



Chapter 29

Cumulative impacts

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Chapter 29 Cumulative impacts

The Secretary's environmental assessment requirements for the Narrabri Gas Project include a requirement to assess the cumulative impacts of the project. This chapter assesses the potential for cumulative impacts to occur, drawing on other assessments contained in the relevant chapters and technical reports in this EIS and assessments of other major projects in the region. The potential for cumulative impacts between the project and other existing or proposed projects is low. Despite the extent of the area included in this cumulative impact assessment, a relatively small number of major projects were identified for inclusion in the assessment. The impact assessment for the project considered all existing projects as part of the baseline assessment and proposed changes to these projects were also considered.

Impacts from the project combined with other existing and proposed projects in the study region will not result in significant cumulative impacts (refer to Table 29-2).

29.1 Methodology

The following tasks were undertaken to assess cumulative impacts:

- identification of existing or proposed projects in the public domain
- screening of identified projects for their potential to interact
- assessment of the significance of potential cumulative impacts.

Existing or proposed projects in the public domain were identified and described with reference to environmental assessment within the local government areas (LGAs) of Narrabri, Moree, Gwydir, Inverell, Glenn Innes Severn, Tamworth Regional, Uralla, Armidale, Gunnedah, Liverpool Plains, Warrumbungle, Gilgandra, Dubbo and Coonamble.

The projects were identified from the NSW Government development assessment tracking system for major projects, or from proponent websites. Other sources were investigated including local council websites and the public register under the *Protection of the Environment Operations Act 1997*. The identified projects were screened based on their nature, size, and proximity to the project, and therefore, their potential for cumulative impacts.

Screening of potential cumulative impact was undertaken by comparing the extent and duration of the residual impacts and their potential to occur in the same place at the same time as that for the project. The significance of these cumulative impacts was then assessed, with consideration of the extent, magnitude and duration of the impact and the sensitivity of the environment.

29.2 Existing or proposed projects

The relevant existing or proposed projects are shown in Figure 29-1 and are listed in Table 29-1. The identified projects include a number of mines in the region, larger developments within the township of Narrabri, solar farm developments and the existing Narrabri gas exploration activities.

As discussed in Chapter 17, existing forestry activities in the vicinity of the project area are minimal. Existing forestry activities are limited to Pilliga East State Forest and are considered small scale, due to the relatively low value of sawlog. The quality of sawlog is not expected to significantly improve over the life of the project and as such operations during the life of the project are likely to continue at this small scale. Forestry activities are therefore considered to have minimal potential to have cumulative impacts with the project and are not considered further.

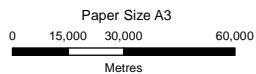
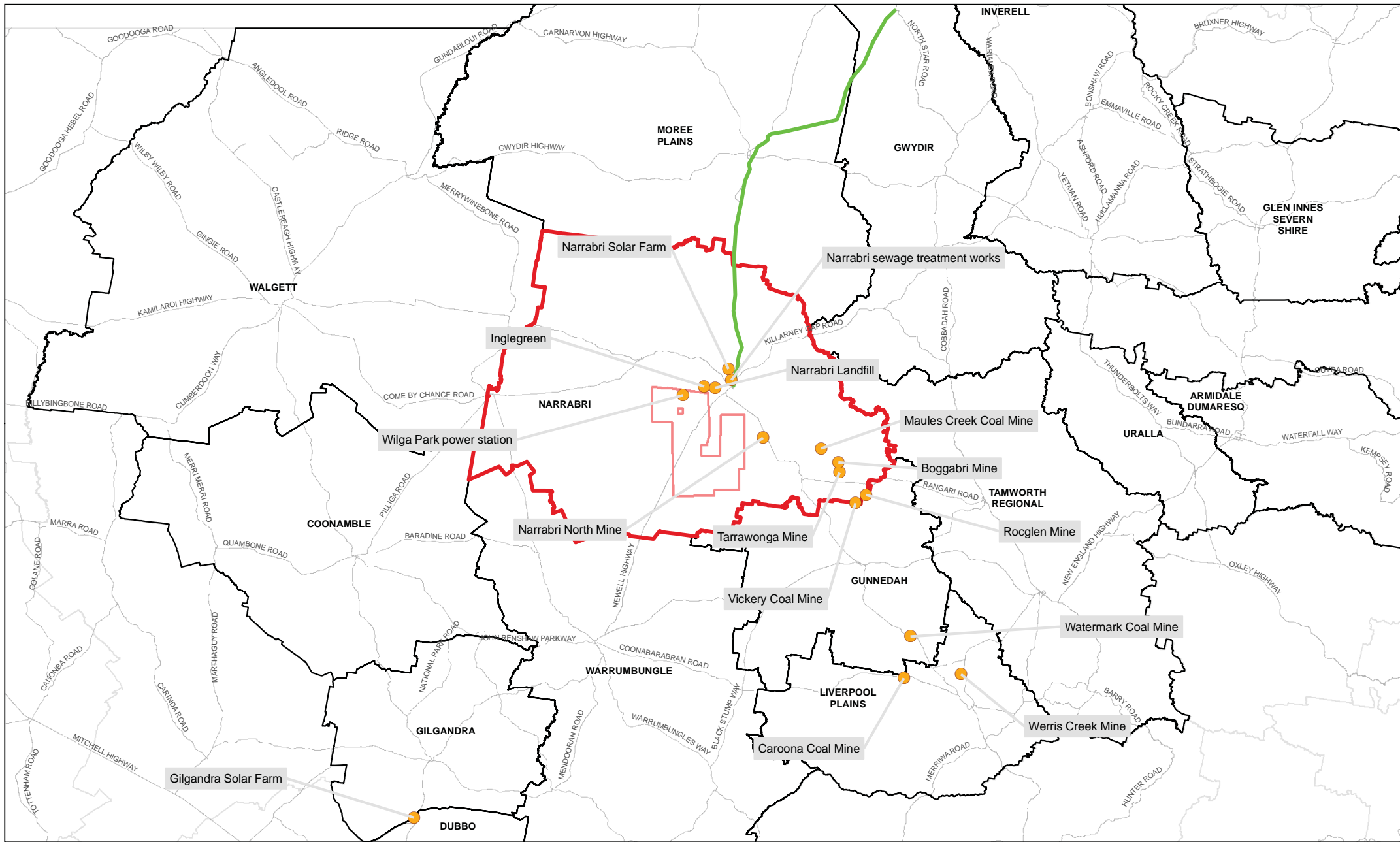
Table 29-1 Existing or proposed projects

