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Santos NSW (Eastern) Pty Ltd

Narrabri Gas Project

Preliminary Environmental Assessment

March 2014

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Executive summary

Santos NSW (Eastern) Pty Ltd (Santos) is proposing to develop natural gas from coal seams in the Gunnedah Basin in New South Wales (NSW), southwest of Narrabri. The primary objective of the Narrabri Gas Project (the proposed development, or project) is to commercialise natural gas from coal seams for the East Australian gas market to support the energy security needs of NSW. The project is considered State significant development assessable under Division 4.1 of Part 4 of the NSW *Environmental, Planning and Assessment Act 1979* (EP&A Act).

The proposed development seeks to develop a gas field with production and appraisal wells, gas and water gathering systems and supporting infrastructure southwest of Narrabri, NSW. The natural gas produced would be treated to a commercial quality at a central gas processing facility at a rural property owned by Santos located southwest of Narrabri.

The estimated $2 billion dollar project is forecast to create approximately 1,200 jobs during the construction phase and sustain approximately 200 jobs during the operational phase. The proposed development would contribute to the NSW economy, including the regional economies, via the direct supply chain and also through the creation of indirect job opportunities. Importantly, the project has the potential to supply approximately 50% of NSW's gas requirements which is significant given the impending expiration of existing interstate gas contracts.

Production of natural gas from coal seams at the Narrabri Gas Project would deliver material economic, environmental and social benefits to the Narrabri region. The key benefits of the proposed development can be summarised as:

- Development of a new source of gas supply into NSW would lead to an improvement in energy security and independence to the State. This would give NSW gas markets greater choice when entering into gas purchase arrangements. Potential would also exist for improved competition on price. Improved competition on price would have flow on benefits for NSW's economic efficiency, productivity and prosperity.
- The provision of a reduced greenhouse gas emission fuel source for power generation in NSW as compared to coal-fired power generation.
- Increased local production and regional economic development through employment and service.
- The establishment of a regional community benefit fund equivalent to 5% of the royalty payment made to the NSW Government within the future production licence area. When matched by the NSW Government, the fund could reach $160 million over the next two decades.

The total project area is approximately 98,000 hectares in size, however, surface infrastructure would directly impact approximately one percent of the total project area. The majority of the proposed development is located within an area known as the 'Pilliga', with the remainder of the proposed development (approximately 30%) located on agricultural land supporting dry-land cropping and pastoral (livestock) activities. It is important to note that none of the agricultural land has been mapped as prime 'biophysical strategic agricultural land' under recent NSW Government coal seam gas legislative amendments.

The collective term 'Pilliga' represents an agglomeration of forested area that totals in excess of 500,000 hectares within north-western NSW around Coonabarabran, Baradine and Narrabri. Within the Pilliga the project would be developed primarily within State Forest, and also on some privately

managed land, but will avoid conservation areas such as the Pilliga National Park, the Pilliga State Conservation Area and the Pilliga Nature Reserve.

The location of the proposed development has been selected as:

- It is greater than 2 kilometres from residential zones or identified future residential growth areas and does not impact on any Critical Industry Clusters (CICs) as defined in the *State Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007* (the Mining SEPP).
- It is consistent with government policy and targets an area that has been identified within the Strategic Regional Land Use Plans and the *Brigalow and Nandewar Community Conservation Area Act 2005* (NSW) as suitable for development of natural gas from coal seams.
- Exploration and appraisal has taken place in the project area within Petroleum Exploration Licence (PEL) 238 and Petroleum Assessment Lease (PAL) 2 to enable an estimation of the recoverable gas resources available in the area to underpin a gas development. The same level of exploration and appraisal has not been undertaken by Santos in other PELs, and hence, there is not the same level of confidence in the recoverable resources in those areas. As a result, the lead time required to produce gas from those areas would be substantially longer.

Santos has been completing baseline environmental studies and undertaking stakeholder consultation in the project area for several years, thereby generating a significant body of scientific and social data. This data would be used to guide the gas field development and to minimise the negative environmental and social impacts of the project through the strategic location of project infrastructure, while maximising community benefit from the proposed development.

A preliminary environmental assessment was completed and is reported herein that helps inform Santos' request for Director-General's Requirements for use in the preparation of an Environmental Impact Statement (EIS) for the proposed gas field.

Key potential environmental risks include: ecological impact, surface water impact and management, groundwater, aboriginal heritage impact, air quality impact, waste management and disposal, hazards and risk management, property and land use impact, agricultural impact, economics, contaminated land risk, decommissioning and rehabilitation, social, community and health impacts, and soil and land suitability impacts. Additional detail on these key potential impacts is detailed in Section 5 of this document. Environmental impacts are most likely to occur during construction when land is being cleared, or during drilling when aquifers are intercepted. During gas field operation, any impacts would mostly relate to groundwater, noise and emissions. These potential impacts would become the focus of the Environmental Impact Statement (EIS), with appropriate mitigation measures developed.

This report provides a broad description of the proposed development, reviews the applicable legislative framework, and identifies potential environmental and social issues associated with construction and operation of the proposed development. These environmental issues would be further investigated in detail in the EIS. This report supports Santos' request for Director-General's Requirements to be used to prepare an EIS for the Narrabri Gas Project under Division 4.1 of Part 4 of the EP&A Act for consideration of the NSW Minister for Planning.

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Acronyms and abbreviations

Term	Definition
ABARE	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
AEMO	Australian Energy Market Operator
AHIMS	Aboriginal Heritage Information Management System
APIA	Australian Pipeline Industry Association
AS	Australian Standard
BSAL	Biophysical Strategic Agricultural Land
CECs	Critically Endangered Communities
CH_4	Methane
CIC	Critical Industry Cluster
CMA	Catchment Management Authority
CO	Carbon Monoxide
CO_2	Carbon Dioxide
Coolah LEP	*Coolah Local Environmental Plan 2000*
Coonabarabran LEP	*Coonabarabran Local Environmental Plan 1990*
CSIRO	Commonwealth Scientific and Industrial Research Organisation
dBA	Decibels (A-weighted)
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DoP	(Then) NSW Department of Planning (now Planning and Infrastructure)
DPI	(Then) NSW Department of Planning and Infrastructure (now Planning and Infrastructure)
DRE	Division of Resources and Energy (within the NSW Department of Trade and Investment, Regional and Infrastructure Services
DTIRIS	NSW Department of Trade and Investment, Regional and Infrastructure Services
EECs	Endangered Ecological Communities
EIS	Environmental Impact Statement
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPA	Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
ESG	Eastern Star Gas Limited
FM Act	NSW *Fisheries Management Act 1994*
GHG	Greenhouse Gas
Gunnedah LEP	*Gunnedah Local Environmental Plan 2012*
ICOMOS	Australia International Council on Monuments and Sites
Infrastructure SEPP	NSW *State Environmental Planning Policy (Infrastructure) 2007*
LALC	Local Aboriginal Land Council
Landholder	Freehold, State or Crown land
LEP	Local Environmental Plan
LGA	Local Government Area
Mining SEPP	NSW *State Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007*

Term	Definition
ML	Megalitre
NHMRC	National Health and Medical Research Council
MNES	Matters of National Environmental Significance
Narrabri LEP	*Narrabri Local Environmental Plan 2012*
NO_x	Nitrogen Oxides
NPW	NSW *National Parks and Wildlife Act 1974*
NSW	New South Wales
NSW Office of Water	A division within the NSW Department of Primary Industries
PAL	Petroleum Assessment Lease
PEL	Petroleum Exploration License
PEA	Preliminary Environmental Assessment
Petroleum Act	NSW *Petroleum (Onshore) Act 1991*
Pipelines Act	NSW *Pipelines Act 1967*
PJ	Petajoules
POEO Act	NSW *Protection of the Environment Operations Act 1997*
PPEOP	Petroleum Production Environment Operations Plan
PPL	Petroleum Production Lease
REF	Review of Environmental Factors
Roads Act	NSW *Roads Act 1993*
RBLs	Rating Background Levels
RFS	Rural Fire Service
RMS	NSW Roads and Maritime Services
Santos	Santos NSW (Eastern) Pty Ltd
SEPP	State Environmental Planning Policy
SO_2	Sulphur Dioxide
State and Regional Development SEPP	*State Environmental Planning Policy (State and Regional Development) 2011*
SQAD	Santos Quality Asset Development
SRLUP	Strategic Regional Land Use Policy
TJ	Terajoules
TSC Act	NSW *Threatened Species Conservation Act 1995*
VOC	Volatile organic compound
WAL	Water Access Licence
WARR Act	NSW *Waste Avoidance and Resource Recovery Act 2001*
WM Act	NSW *Water Management Act 2000*

1. Introduction

1.1 Overview

Santos NSW (Eastern) Pty Ltd (Santos) is proposing to develop natural gas from coal seams in the Gunnedah Basin in New South Wales (NSW), southwest of Narrabri. The primary objective of the Narrabri Gas Project (the proposed development, or the project) is to commercialise natural gas from coal seams for the East Australian gas market and to support the energy security needs of NSW.

The proposed development seeks to develop gas wells, gas and water gathering systems, and supporting infrastructure southwest of Narrabri. The natural gas produced would be treated to a commercial quality at a central gas processing facility on a rural property located southwest of Narrabri (the Leewood property). The gas would then be piped via a high-pressure gas transmission pipeline to market. The gas transmission pipeline would be part of a separate approvals process and is not part of the proposed development.

The proposed development would include construction and operation of a range of exploration and production activities and infrastructure including:

- Exploration and appraisal - Seismic testing, chip holes, core holes and appraisal wells.
- Gas field - Drilling of production wells, monitoring bores, gas and water gathering systems and in-field compression.
- A central gas processing facility for the dehydration, compression and treatment of the gas to commercial quality.
- Water management, treatment and beneficial reuse facilities.
- Supporting infrastructure such as power generation and distribution and operational management facilities.

Santos currently has no plans to use hydraulic fracture stimulation in the project area. Geological data indicates it would not increase gas flows in the coal seams that are being targeted. Santos is not seeking approval to use hydraulic fracture stimulation for the proposed development. If additional geologic data supported the use of the technology in the future, a range of additional Government approvals would be required and community consultation would be undertaken.

The estimated $2 billion dollar project is forecast to create approximately 1,200 jobs during the construction phase and sustain approximately 200 jobs during the operational phase. The proposed development would contribute to the NSW economy, including the regional economies of NSW, via the direct supply chain, in addition to the creation indirect job opportunities. This project has the potential to supply approximately 50% of NSW's gas requirements which is significant given the impending expiration of existing interstate gas contracts.

1.2 Project area

The project would be located within part of Petroleum Exploration Licence (PEL) 238, Petroleum Assessment Lease (PAL) 2, and Petroleum Production Lease (PPL) 3, all of which are located to the south and west of Narrabri (refer to Figure 1). It is proposed to create four PPLs within the project area by converting all of PAL 2 to a PPL and creating three additional PPLs to the north, east and south of PAL 2. These PPLs would each be less than four graticular blocks; the maximum allowable area for a PPL. An application is currently under preparation.

The total project area is approximately 98,000 hectares in size, however, surface infrastructure would directly impact approximately one percent of the total project area. The majority of the proposed development is located within an area known as the 'Pilliga', with the remainder of the proposed development (approximately 30%) located on agricultural land supporting dry-land cropping and pastoral (livestock) activities. It is important to note that none of the agricultural land has been mapped as prime 'biophysical strategic agricultural land' under recent NSW Government coal seam gas legislative amendments (refer to Section 4).

The collective term 'Pilliga' represents an agglomeration of forested area that totals in excess of 500,000 hectares within north-western NSW around Coonabarabran, Baradine and Narrabri. Nearly half of the Pilliga is currently allocated to conservation, and is managed under the NSW *National Parks and Wildlife Act 1974*. Within the Pilliga the project would be developed primarily within State Forest, and also on some privately managed land, but would avoid conservation areas such as the Pilliga National Park, the Pilliga State Conservation Area and the Pilliga Nature Reserve. The Brigalow Park Nature Reserve is also excluded from the project area. Whilst the Brigalow State Conservation Area is within the project area, surface infrastructure (and a buffer of at least 50 metres surrounding the State Conservation Area) would also be excluded.

Resource exploration has been occurring in the area since the 1960s initially for oil but more recently coal and gas. A number of existing exploration and production wells are located within PEL 238, PAL 2 and PPL 3. These are in varying stages with some active, some suspended and others abandoned and rehabilitated, or awaiting rehabilitation.

While the semi-arid climate and unsuitability of the soils for agriculture have combined to protect the Pilliga from widespread clearing for agriculture, the Pilliga has hosted commercial timber harvesting for more than a century. This was preceded by unsuccessful attempts in the mid-1800s to establish a wool production industry. A combination of forestry and related activities, pests, drought and wildfire have impacted the ecology of the Pilliga, including habitat fragmentation by the development of more than 5,000 kilometres of existing roads, tracks and trails.

As discussed above, the proposed development would be located within a number of petroleum exploration licence and lease areas (PEL 238, PAL 2 and PPL 3). PEL 238 covers an area of approximately 7,915 square kilometres in the Narrabri Local Government Area (LGA) (refer to Figure 1). To date, two exploration and appraisal pilots have been drilled within PEL 238. These two pilots target the Early Permian Maules Creek Formation and the Late Permian Hoskissons coal seams. The proposed development is located in the eastern half of PEL 238 and constitutes approximately 12% of the total area of PEL 238.

MOEMA NATIONAL PARK
MOUNT KAPUTAR NATIONAL PARK
BOBBIWAA STATE CONSERVATION AREA
KILLARNEY STATE CONSERVATION AREA
KAMILAROI HIGHWAY
NEWELL HIGHWAY
PIAN CREEK
WEE WAA
NARRABRI
PEL 238
PPL 3
BRIGALOW PARK NATURE RESERVE
JACKS CREEK STATE FOREST
PEL 238
KAMILAROI HIGHWAY
PILLIGA NATIONAL PARK
PILLIGA STATE CONSERVATION AREA
BIBBLEWINDI STATE FOREST
PAL 2
PILLIGA EAST STATE FOREST
BARADINE CREEK
EULIGAL STATE FOREST
BOGGABRI
NEWELL HIGHWAY
PILLIGA EAST STATE CONSERVATION AREA
WILLALA ABORIGINAL AREA
MERRIWINDI STATE CONSERVATION AREA
PEL 238
TIMALLALLIE NATIONAL PARK
PILLIGA NATURE RESERVE
PEL 238
KERRINGLE STATE FOREST
BARADINE
TERIDGERIE CREEK
YARRAGIN NATIONAL PARK
GARRAWILLA NATIONAL PARK
OXLEY HIGHWAY
WARRUMBUNGLE NATIONAL PARK
COONABARABRAN
TINKRAMEANAH NATIONAL PARK

LEGEND

- Project area
- Petroleum licences and leases
- Leewood property
- Existing and proposed coal mining
- Regional parks and reserves
- Aboriginal area
- State forest
- Built up area
- Lakes and dams
- Waterways
- Roads
- Railways

0 5 10 20
Kilometres

Horizontal Datum: GDA 1994
Grid: GCS GDA 1994

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GHD

Narrabri Gas Project - Gas Field
Preliminary Environmental Assessment

Job Number 21-22463
Revision 0
Date 27 Feb 2014

Project area

Figure 1

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: NSW Department of Lands: DTDB and DCDB - 2012. Created by: Bahambly

PAL 2 is contained entirely within PEL 238 and covers an area of approximately 264 square kilometres. PAL 2 was obtained by Eastern Star Gas in 2007 in order to facilitate the economic and technical assessment of natural gas within the coal seams. Four exploration and appraisal pilots have been drilled within PAL 2, targeting coal seams in the Early Permian Maules Creek Formation.

PPL 3 was granted in 2003 under the operatorship of Eastern Star Gas. It is also contained entirely within PEL 238, and covers an area of approximately 24 square kilometres.

A PPL would need to be obtained under the *Petroleum (Onshore) Act 1991 (NSW)* for the proposed development prior to construction and operations commencing. Development consent under the State Significant Development provisions of the *Environmental Planning and Assessment Act 1979* (EP&A Act) is required to be obtained before the PPL can be granted (refer to Section 4).

1.3 The proponent

On behalf of the tenement holders of PEL 238, PAL 2 and PPL3, Santos NSW (Eastern) Pty Ltd, as the operator, is the proponent for the proposed development. The proponent is a wholly owned subsidiary of Santos Limited. Santos Limited is an Australian petroleum company established in 1954, which has been supplying natural gas to NSW since 1976. Santos Limited and its subsidiary companies have been involved in developing natural gas from coal seams in Queensland for 20 years and commenced exploring for natural gas from coal seams in the north-west of NSW in 2008.

In November 2011, Santos Limited acquired Eastern Star Gas and its subsidiary Eastern Star Gas Eastern Pty Ltd (ESG) who was the operator of PEL 238, PAL 2 and PPL 3. Santos NSW (Eastern) Pty Ltd (the proponent), then became the operator of the ESG tenements.

The project will be delivered in conjunction with the joint venture partners EnergyAustralia and Santos NSW (Eastern) Pty Ltd as the tenement holders. EnergyAustralia is an electricity generation, and electricity and gas retailing private company in Australia that is owned by the Hong Kong-based, listed CLP Group.

1.4 Indicative program

Subject to obtaining all the required regulatory approvals, construction of the proposed development is expected to commence in mid-2015, with first gas scheduled for as early as late 2017. Mobilisation and construction of the gas processing facility and water treatment facility would occur for two years between approximately 2016 and 2017, with wells progressively drilled from mid-2015 over the life of the development.

1.5 Purpose and structure of this report

1.5.1 Purpose

The proposed development will require approval from the NSW Minister for Planning and Infrastructure. This report will be used by key NSW Government stakeholders to provide background information to support a request for Director-General's Requirements to prepare an Environmental Impact Statement (EIS) for the proposed development. As such, this report provides a broad description of the proposed development, reviews the applicable legislative framework, identifies the potential environmental and social issues associated with construction and operation of the proposed development, and proposes additional assessment strategies for use during the EIS process.

1.5.2 Structure

The report is structured as follows:

- **Chapter 1 – Introduction.** This chapter introduces the proposed development and the proponent and describes the project area.
- **Chapter 2 – The proposed development.** This chapter provides a summary description of the proposed development.
- **Chapter 3 – Justification.** This chapter describes the strategic context of the proposed development and presents the needs for, and benefits of, the proposed development.
- **Chapter 4 – Legislative context.** This chapter examines the relevant Commonwealth and State legislation relating to the proposed development. Relevant licences, approvals and permits required for the proposed development to proceed are also identified.
- **Chapter 5 – Preliminary environmental assessment.** This chapter examines the potential environmental impacts and benefits associated with the construction and operation of the proposed development.
- **Chapter 6 – Consultation.** This chapter outlines the consultation activities to date and the proposed approach to consultation that would be undertaken during the preparation of the EIS.
- **Chapter 7 – Conclusion and next steps.** This chapter presents a conclusion to the report and presents the next steps in the advancement of the proposed development.

The references provide a list of materials cited in the report and the appendices contain additional information related to the report. Appendix A provides additional information on the listed Commonwealth and State ecological species that were identified from public databases during the preparation of this document.

2. The proposed development

2.1 Introduction

The proposed development would include the undertaking, construction and operation of a range of exploration and production activities and infrastructure including:

- Exploration and appraisal activities including approximately 30 coreholes, approximately ten chip holes and approximately ten sets of four-well pilots.
- Installation and operation of up to 850 individual production wells from a maximum of 425 well sets (refer Section 2.4). A single well may be vertical or lateral; the latter may include several horizontal connections sometimes referred to as a multi-lateral. The target production peak rate is approximately 200 terajoules (TJ) per day.
- Gas and water gathering systems and in-field compression.
- A central gas processing facility for the compression, dehydration and treatment of the gas to commercial quality.
- Water management, treatment and beneficial reuse facilities.
- Supporting infrastructure such as power generation and distribution, communications, roads and operational management facilities.

2.2 Project infrastructure under separate approvals

Separate approvals have either been granted or are currently being sought for natural gas from coal seam exploration and appraisal activities and the construction and operation of supporting infrastructure around Narrabri. Infrastructure constructed as part of these activities may also be utilised for the proposed development. Table 1 and Figure 2 detail existing approvals and applications for the current exploration and appraisal program and whether it is proposed to apply to use these facilities for production and further exploration and appraisal as part of the development application for the Narrabri Gas Project.

