the proposed works, all works in the vicinity must cease immediately. That area will be temporarily fenced with high visibility tape or barrier fencing in order to prevent further impact and a suitably qualified archaeologist contacted. Works in that location should not proceed until the site has been registered with the OEH and an appropriate course of action determined by the archaeologist. In most instances this would involve applying for an Aboriginal Heritage Impact Permit (AHIP) from OEH in consultation with the Aboriginal Community; and
- In the event that skeletal remains are uncovered, work must cease immediately in that area and the area fenced. Employees to complete the Santos Discovery of Cultural Heritage Site Form located on the Santos intranet. Santos should then contact the NSW Police and follow the advised procedure. If the skeletal remains are determined to be Aboriginal, Santos should then contact the OEH and relevant Aboriginal Community Stakeholders in order to determine an action plan for the management of the skeletal remains prior to works commencing.

3.5 European Cultural Heritage Management

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

3.5.1 Environmental Issues

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

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

3.5.2 Management Measures

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

3.6.1 Overview

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

The following is a list of the detailed works involved.

- The existing track will be top dressed with 100mm road base;
- Track is to be top dressed to allow wet weather access; and
- Two cattle ramps and two sets of double gates and end assemblies to be installed in two locations along the access track.

Approximately 300m$^2$ of additional access track will require construction for access to the chip hole lease.

3.6.2 Environmental Issues

The following environmental issues have been identified as key issues potentially arising from the construction of access tracks:

- Soil compaction, erosion and sediment release to land and water;
- Incursion of disease, weeds, vermin or destructive influences to the site;
- Temporary disruption to landholders; and
- Degradation of existing road infrastructure.

3.6.3 Management Measures

The following management measures will be implemented throughout the construction of access tracks:

- Topsoil will be removed prior to surface preparation and either stockpiled within designated work areas for respraying during restoration;
- During the creation of access tracks, erosion or sediment release will be controlled adequately; and
- Appropriate measures will be employed to prevent surface damage to public roads (e.g. limiting dirt track access during wet weather and protecting bitumen surfaces where tracked machinery is required to cross roads).

The following measures will be implemented throughout the construction phase to ensure access tracks are appropriately utilised:

- Access tracks will be speed limited to 20km/h; and
- Vehicle parking will be restricted to designated areas.
3.7 Grading

3.7.1 Overview

Re-grading is proposed along the access tracks, however widening is not required. Grading comprises the removal of topsoil and subsoil and is required where the soil conditions cannot accommodate construction activities.

3.7.2 Environmental Issues

The following issues have been identified as key issues potentially arising from grading:

- Soil erosion and sediment release;
- Soil mixing, compaction and topsoil loss; and
- Increased potential for the spread of weeds and pathogens.

3.7.3 Management Measures

The following management measures will be implemented throughout the construction phase:

- Graded soil will be stockpiled separately from other materials (e.g. vegetation), where it can be readily recovered for respreading and where it will not be lost through wind or water erosion or other means;
- Graded soil shall not be stockpiled where it has the potential to result in sedimentation or acidification of land; and
- Topsoil containment measures (e.g. berms and sediment fencing) will be used as necessary.

3.8 Waste Management

3.8.1 Overview

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

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

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

The following management measures will be implemented throughout the construction phase:

Solid Inert Wastes

Appropriate solid waste management measures will be applied during the construction phase, including:

- Encouraging suppliers to reduce and/or collect packaging;
- Stockpiling reusable and recyclable wastes, such as timber skids, pallets, drums, and scrap metals;
- Supplying designated collection bins at work sites for aluminium cans, glass and paper recycling;
- Collecting and transporting general refuse to local Municipal Council approved disposal sites; and
- Designated work areas will be maintained to an orderly and hygienic standard.

Liquid Inert Wastes

- Drilling muds will consist of approved water based products or synthetic lubricants, and will be contained within the fluid circulation system (i.e. drilling sumps, fluid pump system and drilling orifice) during drilling; and
- Drilling muds will be recycled for use where practicable, or disposed of in accordance with regulatory and requirements as set out in the REF.

