Chapter 8

Assessment of alternatives

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Chapter 8 Assessment of alternatives

8.1 Overview

Throughout the planning and development of the project, alternative options were evaluated against the objective of protecting environmental values, providing a domestic gas supply to the region, improving safety, providing efficiency in design and delivering a commercially viable project. This chapter focuses on the project alternatives considered (rather than the broader issues of gas supply and demand as discussed in Chapter 3). The alternatives discussed include:

- the 'do nothing' alternative (that is, the consequences of not proceeding with the project)
- alternative project sizes
- alternative gas resources and project locations
- alternatives to field development and infrastructure technology.

8.2 The 'do nothing' alternative

The 'do nothing' alternative would mean that the project does not proceed and consequently, the gas resource within the project area would not be developed. Should the project not proceed, and if a feasible alternative to current gas supply is not found in the short term, there is a risk that:

- Jobs may be lost. 'Failing to bring additional gas supply into the NSW market will drive gas prices unnecessarily high and result in job losses' (NSW Business Chamber 2015).
- Industries may close. 'The closure of large industrial users in NSW will be required to balance supply and demand for gas' (AEMO 2015).
- There may be gas shortages. 'The Gas Statement of Opportunities (GSOO) (AEMO 2015) significantly under-estimates gas reserve risk, [NSW] relying on production from fields to which geoscientists might only assign a probability of success of 10 per cent, or which are not yet demonstrated to be technically or economically producible' (Energy Quest 2015).

Furthermore, the 'do nothing' alternative would mean that other significant project benefits would not occur, including:

- the direct creation of approximately 1,300 jobs during the construction phase and 200 jobs during the operational phase
- contributions to the Narrabri region and State's economy through royalties, investment, job creation and infrastructure development
- contributions to the Gas Community Benefit Fund, estimated to receive up to $120 million throughout the life of the project.

There would be no environmental impacts associated with the project under the 'do nothing' alternative.

8.3 Alternative project sizes

During project planning, a range of project sizes were considered in terms of energy output to determine an appropriate project size that would adequately meet the projected increase in gas demand while providing a commercially viable project fit for development.

A project that targets up to 200 terajoules per day meets these project objectives. This would provide up to 50 per cent of the future gas demand in NSW, while also meeting the commercial requirements of Santos shareholders.

8.4 Alternative gas resources and project locations

As shown in Figure 8-1, Santos holds several petroleum exploration licences, an assessment lease and a production lease in NSW. These licences and leases allow Santos to undertake exploration and other gas development activities within these areas, following approval.

In determining the final location of the project, the following were considered:

- geological characteristics of the sedimentary basins
- characteristics of the target coal seams
- alternative locations within Petroleum Exploration Licence (PEL) 238, Petroleum Assessment Lease (PAL) 2 and Petroleum Production Lease (PPL) 3.