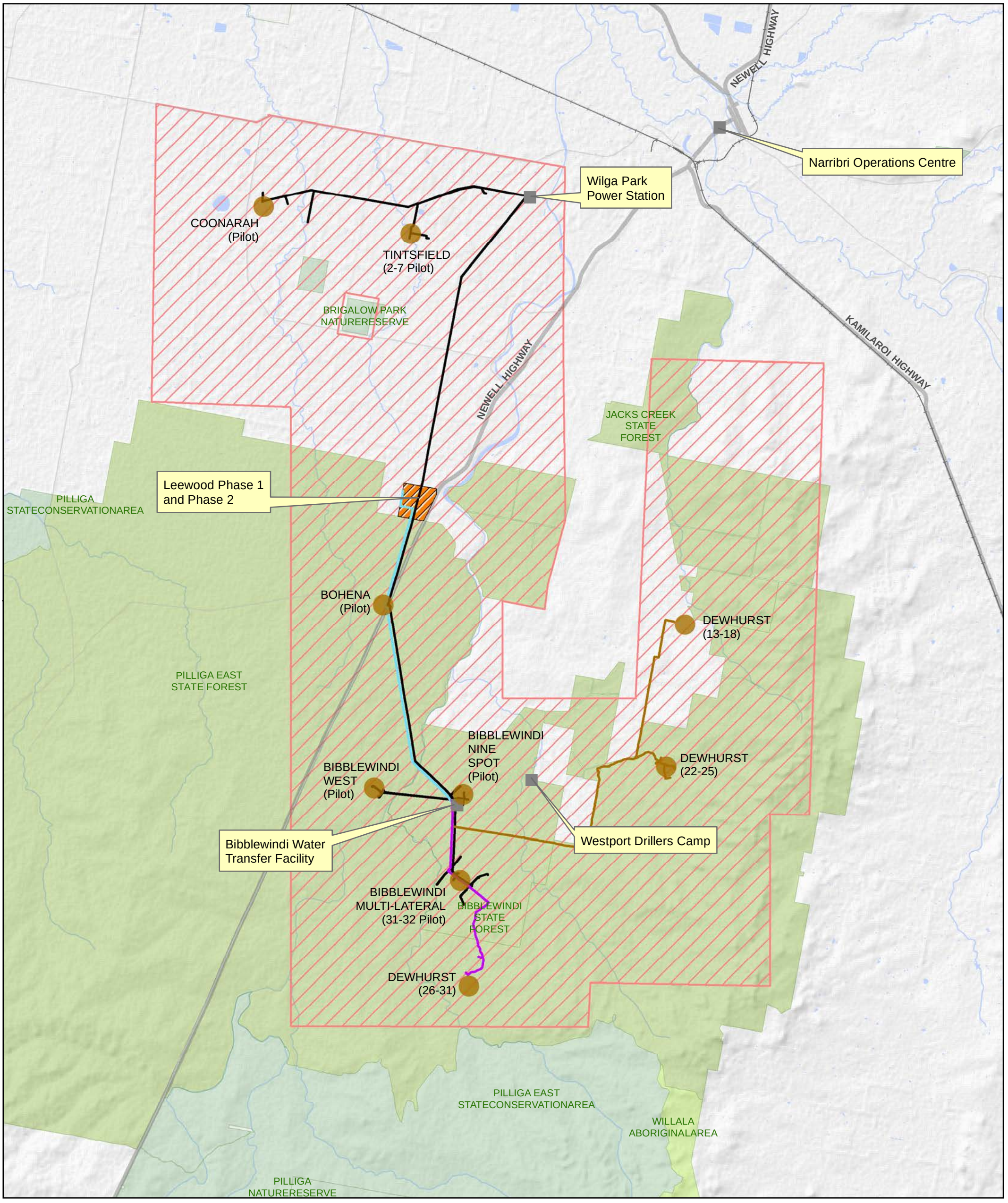
Section 2.4 provides further detail on the nature of the infrastructure and activities being sought under this approval.

During the proposed development approval process, Santos will continue with ongoing exploration and appraisal works to further define the ongoing Narrabri Gas Project feasibility in accordance with the existing approvals or approvals which may be granted for existing applications. The ongoing exploration and appraisal works may also include additional, as yet not applied for, exploration and appraisal works such as additional core holes, pilots and treatment infrastructure. Santos would apply for approval for these exploration and appraisal works through the approval and assessment processes under the petroleum tenements and the EP&A Act. These works are at a much smaller scale than the proposed development but are critical to progressing development of knowledge of the gas resource in a timely fashion.

Table 1 Current Santos approvals and applications for exploration and appraisal activities within PEL 238, PAL 2 and PPL 3

Project	Utilised during operation of the proposed development
Narrabri Operations Centre including offices and the Drilling Fluids Treatment Facility approved by Narrabri Council October 2013.	Yes.
Two additional wells at the existing Bibblewindi multi-lateral pilot (31-32) for which an EIS was submitted to the then NSW Department of Planning and Infrastructure (DPI) on 13 September 2013.	Possibly. The Bibblewindi 31-32 application seeks approval for the pilot wells to be operated for a period of up to three years. Any proposal to convert the pilot wells to production wells would be included the development application for the Narrabri Gas Project
The Dewhurst pilot expansion for which an EIS is being prepared following receipt of Director-General's Requirements on 22 July 2013. This involves re-drilling additional laterals from the existing Dewhurst 13-18 wells, and drilling and operation of two additional wells at Dewhurst 26-31. EIS submitted 30 October 2013.	Possibly. The Dewhurst application seeks approval for the pilot wells to be operated for a period of up to three years. Any proposal to convert the pilot wells to production wells would be included the development application for the Narrabri Gas Project
The Dewhurst 22-25 pilot which involves drilling four appraisal wells, converting an existing core hole to an appraisal well and operating the pilot set for which a Review of Environmental Factors (REF) was approved on 16 August 2013.	Possibly. The Dewhurst approval conditions state that the appraisal and pilot set may be operated for a period of up to three years. Any proposal to convert the appraisal and pilot wells to production wells would be included in the development application for the Narrabri Gas Project.
The Dewhurst 26-29 pilot which involves drilling and operation of four appraisal wells for which a Review of Environmental Factors (REF) was approved on 16 August 2013.	Possibly. The Dewhurst approval conditions state that the well set may be operated for a period of up to three years. Any proposal to convert the approved wells to production wells would be included in the development application for the Narrabri Gas Project.
Tintsfield 2-7 pilot for which a supplementary REF to construct a flare was approved on 25 October 2013.	Possibly. The Tintsfield approval conditions state that the well set may be operated for a period of up to three years. Any proposal to convert the approved wells to production wells or to use the Tintsfield ponds for storage would be included in the development application for the Narrabri Gas Project
The Dewhurst Northern flow lines for which approval was received on 18 September 2013.	Likely. The existing approval excludes gas flow which would be included in the development application for the Narrabri Gas Project.
The Dewhurst Southern flow lines for which approval was received on 18 September 2013.	Likely. The existing approval excludes gas flow which would be included in the development application for the Narrabri Gas Project.
Westport driller's camp for which development consent was issued on 19 December 2012. The camp is located approximately 30 kilometres south west of Narrabri. The camp can accommodate between 24 and 64 persons.	Likely for construction and operation.

Project	Utilised during operation of the proposed development
Leewood Phase 1 which includes the construction and operation of a 300 ML brine pond, a 300 ML produced water pond, a 16 kilometre flow line from the Bibblewindi facility, and associated infrastructure for which approval was received on 19 March 2013.	Yes. The use of these facilities for production purposes will be included in the development application. The facilities will require augmentation for the Narrabri Gas Project which would also be included in the development application.
Leewood Phase 2 which includes capacity to process and beneficially reuse produced water from exploration and appraisal activities. An environmental assessment is currently being prepared for this facility.	Likely. The use of these facilities for production purposes will be included in the development application. The facilities would require augmentation which will be included in the development application.
Bibblewindi west pilot includes the drilling and operation of five wells, Bibblewindi 22-26. Bibblewindi West was approved in April 2009.	Possibly.
Bibblewindi nine spot pilot includes Bibblewindi 1 to 9 and were approved in January 2006.	Possibly.
Any additional, not yet approved, exploration and appraisal activities within the project area over the coming two to three years that is not included as part of this application.	Possibly. The use of these facilities for production purposes will be included in the development application for the Narrabri Gas Project.
Coonarah pilot gas field as approved in November 2002 with the pilot expanded with additional wells in March 2005.	Unlikely.
Bohena pilot included Bohena 3, 7 and 9 were approved between July 1998 and June 2004.	Unlikely.



LEGEND

- Project area
- Leewood property
- Regional parks and reserves
- Aboriginal area
- Lakes and dams
- Waterways
- Roads
- Railways
- Dewhurst Northern flow lines
- Dewhurst Sorthern flow lines
- Leewood Phase 1 flow line
- Existing pipeline
- Well locations

0 2 4 8

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA94 / MGA zone 55

N

Narrabri Gas Project - Gas Field
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Date	18 Feb 2014

Existing exploration infrastructure

Figure 2

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: NSW Department of Lands: DTDB and DCDB - 2012. Created by: Bahambly

2.3 Gas field life cycle

Gas resources are geographically extensive and variable in quality and quantity. This requires widespread project infrastructure which is progressively developed over the life of a project. Gas field development is a coordinated program over time that determines the best locations for all project components, including for example, pilot wells, production wells, gathering lines, transmission pipelines, gas compression and treatment facilities, ground and surface water monitoring, water management facilities and associated infrastructure.

A summary of the life cycle of a gas field is as follows:

- Exploration. This broadly involves undertaking seismic surveys, drilling core holes and collecting baseline scientific data.
- Appraisal. The drilling of pilot wells to gain knowledge of the gas content and composition, to inform gas field design.
- Construction. Building components of the gas field, including drilling wells and in field compression, the gas processing facility and the water treatment facility.
- Operations. Extracting water and gas, compressing gas to commercial quality and treatment and beneficial reuse of the water.
- Well decommissioning and rehabilitation. Once wells are no longer economically producing gas, they are plugged and abandoned and the lease pad rehabilitated.
- Gas Project decommissioning and rehabilitation. Once the gas field is no longer commercial, equipment is decommissioned, and the site is rehabilitated.

To produce natural gas from coal seams, water must first be extracted from those seams. This release of pressure allows the natural gas to flow to the surface via the well. After the water and gas are extracted at the well, they pass through a separator at the well head. The water then travels through discrete flowlines to storage and/or treatment facilities. The gas travels through separate flowlines to a processing facility where it is compressed before being sent via gas transmission pipelines to market. A generalised flow chart of this process is provided as Figure 3.

It is important to recognise that for proposed developments such as the Narrabri Gas Project, the entire gas field is not developed at once. Within the project area, exploration, appraisal, and production would all occur to maintain the target gas production rate throughout the project life. The rehabilitation and decommissioning of the coal seam gas fields would be undertaken progressively in accordance with regulatory requirements and industry standards.

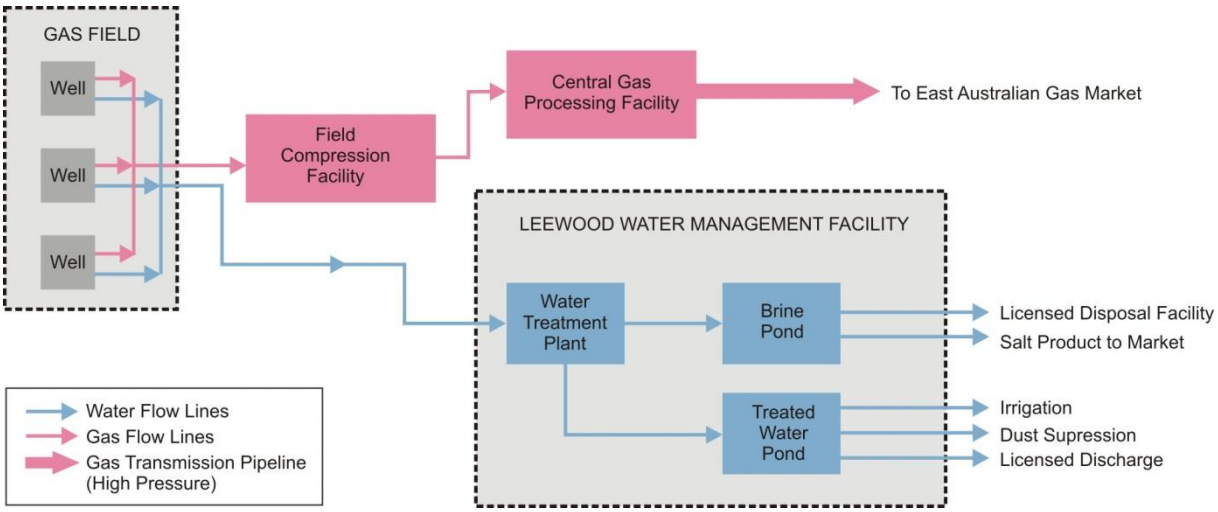


Figure 3 Schematic of water and gas flow during operations

2.4 The proposed development

2.4.1 Exploration and appraisal activities

Exploration and appraisal activities as part of the project would continue through the development of the field over time to help continually enhance the understanding of the resource. Exploration and appraisal activities would include seismic surveys, chip holes, core holes and pilot wells, associated temporary supporting infrastructure (flares or water balance tanks) and the installation of monitoring equipment. Permanent water and gas management facilities would be utilised where possible.

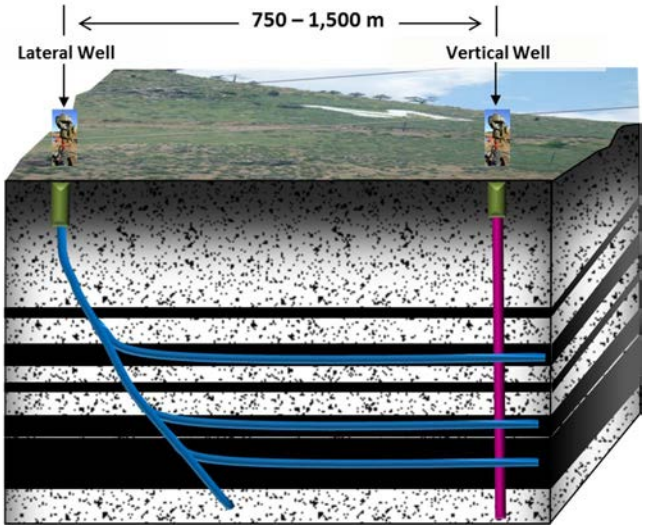
Santos propose to drill approximately 30 coreholes, approximately ten chip holes and approximately ten sets of four-well pilots during the exploration and appraisal process. Approximately 500 kilometres of seismic surveys are also proposed. At completion of exploration and appraisal, all wells will either be:

- Plugged and abandoned and the drill pad rehabilitated.
- Converted to monitoring bores.
- Converted to production wells and counted within the total maximum number of production wells proposed.

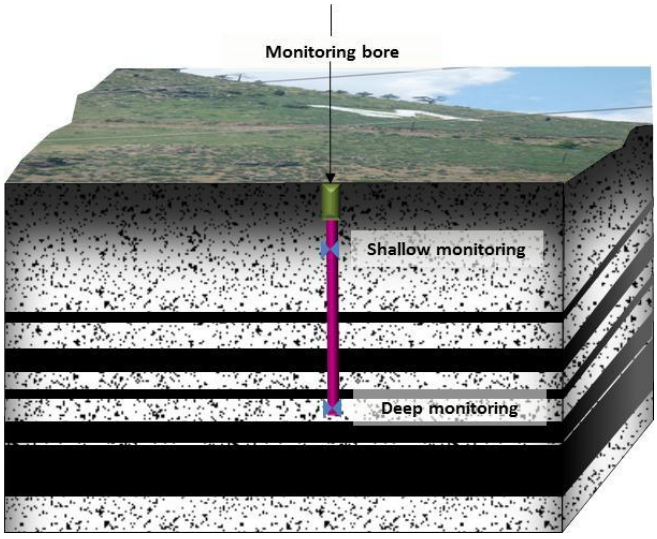
2.4.2 Production wells

It is anticipated that up to 850 individual production wells partnered to a maximum of 425 well sets would be progressively advanced and decommissioned within the project area over the estimated 25 year life span of the project. This would include any core holes or pilots drilled as part of the exploration and appraisal program that are converted to production wells as noted above in Section 2.4.1. All drilling activities would be undertaken in accordance with the NSW *Code of Practice for Coal Seam Gas Well Integrity* (DTIRIS 2012).

A single well may be vertical or lateral; the latter may include several horizontal connections sometimes referred to as multi-laterals. Wells would be drilled using a minimum number of well pad locations with wells and monitoring bores co-located on the same pad, where possible in order to reduce environmental impacts (refer to Figure 4 and Figure 5).



A well set consisting of one lateral well and one vertical well



Monitoring bore

Figure 4 Types of well and bore configurations

The well pads would be spaced approximately 750 to 1,500 metres apart, depending on surface geography and subsurface characteristics. Each well pad would be approximately 100 by 100 metres (one hectare) in size during drilling and construction.

In order to provide a stable working area for the drill rigs during well installation, vegetation would be either trimmed or cleared and either industrial matting laid, or topsoil scraped and stockpiled for use during site rehabilitation. Following well installation, the majority of the pad would be rehabilitated leaving an area of approximately 30 by 30 metres, with remaining surface facilities to include the well head, metering skids, power generation and remote sensor telemetry unit. The remote sensor telemetry unit shuts down the well if communication is lost.

Access to the well pads would be via existing roads and access tracks, wherever possible. Where it is not possible to utilise existing roads and access tracks, new tracks would be constructed. A right of way approximately 12 metres wide would be required for the construction of the new access tracks. The right of way would be restored and reduced to approximately 7 metres during operation; slightly wider on bends as required.

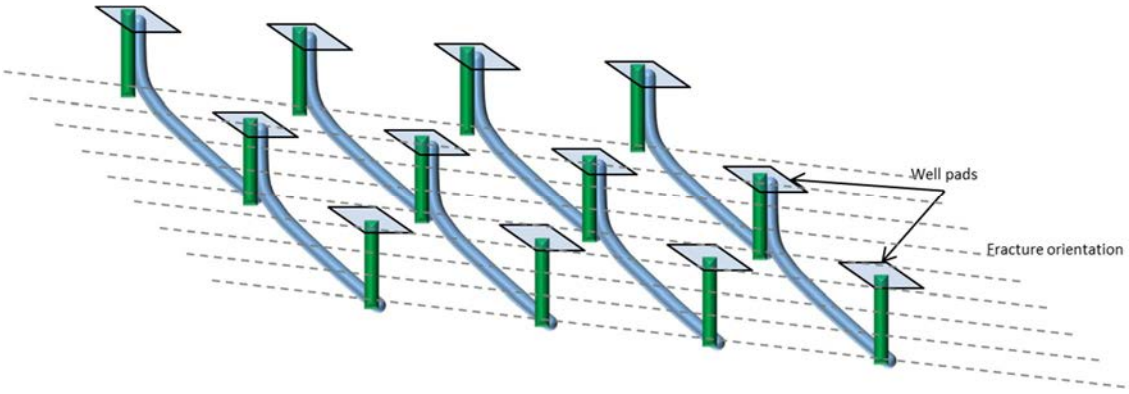


Figure 5 Indicative shared lease pad well configuration (well sets)

The specific location of each well would depend on local operational (e.g. geology/gas accessibility) and environmental factors. It is proposed that the specific location of each well pad within the project area would be determined in accordance with a field development protocol which would set out the detailed environmental criteria for selecting the specific location of the well pad within the project area. The environmental criteria would include for example, proximity to watercourses and significant ecology, upper impact limits for ecology and vegetation clearing, cultural heritage considerations, land access, and amenity. It is proposed that field clearance surveys for well micro-siting in accordance with the field development protocol would be undertaken before construction. The development of the project in accordance with the field development protocol and micro-siting procedure will be detailed and assessed in the EIS.

2.4.3 Gas and water gathering systems

The gas and water gathering systems (comprised of a network of separate, low pressure, underground pipelines) would link each well head to the in-field compression, gas processing facility, and the water management, treatment and beneficial reuse facilities, respectively (refer to Figure 4 and Figure 6).

Where possible, the gas and water gathering systems would be co-located proximal to, and parallel with, existing access roads, tracks or other existing linear features such as fence lines to minimise the need for any additional clearing. The corridors of any new access tracks constructed would also be used to co-locate the gathering systems to further minimise the need for additional clearing. The right of way width would be consistent with that described in Section 2.4.2.

Installation of the gas and water gathering systems would be undertaken via plough-in, trenching or directional drilling, depending on subsurface soil conditions and land use. The burial depth of the gathering systems would range from 0.75 to 2 metres depending on land use. The specific location of the gathering system will be in response to the locations of the wells and would form part of the field development protocol.

2.4.4 Central gas processing facility

A new central gas processing facility would be constructed and operated at the Leewood property, with some in-field compression potentially also required closer to the central location of the wells depending on gas pressure. In-field compression would comprise of package compressors that boost the gas pressure to enable it to be transported via a single pipe to the central gas processing facility.

At the central gas processing facility the gas will be conditioned to a domestic specification by removal of predominately CO_2, then treated to remove suspended moisture before ordorisation and export compression (refer Figure 6). As noted in Section 1.1, the gas transmission pipeline would be part of a

separate approvals process and is not part of the proposed development. The central gas processing facility would be constructed predominantly from prefabricated units transported to site, with a footprint size subject to final design.

Infrastructure installed at the central gas processing facility would include, for example:

- Gas conditioning equipment, as required, to achieve gas quality specification.
- Compressors, compression aftercoolers and dehydration units.
- Plant overpressure protection systems including pressure safety valves and flares.
- Sales gas metering.
- Power generation equipment.
- Utilities including instrument air, fuel gas systems and power generators.
- Petroleum fuel and lubrication oil tanks.
- Buildings including a control room, switch rooms, equipment shelters, offices, workshop, storerooms and first aid room.

Remote monitoring and control capability would be incorporated into the design of the central gas processing facility. The facility would operate 24 hours per day, 7 days per week.