Hazardous Wastes

Hazardous wastes are those which pose an immediate potential risk to human health and/or the environment, including cleaning chemicals, waste oils, and sewerage. Mitigation measures include:

- Managing hazardous wastes in accordance with all relevant regulatory requirements. Many hazardous wastes may also be declared as prescribed wastes under State or Territory legislation for which specific management requirements may be imposed (e.g. waste inventories, tracking systems and permitting);
- Sewage and sullage disposal via approved septic systems, mobile chemical treatment systems or alternatively disposed to municipal sewage treatment plants;
- All waste chemicals and other toxic materials will be stored and collected for safe transport off-site for reuse, recycling, treatment or disposal at locations approved by relevant regulatory authorities;
- Hydrocarbon wastes, including lube oils and oily sludges, will be collected for safe transport off-site for reuse, recycling, treatment or disposal at approved locations;
- Hazardous waste storage areas will be suitably designed to adequately contain any spills (e.g. bunded in accordance with statutory requirements); and
- Contaminated soils will be managed according to their concentration of contaminants, their leachability and the extent of area affected.
3.9  Erosion and Sediment Control

3.9.1  Overview

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

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

3.9.2  Environmental Issues

The following are considered to be the key environmental issues in relation to erosion and sediment control for the construction phase:

- Loss of topsoil and sub-soils;
- Siltation and sedimentation;
- Reduced potential for rehabilitation success; and
- Long term stability of disturbed areas.

3.9.3  Management Measures

The following erosion and sediment controls will be implemented throughout the construction phase:

- Any displaced soil gathered during operations to be stockpiled within the compound. This soil to be used as backfill at the conclusion of drilling operations.
- Upstream diversion bank to direct water around the area of disturbance;
- Maintain existing ground cover where possible;
- Stabilise entry/exit points to the work area or any high traffic areas;
- Install sediment fence at downstream limit of disturbance area;
- If filling of track is required, geotextile fabric will be used as a base so that all imported fill can be removed following completion of works;
- Store all drill cuttings within the area of disturbance contained by the sediment fence and use for backfilling at completion;
- Rehabilitate the disturbed area upon completion of required activities.
- Implement soil stockpile areas and install erosion control devices as per site layout plan (Figure 3.3 of the REF).
3.10 Noise Control

3.10.1 Overview

The site is located in an agricultural area and the existing noise levels are relatively low. There are no residential properties within 1km of the site.

The nearest residential dwelling is approximately just over 1km from the site to the north west. The closest community is Spring Ridge which is approximately 12km to the south of the site. Curlewis is approximately 18km to the north and Breeza is approximately 20km to the east of the site.

3.10.2 Environmental Issues

Noise will be generated by the construction of infrastructure for a duration of approximately 14 days, drilling over approximately 30 days and rehabilitation for 30 days. There will also be noise associated with the movement of trucks and cars associated with the works. The majority of noise will be associated with the operation of the drill rig.

3.10.3 Management Measures

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

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

3.11 Air Quality

3.11.1 Overview

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

3.11.2 Environmental Issues

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

- Vehicle movements to and from the sites;
- Upgrading of the access track and well lease; and
- Drilling of the chip hole.
The air emissions associated with the proposal will be dust and greenhouse gases.

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

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

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

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

- The operation of diesel fuelled vehicular traffic;
- Plant including the drilling rig; and
- Site power generation.

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

### 3.11.3 Management Measures

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

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

### 3.12 Weed Control

#### 3.12.1 Overview

The proposal has the potential to create favourable conditions for introduced weed species, which could potentially lead to an increase of existing weed populations. This is most likely to occur where soil disturbance is to occur.

#### 3.12.2 Environmental Issues

Key environmental issues associated with weed control include:

- The spread of weed species on and off site; and
Potential for unsustainable rehabilitation.

3.12.3 Management Measures

Weed management procedures will be implemented to prevent the spread of weeds both on and off site.

- Where vehicles and machinery are moving between the site and weed free areas, wash down procedures must be implemented.
- Weed monitoring will occur throughout the construction phase and weed removal will be carried out as necessary.
- All cleared weed species will be stockpiled separately, and removed off site. Weed material is not to be re-used as part of site rehabilitation; and
- Weed infestations identified by the supervising ecologist within and adjacent to access tracks and well leased will be eradicated by hand, with non-residual herbicide, or mechanical removal. Appropriate weed removal techniques are outlined in Table 3.1.