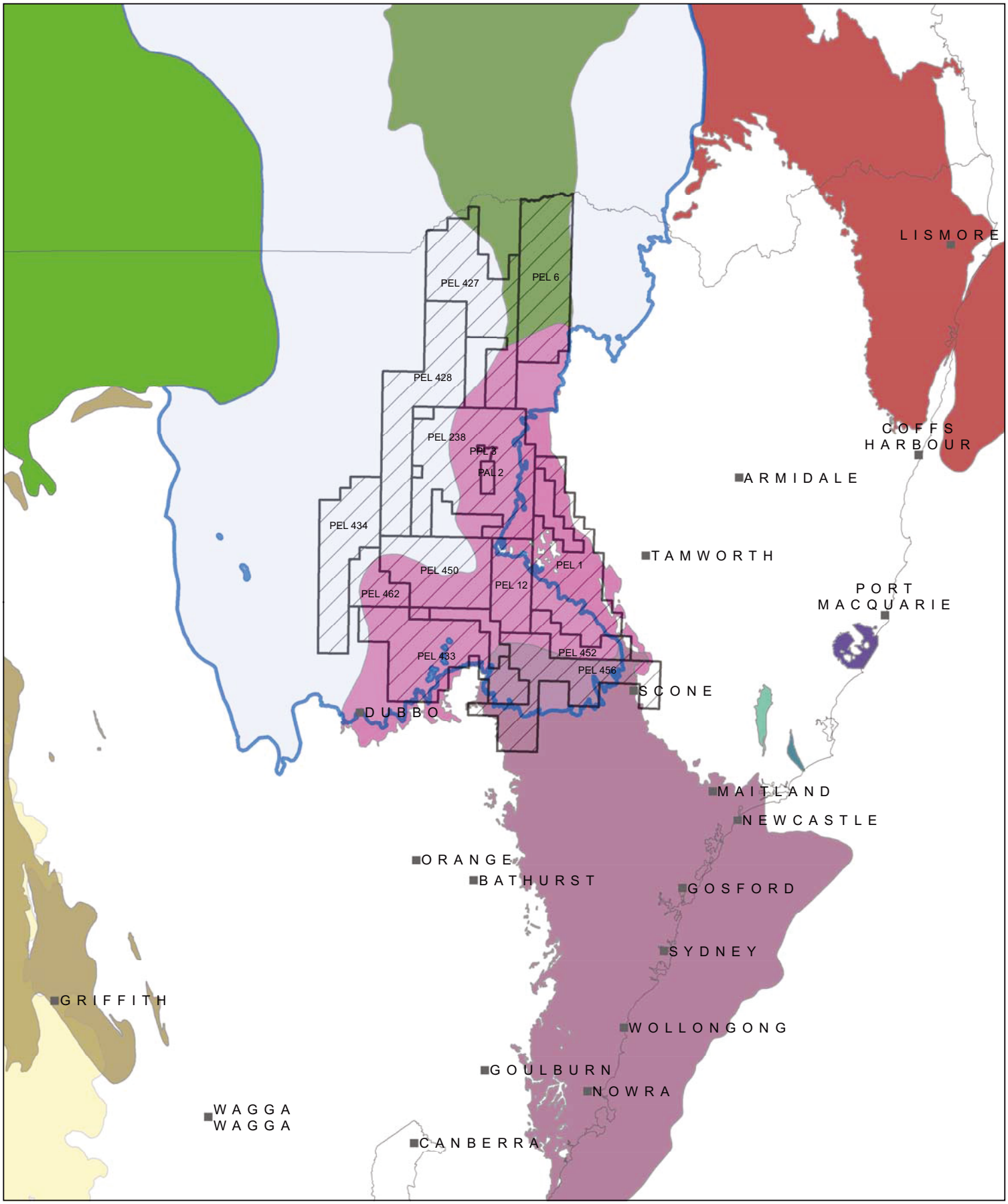
These are discussed in the following sections.

Geological basins

Santos holds petroleum exploration licences and leases in NSW within the Sydney, Gunnedah, Bowen and Surat basins (refer Figure 8-1). Santos and other natural gas exploration entities have undertaken drilling across these areas. Therefore, Santos has access to geological information across large portions of these basins relating to gas potential which it uses to inform the development of a project.

Ultimately, a range of economic, technical and land access considerations frame the decision on where to locate a project. The project assessed in this EIS is located within the Gunnedah Basin. Santos chose this acreage for the project, in part, as they have gas resource estimates based on their exploration drilling. Gas resources are estimates of the amount of gas in the ground that increases in confidence or commercial recovery to reserves status based on additional information gleaned from exploration and appraisal work. The acreage is also relatively close to existing gas infrastructure for tie-in arrangements, and relatively close to gas markets.

Within the Gunnedah Basin, Santos has focussed initial exploration activities predominantly in PEL 238, which was considered the most prospective based on available data. These exploration activities identified substantial gas resources, which could be further appraised and developed for market. Santos has acquired further detailed information through gas appraisal activities in PAL 2 and PPL 3. These activities were originally commissioned by the former title holder, Eastern Star Gas.