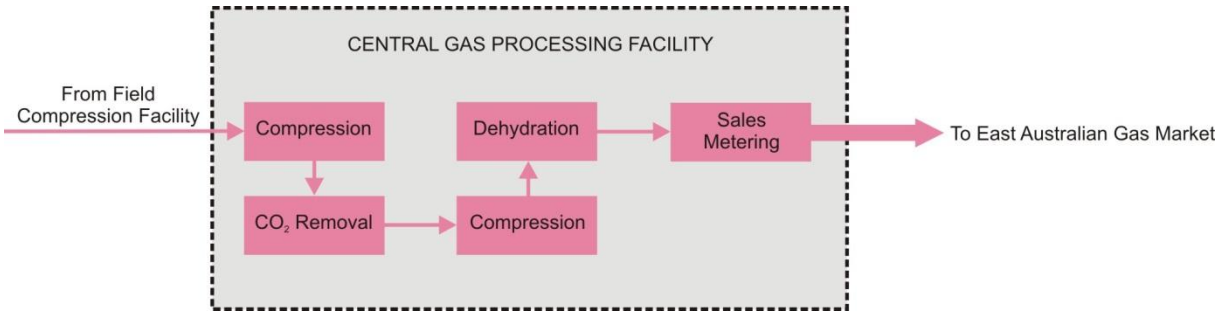


Figure 6 Schematic of the central gas processing facility

2.4.5 Water management, treatment and beneficial reuse facilities

A central water treatment facility will be located at the Leewood property. The construction of two 300 mega litre (ML) ponds associated with exploration and appraisal activities (Leewood Phase 1) was approved in March 2013 and is now underway. These ponds will manage the produced water from previous operations that is currently stored at the Bibblewindi Water Transfer Facility, in addition to servicing the exploration and appraisal program occurring within PEL 238 and PAL 2. The construction and operation of the following facilities was approved under Leewood Phase 1 (refer to Section 2.2):

- One 300 ML brine pond and one 300 ML produced water pond.
- A produced water flow line approximately 16 kilometres in length, linking the Leewood property to the Bibblewindi Water Treatment Facility in the Pilliga State Forest.
- Additional piping to connect the existing water gathering systems terminating at Bibblewindi Water Transfer Facility to new infrastructure.
- A produced water tank with associated infrastructure to be located within the existing disturbed area at Bibblewindi.

- A produced water distribution manifold and associated piping at the Leewood property, to allow water distribution into produced water and brine storage ponds.
- A water bore at the Leewood property.

Additional facilities are required at the Leewood property in order to treat the produced water to a higher standard (i.e. removal of salt). The construction and operation of a pilot water treatment facility will be the subject of a separate approval process (Leewood Phase 2 – refer to Section 2.2). An application is currently under preparation for these works.

Once operational, the proposed development would generate water volumes that would necessitate the upgrade of the water treatment facility at the Leewood property, sought under the approvals described above. Subject to detailed engineering design, specific upgrades or additional water management requirements may include:

- An upgrade of the water treatment facility to store and treat the produced water.
- The treatment of increased brine volumes at the Leewood property to produce solid salt products.
- The upgrade of the water treatment plant layout, tanks and pipes to accommodate increased produced water, brine and permeate.
- The management of water treatment by-products. This would include:
  - Permeate management. The beneficial re-use of permeate for dust suppression, during construction activities, for firefighting purposes, for agricultural irrigation activities, and/or discharge to local waterways.
  - Salt management. The commercial re-use of salt after brine treatment, or, the disposal of salt at an appropriately licensed landfill and/or recycling facility.

Santos proposes that the development application for the project would include this upgrade of the water treatment facilities and the use of the facilities described in the approvals above for production purposes.

2.4.6 Supporting infrastructure

Supporting infrastructure sought as part of the proposed development would include:

- **A concrete batching plant**. In order to minimise the transportation of concrete, particularly during the construction of the gas processing facility, a concrete batching plant may be established at the Leewood property.
- **Worker accommodation**. In addition to the existing Westport driller's camp (refer to Table 1), temporary accommodation would be provided either at the Leewood property or at another appropriate site. The accommodation would consist of demountable buildings and include mess facilities, a canteen, an amenities building, laundry, medical/first aid room and a recreation/games/gym room. Communications facilities and storage areas, vehicle maintenance and parking areas, fuel handling and storage areas, and facilities for the collection, treatment and disposal of wastes would also be provided.

  If well sites are located in remote or difficult to access locations, small relocatable accommodation facilities may be established to service the drill rigs.

  Approximately 200 workers associated with the ongoing operations of the project would primarily be lodged in Narrabri.
- **Electricity**. Construction activities would use temporary power generators to supply sites and facilities prior to the connection of a permanent supply. Power at the proposed

worker accommodation would be generated by diesel generators. During operation, power will be required at each well head, at Bibblewindi for in-field compression and at Leewood for the central gas processing facility and water treatment.

Electricity to power the operational requirements of the proposed development would likely be provided primarily via a combination of the Wilga Park Power Station, with additional electricity provided from a connection at Wilga Park to the existing NSW electricity transmission network, or the utilisation of gas fired turbines located in the project area. The electricity supply for the proposed development may be one of the options outlined above, or more likely a combination of some or all of the three.

Any required upgrade to the NSW electricity transmission network and associated infrastructure located outside of the project area would be subject to a separate approval process. There are currently no plans to expand the Wilga Park Power Station beyond its approved capacity of 40 MW.

- **Sewerage**. Onsite sewage management (e.g. septic) is proposed to cater for the worker accommodation and the central gas processing facility. Untreated sewage from the accommodation would be transported from site to local approved treatment facilities. In cases where local facilities cannot accommodate these wastes, sewage would be treated onsite using transportable sewage treatment unit(s), with the treated effluent subsequently irrigated to land in accordance with all applicable water quality criteria and water reuse guidelines.
- **Telecommunications**. Telecommunications services would include voice and data network services and telemetry services. Existing carrier services would be used, where available. Alternative methods would be used where existing services are insufficient and may include:
  - A fibre network extended from existing facilities and installed parallel with the water and gas gathering systems.
  - Communications equipment accommodated in operational or administration buildings.
  - Satellite communications used in remote locations.
  - VHF radio network.

  Telemetry services would be provided to facilitate the operation and monitoring of field production. Strategically located radio towers would be used for both data telemetry and voice radio services. These services would be connected to the data networks at operation or administration facilities.

2.5 Project decommissioning and rehabilitation

2.5.1 Proposed strategy

A detailed decommissioning and rehabilitation strategy would be developed for the project. The objectives of the decommissioning and rehabilitation strategy would include:

- Returning disturbed areas to a stable condition similar to that of the surrounding area within an acceptable time frame consistent with stakeholder requirements and expectations.
- Enabling the effective transfer of operating areas to landholders compatible with agreed post-closure land use.
- Minimising disturbance to drainage patterns and avoiding contamination of soil, surface waters and shallow groundwater resources.

- Minimising disturbance to native vegetation and fauna.
- Ensuring each rehabilitated area was capable of supporting sustainable ecosystems.

The overriding rehabilitation strategy is the promotion of natural vegetation regrowth through appropriate topsoil stripping, storage and replacement. Only when the native vegetation fails to regenerate to meet approved rehabilitation target metrics would intervention be considered.

It is anticipated that decommissioning of surface infrastructure, with subsequent rehabilitation, would be undertaken progressively as the wells become depleted during the project life cycle.

At the cessation of production, the gathering systems would be isolated at the well head and also where they are connected to both the water treatment and gas processing facilities. The gathering systems would then be made safe, isolated, drained, vented and capped in accordance with the Australian Pipeline Industry Association (APIA) *Code of Environmental Practice for Onshore Pipelines, 2013*. All above ground components of the gathering system would be removed, including all pipeline marker signs.

Rehabilitation of the gathering system corridor would occur after its installation and in accordance with the Rehabilitation Strategy. After the well sets are decommissioned, the subsurface components of the gathering system would remain *in situ* as described above, and vegetation maintenance within the gathering system corridor would cease.

Final site rehabilitation for disturbed areas may vary from area to area depending on the nature of the development in that area and input from the local landholder, Traditional Owners and other relevant stakeholders. Any existing infrastructure that is useful to the landholder may remain once agreement is made, and remaining disturbed areas revegetated in accordance with agreed future land use.

3. Justification

3.1 Strategic context

The project would enable the commercial development of the Narrabri region's natural gas resources, ultimately resulting in economic benefits to both the region and the State, and providing increased energy security for NSW. The proposed development would represent an important development of the State's resources for the following reasons:

- NSW currently imports approximately 95% of its gas from other States (Queensland, Victoria and South Australia) (NSW Chief Scientist and Engineer, 2013).
- The interstate contracts under which NSW is supplied gas begin to expire in 2014, and will be almost completely exhausted by the end of 2017 (NSW Chief Scientist and Engineer, 2013).
- Natural gas has been identified as a transitional fuel for power generation, with reduced greenhouse gas intensity compared with current coal-fired power generation (NSW Chief Scientist and Engineer, 2013).
- The proposed development provides an important new energy source for NSW, development of which would contribute to the State's economy through royalties paid, jobs created and infrastructure investment.

3.1.1 Global and Australian energy and gas consumption

Projections to 2030 indicate that the global, national and State consumption of gas will continue to increase (International Energy Agency, 2009a). World gas production in 2008 was estimated at 120,711 petajoules (PJ) (Geoscience Australia and ABARE, 2010). In 2012, Australia was the world's tenth largest gas producer accounting for around 1.5% of world gas production (AEMO, 2012). Gas currently accounts for approximately 21% of global primary energy consumption and is the third largest global energy source.

The International Energy Agency projects global gas demand to increase by 1.5% per year to reach 149,092 PJ in 2030. The expansion in global demand will increasingly be met by imports including liquefied natural gas from countries such as Australia (Geoscience Australia and ABARE, 2010). The use of gas grows by more than 5% per year in India and China (International Energy Agency, 2009a). Australia is geographically well placed to meet the demands of the Asia-Pacific region.

Australia's primary energy consumption is projected to increase at an average annual rate of 1.4% from 5,724 PJ in 2007-08 to 7,715 PJ in 2029-30. In 2008-09 natural gas comprised 22% of Australia's primary energy consumption. This share is forecast to increase to 33% by 2029-30 (Syed *et al.*, 2010). Gas is Australia's fastest growing energy source with investment in gas-fired electricity generation a key driver (NSW Chief Scientist and Engineer, 2013).

It is projected that NSW energy consumption will increase from 1,640 PJ per year to 2,113 PJ per year between 2008 and 2030. This is a moderate growth rate of 1.2% per year for energy consumption, and NSW is projected to remain the largest contributor to Australia's primary energy consumption over the period to 2030 (Syed *et al.*, 2010).

3.1.2 NSW gas market

NSW currently consumes approximately 138 PJ of gas per annum, which is less than 10% of NSW's total energy consumption (NSW Chief Scientist and Engineer, 2013). In the same annual period, NSW produced only 5 PJ of natural gas, all from the AGL Camden coal seam gas project.

The proposed development would have the capacity to produce approximately 70 PJ per year, which is equivalent to approximately 50% of NSW's gas consumption (using the NSW Chief Scientist and Engineer's (2013) data). Currently, and as noted above, NSW is almost entirely dependent on gas imported from Queensland, Victoria and South Australia to meet its gas requirements.

3.1.3 Power generation

Power generation in NSW and Australia has been dominated by coal as a fuel due to its low cost relative to gas (75% black and brown coal versus 15% gas for Australia in 2009/10, and black coal 11,797 MW versus 1,983 MW for conventional gas for NSW in 2009/10 – ABREE, 2012). Historically, the development of gas-fired power stations has been restricted due to the availability of fuel at economic prices. However, gas is an economically suitable and more flexible alternative to coal during periods of peak electricity demand.

The proposed development would facilitate the delivery of natural gas that would serve as an alternative to coal reserves as a means of energy production and would provide the potential to lower carbon emissions from power generation. Therefore, natural gas is an important part of the energy mix, a potential low emissions transitional fuel and an important feedstock for industry.

3.1.4 Market demand

Using a medium economic growth scenario, the Australian Energy Market Operator (AEMO) (2013) predicted that under the 10-year outlook between 2013/14 to 2022/23; annual energy demand is forecast to grow by 1.3% per annum. The main growth drivers over this period are the three large industrial liquefied natural gas (LNG) projects in Queensland, population growth in most key energy market regions, and an easing in electricity price growth over the 10-year outlook period. In NSW, AEMO (2013) predicted that average annual energy growth over the same 10-year outlook period is forecast to be 0.6%.

On constrained gas supply into NSW markets as a result of increased demand from both NSW consumers and Queensland LNG contracts, the AEMO (2013a) Gas Statement of Opportunities noted that "there will be flow-on effects for New South Wales with potential shortfalls of 50 to 100 TJ/day (terajoules per day) over winter peak demand days from 2018". AEMO (2013a) noted that "committed and advanced projects in New South Wales are not sufficient to completely alleviate these shortfalls without further support from the Moomba to Sydney Pipeline. Opportunities exist to augment transmission capability between Victoria and New South Wales, increase production in the Cooper Basin, undertake moderate development of the Gunnedah Basin, or develop an alternative transmission route between Queensland and New South Wales."

To assess the capability of New South Wales to increase self-supply, AEMO (2013a) modelled a moderate development in the Gunnedah Basin that generated 100 TJ/day (noting that this scenario is approximately half of Santos' proposed Narrabri Gas Project output). Under this modelled scenario, the supply shortfalls predicted from winter 2018 were deferred until 2024. The modelled scenario also assumed that Gloucester Basin gas production would be on line at the rate of 80 TJ/day.

The anticipation of restricted gas supply to NSW heightens the need for a local gas resource for NSW to provide increased security for the current demand and to meet the projected future demand. The

proposed development would provide infrastructure to help facilitate overcoming these predicted challenges and thereby meet projected demand for the eastern states over the next decades.

3.1.5 NSW Gas supply transition to include the Narrabri Gas Project

As noted above, NSW currently imports over 95% of its natural gas from the Gippsland Basin in Victoria, the Cooper Basin in South Australia and from coal seam gas fields in Queensland. This gas is supplied through long-term contracts with key basin producers. However, as also discussed above, these contracts roll-off over the next two to three years, thereby exposing NSW to uncertainties about future gas supply and price. In addition, it is unlikely that all of the expiring contracts can be replaced with new supply contracts.

The project has the potential to supply up to 50% of NSW gas demand to begin to meet the contractual decline in supply. However, it takes significant time to appraise, develop, approve and construct projects of this magnitude. The project has the potential to come online as early as late 2017; in time to alleviate predicted supply tightness, and help manage the NSW gas supply issues.

3.2 Need and benefits

Production of natural gas from coal seams from the proposed development would deliver material economic, environmental and social benefits to the Narrabri region and to NSW as a whole through the provision of sufficient gas to supply approximately 50 percent of the growing NSW demand. The key benefits of the proposed development can be summarised as:

- Development and commercial production of the natural gas from coal seams under the proposed development would contribute to meeting increasing NSW demand for natural gas. This production would offset a portion of gas supply contracts which expire over the next four years.
- Development of a new source of gas supply into NSW would lead to an improved energy security position for NSW. This would give NSW gas markets greater choice when entering into gas purchase arrangements. Potential would also exist for improved competition on price. Improved competition on price would have flow on benefits for NSW's economic efficiency, productivity and prosperity.
- Supply of a reduced greenhouse gas emission fuel source for power generation in NSW as compared to coal-fired power generation.
- Increased local production and regional economic development through employment and services.
- Santos committing to contribute to the Regional Community Benefit Fund the equivalent of 5% of the royalty payment made to the NSW Government within the future production licence area. This amount will then be matched by the Government. It is estimated that the fund could reach $160 million over the next two decades.

3.3 Alternatives considered

3.3.1 Do nothing

The do nothing option would result in the absence of potentially 50% of NSW gas requirements being available for supply to the NSW gas market. Should the proposed development not proceed, there is a risk that there would be a shortfall in gas supply resulting from the expiration of interstate gas supply contracts with no other alternative currently secured (Wood *et.al.* 2013).

The do nothing option would not achieve the following:

- Increased gas supply security to meet current and projected future demand.
- Creation of approximately 1,200 jobs during the construction phase and 200 jobs during the operational phase.
- An alternative to coal reserves as a means of energy production and potential for lower carbon emissions from power generation (compared to coal-fired power generation), consistent with the Commonwealth Government's commitments under the Kyoto Protocol.
- Contribution to the State's economy through royalties paid, jobs created and infrastructure investment.
- Improved competition on price, also having flow on benefits for NSW's economic efficiency, productivity and prosperity.
- Contributions to the regional community benefit fund.

Without a feasible alternative to current gas supply, industries reliant on gas may be impacted by rising gas prices as supply contracts expire and are re-negotiated (Wood *et.al.* 2013).

3.3.2 Alternative locations and alternative infrastructure

The location of the proposed development has been selected as:

- It is greater than 2 kilometres from residential zones or identified future residential growth and does not impact on any critical industry clusters (CICs) as defined in the *State Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007* (the Mining SEPP) (see Section 4.2.1).
- It avoids conservation areas such as the Pilliga National Park, the Pilliga State Conservation Area, the Pilliga Nature Reserve and the Brigalow Park Nature Reserve.
- It is consistent with government policy and targets an area that has been identified within the Strategic Regional Land Use Plans and the *Brigalow and Nandewar Community Conservation Area Act 2005* as suitable for development of natural gas from coal seams.
- Exploration and appraisal has taken place to enable an estimation of the recoverable gas resources available in the area to underpin a gas development. The same level of exploration and appraisal has not been undertaken by Santos in other PELs and hence there is not the same level of confidence in the recoverable resources in those areas. As a result, the time required to produce gas from those areas would be substantially longer, thereby delaying further supply to the NSW market.

There are no alternatives to the proposed location until significant additional exploration and appraisal has been undertaken. A smaller project in the same location was considered but this would generate less than 50% of NSW gas needs and not necessarily have a proportionate reduction in surface footprint. In addition, the economic viability of a smaller project would be more marginal, and therefore, less commercially attractive for investment.

Further, a range of alternative infrastructure options were considered prior to selecting the current configuration, including for example:

- Alternate well pad sizes.
- Alternate water processing configurations; decentralised rather than centralised.
- An alternate location for the centralised gas processing facility.
- Alternate gas field development logic.

4. Legislative context

4.1 Environmental Planning and Assessment Act 1979

The EP&A Act provides the statutory basis and framework for planning and environmental assessment in NSW. The EP&A Act includes provisions to ensure that the potential environmental impacts of a development are assessed and considered in the decision-making process.

As outlined in the following sections, the project is permissible with development consent under the *State Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007*, and is identified as 'State significant development' under section 89C(2) of the EP&A Act and the *State Environmental Planning Policy (State and Regional Development) 2011*.

The project is subject to the assessment and approval provisions of Division 4.1 of Part 4 of the EP&A Act. The Minister for Planning and Infrastructure is the consent authority, who is able to delegate the consent authority function to the Planning Assessment Commission, the Director General or to any other public authority.

Section 79C of the EP&A Act applies to State significant development applications and requires the consent authority to take into consideration a broad range of matters. The matters identified in Section 79C of the EP&A Act would be considered in preparation of an EIS for the proposed development.

Under Division 4.1, the planning and approval process involves the following key steps:

- Submission of a request to the Director-General of the Department of Planning and Infrastructure, including accompanying supporting documentation (this report), seeking the Director General's Requirements for the content of an EIS.
- Preparation of an EIS, addressing the matters outlined in the Director General's Requirements.
- Submission of a development application, accompanied by the EIS.
- Public exhibition of the EIS for a minimum of 30 days.
- Assessment of the application by the Department of Planning and Infrastructure and preparation of the Director-General's environmental assessment report.
- Determination by the Minister for Planning, including conditions of approval if development consent for the project is granted.

4.2 Consideration of relevant environmental planning instruments

4.2.1 State environmental planning policies

State Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007

State Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007 (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 NSW. The Mining SEPP establishes appropriate planning controls to encourage ecologically sustainable development.

Clause 7(2) of the Mining SEPP identifies that development for the following purposes may be carried out only with development consent:

(a) petroleum production on land on which development for the purposes of agriculture or industry may be carried out (with or without development consent),

(b) petroleum production on land that is, immediately before the commencement of this clause, the subject of a production lease under the Petroleum (Onshore) Act 1991,

(c) petroleum production in any part of a waterway, an estuary in the coastal zone or coastal waters of the State that is not in an environmental conservation zone,

(d) facilities for the processing or transportation of petroleum on land on which petroleum production may be carried out (with or without development consent), but only if the petroleum being processed or transported was recovered from that land or adjoining land,

(e) petroleum production on land that is reserved as a state conservation area under the National Parks and Wildlife Act 1974,

(f) drilling or operating petroleum exploration wells, not including:

(i) stratigraphic boreholes, or

(ii) monitoring wells, or

(iii) a set of 5 or fewer wells that is more than 3 kilometres from any other petroleum well (other than an abandoned petroleum well) in the same petroleum title,

(g) drilling or operating petroleum exploration wells (not including stratigraphic boreholes or monitoring wells) that is carried out in an environmentally sensitive area of State significance.

The project is for the purpose of petroleum production. As discussed in Section 4.2.2, the project would be located in the RU1 Primary Production and RU3 Forestry zones under the Narrabri LEP. In the RU1 zone, agriculture is permitted either with or without development consent, depending on the type of agriculture.

In the RU3 zone, uses authorised under the *Forestry Act 2012* are permitted without development consent. Permits to use State forest land for non-forestry uses including recreational, sporting or commercial activities can be issued under section 60 of the *Forestry Act 2012*. This includes agriculture. On this basis, development for the purposes of agriculture may be carried out in the RU3 zone without the need for development consent.

The project is therefore permissible with development consent under clause 7(2)(a) of the Mining SEPP.

Clause 6 of the Mining SEPP specifies that certain development is permissible without development consent, including petroleum exploration. Despite this, section 89E(4)(a) and (b) of the EP&A Act prescribes that if part of a single State significant development application requires development consent, and other parts may be carried out without development consent, then Part 5 does not apply, and those parts of the development may not be carried out except with development consent. Therefore all exploration activities proposed as part of the project require development consent to be obtained.