Project	Proponent	Type	Status	LGA	Separation distance
Boggabri Mine	Idemitsu Australia	Coal mining	Existing	Narrabri	25 km
Maules Creek Mine	Whitehaven Coal	Coal mining	Existing ^a	Narrabri	24 km
Narrabri Gas Exploration	Santos	Petroleum	Existing ^b	Narrabri	-
Narrabri Landfill	Narrabri Shire Council	Resource recovery or waste	Existing	Narrabri	3 km
Narrabri North Mine	Narrabri Coal Operations	Coal mining	Existing	Narrabri	7 km
Narrabri Sewage Treatment Works	Narrabri Shire Council	Resource recovery or waste	Existing	Narrabri	10 km
Rocglen Mine	Whitehaven Coal	Coal mining	Existing	Gunnedah	42 km
Tarrawonga Mine	Whitehaven Coal	Coal mining	Existing	Narrabri	32 km
Werris Creek Mine	Whitehaven Coal	Coal mining	Existing	Liverpool Plains	73 km
Wilga Park	Santos	Electricity generation	Existing ^c	Narrabri	-
Caroona Mine	BHP Billiton	Coal mining	Proposed	Gunnedah Liverpool Plains	53 km
Inglegreen	Power Partners Generation	Electricity generation (biogas)	Proposed	Narrabri	2 km
Vickery Mine	Whitehaven Coal	Coal mining	Proposed	Narrabri Gunnedah	29 km
Watermark Mine	Shenhua Watermark Coal	Coal mining	Proposed	Gunnedah	56 km
Narrabri Solar Farm	CleanGen	Electricity generation	Proposed	Narrabri	12 km
Inland Rail	ARTC	Rail	Proposed	Narrabri, Moree Plains, Gwydir	9.5 km
Gilgandra Solar Farm	Neoen Australia	Electricity generation	Proposed	Gilgandra	161 km

^a Maules Creek Mine commenced construction in January 2014, with first coal in December 2014

^b Narrabri Gas Exploration is situated at various locations within the project area as shown on Figure 29-1. The existing infrastructure is shown on Figure 2-4.

^c Wilga Park power station is situated in the project area, approximately 15 km north of Leewood



Horizontal Datum: GDA 1994
Grid: GCS GDA 1994



LEGEND

- Narrabri LGA
- Surrounding LGA
- Project area
- Narrabri to North Star
- Project locations
- Inland Rail**
- Major roads



Narrabri Gas Project
Environmental Impact Statement

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Existing or proposed projects **Figure 29-1**

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Data source: Topography: NSW LPMA DTDB & DCDB Created by:jrichardson

29.2.1 Existing projects

Boggabri Coal Mine

Boggabri Coal Mine is an open-cut coal mine approximately 15 kilometres north-east of the township of Boggabri, and 25 kilometres from the project area. Boggabri Coal Mine forms part of the mining precinct around Leard State Forest, which includes Maules Creek Mine and Tarrawonga Coal Mine.