LEGEND

Santos CSG Acreage selection

Sedimentary Basins

- Bowen Basin
- Clarence-Moreton Basin
- Darling Basin
- Eromanga Basin
- Gloucester Basin
- Gunnedah Basin
- Lorne Basin
- Murray Basin
- Myall Syncline
- Surat Basin
- Sydney Basin

0 30 60 120

Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Narrabri Gas Project
Environmental Impact Statement

Schematic of Santos petroleum title relative to regional sedimentary basins

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Figure 8-1

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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 - 2012-13. Santos: Operational and Base Data - 2013. Created by: afoddy

Santos' knowledge of gas accumulations in the region, coupled with its additional exploration and appraisal drilling within PEL 238, PAL 2 and PPL 3 confirmed the preferred location for the project. This area also provides Santos with an opportunity to further develop existing infrastructure in an area where gas resources are located.

Target coal seams

The target coal seams include the:

- Bohena, Parkes, Namoi and Rutley seams within the early-Permian Maules Creek Formation
- Hoskissons seam in the late-Permian Black Jack Group.

Other coal seams within the Porcupine and Watermark formations are not as thick or do not contain as much gas. These seams may be considered in future as more data about the available gas resources become available—subject to gaining the required legislative approvals.

Refining locations within PEL 238

PEL 238 covers an area of approximately 7,915 square kilometres. The project would be developed within the defined project area which comprises about 950 square kilometres (about 12 per cent of the entire PEL 238 area). The project area is contained within the existing petroleum exploration lease (PEL) 238 and incorporates petroleum assessment lease (PAL) 2 and petroleum production lease (PPL) 3. Four petroleum production lease applications (PPLAs) were lodged in May 2014 covering the project area, being PPLAs 13, 14, 15 and 16. The location and configuration of the project area within PEL 238 was based on the following opportunities and constraints:

- Residential zones – the project area would be more than two kilometres from residential zones and identified future residential growth areas, and would not impact on critical industry clusters as defined in the St*ate Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007* (the Mining SEPP) (see Chapter 4).
- Conservation areas – the project area would avoid conservation areas such as the Pilliga National Park, the Pilliga State Conservation Area, the Pilliga Nature Reserve and the Brigalow Park Nature Reserve.
- Government policy – the project area would be consistent with government policy and would target 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.
- Coal seam thickness and quality – there are positive subsurface geological indicators over the target gas areas, specifically within the Bohena Trough. For example, should the project be relocated slightly to the east, west or south of its current location, the Bohena Trough becomes shallower, resulting in coal seams thinning and ultimately pinching out. This would not result in an economic project.
- Known resource – the project area contains a significant gas resource. Exploration and appraisal in PEL 238 has enabled Santos to confirm that the recoverable gas available in the project area can potentially underpin a commercial gas development. The same level of exploration and appraisal has not been undertaken by Santos in other areas of PEL 238. As a result, the time required to produce gas from other areas in PEL 238 (assuming they hold sufficient gas) would be substantially longer.

- Biophysical strategic agricultural land (BSAL) – the project area would avoid areas of BSAL (refer to Chapter 14 and Appendix I2). No agricultural land in the project area is mapped by the NSW Government to be biophysical strategic agricultural land (BSAL) and detailed soil analysis has established the absence of BSAL. This has been confirmed by the issue of a BSAL Certificate for the project area by the NSW Government (refer to Appendix I2).
- Existing leases – the project area would avoid the constraints of coal mining leases to the east. It also aligns on the western boundary with the existing PAL 2 lease.

8.5 Alternative field development and infrastructure technologies

The development of the project involved planning the location and configurations of the following components:

- gas wells, access tracks and gathering lines
- in-field compression
- a centralised gas processing facility
- a centralised water management facility
- power infrastructure.

The alternatives considered for these components, including consideration of minimising the environmental and social impacts, are described below.

Gas wells, access tracks and gathering lines

The proposed location of gas wells and, consequently, the water and gas gathering lines and access tracks, is primarily determined by the availability of gas within the target seams. Final well pad locations are then refined based on community, landholder and environmental considerations. Chapters 6 and 10 discuss how the Field Development Protocol is used to micro-site gas wells and gathering lines.