Clause 9A of the Mining SEPP states that coal seam gas development is prohibited within:

- A coal seam gas exclusion zone, which is land within a residential zone or future residential growth area land, additional rural village land or critical industry cluster land.

- A buffer zone, which is land within two kilometres of land within a residential zone, future residential growth area land or additional rural village land.

The project is not located in, or within two kilometres of, a residential zone, future residential growth area, additional rural village land or critical industry cluster land.

Part 3 of the Mining SEPP sets out matters which must be considered prior to granting development consent. These matters relate to natural resource and environmental management, resource recovery, transport and rehabilitation, and will be addressed in the EIS.

Amendments to the Mining SEPP recently came into force. The amendments establish a gateway process for scientific assessment of the impacts of certain State significant mining and petroleum proposals located on Biophysical Strategic Agricultural Land (BSAL).

The Mining SEPP includes regional scale maps of BSAL. The project is not located on mapped BSAL.

A site-specific verification process is established by the SEPP to confirm that other land is not BSAL, which involves further specific investigation and the issuing of a site verification certificate. Santos would undertake BSAL site verification for the cleared agricultural areas of the project.

Mining SEPP and Strategic Regional Land Use Plans

The Strategic Regional Land Use Policy seeks to provide a regulatory framework to facilitate the assessment of mining and coal seam gas projects in NSW, while ensuring the protection of the State's valuable agricultural lands and related water sources.

Strategic Regional Land Use Plans (SRLUPs) identify BSAL and CICs within these regions, which are subject to additional protection through the gateway process.

The SRLUPs state that development of the gas industry in the New England North West and Upper Hunter Regions will bring capital investment and economic benefits, and has the potential to play a significant role in the delivery of reliable energy in a carbon constrained economy, provide security of supply for domestic gas, and alleviate the State's reliance on imported gas.

The SRLUPs emphasise the importance of protecting valuable agricultural land and natural environments. The EIS will consider the potential impacts of the proposed development with reference to the requirements of the SRLUPs.

State Environmental Planning Policy (State and Regional Development) 2011

Section 89C(2) of the EP&A Act provides that a SEPP may declare any development or any class or description of development, to be State significant development. *State Environmental Planning Policy (State and Regional Development) 2011* (State and Regional Development SEPP) identifies development which is 'State significant development' for this purpose.

Clause 8(1) of the State and Regional Development SEPP states that development is State significant development if:

(a) the development on the land concerned is, by the operation of an environmental planning instrument, not permissible without development consent under Part 4 of the Act, and

(b) the development is specified in Schedule 1 or 2.

Clause 8(2) of State and Regional Development SEPP further states that:

"If a single proposed development the subject of one development application comprises development that is only partly State significant development declared under subclause (1), the remainder of the development is also declared to be State significant development except for:

(a) so much of the remainder of the development as the Director-General determines is not sufficiently related to the State significant development, and

(b) coal seam gas development on or under land within a coal seam gas exclusion zone or land within a buffer zone (within the meaning of clause 9A of the State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007."

Clause 6 of Schedule 1 specifies the following petroleum (oil and gas) development:

(1) Development for the purpose of petroleum production.

(2) Development for the purpose of drilling or operating petroleum exploration wells, not including:

(a) stratigraphic boreholes, or

(b) monitoring wells, or

(c) a set of 5 or fewer wells that is more than 3 kilometres from any other petroleum well (other than an abandoned petroleum well) in the same petroleum title.

(3) Development for the purpose of drilling or operating petroleum exploration wells (not including stratigraphic boreholes or monitoring wells) that is carried out in an environmentally sensitive area of State significance.

(4) Development for the purpose of petroleum related works (including pipelines and processing plants) that:

(a) is ancillary to or an extension of another State significant development project, or

(b) has a capital investment value of more than $30 million.

The project is permissible with development consent (as outlined above), and is development for the purposes of petroleum production, therefore the project is State significant development under clause 8(1) of the State and Regional Development SEPP. The exploration and appraisal activities which are permissible without consent and are proposed to be included in the development application would also form part of the State significant development under clause 8(2) of the State and Regional Development SEPP.

Other State environmental planning policies

In addition to the key SEPPs discussed above, the relevant provisions of the following SEPPs will be addressed in the EIS:

- *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development.*
- *State Environmental Planning Policy No. 44 – Koala Habitat Protection.*
- *State Environmental Planning Policy No. 55 – Remediation of Land.*
- *State Environmental Planning Policy (Rural Lands) 2008.*

4.2.2 Local environmental plans

The project is located within Narrabri LGA and is subject to the *Narrabri Local Environmental Plan 2012* (Narrabri Local Environmental Plan (LEP)). The project is located within the RU1 Primary Production and RU3 Forestry zones under the Narrabri LEP.

In the RU1 zone, agriculture is permitted either with or without development consent, depending on the type of agriculture. A range of other uses are permissible with consent in the RU1 Zone including extractive industries, open cut mining and rural industries.

In the RU3 zone, uses authorised under the *Forestry Act 2012* are permitted without development consent. Under section 60 of the *Forestry Act 2012*, forest permits can be issued to use forestry area for non-forestry purposes specified in the permit, including recreational, sporting or commercial activities. Whilst section 60 does not explicitly reference agricultural uses, it allows for any use provided it is specified in the permit. On this basis, the development may be carried out in the RU3 zone without the need for development consent.

Other provisions of the Narrabri LEP will be considered in the preparation of the EIS.

4.3 Other NSW legislation and approvals

4.3.1 Approvals that do not apply

Section 89J of the EP&A Act specifies certain authorisations which are not required for State significant development that is authorised by development consent. These include the following authorisations, which may otherwise have been relevant to the project:

- Permit for work or structures within a waterway under the *Fisheries Management Act 1994* – the project has the potential to require works within water courses, and permits for dredging or reclamation under section 201 and for blocking fish passage under section 219 would have otherwise been required.
- Approval to disturb a State heritage-listed item or an excavation permit to impact on a relic under the *Heritage Act 1977* – as discussed in Section 5.6, there is potential for direct and indirect impacts to relics occurring in the project area, and excavation permits under section 139 would have otherwise been required.
- Aboriginal heritage impact permit under the *National Parks and Wildlife Act 1974* – as discussed in Section 5.7, there is potential for direct and indirect impacts on items of Aboriginal cultural heritage, and an Aboriginal heritage impact permit may have been required under section 90 under the Act.
- Consent to clearing native vegetation under the Native Vegetation Act 2003 – as discussed in Section 5.2, the proposed development would involve clearing of native vegetation. While native vegetation clearing within the Pilliga State Forest is excluded from the operation of the *Native Vegetation Act 2003*, authorisation for native vegetation clearing outside of the State Forest under section 12 may have otherwise been required.
- Water use approval, water management work approval or activity approval (other than an aquifer interference approval) under the *Water Management Act 2000* – both the gas field and gas transmission pipeline would require works within 40 metres of various watercourses and a controlled activity approval under section 91 would have otherwise been required. In addition, the extraction of water would have otherwise required a water use approval under section 89.

These authorisations would not be required if the Minister grants development consent to carry out the project under Division 4.1 of Part 4.

Subsection 89J(3) states that a reference in section 89J to approved State significant development includes a reference to any investigative or other activities that are required to be carried out for the purpose of complying with any environmental assessment requirements in connection with an application for approval to carry out the State significant development. Should the investigations required to comply environmental assessment requirements involve activities that may trigger the need for any of the approvals discussed above, these approvals would not be required.

4.3.2 Legislation to be applied consistently

Under Section 89K of the EP&A Act, the following authorisations cannot be refused if necessary for the carrying out of State significant development that is authorised by development consent and are to be substantially consistent with the consent:

- *Petroleum (Onshore) Act 1991* – a PPL under Division 5 of Part 3.
- *Protection of the Environment Operations Act 1997* – an environment protection licence under Chapter 3 of the Act.
- *Roads Act 1993* – a permit under Section 138 to impact on public roads.
- *Pipelines Act 1967* – a licence under Section 11 to construct and/or operate a pipeline.

Petroleum (Onshore) Act 1991

The *Petroleum (Onshore) Act 1991* (Petroleum Act) regulates the onshore exploration for and production of petroleum. Santos proposes to submit applications for petroleum production leases under the Petroleum Act. Part 3, Division 1 of the Petroleum Act outlines the requirements for the making of applications for petroleum titles.

Part 3, Division 5, Section 41 of the Petroleum Act states that:

> *The holder of a production lease has the exclusive right to conduct petroleum mining operations in and on the land included in the lease together with the right to construct and maintain on the land such works, buildings, plant, waterways, roads, pipelines, dams, reservoirs, tanks, pumping stations, tramways, railways, telephone lines, electric power lines and other structures and equipment as are necessary for the full enjoyment of the lease or to fulfil the lessee's obligations under it.*

The project would be undertaken in accordance with a PPL, provided that development consent for the project has been obtained. The conditions of the future PPL are likely to require activities to be undertaken in accordance with an approved Petroleum Production Environment Operations Plan (PPEOP). The PPEOP would be developed to guide the operation of the project and would be submitted to the NSW Department of Trade and Investment, Division of Resources and Energy (DRE) and other agencies, as required.

Approval will also be required under section 70 of the Petroleum Act for the parts of the operations within the State Forest.

Protection of the Environment Operations Act 1997 (POEO Act)

The *Protection of the Environment Operations Act 1997* (POEO Act) establishes, amongst other things, the procedures for issuing of licences for environmental protection on aspects such as waste, air, water and noise pollution control. The occupier of premises at which any scheduled activities are

carried out is required to hold an environment protection licence (EPL) and comply with the conditions of that licence. The construction and operation of the project will require an EPL because coal seam gas production is a scheduled activity listed in Schedule 1 of the POEO Act and discharges of the treated water to local watercourses, if proposed, would require an EPL.

Pipelines Act 1967

Section 11 of the *Pipelines Act 1967* (Pipelines Act) outlines licensing requirements for pipelines. Under Section 11 a licence is required to:

- Commence, or continue, the construction of a pipeline.
- Alter or reconstruct a pipeline.
- Operate a pipeline.

However, Section 5 notes when a licence is not required. This includes:

> (f) a pipeline constructed or to be constructed:
>
> (i) for returning petroleum to a natural reservoir,
>
> (ii) for conveying petroleum for use for the purposes of petroleum exploration operations or operations for the recovery of petroleum,
>
> (iii) for conveying petroleum that is to be flared or vented,
>
> (g) a pipeline, or a pipeline belonging to a class, for the time being declared by a notification under subsection (2) or by such a notification, as varied by a notification under subsection (9), to be a gathering line

The gathering system is part of a system for conveying petroleum for operations for the recovery of petroleum and does not require a pipelines licence. The gas transmission pipeline, which is subject to a separate approvals process, does require a pipelines licence.

Roads Act 1993

The *Roads Act 1993* (Roads Act) provides the statutory framework for the management of public roads within NSW. The Roads Act is administered by the NSW Roads and Maritime Services (RMS), Councils, and/or the NSW Department of Lands. RMS has jurisdiction over major roads, Councils over minor roads, and the Department of Lands over Crown road reserves or Crown roads.

Section 138 of the Roads Act requires that a person obtain the consent of the appropriate roads authority for the erection of a structure, or the carrying out of a work in, on or over a public road, or the digging up or disturbance of the surface of a public road.

Construction of the project may require works within public roads. Consent of the appropriate roads authority under Section 138 of the Roads Act would be required for any works within a public road.

4.3.3 Other statutory approvals

Water Management Act 2000

The *Water Management Act 2000* (WM Act) is intended to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. It is also intended to provide a formal means for the protection and enhancement of the environmental qualities of waterways and their catchments.

The WM Act applies to areas of NSW that have a water sharing plan. Water sharing plans affecting the project could include:

- Namoi Unregulated and Alluvial.
- NSW Upper and Lower Namoi Groundwater Source.
- NSW Great Artesian Basin Groundwater Sources.
- NSW Murray Darling Basin Porous Rock Groundwater.
- NSW Murray Darling Basin Fractured Rock Groundwater Sources.

In accordance with Section 91F of the WM Act, an aquifer interference approval is required for an aquifer interference activity. An aquifer interference activity means an activity involving any of the following:

(a) the penetration of an aquifer,

(b) the interference with water in an aquifer,

(c) the obstruction of the flow of water in an aquifer,

(d) the taking of water from an aquifer in the course of carrying out mining, or any other activity prescribed by the regulations,

(e) the disposal of water taken from an aquifer as referred to in paragraph (d).

The project would encounter groundwater, and would, therefore, penetrate an aquifer.

However, Section 91F of the WM Act does not currently apply. Section 88A provides that Part 3 of Chapter 3 (including Section 91F) applies to each part of the State or each water source and each type or kind of approval that relates to that part of the State or that water source that is declared by proclamation.

At the time of the writing, no proclamation had been made declaring that Part 3 of Chapter 3 of the WM Act applies in relation to aquifer interference approvals.

Accordingly, an aquifer interference approval would not be required for the proposed development.

Under Part 2 of Chapter 3 of the WM Act, it is an offence to take water from a source regulated by the WM Act unless in accordance with a Water Access Licence (WAL). Santos will apply for a WAL for its water take.

Forestry Act 2012

The *Forestry Act 2012* provides for the dedication, management and use of State forests and other Crown-timber land for forestry and other purposes.

Section 60 of the *Forestry Act 2012* states that the land manager of a forestry area may, on payment of such fee as may be determined by the land manager, issue a forest permit authorising the holder of the permit to use the forestry area for such purposes (including recreational, sporting or commercial activities) as are specified in the permit.

Santos holds an occupation permit enabling land use for access and activities associated with petroleum titles, issued under the now repealed *Forestry Act 1916*. In accordance with this permit, Santos may use the area subject to the permit (defined in Schedule 1 of the permit) for any activities it is authorised to carry out under the Petroleum Act, including access through the permit area.

Schedule 3 of the *Forestry Act 2012* contains savings, transitional and other provisions, and clause 9 states:

> *Any licence, permit or lease granted under the former Act and in force immediately before the repeal of the former Act is taken to be a licence, permit or lease of the corresponding kind (as determined by the Corporation) in force under this Act.*

Santos is proposing to negotiate an updated agreement under the *Forestry Act 2012* that will re-define the area subject to the permit.

4.4 Commonwealth legislation

Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for the protection of certain matters of national environmental significance (MNES).

Under the EPBC Act, approval is required from the Commonwealth Minister for the Environment for any action that will have or is likely to have a significant impact on a MNES, or on the environment of Commonwealth land, or on the environment if the action is proposed to be taken by a Commonwealth agency (known as a 'controlled action').

The nine matters of national environmental significance are:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (listed under the Ramsar Convention).
- Listed threatened species and ecological communities.
- Migratory species protected under international agreements.
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear actions (including uranium mines).
- A water resource, in relation to coal seam gas development and large coal mining development.

EPBC Act Protected Matters Search Reports have been generated for the purposes of informing this report. Section 5.2 provides additional information in this regard, with the full results included as Appendix A.

An assessment of the proposed development against MNES would be undertaken during preparation of the EIS. Santos intends to refer the matter to the Commonwealth Minister for the Environment having regard to listed threatened species, the water trigger, and any other triggers identified during preparation of the EIS.

Native Title Act 1993

The objectives of the Native Title Act 1993 are to:

- Recognise native title rights and sets down basic principles in relation to native title in Australia.

- Provide for the validation of past acts which may be invalid because of the existence of native title.
- Provide for a future regime in which native title rights are protected and conditions imposed on acts affecting native title land and waters.
- Provide a process by which native title rights can be established and compensation determined, and by which determinations can be made as to whether future grants can be made or acts done over native title land and waters.
- Provide for a range of other matters, including the establishment of a National Aboriginal and Torres Strait Islander Land Fund.

The Native Title Act 1993 is administered by the National Native Title Tribunal. The Act prescribes that native title can be extinguished under certain circumstances, including the granting of freehold land.

A native title claim currently exists over the proposed project area as discussed in Section 5.7. Santos respects, and is currently engaging in, Native Title discussions with the Native Title claimants.

5. Preliminary environmental assessment

This chapter describes the existing environment and the potential environmental impacts of the proposed development, including the approach taken in identifying these risks. Detail is provided on the issues and strategies to address these including the need for and possible scope of further investigations and assessment methods to be undertaken as part of the EIS.

5.1 Environmental risk assessment approach

Potential environmental issues associated with the proposed development have been identified based on:

- Knowledge of the area held by Santos.
- Information included in previous studies.
- Preliminary desktop investigations.
- Previous field experience.
- Publically available information.
- A preliminary risk assessment.

Table 2 summarises the environmental aspects identified as being potentially affected by the proposed development to varying degrees.

Table 2 Summary of the preliminary risk assessment process findings

Key risks	Other Risks
- Ecological impact. - Surface water impact and management. - Groundwater impact and management. - Aboriginal heritage impact. - Air quality impacts and greenhouse gas emissions. - Soils and land suitability impact. - Waste management. - Hazards and risk management (gas, chemicals, bushfire and water storage). - Property and land use impact. - Agricultural impact. - Social, community and health impact. - Economic impact. - Contaminated land. - Decommissioning and rehabilitation.	- Non-Aboriginal heritage impact. - Traffic and transport impact. - Noise and vibration impact. - Climate risk and resilience. - Landscape and visual amenity impact.

It is anticipated that during investigations for the EIS that there would be emphasis placed on the identified key risks. The key risks are more likely to require detailed investigations and are likely to be managed with specific and more stringent mitigation strategies. Anticipated investigations of these key risks are outlined in the following sections.

Aspects identified as “other risks” would be investigated, however, the requirements in relation to these risks are anticipated to be less detailed and they would be readily managed by application of best practice management and mitigation measures.

5.2 Ecology

5.2.1 Existing environment

The project would span several state forests including the Pilliga East State Forest, Bibblewindi State Forest, and Jacks Creek State Forest (refer to Figure 1). It would also be located within improved and irrigated pasture, cropping and grazing land.

Since 2002, numerous flora and fauna surveys have been carried out totalling more than 3,000 hours in the field in a range of seasons and weather events. These surveys covered an area of approximately 48,000 hectares including (in part) the Pilliga East State Forest, Bibblewindi State Forest, Jacks Creek State Forest and Pilliga East State Conservation Area as well as Crown Land and privately owned land. These surveys have included:

- Pilliga Mouse surveys and habitat mapping utilising mark-recapture techniques.
- Spotted-tail Quoll survey utilising remote cameras and hair tubes.
- Migratory and woodland bird survey.
- Koala survey and habitat mapping.
- Small/medium mammal survey targeting a range of species.
- Nocturnal survey incorporating call play-back and spotlighting, targeting a range of species.
- Microbat survey utilising harp traps and anabats.
- Active reptile search and funnel trapping.
- Vegetation survey and mapping to fill survey gaps and improve accuracy of existing regional forestry mapping.

The substantive survey effort has resulted in a large database that Santos would use to assess and mitigate the ecological impacts of the proposed development through the strategy articulated below.

A desktop assessment was undertaken in September 2013 to identify threatened flora and fauna species, populations and ecological communities listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) the NSW *National Parks and Wildlife Act 1974* (NPW Act) and the NSW *Fisheries Management Act 1994* (FM Act), in addition to MNES listed under the EPBC Act that may be affected by the proposed development. Biodiversity databases pertaining to the project area and locality (i.e. within 5 kilometres of the project area boundary) were reviewed and included:

- The NSW Office of Environment and Heritage NSW Bionet Wildlife Atlas to determine records of threatened species, populations or communities listed under the TSC Act, the NPW Act, the FM Act and the EPBC Act; the latter for species listed at both State and Commonwealth levels.
- Department of the Environment Protected Matters Search Tool for MNES listed under the EPBC Act which are predicted to occur in the locality.
- The NSW Department of Primary Industries Threatened and Protected Species Records Viewer for records of threatened aquatic species in the locality.

- The NSW Department of Primary Industries Threatened Fish and Marine Vegetation – Find a Species by Geographic Region online search tool for the Namoi and Central West Catchment Management Authority (CMA).

The results of the database searches are summarised below with further detail provided in Appendix A.

Flora

Database search results indicate that nine threatened flora species and 10 Endangered Ecological Communities (EECs) listed under the TSC Act may occur in the vicinity of the project area. In addition, the protected matters search identified 10 threatened flora species, four EECs and two Critically Endangered Communities (CECs) listed under the EPBC Act as potentially occurring in the vicinity of the proposed development.

Field surveys carried out by EcoLogical Australia (2011) recorded a total of 388 flora species occurring within the project area, including *Rulingia procumbens*, listed as a vulnerable species under the EPBC Act and the TSC Act, and Native Milkwort (*Polygala linariifolia*), listed as an endangered species under the TSC Act. Two noxious weed species for the Narrabri LGA were recorded: Noogoora Burr (*Xanthium occidentale*) and Coolatai Grass (*Hyparrhenia hirta*).

Fauna

Database search results indicate that 26 threatened fauna species (16 birds, nine mammals, and one reptile) listed under the TSC Act may occur in the vicinity of the project area. In addition, the protected matters search identified 18 threatened fauna species (eight birds, five mammals, three reptiles, one frog and one fish) and 12 migratory bird species listed under the EPBC Act as potentially occurring in the vicinity of the proposed development.

Field surveys carried out by EcoLogical Australia (2011) recorded a total of 124 fauna species: 59 birds, 20 reptiles, seven frogs, 18 mammals and 20 bats. This included 11 threatened species listed under the TSC Act and two species listed under the EPBC Act.