<table>
<thead>
<tr>
<th>Weed Type</th>
<th>Removal Technique</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woody Weeds</td>
<td>Cut and Paint</td>
<td>- Make a horizontal cut through the stem close to the ground using secateurs, loppers or a bush saw; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Immediately apply herbicide to the exposed flat stump surface.</td>
</tr>
<tr>
<td>Stem Injection</td>
<td></td>
<td>- At the base of the tree drill holes at a 45 degree angle into the sapwood;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Fill each hole with herbicide immediately; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Repeat the process at 5 cm intervals around the tree.</td>
</tr>
<tr>
<td>Frilling or Chipping</td>
<td></td>
<td>- At the base of the tree make a cut into the sapwood with a chisel or axe;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Fill each cut with herbicide immediately; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Repeat the process at 5 cm intervals around the tree.</td>
</tr>
</tbody>
</table>

Small Plants Hand removal

- Remove any seeds or fruits and carefully place into a bag;
- Grasp stem at ground level, rock plant backwards and forwards to loosen roots and pull out; and
- Tap the roots to dislodge any soil, replace disturbed soil and pat down.
<table>
<thead>
<tr>
<th>Weed Type</th>
<th>Removal Technique</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vines and Scramblers</td>
<td>Hand removal</td>
<td>- Take hold of one runner and pull towards yourself;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Check points of resistance where fibrous roots grow from the nodes;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Cut roots with a knife or dig out with a trowel and continue to follow the runner;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The major root systems need to be removed manually or scrape/cut and painted with herbicide; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Any reproductive parts need to be bagged.</td>
</tr>
<tr>
<td>Stem Scraping</td>
<td></td>
<td>- Scrape 15 to 30 cm of the stem with a knife to reach the layer below the bark/outer layer; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Immediately apply herbicide along the length of the scrape.</td>
</tr>
<tr>
<td>Weeds with Underground Reproductive Structures</td>
<td>Hand removal</td>
<td>- Remove and bag seeds or fruits;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Push a narrow trowel or knife into the ground beside the tap root, carefully loosen the soil and repeat this step around the taproot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Grasp the stem at ground level, rock plant backwards and forwards and gently pull removing the plant; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Tap the roots to dislodge soil, replace disturbed soil and pat down.</td>
</tr>
<tr>
<td>Crowning</td>
<td></td>
<td>- Remove and bag stems with seed or fruit;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Grasp the leaves or stems together so the base of the plant is visible;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Insert the knife or lever at an angle close to the crown;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Cut through all the roots around the crown; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Remove and bag the crown.</td>
</tr>
<tr>
<td>Stem Swiping</td>
<td></td>
<td>- Remove any seed or fruit and bag; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Using an herbicide applicator, swipe the stems/leaves.</td>
</tr>
</tbody>
</table>
3.13 Disease Control

3.13.1 Overview

Disease control is required due to the potential for particular plant / soil diseases to be spread, particularly *Phytophthora*. *Phytophthora* can be spread via unregulated exposure and movement of soils between areas of construction. Measures will therefore be implemented to avoid such disease facilitation from occurring.

3.13.2 Environmental Issues

The following are key environmental issues in relation to disease control:

- Damage to native vegetation possibly leading to death;
- Loss of biodiversity; and
- Poor regeneration.

3.13.3 Management Measures

- If machinery is transported from an area of confirmed infection to the site, stringent wash down must be completed before leaving the area, removing all soil and vegetative material from cabins, trays, and under carriages;
- Construction personnel will be trained adequately in pest management and hygiene procedures; and
- All machinery to be clean of foreign soil and propagative matter to avoid the importation of *Phytophthora*.

3.14 Bushfire Prevention

3.14.1 Overview

Bushfire prevention needs to be considered as there is the potential for bushfires to ignite as a result of the construction activities. This can occur as a result of vehicles operating in dry flammable areas, conducting construction activities, and as a result of equipment such as petrol-driven pumps and generators.

3.14.2 Environmental Issues

The following key environmental issues are associated with bushfires:

- Damage to, or loss of, flora, fauna and habitat;
- Impacts to primary industry production; and
- Damage to, or loss of, third party infrastructure.
3.14.3 Management Measures

The following measures will be implemented throughout the construction phase:

- Clearing all flammable material from around potential fire ignition sources;
- Ensuring flammable materials are cleared from the immediate vicinity of field equipment which may pose a potential fire hazard e.g. petrol driven pumps, generators;
- Maintenance and operation of all machinery so as to comply with relevant fire safety standards thus minimising fire risk; and
- Machinery and vehicles not in use will be parked in areas free of flammable material and vegetation (e.g. not parked over shrubs, tall grass or cleared vegetation residue).