Boggabri Coal Mine was originally approved for development in August 1989 and coal mining commenced in May 2006. The approval allowed the extraction of five million tonnes of run-of-mine coal each year. Due to the time-bound nature of the original approval, a subsequent application was made to continue mining, albeit at an increased production rate of up to seven million tonnes of run-of-mine coal each year for a further 21 years. The application was approved in July 2012.

Coal is processed at an on-site coal handling and processing plant, before being transported by rail to Newcastle. The construction of the extension will employ approximately 150 workers at peak, while the operating mine will employ approximately 500 workers (including 320 employed at the existing mine) (NSW Planning & Infrastructure 2012a).

Maules Creek Mine

Maules Creek Mine is an open-cut coal mine approximately 18 kilometres north-east of the township of Boggabri and 24 kilometres from the project area. Maules Creek Mine forms part of the mining precinct around Leard State Forest, which includes Boggabri Coal Mine and Tarrawonga Coal Mine. Maules Creek Mine was approved for development in October 2012.

Construction of Maules Creek Mine commenced in January 2014, with first coal produced in January 2015. The mine is intended to extract up to 13 million tonnes of run-of-mine coal each year for 21 years and employ up to 470 workers. Coal will be processed at an on-site coal handling and processing plant, before being transported by rail to Newcastle (NSW Planning & Infrastructure 2012b).

Narrabri Landfill

Narrabri Landfill is a waste disposal facility near the township of Narrabri and approximately three kilometres from the project area. The landfill accepts general solid wastes (putrescible and non-putrescible), asbestos and other wastes below additional licensing thresholds in Schedule 1 of the *Protection of the Environment Operations Act 1997*. The facility is licensed to accept up to 12,000 tonnes of waste each year.

Narrabri Gas Exploration

The project area for the Narrabri Gas Project hosts a range of existing and approved infrastructure for natural gas exploration and appraisal activities. The infrastructure includes exploration and appraisal wells, gas and water gathering lines, water management facilities at Leewood and Bibblewindi and an interconnecting infrastructure corridor. This infrastructure and its relationship to the Narrabri Gas Project is discussed further in Chapter 2 – Location and setting.

Narrabri North Mine

Narrabri North Mine is an underground coal mine approximately 30 kilometres south-east of the township of Narrabri, and approximately seven kilometres from the project area. The project is divided into two stages, with Stage 1 approved in November 2007 and Stage 2 approved in July 2010. The mine site covers approximately 5,210 hectares.

Stage 1 involved production of 2.5 million tonnes of run-of-mine coal each year for 50 years using underground continuous mining methods. Stage 2 introduced longwall mining methods and increased production up to eight million tonnes of run-of-mine coal each year for 21 years. Subsequent modification to Stage 2 increased approved production to 11 million tonnes each year (Whitehaven Coal 2015). Coal is processed at an on-site coal handling and processing plant, before being hauled by rail to Newcastle.

Narrabri North Mine also includes a water pipeline to source raw water and / or discharge treated water to the Namoi River. The Namoi River is a secondary source of water, where insufficient water is available from underground mine workings and associated storages (NSW Planning 2010). The mine employs approximately 370 workers (Whitehaven Coal 2015).

Narrabri Sewage Treatment Works

Narrabri Sewage Treatment Works is an existing sewage treatment facility near the township of Narrabri, and approximately 10 kilometres from the project area. The facility is licensed to discharge to water and / or a discharge utilisation area. Discharges to waters are limited at 20 megalitres per day (NSW Environment Protection Authority 2014b).

Rocglen Mine

Rocglen Mine is an open-cut coal mine approximately 25 kilometres north of Gunnedah and 42 kilometres from the project area. Rocglen Mine was originally approved in April 2008, with a subsequent expansion approved in September 2011.

The original approval allowed the extraction of 1.5 million tonnes of run-of-mine coal each year for 12 years. The subsequent approval allowed the extension of the open-cut pit to recover an extra five million tonnes of run-of-mine coal, extending the life of the mine by four years. The mine covers approximately 460 hectares and employs about 54 workers (NSW Planning & Infrastructure 2011).

Coal is transported 24 kilometres by road to the Whitehaven Siding coal handling and processing plant, before being hauled by rail to Newcastle.