Habitat contained within Pilliga East State Forest, Bibblewindi State Forest and Jacks Creek State Forest, in which the project infrastructure is located, maintains connectivity with large expanses of habitat occurring within numerous state forests and nature reserves to the south and west. This expanse of continuous habitat likely facilitates the movement of many fauna species across the landscape and adds to the conservation value of the area.

Aquatic species

The project is located within the Namoi River Catchment. Major drainage lines in proximity to the project include Bohena, Bibblewindi, Cowallah, Yellow Spring and Jack Creeks. All of these five creeks are ephemeral. Bohena Creek flows into the Namoi River downstream of Boggabri. The Namoi River is associated with an extensive floodplain and approximately one quarter of the basin is prone to flooding (NSW Office of Water, 2013).

Database search results indicate that seven threatened aquatic species (six fish and one invertebrate) and one EEC may occur within the vicinity of the project area.

5.2.2 Potential issues

The proposed development would require the clearing of vegetation to enable the construction of the gas field, gas processing facility and water processing facility. This may result in the following impacts to ecology:

- Vegetation clearing resulting in a loss of native vegetation, including threatened flora species, EECs and CECs.
- Vegetation clearing resulting in a loss of fauna habitat for a diversity of reptiles, amphibians, birds and mammals, including threatened species, migratory species and threatened populations.
- Vegetation clearing resulting in habitat fragmentation, which may reduce the capacity of some less mobile fauna to move within and between patches of remaining habitat.
- Fauna mortality may result from clearing activities, collisions with vehicles or plant, or accidental entrapment in plant, trenches or other earthworks.
- Changes in runoff, redirection of flows, influences to groundwater, infiltration, pollution, sedimentation and erosion may contribute to the alteration to the natural flow regimes of rivers and streams, floodplains and wetlands.
- Edge effects and weed invasion may occur along newly cleared edges, areas of soil disturbance and areas in proximity to existing weed infestations.
- Alteration to air quality and noise environments may impact upon the roosting, breeding and foraging activities of locally occurring fauna.

5.2.3 Strategy to address potential issues

In designing the proposed development and during gas field development, primary consideration would be given to measures to avoid or minimise impacts. Where avoidance and mitigation are not possible, offset strategies may be considered. The steps in the avoid, mitigate and offset approach are as follows:

- Avoid areas of high biodiversity value, wherever possible (e.g. avoid Brigalow Park Nature Reserve, co-locate infrastructure with existing roads, fence lines, access tracks and pipeline easements, etc.) by implementing a field development protocol which would set out the locational principles for micro-siting of infrastructure.
- Mitigate actions and safeguard values identified for retention by prescribing appropriate controls.
- Compensate for or offset the removal of biodiversity values.
- To avoid impacts on biodiversity at a site scale, an in-field micro-siting procedure would be developed. The micro-siting procedure would include:
  - Sensitivity mapping progressively updated as new data becomes available.
  - Ground-truthing and further mapping of ecological values (e.g. threatened flora populations) to facilitate micro-siting of the infrastructure consistently with the locational principles in the field development protocol.

Santos would use the ecological sensitivity analysis to avoid and minimise impacts on areas of high ecological sensitivity. These measures would be detailed in relevant plans and procedures that would accompany an Environmental Management Plan, which may include a Clearing Procedure, Fauna Rescue Procedure and Vegetation Management Plan (including weed management and re-vegetation).

Further assessment and management activities to be carried out as part of the environmental assessment for the proposed development would include the following:

- Review of vegetation mapping, threatened terrestrial and aquatic flora and fauna records and previous surveys.
- Targeted field surveys to identify the occurrence of terrestrial and aquatic flora and fauna (including threatened flora and fauna species, populations and ecological communities) and to assess ecological values present within the project area.
- Ecological sensitivity mapping and predictive modelling to identify ecological values present within the project area. The mapping would be based on previous detailed field surveys of ecological values (e.g. vegetation types, threatened flora and fauna, ecological sensitivity) and predicted spatial extrapolation.
- Establishing field development planning and well pad siting protocols and upper limits of disturbance.
- Assessment of impacts, including cumulative impacts, on threatened terrestrial and aquatic flora and fauna species, populations and ecological communities listed under the TSC Act, FM Act and the EPBC Act and their habitats, and consideration of key threatening processes.
- Assessment of impacts on aquatic and riparian habitat.
- Assessment of fire hazard.
- Identification of appropriate management and mitigation measures to avoid, minimise, mitigate or offset the potential impacts to ecology, including:
  - Detailed sensitivity mapping to inform field development planning.
  - Micro-siting of well pads.
  - Pre-clearing survey to re-locate fauna species and habitat features prior to clearing.
  - Clearing within approved overall limits for specific ecological features.
  - Measures to protect ecological values to be retained, such as exclusion fencing, sediment and erosion controls, signage and site inductions.
  - Rehabilitation of disturbed sites, including weed management.
  - Measures to offset the removal of high conservation vegetation.

5.3 Surface water quality and hydrology

5.3.1 Existing environment

The project is located within the Namoi catchment which is based around the Namoi, Manilla and Peel rivers. The Namoi catchment borders the Gwydir and Castlereagh catchments and is bounded by the Great Dividing Range in the east, the Liverpool Ranges and Warrumbungle Ranges in the south, and the Nandewar Ranges and Mount Kaputar to the north. Stretching from Bendemeer in the east to Walgett on the western boundary, the Namoi catchment is approximately 42,000 square kilometres and over 350 kilometres long. Elevations range from over 1,500 metres to the south and east to 100 metres on the alluvial floodplain of the lower catchment west of Narrabri (NSW Office of Water, 2011).

The Namoi catchment has been used for agricultural activities for over 100 years, and supports significant cotton and broadacre cropping, in addition to sheep and cattle grazing. Surface water quality is affected by spray drift, vapour transport and runoff from agricultural practices, particularly cropping (NSW Office of Water, 2011).

The Namoi catchment provides water resources to water users including local councils and water utilities, dryland agriculture, irrigated agriculture (cotton), livestock grazing and forestry. The catchment also contains important environmental features including the largest remaining dry sclerophyll forest west of the Great Dividing Range in NSW, and numerous small lagoons, wetlands, and anabranches associated with the river, in addition to extensive areas of floodplain woodlands (NSW Office of Water, 2011).

5.3.2 Potential issues

The proposed development may result in the following impacts to surface water:

- Erosion, sedimentation and reduction of water quality in local waterways or floodplains during construction.
- Surface water contamination due to chemical spill or fuel release as a result of accidents and leakages, brine and produced water pond overflow, or pipeline/gathering system leakages.
- Disturbance of waterway beds and banks resulting in bank erosion and increased sediment loads in adjacent creeks and downstream.
- Modification to local waterways or flood prone lands through the installation of the gas and water gathering infrastructure.
- Changes to the velocity, location and magnitude of floods and flood characteristics due to construction within flood prone lands.
- Impacts on surface water flows and/or water quality from discharge of treated permeate water from the water management, treatment and beneficial reuse facilities.
- Impacts to riparian vegetation as watercourses are crossed by the gathering systems.
- Impacts to surface water quantity and quality from excessive irrigation of produced water following treatment.

5.3.3 Strategy to address potential issues

Further assessment would include the following:

- Identification of sensitive surface water receiving environments.
- Assessment of impacts to water quality during construction and operation and identification of management and mitigation measures.
- Assessment of the impacts on surface hydrology and flooding.
- Identification of appropriate design requirements and of management and mitigation measures in relation to flooding.
- Consideration of existing water quality, and detailed assessment of constraints and opportunities for beneficial discharge of treated permeate water into receiving environments, including measures to ensure treated permeate is fit for purpose.
- Development of a water management strategy to provide a strategic management framework for the long-term adaptive and sustainable management of treated water.

5.4 Groundwater

5.4.1 Existing environment

The project falls within the Namoi River catchment, an area that includes one of the most intensely developed groundwater resources in Australia. Groundwater in the Namoi catchment supports an irrigation industry worth in excess of $380 million as well as being the water supply for many towns and water intensive industries (Namoi CMA, 2013). There are a total of 700 license holders in the Namoi catchment. Groundwater bores are primarily located in alluvial aquifers associated with the main rivers and their tributaries. Local drinking water for Narrabri and Boggabri is sourced from groundwater bores close to those townships, indicating good water quality.

A number of aquifer systems are present beneath the project area. The main systems include:

- Quaternary alluvial aquifers associated with the major rivers and their tributaries.
- The Jurassic aged Pilliga Sandstone aquifer that is part of the Great Artesian Basin.
- Permian aged aquifers associated with the Permo-Triassic Sydney-Gunnedah Basin. These include the strata above and below the target coal seams being the Late Permian Black Jack Group and the early Permian Maules Creek Formation.

In between the aquifers identified above, there are a number of geological units that provide a probable hydraulic barrier and hence impede the movement of water between aquifers (CH_2M Hill, 2013). These are known as aquitards and include:

- The Purlawaugh Formation.
- The Digby Formation.
- The Napperby Shale.
- The Watermark, Porcupine and Upper Maules Creek Formations.
- The Lower Maules Creek, Goonbri and Leard Formations.

A typical cross section showing the geology, aquifers and likely aquitards within the project area is shown in Figure 7. Santos would extract groundwater from the Black Jack Group and the Maules Creek Formation during the proposed development, if approved.

A number of water sharing plans apply across the study area. These include:

- Namoi Unregulated and Alluvial.
- NSW Upper and Lower Namoi Groundwater Source.
- NSW Great Artesian Basin Groundwater Sources.
- NSW Murray Darling Basin Porous Rock Groundwater.
- NSW Murray Darling Basin Fractured Rock Groundwater Sources.

Any groundwater extracted from these plans would be subject to relevant licensing requirements. Where relevant, the geological layers that the water sharing plans refer to are also shown in Figure 7.

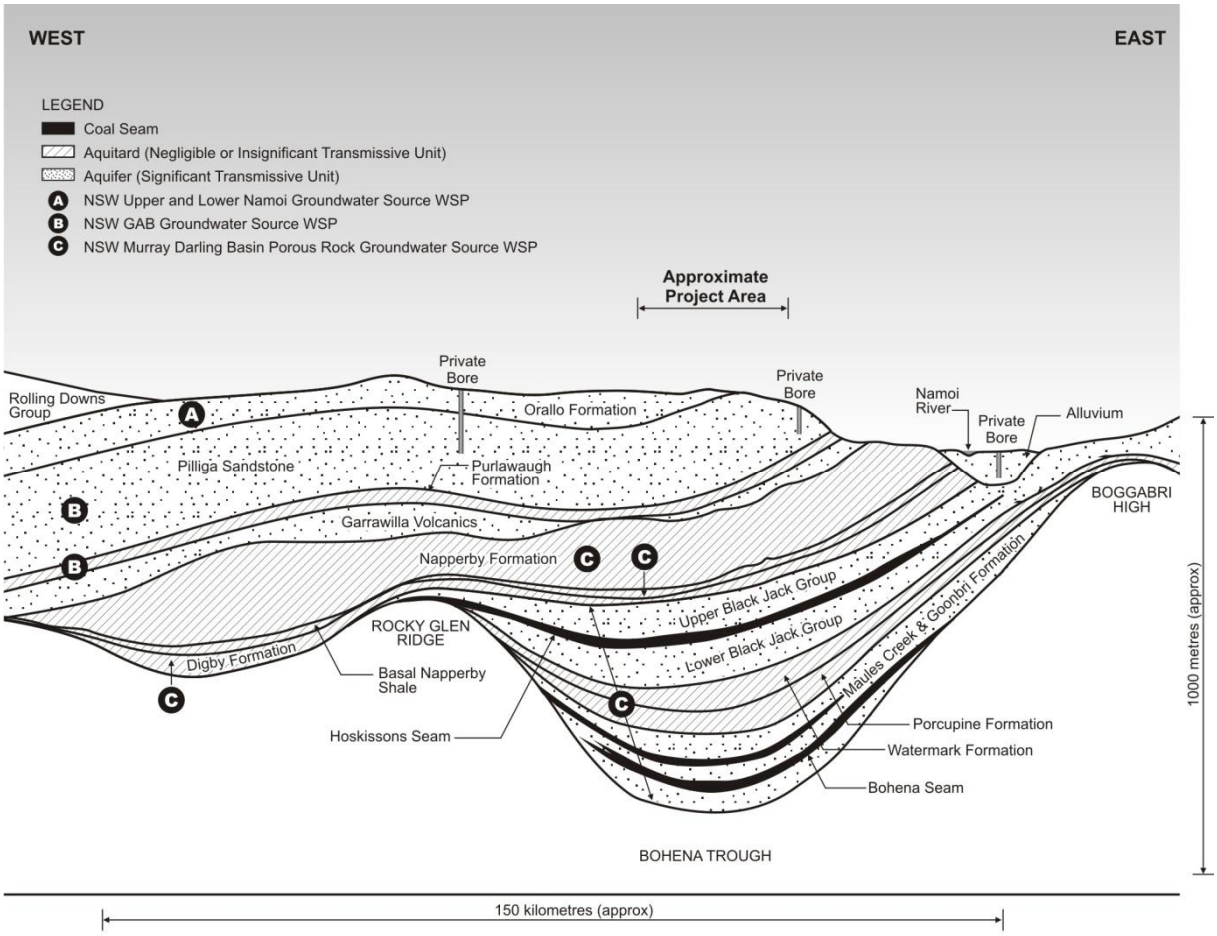


Figure 7 Project area hydrogeology

5.4.2 Potential issues

The proposed activities that have the potential to impact groundwater include:

- Drilling and installation of coal seam gas wells.
- Installation of groundwater monitoring wells.
- Management of produced water, permeate and brine.
- Dewatering of groundwater aquifers during operations.

Other project infrastructure (excluding the wells), such as gas and water flow lines are shallow in nature and their construction is therefore unlikely to intercept major alluvial systems within the catchment, however, this will be assessed further as part of the impact assessment process.

Groundwater studies undertaken in the project area suggest that several of the confining geological layers including the Purlawaugh Formation and Napperby Shale substantially reduce the hydraulic connectivity between the shallower Quaternary alluvial aquifers, the Great Artesian Basin units such as the Pilliga Sandstone, and the target coal seams. Therefore, based on the modelling completed to date, the upper Quaternary aquifers and the Great Artesian Basin units are unlikely to be impacted by the coal seam dewatering process (CH_2M Hill, 2013).

The project infrastructure has the potential to impact groundwater through:

- Hydrostatic depressurisation within the coal seams. As noted above, this is likely to have limited impact on current groundwater supplies from Quaternary alluvial aquifers due to

the presence of aquitards, and the fact that the coal seam groundwater is not currently available to users or the environment.

- Leakage from aquifers if coal seam gas wells are poorly constructed.
- Changes to groundwater quality.
- Cumulative impacts to regional groundwater resources including:
  - Cross-contamination of groundwater resources.
  - Cumulative drawdown impacts.
  - Subsidence.
- Contamination of alluvial groundwater due to mismanagement of produced water such as the overtopping of or leakage from ponds or rupture of the water gathering system. Produced water can contain elevated concentrations of total dissolved solids, heavy metals, and/or certain cations and anions commensurate with in situ groundwater quality.
- Changes to groundwater dependant ecosystems including stygofauna.

The Namoi Catchment Water Study (Schlumberger Water Services (Australia) Pty Ltd, 2012) provides an integrated suite of models to assess the nature and extent of potential effects from coal and coal seam gas developments on the Namoi region water resources. In addition, Santos has developed a complimentary project-specific groundwater model to assist with the identification and assessment of impacts associated with the project.

The project-specific model that has been developed simulates the potential cumulative impact on surface water and groundwater resources and Groundwater Dependent Ecosystems from the operation coal seam gas wells. Initial model development has included:

- Data collation, literature review and gap analysis.
- Characterisation of the groundwater environment, including identification of environmental values associated with groundwater resources.
- Development of the hydrogeological conceptual model.
- Development of a groundwater flow model to facilitate the assessment of the potential impacts of coal seam gas water extraction on water resources.

Santos is implementing a surface and groundwater monitoring program to establish baseline data, confirm modelling assumptions and to monitor for any impacts from the proposed development. The monitoring of groundwater is required to confirm the absence or onset (and magnitude) of any impact associated with coal seam gas activities at both the deep and shallow aquifer level. Registered bore users currently extract water from the shallow aquifers, and whilst modelling has concluded that this activity would not be impacted, long-term monitoring over the duration of coal seam gas production is proposed.

5.4.3 Strategy to address potential issues

Further assessment on the potential groundwater impacts would include the following:

- Identification of sensitive groundwater receiving environments including groundwater dependent ecosystems.
- Identification of licensed groundwater users within the vicinity of the project area and an assessment of the risk of impact to those users.

- Identification of activities and hazards that may increase risks to groundwater quality during construction and operation of the project.
- Consideration and application of the Aquifer Interference Policy (DTIRIS, 2012) as it relates to all facets of the proposed development.
- Assessment of the impacts associated with coal seam depressurisation and cumulative impacts to groundwater with particular reference to the Upper and Lower Namoi Alluvium and the southern recharge groundwater sources of the NSW Great Artesian Basin. This would be completed by undertaking a groundwater model simulation run once produced water volumes and the project schedule has been finalised.
- Consultation with relevant government agencies, including the NSW Department of Primary Industries Office of Water regarding the proposed development and proposed groundwater assessment methodology.
- Identification of appropriate management and mitigation measures to avoid, minimise, mitigate or offset impacts to groundwater, including but not limited to:
  - Ensuring that all wells are drilled and constructed in accordance with the *Code of Practice for Coal Seam Gas - Well Integrity* (DTIRIS, 2012).
  - Developing a water management strategy to provide a strategic management framework for the long-term adaptive and sustainable management of treated permeate water.
  - Monitoring of groundwater.

5.5 Socio-economic

5.5.1 Existing environment

The project would be located within the Narrabri LGA. In 2011, there were approximately 12,925 persons residing in the Narrabri LGA. In 2011, the largest industry employer in the Narrabri LGA was the sheep, beef cattle and grain farming sector with 684 persons, or 11.7% of the total workforce. The school education (4.8%), other crop growing (4.6%), agriculture and fishing support services (3.3%) and cafes, restaurants and takeaway food services (3.2%) sectors were also significant employers (ABS, 2013a). Mining accounted for less than 3.2% of the total employment in the Narrabri LGA in 2011 (ABS, 2013a).

5.5.2 Potential issues

Benefits associated with the proposed development may include:

- Approximately 1,200 jobs during the construction phase.
- Approximately 200 additional jobs during the operational phase.
- Direct and indirect benefits to the local economy through use of local goods and service providers across both construction and operational phases.
- Injection of funds to the local community through payment of royalties to the community benefit fund.
- NSW gas security.

Adverse impacts may include:

- Cumulative impacts from the proposed development and other regional resources projects including:

  - Excessive demand on local temporary accommodation, housing, education facilities, general amenities and community infrastructure.
  - Labour shortages in other local businesses, potentially increasing the price of local labour, raising the need to source labour from outside the Narrabri/Gunnedah/Warrumbungle LGAs, altering economic and employment benefits for the region.
- Temporary interruptions to property access during construction impacting residential and agricultural activities such as produce haulage and livestock handling.
- Reduced access to state forests for recreational use and/or impacts on timber production in the Pilliga East State Forest.
- Impacts on agricultural land and management, primarily during construction.

There is also growing concern from the public around perceived insufficient research and community health risks resulting from extraction of natural gas from coal seams, particularly related to water quality and fugitive emissions.

Increased population and employment opportunities within a small rural town also change the social fabric of the community which can have either benefits or adverse impacts, depending on the individual.

5.5.3 Strategy to address potential issues

Further assessment would include the following:

- Assessment of the socio-economic impacts and benefits of the proposed development, including cumulative impacts on local towns and on local industries such as agriculture, forestry and tourism.
- Assessment of potential health risks associated with water quality and fugitive emissions.
- Assessment of impacts on local access and amenity resulting from construction and operation of the proposed development.
- Assessment of social infrastructure capacity to accommodate increased population.
- Provision of fly in/fly out workers to reduce the pressure placed on the local infrastructure (i.e. education, housing and community infrastructure) and labour market.
- Consultation with stakeholders including local landowners, community groups, businesses and local councils.
- Investigation into community health risks from the proposed development.
- Identification of appropriate management and mitigation measures.

5.6 Non-Aboriginal heritage

5.6.1 Existing environment

The project is located primarily within state forest and agricultural land. Existing forested land once formed part of a much larger expanse of vegetation known as the Pilliga Scrub. Evidence of pastoral and forestry activities in the eastern Pilliga Scrub date from the 1880s, when large areas were under timber and grazing licences (Rolls 1981).

In 1916 and 1917, parts of the area were gazetted as some of the earliest state forests in NSW. These original forests were augmented after World War II to meet the increasing timber demands of the post-war housing boom (Rolls 1981).

Historic register database searches were carried out in September and October 2013. The results of the searches are detailed in Table 3. Several items of non-Aboriginal heritage significance were identified within or in the vicinity of the project area (i.e. within 5 kilometres of the project area boundary). These items, however, would not likely be impacted by construction or operation of the proposed development.

Based on database searches and the historical context, it is predicted that historic heritage sites and/or places present within the project area may be associated with:

- Exploration e.g. survey markers, blazed trees.
- Timber harvesting e.g. wood/sleeper cutters camps, huts, saw pits and mills.
- Agriculture e.g. homesteads, sheds, machinery, stock routes, stock yards and fences.

5.6.2 Potential issues

Construction and operation of the proposed development would result in surface and sub-surface disturbance. These activities have the potential for direct and indirect impacts on sites of known and unknown non-Aboriginal heritage.