Fire response preparation measures will be implemented throughout the construction phase, including:

- Storage of appropriate fire fighting equipment in accordance with the requirements of the relevant State Fire Protection Regulations. Equipment will be of the required standard and be inspected and well maintained throughout the construction phase;
- Equipping construction machinery and vehicles with fire fighting equipment at the appropriate times in accordance with the relevant Fire Protection Regulations; and
- Construction workforce bushfire education and training will be undertaken as appropriate detailing fire prevention and safety, personnel responsibilities and basic fire suppression.

3.15 Ground Water

3.15.1 Overview

Ground water contamination is not anticipated due to the proposed drilling and chip hole construction and abandonment methodologies.

3.15.2 Environmental Issues

Potential impacts on ground water may arise from the drilling process in mixed multi-aquifer systems that relate to the possibility of cross contamination of aquifers, the possibility of contamination of the aquifers by drilling muds/fluids and groundwater discharging to the surface, which might cause flooding or impact on surface water quality depending on the discharge and receiving water qualities. This will be prevented, as the proposed drilling and chip hole construction and abandonment methodologies eliminate the risk.

There is also the potential impact of seepage of drilling mud, drilling additives and/or hydrocarbons (oils/lubricants etc) to shallow groundwater beneath the rig and chip hole site. During the drilling of the three hole sections (shallow, intermediate and deep), the circulating drilling mud will establish a wall cake (low permeability “skin” around the wall of the hole) and also maintain a positive head (pressure) on the various aquifers intercepted (NB. there are no artesian pressures in the area).

Mitigation measures to minimise/negate the risk of impacts and to confirm that no impact has occurred are outlined below.
3.15.3 Management Measures

To minimise impacts on groundwater, the following mitigation measures are proposed.

There is negligible risk of cross contamination of aquifers or discharge of groundwater to the surface as a result of the proposed drilling, chip hole construction and abandonment methodologies. However, in order to confirm that no impacts have occurred, it is proposed that:

- Monitoring of private groundwater bores within a 2km radius (with landholder permission) be undertaken before drilling commences, to more clearly establish baseline conditions and then continue monitoring on a regular basis throughout the duration of all drilling activities. It is proposed that monitoring will include water level and water quality (electrical conductivity) observations.

In order to manage/prevent the risk of any seepage of drilling fluids to shallow groundwater, it is recommended that:

- The drilling sumps should be lined (with an appropriate impermeable material) and that all drilling fluids are completely removed from site prior to site rehabilitation.

The management of the risks associated with chemicals, hydrocarbons and any other hazardous substances are covered in the EMP Implementation of the EMP should minimize/negate risks of contamination of ground and surface water. In addition to the above, the natural existence of shallow subsurface alluvium (which contains relatively impermeable clays) will further minimize potential water quality risks associated with possible partial failure of these mitigation measures. These clays will tend to hold any contaminant in the near surface zone above the water table.

The management measures to control the handling and storage of chemical and hazardous substances and for spill prevention and response are identified in Section 3.17 Hazardous and Chemical Substances Management.

3.16 Surface water

3.16.1 Overview

PEL 1 is located in the Namoi catchment management area; however the subject site forms part of the Goran sub-catchment. The significant feature of this area is the Goran Lake which is a wetland, with a surface area of 590km².

3.16.2 Environmental Issues

There is potential for chemicals and fuels to come into contact with watercourses and therefore mitigation measures to minimise this risk are identified below. It is considered that the potential impacts associated with surface water can be appropriately managed if the mitigation measures presented below are implemented.
3.16.3 **Management Measures**

General measures to protect surface waters include:

- Contaminated waters to be contained and where necessary disposed of at an appropriate facility;
- Drilling fluids to be contained on site and not discharged to surrounding watercourses. Over-balanced drill techniques to be utilised to prevent formation fluid from rising through the well the surface;
- Excessive fluid losses to be cured by LCM (cellulose material such as sawdust) to ensure most fluids return to the surface;
- Sediment fences and traps to be installed so as to prevent soil loss or sedimentation;
- Fuel and lubricants to be stored on site only when necessary and maintained off site whenever possible;
- All areas storing or handling fuel, fuel using equipment, and chemicals to be bunded in accordance with Australian Standard AS1940:2004 The storage and handling of flammable and combustible liquids;
- The maintenance and cleaning of vehicles and other equipment or plant to be carried out in areas from where the resultant contaminants cannot be released into any waters;
- Wastewater removed from site to be managed by a contractor licensed to carry and handle water; and
- Where applicable maintenance of roads, drains, bund walls, contour and diversion banks to occur. All drainage structures will be maintained for the life of the development.