The proposed development is based on minimising the surface footprint of the field. This would be achieved by:

- locating gathering lines and access tracks along existing roads where practicable
- minimising the width of access tracks (an average of 10 meters wide and a maximum of 12 metres on bends during construction; rehabilitated to five metres wide for operations, slightly wider on bends)
- the inclusion of passing bays rather than two lane access tracks
- drilling multiple wells from the same well pad
- drilling a number of laterals per well set (refer to Chapter 6).

Improvements in drilling sensor and global positioning technology have enabled improvements in directional drilling technology. Improvements in this technological area have resulted in benefits such as increased efficiency and reduced costs, in addition to minimising environmental impact through less surface disturbance. Stacking lateral wells and locating more than one well on each well pad significantly reduces the surface footprint of the field.

The spacing of wells is driven by reservoir parameters and is optimised to maximise gas recovery. It is expected that as more information becomes available and the changes in reservoir characteristics across the field are refined, the well spacing would be adjusted accordingly taking into account the abovementioned constraints.

In-field compression alternatives

Gas compression increases the pressure of gas by reducing its volume, which is required to transport the gas to the central gas processing facility at Leewood where the gas would be treated, and further compressed for transport to market. Compression can be undertaken at a centralised facility, or at decentralised facilities. A consolidated in-field compression option at Bibblewindi was selected in favour of decentralised compression because:

- the relatively small size of the field would allow for centralised compression
- noise impacts would be localised as opposed to dispersed (which would occur with decentralised compression)
- it is more cost-effective than decentralised compression.

During detailed design of the project, different options would be advanced seeking to optimise process efficiencies and minimise energy use in compressor type, system operating pressures, and power requirements.

Alternative gas processing locations and infrastructure

The proposed central gas processing facility would be located at Leewood (refer to Chapter 6). This location was chosen because:

- it is centrally located within the project area
- it is owned by Santos and contains existing infrastructure associated with ongoing exploration and appraisal activities within the project area
- it has largely been cleared as it was used for farming, hence minimising the amount of clearing required.

Bibblewindi was also considered as a location for a centralised gas plant. It was rejected because:

- it would require a greater area of clearing within State forest
- road access to the site would need to be significantly upgraded, which would require additional vegetation clearing
- it would not allow for the co-location of gas processing and water management facilities at the one site to enable the sharing of power infrastructure.

There are limited technical options available for gas processing infrastructure because the gas must be compressed to allow transport to market, thereby necessitating a compression plant. In addition, raw gas must be conditioned to meet the necessary product quality as stipulated by Australian Standards and contractual arrangements.

Alternative power infrastructure

Two options are being considered to supply power for the gas and water processing facilities at the Leewood and Bibblewindi sites: gas-fired generation, or connection to grid power. In determining options for power, consideration was given to:

- the power source, being either gas-fired generated on site, gas-fired sourced from the existing Wilga Park Power Station or electricity sourced from the grid
- fuel types such as diesel or gas options
- waste heat recovery options.

The great majority of the project's electrical power demand will be at the Bibblewindi and Leewood sites. It is estimated that approximately 100 megawatts of electrical power will be required to support the electrical demand at these two sites. Wilga Park Power station currently has 16 megawatts of generating capacity installed, with approvals in place to increase the installed generating capacity up to 40 megawatts. The increased generating capacity would not be sufficient to supply the project's electrical power demand. Therefore, on site generation or grid power are both considered viable options to meet the project's power requirements.

If on site power generation is constructed, it would be gas fired. The use of gas over diesel for on-site power generation at Leewood would:

- minimise emissions of greenhouse gas, nitrogen oxides, and particulates
- remove the need for vehicle movements associated with delivery of diesel to the site
- Minimise risks associated with the storage of diesel required for power generation.

Waste heat recovery opportunities will be considered further during detailed design.

The reticulation of power to well sites and well site generation were both considered as options for delivering the required electrical power for well site activities. Well site generation was selected in favour of power reticulation for a number of reasons including:

- the relatively small electrical power demand of well sites
- the ability for well site solar panels to supply a proportion of the power needs
- the elimination of a source of risk associated with the reticulation of electrical infrastructure throughout the project area.