5.6.3 Strategy to address potential issues

The detailed design for the proposed development would seek to minimise impacts, as far as practicable, on non-Aboriginal heritage items. Further assessment would include the following:

- Investigation and further field survey to identify additional non-Aboriginal heritage items.
- Assessment of the significance of heritage items that would be impacted in accordance with The Burra Charter (Australia ICOMOS, 1999), Assessing Heritage Significance (NSW Heritage Office, 2001) and Statements of Heritage Impact (NSW Heritage Office, 1991) including cumulative impacts and cultural landscape impacts.
- Undertake archaeological test investigations during construction, where required.
- Consultation with stakeholders such as the Office of Environment and Heritage, local councils and other government and non-government stakeholders.
- Identify appropriate management and mitigation measures, including but not limited to:
  - For unavoidable direct impacts, implementing photographic archival recording in accordance with the relevant Heritage Council of NSW guidelines.
  - Avoiding impacts during construction through implementation of no-go zones.
  - Implementing an unexpected finds procedure for unidentified relics or sites encountered during construction.

Table 3 Non-Aboriginal heritage register search results

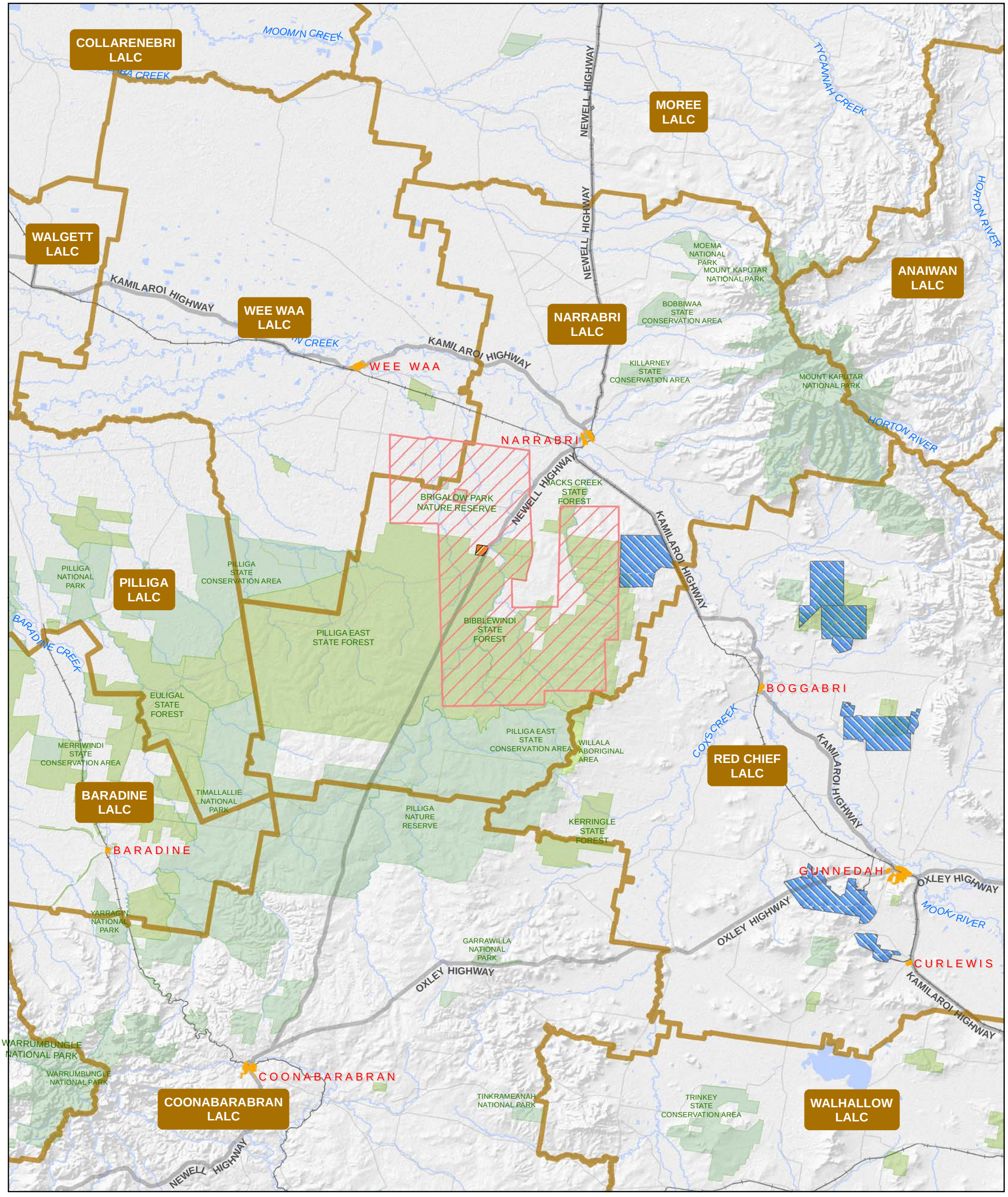
Listing	Results
World Heritage List	There are no items within, or in the vicinity of, the project area.
Register of the National Estate	Six items are located within the vicinity of the project area. These items are located in Narrabri (five) and Wee Waa (one) and would likely not be impacted by the proposed development.
National Heritage List	There are no items within, or in the vicinity of, the proposed project area.
Commonwealth Heritage List	One item in Narrabri is located within the vicinity of the project area. This item would likely not be impacted by the proposed development.
NSW State Heritage Register	One item in Narrabri is located within the vicinity of the project area. This item would likely not be impacted by the proposed development.
State Agency Section 170 Registers	Fifteen items in the Narrabri LGA have been listed by local councils, shires and state government agencies. Eleven items, eight of which are located in Narrabri and three in Wee Waa, are located in the vicinity of the project area. These items would likely not be impacted by the proposed development.
Interim Heritage Orders, Authorised Interim Heritage Orders, State Agency Section 136 Registers, Regional Environmental Plan	There are no items listed within, or in the vicinity of, the proposed project area.
Narrabri LEP	Forty items are listed in the Narrabri LGA. Twenty items in Narrabri and three in Wee Waa would be located in the vicinity of the project area. These items would likely not be impacted by the proposed development.

5.7 Aboriginal heritage

5.7.1 Existing environment

The project is located within the boundaries of the Narrabri and Wee Waa Local Aboriginal Land Councils (LALCs) (refer to Figure 8), and wholly within the area of the Registered Native Title Claimants - the Gomeroi People (refer to Figure 9).

A search of the Office of Environment and Heritage Aboriginal Heritage Information Management System (AHIMS) database was undertaken in September 2013 to determine whether there are any Aboriginal sites within the project area or vicinity (i.e. within 5 kilometres of the project area boundary).



LEGEND

- Project area
- Local Aboriginal Land Council (LALC) boundary
- Leewood property
- Existing and proposed coal mining
- Regional parks and reserves
- Aboriginal area
- State forest
- Built up areas
- Lakes and dams
- Waterways
- Roads
- Railways

0 5 10 20
Kilometres

Horizontal Datum: GDA 1994
Grid: GCS GDA 1994

N

GHD

Narrabri Gas Project - Gas Field
Preliminary Environmental Assessment

Job Number	21-22463
Revision	0
Date	14 Feb 2014

Local Aboriginal Land Councils

Figure 8

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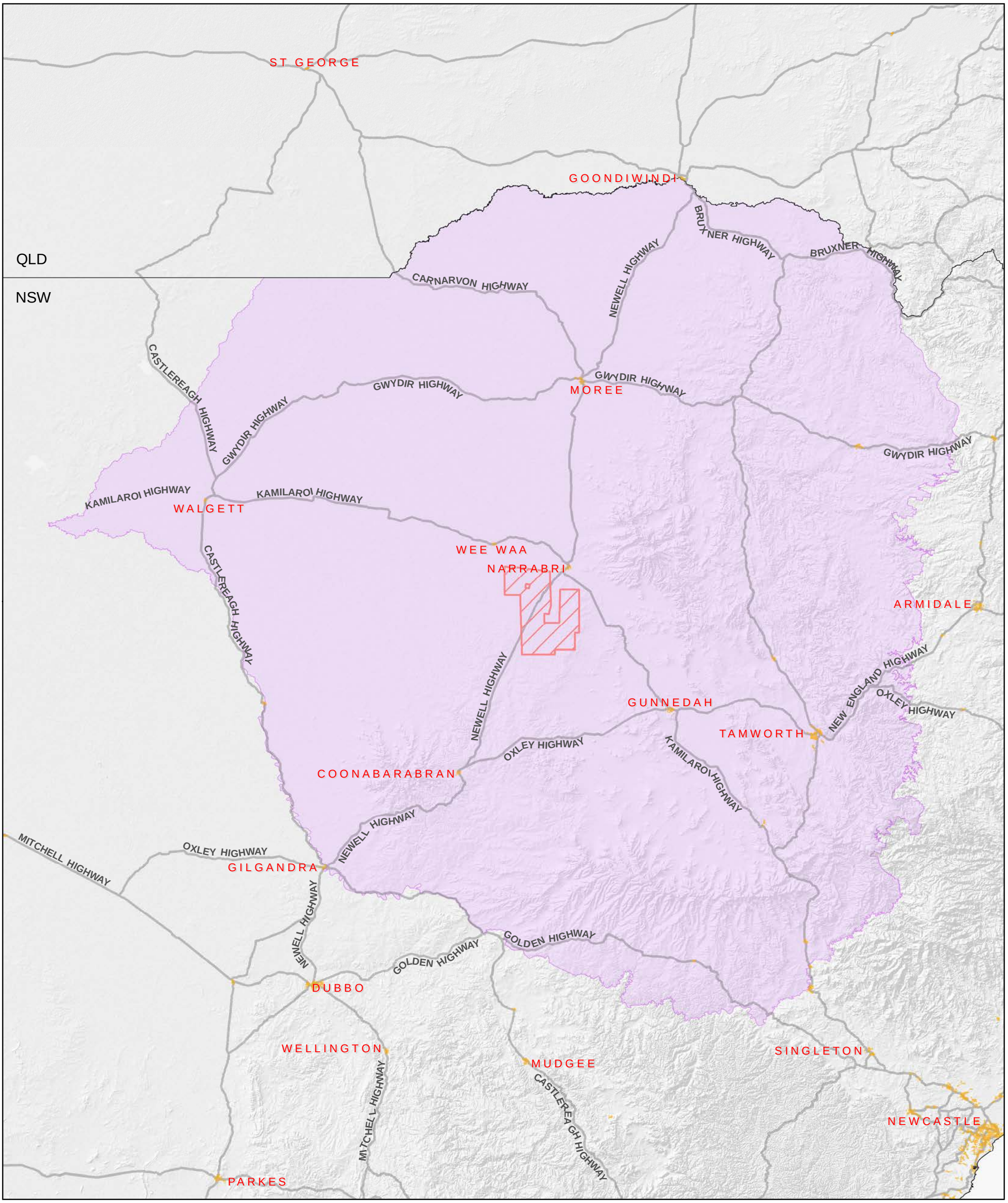
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: NSW Department of Lands: DTDB and DCDB - 2012. Created by: bahambly



LEGEND

- Project area
- Gomeroi People Native Title Claim
- Built up area
- Roads

0 20 40 80
Kilometres

Horizontal Datum: GDA 1994
Grid: GCS GDA 1994

N

Narrabri Gas Project - Gas Field
Preliminary Environmental Assessment

Job Number	21-22463
Revision	0
Date	14 Feb 2014

Extent of Gomeroi Native Title Claim

Figure 9

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data Source: NSW Department of Lands: DTDB and DCDB - 2012. Commonwealth Australia: National Native Title Tribunal - 2013. Created by: bahambly

The database search results indicate that 160 registered Aboriginal sites have been recorded in the vicinity of the project area. The database search results are presented in Table 4.

Of these 160 Aboriginal sites, 22 are located within the project area. These include 14 modified trees, seven artefacts and one grinding groove site. There may also be Aboriginal heritage sites within the project area that have not been recorded within the AHIMS.

The native title claim of the Gomeroi People was registered by the National Native Title Tribunal on 20 December, 2011. This claim extends over an area of approximately 111,340 square kilometres and encompasses the project area. Santos has engaged directly with the Gomeroi Registered Applicants and with NTSCORP Limited, which is the native title representative body for NSW, and would continue to consult and negotiate with them regarding the potential impacts of native title (and as cultural heritage stakeholders) on areas within the project area.

Table 4 AHIMS database search results

Item	No. recorded in vicinity of project
Aboriginal ceremony/dreaming	1
Artefact	135
Burial	1
Grinding groove	2
Habitation structure	2
Hearth	2
Modified tree	16
Shell	1
Total	**160**

5.7.2 Potential issues

Surface and sub-surface disturbance may have the potential for direct and indirect impacts on items of Aboriginal cultural heritage, including:

- Impacts to archaeological deposits, modified trees, artefacts, or habitation structures.
- Impacts to cultural sites such as corridors of movement and landscapes.
- Impacts to burial sites.
- Impacts on native title rights and interests.
- Impacts to unknown Aboriginal cultural heritage.

5.7.3 Strategy to address potential issues

The overall strategy for the protection and management of Aboriginal cultural heritage would be to work with the relevant Aboriginal parties to enable the assessment of the impacts of the proposed development on Aboriginal cultural heritage and to develop an integrated and comprehensive management framework for cultural heritage that would apply for the life of the project.

Santos is currently undertaking an audit of all Aboriginal cultural heritage, including information held by the Narrabri LALC. An analysis of the information identified through the audit will be undertaken in collaboration with the Registered Native Title party, Narrabri LALC and the NSW Office of Environment and Heritage. Santos will also undertake targeted field surveys to ground-truth selected historic site data.

In addition to the data audit, Santos proposes to undertake the following activities as part of the environmental assessment:

- Identification, notification and registration of Aboriginal people who hold cultural knowledge relevant to the project area.
- Provide registered Aboriginal parties with information about the scope of the project and the proposed cultural heritage assessment process.
- Undertake consultation with the Aboriginal parties in regards to gathering cultural information, research methods, identifying the potential impacts of the proposed development on Aboriginal cultural heritage and management options. This information will inform zone mapping to guide field development, construction and operation during production and assessment of impacts.
- Assessment of potential impacts on Aboriginal cultural heritage and appropriate mitigation measures in relation to the project.

In contrast to many local resource developments which are required to clear and excavate large areas of land in specific locations, the proposed development would have greater flexibility in siting of infrastructure, and in particular, wells and gas and water gathering lines. Consultation with key Aboriginal stakeholders will include the development of a robust cultural heritage management framework that will guide the micro-sitting of infrastructure at the time of construction. Field development would be undertaken in consultation with the relevant Aboriginal stakeholders and would seek to minimise impacts, as far as practicable, on Aboriginal heritage. The framework will be informed by a number of elements as described in Figure 10.

The Santos Cultural Heritage Standards and supporting systems would ensure compliance with:

- The management framework developed with the Aboriginal stakeholders.
- All legislative requirements, in a manner that is comprehensive, documented and auditable.

The Cultural Heritage Management Framework will include appropriate response management protocols and systems for landscapes, sites and objects as identified in the mapping and will be finalised prior to construction commencing.

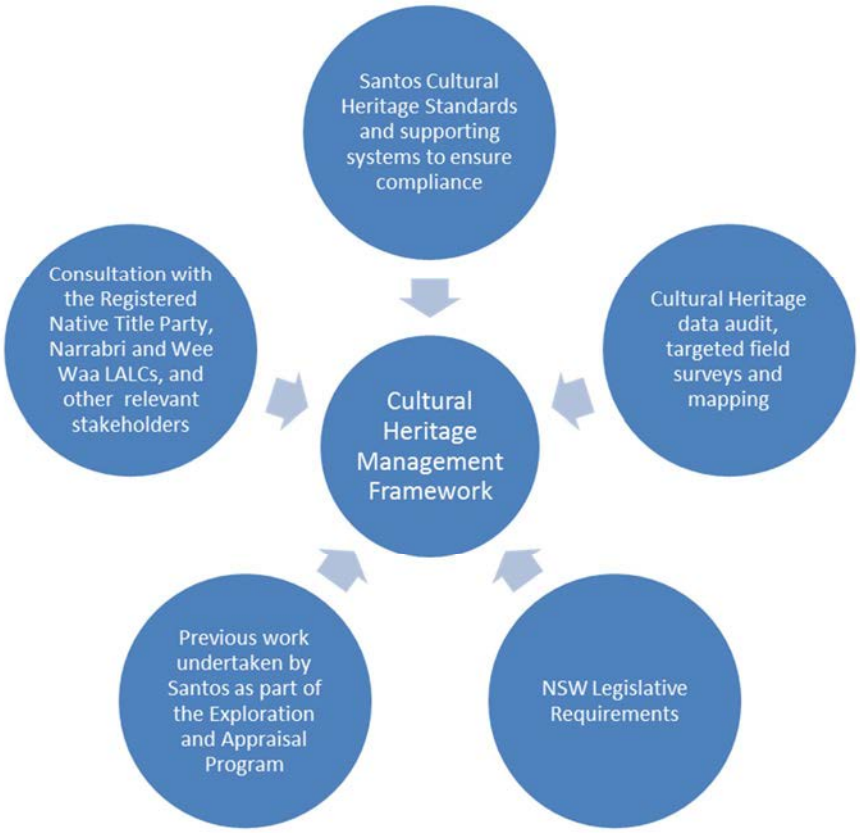

Figure 10 Development of a Cultural Heritage Management Framework

5.8 Traffic and transport

5.8.1 Existing environment

The Newell Highway (the Newell) passes through the project area. The Newell extends more than 1,000 kilometres south from Goondiwindi (in Queensland) to Tocumwal (in NSW), via Narrabri, and acts as a major transport route between NSW and Queensland. Near Narrabri, the Newell carries approximately 1,860 vehicles per day with approximately 40% heavy vehicles. The proportion of heavy vehicles is seasonal and dependent on agricultural activities within the region.

To the east of the project area is the Kamilaroi Highway, which extends west from Willow Tree (south of Tamworth) to Bourke, passing through the regional centres of Quirindi, Gunnedah, Narrabri, Walgett and Brewarrina. Both roads are two-way rural highways, with one lane in each direction. Within the project area, most roads are either minor sealed roads or unsealed roads used primarily for agricultural purposes, in addition to unsealed forest roads and management tracks. Traffic on the road network through and surrounding the project area is operating with considerable spare capacity despite moving a higher than average proportion of heavy vehicles.

Public transport in the vicinity of the project area is very limited. There are no regular bus services along the Newell (apart from school bus routes) between Narrabri and Coonabarabran. There are also limited dedicated cycle and pedestrian facilities.

5.8.2 Potential issues

The proposed development may result in the following impacts to traffic:

- Construction within existing road reserves, plus the addition of both light and heavy vehicle traffic for the delivery of plant, equipment and materials could affect the operational capacity and safety of the existing local and regional road network, including:
  - Delays and reduced efficiencies for regional and local traffic movements, including forestry vehicles.
  - Damage to local roads from construction vehicles.
- Increased usage of regional airports including Narrabri, Moree and Tamworth from fly-in, fly-out personnel that could strain the operational capacity of the airports.
- Traffic generation during operation would predominantly be light vehicle movements of personnel getting to and from work sites and some heavy vehicle movements associated with both operation and maintenance activities.
- Access to the project area during construction and operation would require the construction of access tracks that would connect the infrastructure with the existing road network. Access tracks and minor roads would typically be constructed as unsealed roads.

5.8.3 Strategy to address potential issues

Further assessment would include:

- Identification of the existing traffic and transport performance of the local and regional road network including traffic efficiency, access arrangements and public transport services.
- Identification of likely haulage routes.
- Estimation of road traffic associated with construction and operation of the proposed development.
- Assessment of the impacts of construction and operation traffic on the capacity, efficiency and safety of the road network including any local/forestry access arrangements and changes to local roads.
- Assessment of impacts to the operational capacity of Narrabri and potentially, Moree and Tamworth Airports.
- Identification of appropriate management and mitigation measures.

5.9 Noise and vibration

5.9.1 Existing environment

The project infrastructure would predominantly be located within state forest and in agricultural areas with low residential density. Existing noise sources are expected to be typical of the environment including those generated by commercial logging operations, agricultural activities and traffic along local roadways and the Newell Highway.

Noise investigations have been recently conducted within the forest for Santos exploration and appraisal activities. Background noise monitoring was conducted in June and November, 2013, at four locations (both residential and forested locations) to establish existing noise levels. Rating Background Levels (RBL) between 23 and 32 dBA (day), 20 and 33 dBA (evening) and 16 and 35 dBA (night) were

recorded at the four locations. Ambient noise levels ranged between 43 and 48 dBA (day), 31 and 56 dBA (evening) and 33 and 54 dBA (night) and were identified as being primarily affected by residential and agricultural activities plus insects, birds and noise in vegetation (Noise Measurement Services, 2013).

The number of sensitive receivers within the project area has not yet been identified though would potentially include a number of residential receivers that would be identified and mapped through the EIS process. Noise constraints for residential receivers would be used to inform gas field development. Santos would locate the wells a suitable distance from sensitive receivers to achieve the Industrial Noise Policy (EPA, 2000) guideline during operation.

5.9.2 Potential issues

Construction of project infrastructure would generate noise from a variety of sources, including those from drilling activities and construction traffic. The impact of construction noise on sensitive receivers would be influenced by the proximity to works, the length of works, when works are undertaken and the types of equipment used.