3.17 **Chemical and Hazardous Substances Management**

3.17.1 **Overview**

The drilling operations would generally only use chemicals such as drilling fluids/agents, fuels, and lubricants. While these substances are not considered highly hazardous, there is still the potential risk of fire and pollution to land, water and air if an accidental spillage was to occur.

3.17.2 **Management Measures**

The following measures will be implemented throughout the construction phase:

- Any storage of Flammable & Combustible Liquids shall be stored and handled in accordance with Australian Standards AS1940:2004; The storage and handling of flammable and combustible liquids;
- Disposal of all waste (including fuels, chemicals and LCM) off-site in accordance with relevant regulations;
- All plant operators and maintenance personnel shall be trained in spill response and be competent in the use of spill response kits and products;
- A spill response kit shall be kept at a central location to enable quick response in events of contaminant spills;
- Undertake regular maintenance of equipment and plant to prevent leaks and maintenance on site;
- Any planned maintenance on plant and equipment shall not be carried out on site, but rather at an approved offsite maintenance facility;
- Any unplanned maintenance shall only be undertaken on site if appropriate spill control measures are employed (i.e. drip trays, waste oil drums, general waste bins, spill response kit etc.);
- There shall be no storage of bulk fuels or lubricants at the site. Only minor quantities of fuels and lubricants shall be taken on site; and
- Minor quantities of fuels and lubricants will be stored on an appropriately sized bunded structure (or similar containment device) and not located within 20m of waterways, open drainage paths or drilling areas. The location shall be kept free of combustible vegetation or refuse for a distance of at least 3 m.
4.0 **Decommissioning**

Site decommissioning includes:

- Plugging and abandonment of the well; and
- Removal of equipment and imported materials; and
- Rehabilitation of the site.

4.1 **Well Plug & Abandonment**

The well will be cemented, plugged and abandoned in accordance with Department of Industry and Investment requirements, unless needed for further exploration testing. In the case of plug and abandonment, the casing would be removed (where required and practicable) and a steel identification plate installed near the top of the hole > 1 metres below the surface.

4.2 **Equipment Removal**

All equipment and imported materials will be removed off site under the following management procedures:

- All site equipment will be removed using existing access tracks to minimise weed spread and further disturbances;
- All fencing and erosion and sediment control devices will be pulled down and taken off site.
- All holes and drains will be backfilled to ground level, stockpiles to be levelled or removed off site; and
- All wastes removed off site and disposed off at the appropriate facility.

4.3 **Site Rehabilitation**

Once the drilling and testing activities are complete, the disturbed area is proposed to be rehabilitated. All rehabilitation works will be undertaken with maximum regard to environmental protection and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation in accordance with the relevant statutory requirements. Disturbed land will be rehabilitated to pre-operational quality or better, to minimise sediment erosion. During rehabilitation, diversion banks and ripping along the contour to be completed to prevent the concentration and momentum of water flow as required.

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

All areas of disturbance, including well leases and where access tracks have required widening, will be re-vegetated within 6 months of decommissioning. Rehabilitation will aim to:

- Ensure a stable landform is maintained;
- Remove site access tracks and changes in the landscape as a result of the Project; and
- Re-instate the site to a stable landform that is representative of the pre-clearing vegetation condition and composition, or better.

4.3.2 Species Schedule

The desired rehabilitation species have been identified in Table 4.1. These species are native grasses representative of the surrounding White Box / Yellow Box / Blakely’s Red Gum Grassy Woodland community, and are consistent with the species currently present within the grazing lands. These species should be added to a hydro mulch mix and sprayed over the well lease area.

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aristida ramosa</td>
<td>Purple Wiregrass</td>
<td>Seed</td>
</tr>
<tr>
<td>Austrostipa scabra subsp. scabra</td>
<td>Speargrass</td>
<td>Seed</td>
</tr>
<tr>
<td>Austrostipa verticillata</td>
<td>Slender Bamboo Grass</td>
<td>Seed</td>
</tr>
</tbody>
</table>

4.3.3 Rehabilitation Performance Criteria, Monitoring and Actions

To determine the success of rehabilitation efforts a number of performance criteria for the site have been developed in Table 4.2. This table also identifies rehabilitation actions to be implemented and monitoring requirements to evaluate rehabilitation success.
### Table 4.2 Rehabilitation Management Schedule