Tarrawonga Mine

Tarrawonga Mine is an open-cut coal mine approximately 16 kilometres north-east of Boggabri and 32 kilometres from the project area. Tarrawonga Mine forms part of the mining precinct around Leard State Forest, which includes Boggabri Coal Mine and Maules Creek Mine. Tarrawonga Mine was originally approved in November 2005 as East Boggabri Coal Mine, with expansions approved in October 2010 and January 2013 as the renamed Tarrawonga Coal Project.

The original approval allowed the extraction of up to two million tonnes of run-of-mine coal each year for eight to 10 years. The subsequent approvals allowed the extensions of the open-cut areas and increased extraction to up to three million tonnes of coal each year until 2030.

Coal is transported 41 kilometres by road to the Whitehaven Siding coal handling and processing plant in Gunnedah, before being hauled by rail to Newcastle. Rail haulage to the neighbouring Boggabri Mine was

approved as part of the Tarrawonga Coal Project, but a subsequent modification to Tarrawonga Mine approved in November 2014 reinstated the haulage of coal by road to the Whitehaven Siding coal handling and processing plant for economic reasons. Tarrawonga Mine employs approximately 120 workers (NSW Planning & Infrastructure 2012c).

Werris Creek Mine

Werris Creek is an open-cut coal mine approximately four kilometres south-west of Werris Creek and 73 kilometres from the project area. Werris Creek Mine operated as an underground coal mine from 1925 and the mid-1960s and was approved to be recommissioned as an open-cut mine in February 2005, with subsequent expansions approved in October 2009 and October 2011 as the Werris Creek Mine Extension Project.

The original approval allowed the extraction of two million tonnes of run-of-mine coal each year for 10 years. The subsequent approvals allowed the expansion of the open-cut areas and increased extraction to up to 2.5 million tonnes of run-of-mine coal. Coal is processed at an on-site coal handling and preparation plant, before being hauled by rail from the on-site rail siding. A relatively small proportion of the coal (50,000 tonnes) is approved for transport by road to areas where delivery by rail is not practicable. Werris Creek Mine employs approximately 90 workers (NSW Planning & Infrastructure 2011b).

Wilga Park Power Station

Wilga Park power station is an existing 16 megawatt capacity gas-fired power station within the project area, approximately 15 kilometres north of Leewood. Approval to expand the Wilga Park Power Station to 40 megawatt capacity was approved in December 2008 (NSW Department of Planning 2008); however, the plant capacity currently remains at 16 megawatts.

29.2.2 Proposed and approved projects

Caroona Coal Mine

Caroona Coal Mine was a proposed underground coal mine approximately 40 kilometres south-east of Gunnedah and 53 kilometres from the project area.

If approved, Caroona Coal Mine would have extracted up to 260 million tonnes of run-of-mine coal during its planned 30-year life (an average of approximately nine million tonnes each year). The coal would have been processed at an on-site coal handling and processing plant before being transported off site by rail. Caroona Coal Mine would have employed up to 400 workers at peak production (BHP Billiton 2014).

In 2016 the NSW Government bought back the exploration licence associated with Caroona Coal Mine from BHP, signalling the cancellation of the development.

Gilgandra Solar Farm

The Gilgandra Solar Farm is a proposed development located around 26 kilometres south of Gilgandra, which is around 161 kilometres from the project area. The proposed development would generate up to 30 megavolt amperes of power.

The proposed site for the Gilgandra Solar farm is around 85 hectares in size, of which around 55 hectares would be developed (NGH Environmental 2014). The majority of the site has been cultivated meaning that minimal vegetation clearing would be required.

The Secretary's environmental assessment requirements for the project were issued in June 2016, however the environmental assessment had not been released at the time of preparation of this EIS.

Inglegreen Biogas and Electricity Generation Facility

Inglegreen Biogas and Electricity Generation Facility is a proposed biogas harvesting and electricity generation facility approximately nine kilometres west of Narrabri and two kilometres from the project area. The site of the proposed biogas harvesting is an existing piggery.

The project would consist of a biogas harvesting facility approximately six hectares in size and a switching station approximately two hectares in size two kilometres to the north, connected by an overhead power line (Power Partners Generation 2012).

The Secretary's environmental assessment requirements for the project were issued in May 2012, however the environmental assessment had not been released at the time of preparation of this EIS.

Vickery Mine

Vickery Mine is proposed open-cut coal mine approximately 18 kilometres south-east of Boggabri and 29 kilometres from the project area. Vickery Mine was approved in September 2014. The approval allowed the extraction of up to 4.5 million tonnes of run-of-mine coal each year for 30 years.

A subsequent development application was made as the Vickery Extension Project to extend the proposed Vickery Mine to allow for construction of a coal handling and processing plant and other supporting infrastructure and extraction of up to 10 million tonnes of run-of-mine coal each year.