The proposed development may result in the following impacts:

- Noise from construction activities, including the use of plough, trenching, and directional drilling equipment may impact on sensitive receivers along the gathering systems.
- Sleep disturbance during night time construction works.
- Noise from operational activities. The project infrastructure would generate noise from the in-field compression, the water management, treatment and beneficial reuse facilities and the central gas processing facility. This may have an impact on residential receivers in the project area.

5.9.3 Strategy to address potential issues

Further assessment would include the following:

- Identification of sensitive receivers.
- Consideration of construction activities including the types of plant and equipment to be used during construction and working hours.
- Noise monitoring to identify the prevailing ambient noise environments.
- Assessment of construction, operation and transport noise and vibration impacts against the relevant noise and vibration criteria.
- Identification of feasible and reasonable noise mitigation and management measures.

Investigations would be in accordance with the following guidelines, as relevant:

- *Industrial Noise Policy* (EPA, 2000).
- *Interim Construction Noise Guideline* (DECC, 2009).
- *Assessing Vibration: A Technical Guideline* (DECC, 2006).
- *NSW Road Noise Policy* (DECCW, 2011).

5.10 Air quality and greenhouse gases

5.10.1 Existing environment

Regional air quality within the project area is generally good and representative of a rural environment.

The air quality is influenced by mining, exploration activities of natural gas from coal seams, and agriculture. The National Pollutant Inventory lists nine sources of emissions within the Narrabri LGA. These include:

- Boggabri Coal Mine.
- Boral Narrabri Quarry.
- Cargill Processing Narrabri.
- Lowes Petroleum Narrabri Depot.
- Boland Petroleum Narrabri Depot.
- Narrabri Coal Mine – Baan Baa.
- Narrabri Coal Seam Gas Project (currently non-operational).
- Wilga Park Power Station (currently non-operational).
- Tarrawonga Coal Mine.

5.10.2 Potential issues

Impacts on regional air quality as a result of the proposed development could include:

- An increase in dust during clearing, earthworks and construction activities.
- Air quality impacts during drilling associated with venting and flaring.
- Air quality impacts from emissions, such as exhaust fumes, generated by the operation of machinery and other construction vehicles.
- Operational emissions to the atmosphere including gas flaring, vehicle exhaust, and generators associated with the operation of the water management, treatment and beneficial reuse facilities and central gas processing facility.
- Fugitive greenhouse gas (GHG) emissions associated with gas extraction, transport and processing.
- Emissions from on-site power generation.
- Release of stored carbon as a result of vegetation clearing.

Atmospheric emissions may include:

- Carbon dioxide (CO_2).
- Carbon monoxide (CO).
- Methane (CH_4).
- Nitrogen oxides (NOx).
- Particulates and dust.

5.10.3 Strategy to address potential issues

Further assessment would include the following:

- Continue the collection of baseline CO_2 and CH_4 data across the site and surrounding areas.
- Identification of sensitive receivers for air quality.
- Identification of activities and weather conditions impacting air quality.
- Assessment of typical air quality impacts at sensitive receivers during construction and operation.
- Identification of best practice management measures (particularly dust suppression measures) to be implemented during construction of the proposed development.
- Quantitative assessment of the potential Scope 1, 2 and 3 GHG emissions including fugitive GHG emissions.
- Qualitative assessment of the impacts of these emissions on the environment.
- Identification of feasible and reasonable mitigation and management measures to minimise fugitive GHG and other emissions to air.

5.11 Landscape and visual amenity

5.11.1 Existing environment

The proposed development is within, and surrounded by, state forest and agricultural properties. The visual setting within the project area is generally representative of a productive rural environment. Sensitive receivers will be identified and assessed as part of the EIS. Identification and assessment of potential impacts will be undertaken as detailed in Section 5.11.3.

5.11.2 Potential issues

Most activities would be carried out in rural, low-density areas or state forest. The extent of construction and operation impacts would depend on the location of the proposed activities in relation to sensitive visual receptors, including adjacent rural residential properties. Infrastructure and lighting would likely be visible from surrounding properties and/or the surrounding road network; however, it is likely that existing vegetation would provide screening for some visual receptors.

Visual impacts associated with construction and operation of the project could include:

- Well head infrastructure and in-field compression in open areas.
- Gas processing and water treatment infrastructure at the Leewood property.
- Activities associated with the construction and operation of wells, gathering systems, flares and the gas processing facility and the water treatment facility.
- Construction and operation of worker camps, and lay down areas.
- Lighting for night works to accommodate 24 hour drilling of wells and other construction activities.
- Transport and traffic associated with the supply and delivery of materials, plant and equipment and personnel during construction and operation.

From a visual perspective, once the well is installed, the well head production infrastructure is relatively unobtrusive following rehabilitation of the majority of the disturbed area (refer to Figure 11).

5.11.3 Strategy to address potential issues

Further assessment would include the following:

- Identification of the visual qualities present, including the existing landscape character of the region, sensitive locations, visual catchments and key viewpoints.
- Assessment of impacts on sensitive visual catchments, especially from any permanent aboveground infrastructure and, where possible, siting that infrastructure outside sensitive visual catchments.
- Identification of appropriate management and mitigation measures including detail on landscape and rehabilitation measures.
- Partial rehabilitation of the well head footprint following well installation from approximately 1 hectare to approximately 0.09 hectare.

Figure 11 Typical well head infrastructure

5.12 Geology and soils

5.12.1 Existing environment

PEL 238 is located in the central portion of the Gunnedah Basin where Jurassic and Cretaceous Surat Basin sediments unconformably overlie Permo-Triassic Gunnedah Basin sediments. The Gunnedah Basin covers an area of more than 15,000 square kilometres 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.

The Gunnedah Basin consists of Early Permian to Late Triassic aged consolidated sediments of shallow marine and fluvial origin. These sediments are underlain by basement rocks of the Lachlan Fold Belt. Basement rocks of the New England Fold Belt abut the eastern boundary of the Gunnedah Basin.

The most important Gunnedah Basin structure within the project area is the Bohena Trough (refer to Figure 12). The Bohena Trough contains two well-developed coal measures, which are the primary coal seam gas targets for the proposed development. These are:

- The Late Permian Black Jack Group, which contains the Hoskissons Seam (between 6 to 10 metres thick, a laterally extensive seam, located at a depth of less than 700 metres).

- The Early Permian Maules Creek Formation, which contains the Bohena coal seam (up to 22 metres thick, a laterally extensive seam, located at depths of between 600 and 1,200 metres).

The project area is dominated by sandy soils associated with undifferentiated alluvium and deeper weathered sandstone. It is situated within outcropping Pilliga Sandstone recharge zones of the Great Artesian Basin. Due to the sandy soils, and subsequent high infiltration rates, precipitation would infiltrate the soil and then into the underlying sediments. Most stream sediment within this landscape is derived from Pilliga Sandstone plateaus, or as a result of reworking of the broad outwash plain.

Australian Soils Classification mapping identify the pilot sites and much of the surrounding area as being dominated by Sodosols, with some occurrence of Rudosols/Tenosols. Sodosols are typical of those derived from the Pilliga Sandstone and are described as being highly siliceous with poor soil nutrient status, and low Plant Available Water Capacity (NSW OEH 2012a).

Soil nutrient mapping by NSW OEH (2012b) confirms the low fertility in the project area, with the bulk of the area showing 'moderately low' as the inherent soil fertility classification.

Separate soil profiles collected by RPS at various locations within the project area also found soils to be either Rudosols/Tenosols or Sodosols (RPS 2013).

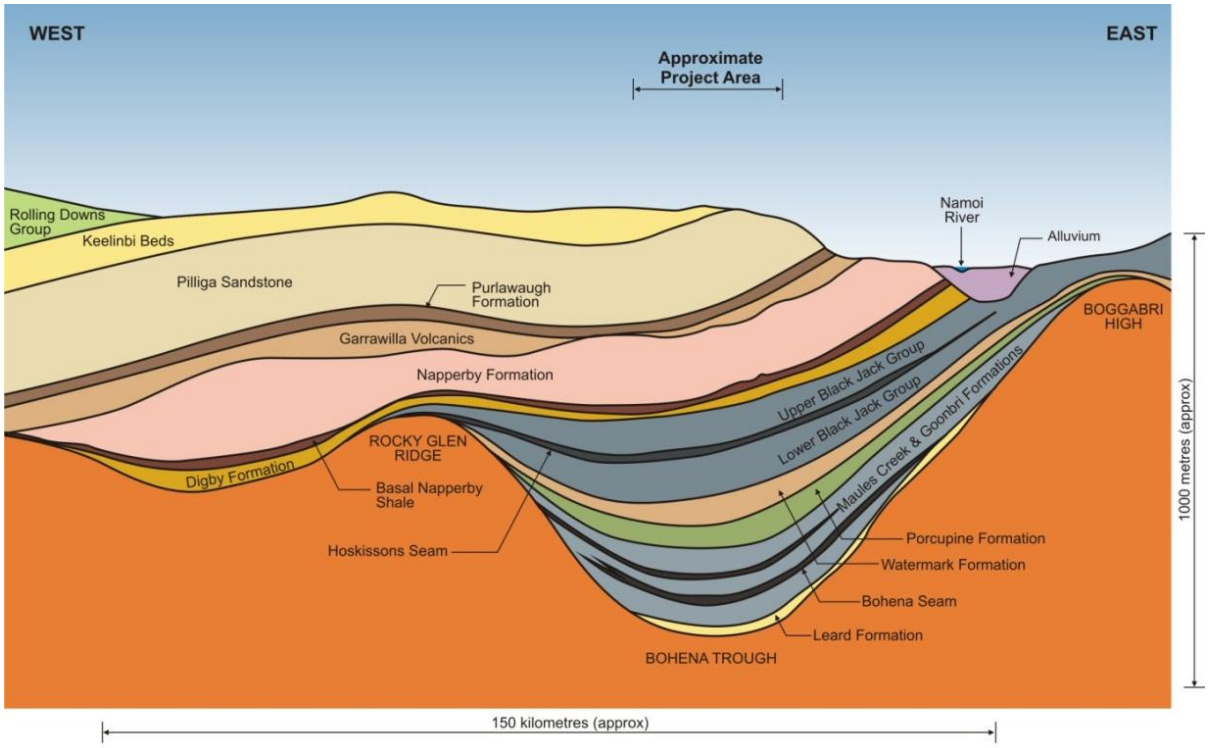

Figure 12 Schematic cross section through the Bohena Trough

A search of the contaminated land record database maintained by the EPA did not identify any recorded contaminated sites present in the project area. This database, however, is not a comprehensive list of all contaminated sites that may be present in the project area. Other contaminated sites may exist that have not been reported to the EPA, in particular where contamination from past or present agricultural or forestry practices has occurred.

5.12.2 Potential issues

Construction of the proposed development has the potential to impact soils within the project area. Impacts would be associated with the following activities:

- Clearing of vegetation to establish lease areas.
- Drilling and operation of wells.
- Pipe laying activities, including watercourse crossings and directional drilling for example.
- Construction and operation of ancillary infrastructure and associated access tracks.
- Storage of chemicals, produced water and waste (including brine).
- Rehabilitation failure.

The impacts of these activities may include:

- Contamination of soil from spills such as produced water, chemicals or fuel.
- Loss of topsoil and increased erosion potential due to clearance of vegetation, excavation and earthworks and pipe laying activities.
- Erosion of waterway banks and beds due to waterway crossings.
- Compaction of soils due to heavy machinery and construction vehicle traffic.
- Erosion and dust generation from soil stockpiles.
- Salinisation of soils from brine associated with spills due to infrastructure failure.
- Damage to soil structure through inappropriate soil handling and management.
- Rehabilitation failure in areas of more sodic soils.
- Disturbance of areas contaminated as a result of long term agricultural practices.

5.12.3 Strategy to address potential issues

Further assessment would include the following:

- Detailed review of the geology and soils within the project area.
- Identification of soil constraints including contamination, sodicity, acidity and salinity.
- Identification of slope instability and landslip areas.
- Identification of activities and hazards and risks that may increase erosion and other risks to soils during construction and operation.
- Identification of appropriate measures to avoid, minimise or mitigate impacts on geology and soils during construction and operation.
- Completion of a desktop contaminated sites investigation of the project area.

5.13 Waste management

5.13.1 Existing environment

Key waste streams currently produced in the vicinity of the proposed development are derived primarily from existing industry including:

- The Narrabri Quarry.
- The Narrabri Coal Mine.
- The Boggabri Coal Mine.

Waste associated with other activities in the vicinity of the proposed development may also include:

- General domestic waste (including sewage).
- Commercial and hazardous wastes (including from hospitals).
- Agricultural waste (including pesticides and herbicides).
- Industrial waste (including mining).

Waste is typically managed at a local government level with waste management infrastructure to suit the economic and social activities of that area.

5.13.2 Potential issues

Waste generated during construction of the proposed development may include:

- Excavated/drilling wastes.
- Vegetation waste from the removal of trees, shrubs and groundcovers that are unsuitable for onsite mulching and reuse.
- Packaging materials such as crates, pallets, cartons, plastics and wrapping materials.
- Used chemical, oil and fuel containers.
- Drilling fluid from well drilling and directional drilling for pipe laying.
- Sewage waste from portable facilities and from workers camps.
- Site compound waste such as liquid wastes from cleaning, repairing and maintenance, waste from spills, fuel or oil waste, sewage waste from site amenities and general office wastes.

Waste generated during operation of the proposed development may include:

- Brine resulting from produced water treatment activities.
- Liquid wastes (e.g. sewage, drilling fluids, fuels and hydrocarbons).
- Salt produced from the brine management, treatment and beneficial reuse facilities.
- Drilling fluid from well maintenance activities.
- General maintenance waste.

Mishandled or miss-managed waste may result in:

- Contamination of water and soils.
- Increases in feral and pest populations and weed infestation.

- Littering of construction sites, work camp areas and adjacent areas.
- Odours caused by chemical use or management of putrescible waste.
- Visual amenity impacts.

5.13.3 Strategy to address potential issues

Santos has received approval under their 2013 exploration and appraisal program (refer to Table 1) of a waste management strategy to minimise drilling fluid waste. As part of this strategy used drilling fluids generated as part of the exploration and appraisal program would be separated into liquids and solids (cuttings), with fluids being continuously reused throughout the drilling process. Once the well has been drilled, the drilling fluid would be displaced from the well by the cementation process or by production fluids.

To manage the treatment of drilling fluids, Santos has established the Narrabri Operations Centre on the Newell Highway south west of Narrabri which includes the fluids treatment facility. The fluids treatment facility would treat and store drilling fluids for future re-use in drilling activities.

Drilling fluids would be mixed at the fluids treatment facility and then transported to site. This would reduce wastes associated with mixing chemicals on site (such as chemical containers).

The residual volume of fluid would be tested prior to being removed from the site by a contractor licensed under the POEO Act to transport trackable wastes. It would be transported to a subsequent well for re-use or back to the fluids treatment facility for storage and treatment. Before drilling fluid is used on a subsequent well the chemical and physical properties would be tested and the fluid amended, as required.

There would be a residual amount of waste from the treatment facility in Narrabri which would eventually need to be disposed of at a licensed waste facility.

Santos would propose to continue the use of the fluids treatment facility during construction and operation of the proposed development.

Further assessment would include the following:

- Identification of specific waste impacts of the project infrastructure and the proposed approach to waste management.
- Options for salt management, beneficial use or disposal.
- Options for managing treated produced water.
- Identification of appropriate management and mitigation measures for waste including though not limited to:
  - A process for the co-ordination of use and re-use of resources.
  - Measures to minimise the production of waste.
  - Measures to manage and dispose of waste in accordance with relevant state legislation and government policies including the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act) and the *Waste Avoidance and Resource Recovery Strategy 2007*. The Office of Environment and Heritage *Waste Classification Guidelines* (DECC, 2008) would be used to classify the different types of waste, and develop the management, treatment and disposal protocols.

5.14 Hazards and risk

5.14.1 Existing environment

The project area is identified as bushfire prone and contains bushfire prone vegetation. Large bushfires, mostly started by dry thunderstorms, burn through the Pilliga and surrounding areas approximately every 10 years. The last major fire in the Pilliga was in 2006, occurring in Pilliga East State Forest and in Pilliga Nature Reserve. Due to the relatively low topography, quality and density of the forest vegetation, the vast majority of the area is identified as having a moderate to high severity bushfire hazard.

5.14.2 Potential issues

Santos has completed a project hazard and risk assessment which identified the following potential hazards associated with the construction and operation of the project infrastructure:

- Hazardous properties of materials processed, stored and used.
- Chemical storage:
  - Dangerous goods storage.
  - Bulk chemical storage.
- Well head – gas leak and fire impacting adjacent bushland and initiating a bush fire.
- Compressor station inlet pipework – gas leaks at flanges, valves and instrument fittings resulting in jet fire.
- Boost compressor to low pressure compressor – gas leaks at flanges, valves and instrument fittings resulting in jet fire.
- Low pressure compression and CO_2 removal including:
  - Gas leaks at flanges, valves and instrument fittings resulting in jet fire.
  - Gas leak at nozzle failure.
- High pressure compression and dehydration units including:
  - Gas leaks at flanges, valves and instrument fittings resulting in jet fire.
  - Gas leak at nozzle failure.
  - Chemical storage - combustible liquids storage - bund fire and delivery spill/pool fire.

5.14.3 Strategy to address potential issues

Further assessment would include the following:

- Preliminary hazard analysis to identify and screen hazards in accordance with Hazardous Industry Planning Advisory Paper No. 6 — Guidelines for Hazard Analysis (DoP, 2011).
- Preparation of a bushfire hazard and risk assessment.
- Identification of the management and mitigation measures for hazards and risk including but not limited to:
  - Utilising non-toxic, biodegradable drilling fluids.
  - Minimising hazards arising from jet flames and methane seepages at well heads or the gas processing facility.
  - Developing asset protection zones in accordance with *Planning for Bushfire Protection* (RFS, 2006).

– Developing separation zones between the gas processing facility and surrounding vegetation, and well heads and surrounding land uses.
– Developing a Bushfire and Emergency Management and Evacuation Plan.

5.15 Property and land use

5.15.1 Existing environment

The proposed development would be wholly located within the Narrabri LGA. Land use in the Narrabri LGA is dominated by agriculture (54.7%). Other land uses comprise rural residential development (18.7%), native vegetation (14.6%), irrigated plants consisting predominantly of cotton (11.1%), intensive animal husbandry (0.2%) and extractive industries (0.1%) (Edge Land Planning, 2009).

The majority of the project would be located in an area designated as either RU1 (Primary Production) or RU3 (Forestry) under the Narrabri LEP 2012. Brigalow Park Nature Reserve, which is surrounded by the project area though excluded from the project footprint, is designated E1 (National Parks and Nature Reserves). Land designated as RU1 (Primary Production) consists predominantly of agricultural land supporting dry-land cropping and pastoral (livestock) activities. Land designated as RU3 (Forestry) includes the Pilliga East State Forest, Bibblewindi State Forest and Jacks Creek State Forest. These state forests are designated Crown Lands under the *Forestry Act 1916.*

State forests and conservation areas in the region are administered under the *Brigalow and Nandewar Community Conservation Area Act 2005*, which designates the area into Community Conservation Areas. The purpose of Community Conservation Areas is to reserve land for conservation, protect areas of natural and cultural heritage significance to Aboriginal people, sustainable forestry and mining and other appropriate uses. Pilliga East State Forest, Bibblewindi State Forest and Jacks Creek State Forest located within the project area are managed as Zone 4 Community Conservation Areas, in accordance with the *Forestry Act 1916*. Zone 4 Community Conservation Areas are managed specifically for forestry, recreation and mineral extraction (NSW EPA, 2013). State forests within the project area and vicinity are also used for recreational activities such as bird watching and bushwalking, and hunting.

As discussed in Section 1.2, the proposed development would also be located within the following petroleum title areas - PEL 238, PAL 2 and PPL 3 (refer to Figure 1).

The New England North West SRLUP (DPI, 2012) represents one component of the NSW Government's broader Strategic Regional Land Use Policy which comprises multiple initiatives to address land use conflict in regional areas, particularly focused on managing coal and coal seam gas issues. The SRLUP maps areas of strategic agricultural land. Strategic agricultural land includes both land with unique natural resource characteristics, known as BSAL, and clusters of significant agricultural industries that are potentially impacted by coal seam gas or mining development, known as Critical Industry Clusters.

The project falls within the area regulated by the New England North West SRLUP. However, regional broad scale mapping of strategic agricultural land within the SRLUP indicates that the proposed gas field would not fall within any mapped BSAL (DPI 2012 and 2013). Further, the project would not be located on or near any mapped CICs, as no CICs have been identified in the New England North West region (DPI, 2012). Due to the regional scale of the mapping, it is important that site-specific verification is undertaken. Therefore, a site verification application would be prepared to determine if the project area meets the BSAL site criteria as defined by the SRLUP *Interim protocol for site verification and mapping of biophysical strategic agricultural land* (NSW Government, 2013).

Open cut coal mines including Maules Creek, Narrabri, and Boggabri exist in the Narrabri LGA. There are also a number of petroleum titles within and around the proposed development, all held by Santos.

5.15.2 Potential issues

The proposed development would be located primarily within state forests and agricultural lands. Due to the low levels of logging activity in the state forests, impacts on forestry production are not likely to be significant. Recreational opportunities within some of the state forests would be affected during construction and operation through a reduction in the area of forest accessible for bush walkers, bird watching activities and hunting.

There would potentially be temporary impacts to agricultural land. However, impacts would be limited to the discrete footprint of infrastructure.