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Success verification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 months following rehab</td>
</tr>
<tr>
<td>1. Evidence of ground cover (ground cover includes mulch, plants and habitat features)</td>
<td>≤70% ground cover</td>
</tr>
<tr>
<td>2. Plants showing healthy growth and signs of recruitment</td>
<td>Evidence of growth</td>
</tr>
<tr>
<td>3. Correct species used</td>
<td>Evidence of native species generation</td>
</tr>
<tr>
<td>4. Minimal presence of declared pest plants</td>
<td>≤30% declared weed cover</td>
</tr>
</tbody>
</table>

#### Timing

**Upon Decommissioning**
- Erosion and sediment control measures are implemented to reduce runoff and disturbances prior to rehabilitation.
- Control weeds present on site

**Within 6 months of decommissioning**
- Control weeds present on site
- Rip soil to ensure no compaction where required. Ensure rip lines are spaced >1m apart to prevent soil mass movement
- Respread topsoil
- Spray and maintain hydromulch as per revegetation contractors requirements
- Where widening has been required, the track will be progressively removed
- Ensure erosion and sediment control measures are implemented as required

#### Monitoring Tasks

**60 days since rehabilitation**
- Survey undertaken by ecologist to verify 60 day performance criteria. Surveys to document rehabilitation
## Rehabilitation Management Schedule

<table>
<thead>
<tr>
<th>Timing</th>
<th>Corrective Procedures</th>
<th>Responsibility</th>
</tr>
</thead>
</table>
| 1 year since rehabilitation   | • Survey undertaken by ecologist to verify 1 year performance criteria. Surveys to document rehabilitation success with site data and photo monitoring.  
• Review rehabilitation success and investigate areas that have been unsuccessful | Santos & Ecologist     |
| Timing                        | Reporting                                                                             | Responsibility         |
| Following each monitoring event or as required by site approval. | • Report identifying results of monitoring events with assessment against each performance criteria. | Santos & Ecologist     |
5.0 Reporting

One final report is required for the project. This report will discuss the sites construction and decommissioning activities as well as rehabilitation success. The report is to include an assessment of compliance with statutory authorities, success in achieving objectives, and any environmental outcomes. The report will be completed within 6 months of decommissioning, and kept by Santos QNT Pty Ltd.
Appendix F

Lake Goran Flood Levels

prepared by Aquaterra
Dear Ms Lewis,

RE: LAKE GORAN FLOOD LEVELS

This letter confirms that RPS Aquaterra recently (July, 2011) investigated the historical variations in surface elevations of Lake Goran. The investigation was carried out with a view to understanding the water levels reached during large floods and the likelihood of such events occurring.

The assessment was based on information received from:

- NSW Office of Water (NOW);
- Inland Flood Unit, Office of Environment and Heritage in Tamworth; and
- Bureau of Meteorology;
- A review of work conducted by other consultants (Most relevant is: Bewsher Consulting, 1995, Hydrological Study of Lake Goran, prepared for Department of Water Resources)

The most relevant information included rainfall records from Gunnedah (1881 to 2010) and measured lake levels (1974 to 2005).

The dimensions of the lake as well as graphical plots of simulated lake levels for the period 1881 to 1992 were obtained from the above report by Bewsher (1995). Monitoring conducted subsequent to the Bewsher report has provided a further thirteen years of lake level information (till 2005) and an additional 18 years of rainfall information (till 2010). These records were processed and included in statistical analyses as part of our investigation.

Some of the main features of the lake and key findings of our study and reviews are as follows:

- The Bewsher Report described the lake as having a surface area of 8,800 Ha and a volume of 123 GL;
- The area surrounding the lake is generally low lying and forms part of the Liverpool Plains. The water level and the surface area of the lake vary considerably in response to rainfall and catchment runoff as a result of very gentle topographical gradients. When full, large volumes of water are needed to obtain small increments in water levels and the accompanying increase in surface area is substantial;
- The nominal full supply level of the lake is 296.4 m AHD according to the Bewsher report;
- The probability of the lake spilling is about 14% based on the period of measured lake levels (1974 to 2005);
- The highest recorded lake level during the period of monitoring is 296.79 m AHD. The probability of occurrence of this event is 2%, based on the period of lake level monitoring; and
- The highest observed lake level within the 112 years of simulated results presented in the Bewsher Report was about 296.85 m AHD in 1890. The probability of this occurring as deduced from the occurrence of rainfall amounts between 1880 and 2010 is about 0.5% or 1:200 years.
Should you require further information please feel free to contact the undersigned.

Yours sincerely
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