Alternative water management options

A water management facility is required to desalinate and treat the produced water extracted from the coal seams.

The proposed water management facility would be located at Leewood (refer to Chapters 6 and 7). This location was chosen because:

- it is centrally located within the project area
- it has water treatment and storage infrastructure already approved and / or constructed to service Santos' ongoing exploration and appraisal activities within the project area
- other locations in the State forest would involve clearing State forest land.

A range of water treatment technologies and configurations were considered prior to settling on reverse osmosis. These technologies included:

- forward osmosis
- ion exchange
- Higgins loop
- Electrodialysis / electrodialysis reversal
- vibratory shear enhanced process
- capacitive deionization
- thermal processes.

Reverse osmosis was considered the most appropriate desalination technology because:

- it can manage the produced water for the project given the mean concentrations of total dissolved solids
- it is a proven technology that is widely available and used on a variety of desalination applications, including all major projects involving natural gas from coal seams currently in operation or under development in Australia
- it is more cost-effective than thermal treatment
- it has lower specific energy consumption than thermal treatment
- it is highly modular, thereby lending itself to relatively simple changes in plant capacity.

To reduce the overall volume of brine produced from the initial reverse osmosis process, it is necessary to further concentrate it. This requires the use of thermal processes. A range of thermal treatment technologies was considered for further processing the brine. These included:

- multi-stage flash distillation
- multiple-effect distillation
- brine concentration using mechanical vapour compression
- brine concentration using thermal vapour compression
- membrane distillation.

Thermal technologies typically employ thermal vapour compression or mechanical vapour compression to enhance the efficiency of the process. Thermal vapour compression processes require the addition of a heat source (typically steam) and supplementary cooling (usually provided by cooling towers). Mechanical vapour compression only requires electrical energy.

At the time the EIS studies were completed, it was determined that the best solution for the project would be to use brine concentration, followed by crystallisation using mechanical vapour compression. This decision was based on proven technology performance and lower energy consumption.

8.6 Summary

The Narrabri Gas Project has been proposed as a result of the following considerations discussed in this chapter:

- The project has the capacity to deliver up to 200 terajoules of gas per day, or about 50 per cent of current gas demand in NSW.
- The Narrabri Gas Project would help ensure that NSW can take advantage of the many opportunities arising from utilisation of its natural resources. The project's capacity to supply up to half of NSW's natural gas needs would promote balance across the NSW, east coast and export markets. A well-balanced market that allows both consumers and producers to respond to price signals efficiently is critical in ensuring maximum benefit to all stakeholders.
- There are favourable geological and hydrogeological conditions, including the presence of thick aquitards that separate the target coal seams from the overlying freshwater aquifers accessed by groundwater users.
- The area has been strategically set aside in anticipation of this gas project under the NSW Government's own planning processes, being the *Brigalow and Nandewar Community Conservation Area Act 2005.*
- The project is compatible with existing land use—being predominantly forestry and agriculture.
- A large proportion of the Narrabri host community is supportive of the project.
- There is no Government mapped BSAL in the project area, nor was BSAL found during a soil survey undertaken over the project area under the Government's methodology as outlined in the *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (NSW Government 2013a). This has been confirmed by the issue of a BSAL Certificate for the project area by the NSW Department of Planning and Environment. (refer to Chapter 14 and Appendix I2).
- Gas would be made available to the NSW market via a high-pressure gas transmission pipeline. The pipeline will be constructed and operated by a specialist pipeline company and is not part of the EIS for this project. It is likely that the gas transmission pipeline, starting at Leewood, would tie into the Moomba to Sydney pipeline located to the south of the project area.
- The first phase of the project area is sparsely populated.
- The project area excludes the Brigalow Nature reserve.
- The project area has a 200 metre exclusion zone around Yarrie Lake.
- The two Brigalow State Conservation areas located within the project area will not host surface infrastructure.
- There is ease of access to Bibblewindi and Leewood as the Newell Highway passes through the project area. There is also an extensive network of existing tracks throughout the forest, thereby minimising the need for clearing.