During construction of the proposed development, impacts to land use may include:

- Clearing of agricultural or forested land including pasture, crops or native vegetation.
- Short term impacts on mapped BSAL, as identified.
- Short term isolation of areas of usable land (agricultural or otherwise) during construction.
- Temporary land use changes in and around locations of worker accommodation.
- Permanent land use change for sites selected for production wells, the gas processing facility and other ancillary facilities.

All landholders would be approached with the aim of establishing easement agreements on mutually acceptable terms. Easement agreements would include the use of the property during construction, operation and maintenance of the proposed development.

5.15.3 Strategy to address potential issues

Further assessment would include the following:

- Assess the impacts on existing land uses including impacts on land use viability, change to access, forestry, recreation use and strategic agricultural land. This would be undertaken in accordance with the *SRLUP Guideline for Agricultural Impact Statements* (NSW Government, 2012).
- Identify property acquisition and land access requirements.
- Conduct BSAL verification assessment to determine if the project area contains BSAL in accordance with the *SRLUP Interim protocol for site verification and mapping of biophysical strategic agricultural land* (NSW Government, 2013).
- Identify appropriate construction and operation phase management and mitigation measures.

5.16 Sustainable development

Ecologically sustainable development is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The four principles to assist achievement of ecologically sustainable development are defined in both the NSW *Environmental Planning and Assessment Regulation 2000* and the NSW *Protection of the Environment Administration Act 1991* as:

- The precautionary principle - namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decisions should be guided by:
  - Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment.
  - An assessment of the risk-weighted consequences of various options.
- Inter-generational equity - namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.
- Conservation of biological diversity and ecological integrity - namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration.
- Improved valuation, pricing and incentive mechanisms - namely, that environmental factors should be included in the valuation of assets and services, such as:
  - Polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement.
  - The users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.
  - Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

The principles of ecologically sustainable development would be considered in scoping and defining the proposed development and the EIS will outline how the approach to design, construction and operation of the proposed development addresses the four principles of ecologically sustainable development.

6. Consultation

6.1 Consultation objectives

In relation to the project and the environmental impact assessment, Santos has initiated a comprehensive consultation program with the community, government agencies and other potentially affected stakeholders. This program is being undertaken to assist with identifying relevant environmental issues and impacts, as well as enabling a process to address concerns held over the proposed development.

The objectives of the consultation process are to:

- Increase overall awareness and understanding of the coal seam gas industry and in particular the proposed activity.
- Identify and keep informed landholders, neighbours, residents, and relevant local and state government agencies.
- Build and maintain effective relationships with stakeholders and communities based on open communication, trust and understanding of the project.
- Ensure the interests of stakeholders are considered in the proposed activity design and implementation.
- Provide timely, accurate and credible information to stakeholders and the broader community.
- Identify potential issues and/or risks and strategies for mitigation and resolution.

6.2 Approach to consultation

A stakeholder engagement plan has been initiated and stakeholder groups identified. These stakeholder groups have been categorised according to their level of interest in the proposed development and their potential level of impact on planning, implementation and outcomes of the proposed development.

Engagement regarding the proposed development is occurring with all relevant stakeholders to ensure that potential impacts are identified and, where possible, avoided or minimised. To achieve this, communication is being undertaken in an open, transparent manner.

This consultation program will be ongoing throughout the EIS process and would continue during construction and operation of the proposed development. The consultation process is dynamic and the role and importance of stakeholders is likely to vary during the assessment process as new stakeholders emerge as the process progresses. Stakeholders for the proposed development are likely to include:

- Local, State and Commonwealth government authorities.
- Industry stakeholders.
- Property owners and neighbours.
- Aboriginal community and Local Aboriginal Land Councils.
- Registered Native Title Applicants.
- Elected representatives (federal, state and local).

- Interest groups, such as community, environment and business groups.
- The broader community.
- Media (local and national).

There are four levels of targeted engagement and consultation proposed:

- Inform – aimed at community, business and industry in the broader regional and state-wide context.
- Consult – aimed at community groups, industry, business and residents not directly involved but living and operating within the local area; landholders, government departments; non-government organisations, local industry and business.
- Involve – aimed at key stakeholder groups directly involved. This includes neighbouring landholders; government departments listed as referral agencies; non-government organisations; community groups; local contractors and businesses.
- Collaborate – aimed at individuals and entities that are directly impacted by the project and/or involved in project decisions. This includes landholders; government departments responsible for assessments and approvals; local government; native title claimant groups; and community consultative committees.

6.3 Consultation to date

6.3.1 Eastern Star Gas

A draft environmental assessment was prepared in 2010-2011 by Eastern Star Gas for a portion of the proposed development, and in response to the Director-General's Requirements issued as part of that process, a number of consultation activities were undertaken. Consultation requirements were identified by the Director-General's Requirements. Consultation activities undertaken as part of the Eastern Star Gas environmental assessment process included:

- A Planning Focus Meeting held in October 2010.
- Meetings with relevant government authorities.
- Consultation with industry stakeholders.
- Consultation, meetings and field visits with representatives of the Aboriginal community and Local Aboriginal Land Councils.
- Communication with specialist interest groups including community and business groups.
- Site visits and meetings with potentially directly affected property owners.
- Engagement and consultation activities with the broader community, including establishment of a Community Working Group, holding Community Information Sessions, publication of Community Information Sheets and advertising in local media.

The main issues raised by government agencies included: hazard and risk, ecology, rehabilitation, water, waste, heritage, soils, air quality, noise, land use, landscape, traffic, and greenhouse gas emissions.

6.3.2 Santos

Consultation undertaken to date by Santos, in relation to this project includes:

- Meetings with relevant State and Commonwealth government authorities.
- Information provided to an independently chaired Community Consultative Committee that meets monthly in Narrabri.
- Regular Government Information forums and meetings with local government staff and elected representatives.
- Technical briefing and site tours with the Gomeroi Native Title Applicants, follow up meetings and ongoing liaison.
- Information forums, on-site meetings and site tours with neighbouring landholders, Aboriginal representative groups, farmers and rural industry representatives and local business and contractors.
- Provisions of information through Santos' website and media announcements, shopfronts in Narrabri and Gunnedah, information stands at local agricultural shows and community events.

6.4 Proposed consultation

The planned community and stakeholder consultation throughout development of the EIS is described in Table 5.

Table 5 Proposed consultation during the EIS

Stakeholder	Format/engagement tools
Government	- Briefing to Councillors and Officers prior to lodgement of the Preliminary Environmental Assessment (PEA) and EIS. - Ongoing monthly updates to Council. - Letters to State and Federal members to provide project updates on the status of the planning approval process and lodgement of the PEA. Offer a briefing if required. - Notification of EIS exhibition process. - Provide PEA and EIS summary documents.
Regulators	- Invitation to attend quarterly government forums for local and regional staff. - Additional one-on-one meetings as required.
Landholders	- Written communication to advise of EIS process. - Follow up telephone calls. - Opportunity to attend landholder functions. - Sharing of studies and impact monitoring data. - Seek input into EIS development on those areas of interest/concern. - Provide PEA and EIS summary documents. - Invitation to field tours. - Notification in a public newspaper of advice of Public Exhibition and opportunity to submit comments.

Stakeholder	Format/engagement tools
Registered Native Title Applicants	- Written communication to advise of EIS process. - Follow up telephone calls. - Direct and ongoing engagement. - Sharing of studies and impact monitoring data. - Seek input into EIS development on those areas of interest/concern. - Provide PEA and EIS summary documents. - Invitation to field tours. - Notification in a public newspaper of advice of Public Exhibition and opportunity to submit comments.
Local Aboriginal communities and Aboriginal Land Council	- Direct one-on-one briefings to identify concerns and demonstrate how the EIS is designed to manage/mitigate those issues. - Seek input into relevant aspects of EIS development. - Sharing of studies and impact monitoring data. - Provide PEA and EIS summary documents. - Invitation to field tours. - Advertorials on PEA and EIS summary documents in local media.
Neighbouring landholders	- Advertorials on PEA and EIS summary documents in local media. - Local landholder meetings as required.
Local community - including schools and all community associations	- Community Consultative Committee briefings. - Activity updates in local papers. - Advertorials on PEA and EIS summary documents in local media. - Information forums and community open days. - Invitation to attend field tours.
NGOs/ Interest Groups	- Direct one-to-one engagements with priority stakeholders to provide opportunity to comment on/input into EIS development. - Advertorials on PEA and EIS summary documents in local media. - Letters of advice to others. - Invitations to attend information forums. - Invitation to field tours.
Local business/contractor community (existing relationships)	- Letters of advice to update on the status of the planning approval process. - Advertorials on PEA and EIS summary documents in local media. - PEA and EIS summary documents. - Invite to information forums/function. - Invitation to field tours.
Media	- Regular (at least monthly) updates in local media to include status of the EIS process.

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7. Conclusion and next steps

The proposed development will require development consent from the consent authority following review of an EIS prepared under Division 4.1 of Part 4 of the EP&A Act.

This report provided a broad description of the proposed development, reviewed the applicable legislative framework, and identified potential environmental issues associated with construction and operation of the proposed development. These environmental issues will be further investigated in detail in the EIS. A range of stakeholders will also be consulted during preparation of the EIS.

This report supports Santos' request for Director-General's Requirements that would be used to prepare the EIS. Once submitted, the EIS will be placed on public exhibition for a minimum period of 30 days, during which time the public and government agencies will be invited to make submissions.

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Appendices

Appendix A – Threatened species database search results and Protected Matters Search Tool results

NSW Bionet Wildlife Atlas Database, NSW Department of Primary Industries Online Protected Species Viewer and NSW Department of Primary Industries Threatened Fish and Marine Vegetation – Find a Species by Geographic Region Search Results

Threatened biota included in the following tables indicates records of threatened ecological communities, flora and fauna which have been recorded within the vicinity of the project infrastructure.

'NSW Status' refers to the legal status of species within NSW, and includes listings under the *Threatened Species Conservation Act* (TSC Act 1995) *National Parks and Wildlife Act 1974* (NPW Act 1974) and the *Fisheries Management Act 1994* (FM Act 1994). 'Commonwealth Status' identifies the legal status of these species at a federal level, including listings under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The following codes are used in the tables:

- CE – Critically Endangered.
- E – Endangered.
- V – Vulnerable.
- P – Protected.
- EP – Endangered Population.
- CEEC – Critically Endangered Ecological Community.
- EEC – Endangered Ecological Community.
- M - Migratory.

Table 1 Threatened biota recorded within 5 kilometres of the project area

Scientific Name	Common Name	NSW Status	Commonwealth Status
Threatened Ecological Communities			
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions		EEC	EEC
Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South Bioregions		EEC	-
Carex Sedgeland of the New England Tableland, Nandewar, Brigalow Belt South and NSW North Coast Bioregions		EEC	-
Coolibah-Black Box Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands Bioregion		EEC	EEC
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions		EEC	-
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions		EEC	EEC
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions		EEC	EEC
Native Vegetation on Cracking Clay Soils of the Liverpool Plains		EEC	CEEC
Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions		EEC	EEC
White Box Yellow Box Blakely's Red Gum Woodland		EEC	CEEC
Flora			
Bertya opponens	Coolabah Bertya	V, P	V
Diuris tricolor	Pine Donkey Orchid	V, P	-

Scientific Name	Common Name	NSW Status	Commonwealth Status
Lepidium aschersonii	Spiny Peppercress	V, P	V
Philotheca ericifolia		P	V
Polygala linariifolia	Native Milkwort	E, P	-
Pomaderris queenslandica	Scant Pomaderris	E, P	-
Pterostylis cobarensis	Greenhood Orchid	V, P	V
Rulingia procumbens		V, P	V
Tylophora linearis		V, P	E
Fauna			
Birds			
Anseranas semipalmata	Magpie Goose	V, P	-
Calyptorhynchus lathami	Glossy Black-Cockatoo	V, P	-
Chthonicola sagittata	Speckled Warbler	V, P	-
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V, P	-
Daphoenositta chrysoptera	Varied Sittella	V, P	-
Glossopsitta pusilla	Little Lorikeet	V, P	-
Grantiella picta	Painted Honeyeater	V, P	-
Hieraaetus morphnoides	Little Eagle	V, P	-

Scientific Name	Common Name	NSW Status	Commonwealth Status
Lophoictinia isura	Square-tailed Kite	V, P	-
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V, P	-
Neophema pulchella	Turquoise Parrot	V, P	-
Ninox connivens	Barking Owl	V, P	-
Polytelis swainsonii	Superb Parrot	V, P	V
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V, P	-
Stagonopleura guttata	Diamond Firetail	V, P	-
Tyto novaehollandiae	Masked Owl	V, P	-
Mammals			
Cercartetus nanus	Eastern Pygmy-possum	V, P	-
Macropus dorsalis	Black-striped Wallaby	E, P	-
Chalinolobus picatus	Little Pied Bat	V, P	-
Nyctophilus corbeni	Corben's Long-eared Bat	V, P	V
Petaurus norfolcensis	Squirrel Glider	V, P	-
Phascolarctos cinereus	Koala	V, P	V
Pseudomys pilligaensis	Pilliga Mouse	V, P	V
Saccolaimus flaviventris	Yellow-bellied	V, P	-

Scientific Name	Common Name	NSW Status	Commonwealth Status
	Sheathtail-bat		
Vespadelus troughtoni	Eastern Cave Bat	V, P	-
Reptiles			
Hoplocephalus bitorquatus	Pale-headed Snake	V, P	-
Aquatic species			
Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River.[1, 2]		EEC	-
Ambassis agassizii[1, 2]	Olive Perchlet	EP	-
Bidyanus bidyanus[1, 2]	Silver Perch	V	-
Maccullochella macquariensis[2]	Trout Cod	E	E
Maccullochella peelii[1, 2]	Murray Cod		V
Mogurnda adspersa[1, 2]	Purple-spotted Gudgeon	E	-
Notopala sublineata[1, 2]	River Snail	E	-
Tandanus tandanus[1, 2]	Freshwater Catfish	E	-

Note: 1 = Namoi CMA, 2 = Central West CMA

Department of the Environment Protected Matters Search Results

Australian Government

Department of the Environment

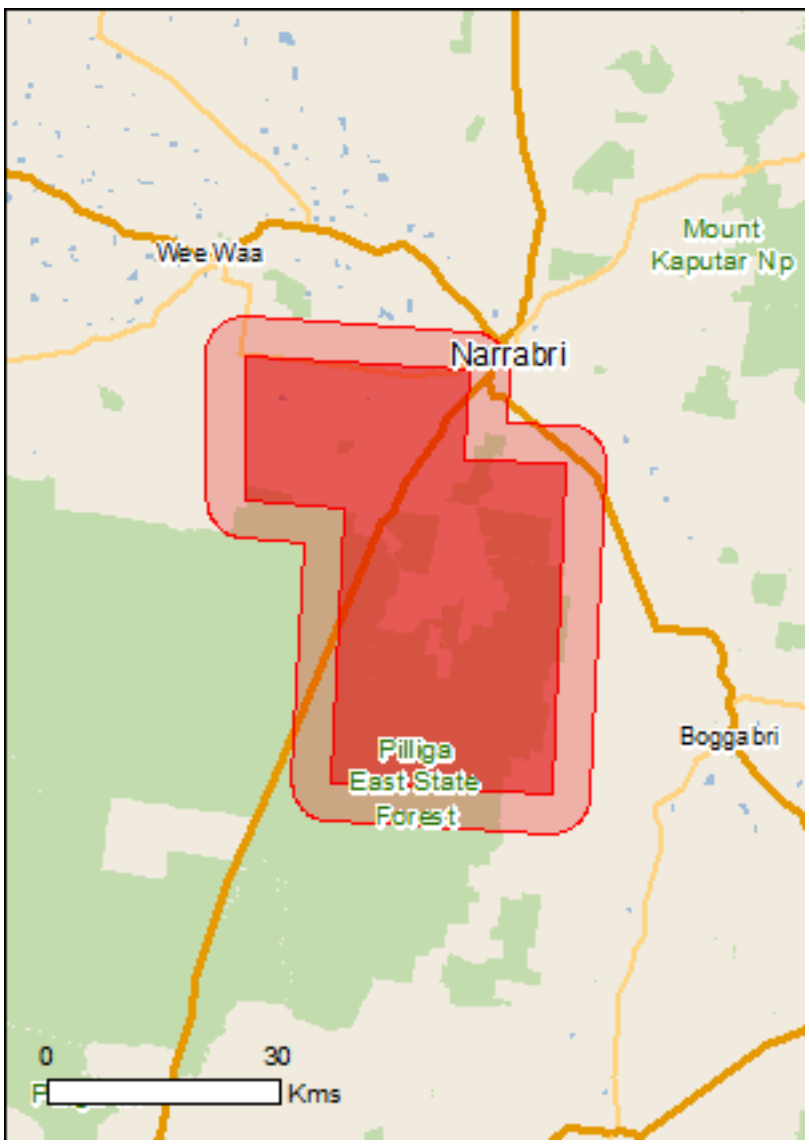
EPBC Act Protected Matters Report

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.

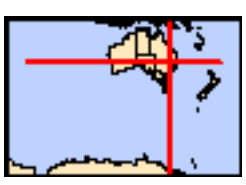
Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 24/10/13 09:01:43



Coordinates

Buffer: 5.0Km



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.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	6
Listed Threatened Species:	28
Listed Migratory Species:	12

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.

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.

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.

Commonwealth Land:	2
Commonwealth Heritage Places:	None
Listed Marine Species:	11
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

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

Place on the RNE:	1
State and Territory Reserves:	3
Regional Forest Agreements:	None
Invasive Species:	28
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

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

Name	Status	Type of Presence
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community likely to occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community may occur within area
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Lathamus discolor		
Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Polytelis swainsonii		
Superb Parrot [738]	Vulnerable	Species or species habitat may occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Fish		
Maccullochella peelii		
Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Frogs		
Litoria booroolongensis		
Booroolong Frog [1844]	Endangered	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri		
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Nyctophilus corbeni		
South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pseudomys pilligaensis		
Pilliga Mouse, Poolkoo [99]	Vulnerable	Species or species habitat known to occur within area
Plants		
Bertya opponens		
[13792]	Vulnerable	Species or species habitat likely to occur within area
Cadellia pentastylis		
Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area
Digitaria porrecta		
Finger Panic Grass [12768]	Endangered	Species or species habitat likely to occur within area
Lepidium aschersonii		
Spiny Pepper-cress [10976]	Vulnerable	Species or species habitat likely to occur within area
Philotheca ericifolia		
[64942]	Vulnerable	Species or species habitat likely to occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269)		
a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Pterostylis cobarensis		
Cobar Greenhood Orchid [12993]	Vulnerable	Species or species habitat likely to occur within area
Pultenaea setulosa		
[2705]	Vulnerable	Species or species habitat likely to occur within area
Rulingia procumbens		
[12903]	Vulnerable	Species or species habitat likely to occur within area
Tylophora linearis		
[55231]	Endangered	Species or species habitat likely to occur within area
Reptiles		
Anomalopus mackayi		
Five-clawed Worm-skink, Long-legged Worm-skink [25934]	Vulnerable	Species or species habitat may occur within area
Aprasia parapulchella		
Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat may occur within area
Uvidicolus sphyrurus		
Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko [84578]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat known to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Xanthomyza phrygia		
Regent Honeyeater [430]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Migratory Wetlands Species		
Ardea alba		
Great Egret, White Egret [59541]		Breeding known to occur within area

Name	Threatened	Type of Presence
Ardea ibis		
Cattle Egret [59542]		Breeding likely to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

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

Name
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Commonwealth Scientific & Industrial Research Organisation

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis		
Cattle Egret [59542]		Breeding likely to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor		
Swift Parrot [744]	Endangered	Species or species habitat likely to occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Historic		
Collins Park Grandstand	NSW	Indicative Place

State and Territory Reserves [Resource Information]

Name	State
Brigalow Park	NSW
Pilliga East	NSW
Willala	NSW

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis		
Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos		
Mallard [974]		Species or species habitat likely to occur within area
Columba livia		
Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus		
House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis		
Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris		
Common Starling [389]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
[Turdus merula](#) Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
[Bufo marinus](#) Cane Toad [1772]		Species or species habitat likely to occur within area
[Rhinella marina](#) Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
[Bos taurus](#) Domestic Cattle [16]		Species or species habitat likely to occur within area
[Canis lupus familiaris](#) Domestic Dog [82654]		Species or species habitat likely to occur within area
[Capra hircus](#) Goat [2]		Species or species habitat likely to occur within area
[Felis catus](#) Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
[Feral deer](#) Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
[Lepus capensis](#) Brown Hare [127]		Species or species habitat likely to occur within area
[Mus musculus](#) House Mouse [120]		Species or species habitat likely to occur within area
[Oryctolagus cuniculus](#) Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
[Rattus rattus](#) Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
[Sus scrofa](#) Pig [6]		Species or species habitat likely to occur within area
[Vulpes vulpes](#) Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
[Lycium ferocissimum](#) African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
[Opuntia spp.](#) Prickly Pears [82753]		Species or species habitat likely to occur within area
[Parthenium hysterophorus](#) Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat may occur within area
[Pinus radiata](#) Radiata Pine Monterey Pine, Insignis Pine, Wilding		Species or species

Name	Status	Type of Presence
Pine [20780]		habitat may occur within area
Rubus fruticosus aggregate		
Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii		
Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Tamarix aphylla		
Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Coordinates

-30.429671 149.732982,-30.433223 149.852458,-30.763021 149.834605,-30.751219 149.579173,-30.477024 149.595653,-30.468739 149.480296,-30.325413 149.478923,-30.339636 149.739848,-30.428487 149.734355,-30.429671 149.732982

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.

Acknowledgements

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

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department 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.

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