Construction Vickery Mine, including the Vickery Extension Project, would employ about 500 workers while the operating mine would employ about 450 workers.

Construction of Vickery Mine had not commenced at the time of preparation of this EIS. The Secretary's environmental assessment requirements for the Vickery Extension Project issued in February 2016, however the environmental assessment had not been released at the time of preparation of this EIS.

Watermark Mine

Watermark Mine is proposed open-cut coal mine approximately 25 kilometres south-east of Gunnedah and 56 kilometres from the project area. The mine was approved in January 2015.

Once operating, the mine will extract up to 10 million tonnes of run-of-mine coal each year for 30 years. Coal will be processed at an on-site coal handling and preparation plant, before being transported by rail to Newcastle. The Watermark Mine will employ approximately 600 workers during construction and operation (NSW Planning & Environment 2014b).

Narrabri Solar Farm

The Narrabri Solar Farm is a proposed development that would generate 120 megawatts of power into the Narrabri 132 / 66 kV substation. The project proposes to generate 280 full-time equivalent jobs through construction, and around 10 to 14 full-time jobs through operation.

The project would be located approximately four kilometres north-north-west of the town of Narrabri, around 12 kilometres from the project area. Land for the proposed site is existing rural grazing land meaning that minimal vegetation clearing would be required for construction (CleanGen 2015).

The Secretary's environmental assessment requirements for the project were issued in February 2016, however the environmental assessment had not been released at the time of preparation of this EIS.

Inland Rail

Inland Rail is an Australian Government project that seeks approval to build a significant new piece of national transport infrastructure. The linear route would run between Melbourne and Brisbane via central-west NSW and Toowoomba in Queensland.

Inland Rail is divided into a number of portions at varying stages of the development assessment process. The portions with potential to be the region of the Narrabri Gas Project are Narromine to Narrabri and Narrabri to North Star.

At the time of preparation of this EIS, Narromine to Narrabri was not in the NSW Government development assessment tracking system for major projects and accordingly publicly available information, including the final alignment, was not sufficient for an assessment of cumulative impacts.

Narrabri to North Star was, however, in the NSW Government development assessment system and there was sufficient publicly available information. As such, the assessment of cumulative impacts of the Narrabri Gas Project and Inland Rail focussed on this portion.

It is expected that cumulative impacts would be considered further in environmental impact assessments for Inland Rail, including Narromine to Narrabri, at future stages of the development assessment process.

29.3 Cumulative impacts

29.3.1 Groundwater and geology

The groundwater impact assessment included as Appendix F and summarised in Chapter 11 considered cumulative impacts of the Narrabri Gas Project and surrounding developments. Most of the surrounding developments were not considered to have the potential to have cumulative groundwater impacts with the project given their lack of groundwater connectivity. Potential for cumulative impacts was identified for the project and Narrabri North Mine given their mutual location in the Bohena Trough geological formation.

The Narrabri Gas Project and surrounding developments were included in the conceptual and numerical groundwater modelling undertaken as part of the groundwater impact assessment. The main findings of the numerical modelling indicate that the cumulative impacts are dominated by the effects of groundwater inflow to the Narrabri North Mine, with very minor contributions to maximum cumulative drawdowns from the Narrabri Gas Project in the areas of cumulative impact.

In terms of the shallower water sources the assessment found that:

- Predicted maximum drawdown of the water table within the Namoi alluvium is less than 0.5 metres.
- Predicted maximum cumulative drawdown of the water table within the outcrops of the Jurassic / Triassic strata (within the vicinity of the projects) is 5.2 metres both for the sole development of the Narrabri Mine and for concurrent development with the Narrabri Gas Project. By comparison, the maximum extent of drawdown in the water table within the outcrops of the Jurassic / Triassic strata associated with the Narrabri Gas Project in isolation is less than 0.5 metres. Maximum drawdown in the water table within the outcrops of the Jurassic / Triassic strata (in the vicinity of the projects) is reached after around 48 to 120 years for the sole development of the Narrabri Mine and 48 to 550 years for concurrent development with the Narrabri Gas Project. This indicates that the predicted cumulative impacts are dominated by inflows through the Hoskissons Coal formation at Narrabri Mine.
- The largest predicted cumulative drawdown in the Pilliga Sandstone is 1.8 metres both for the sole development of the Narrabri Mine and for concurrent development with the Narrabri Gas Project. Maximum drawdown in the Pilliga Sandstone (in the vicinity of the projects) is reached after around 48 to 81 years for the sole development of the Narrabri Mine and 48 to 90 years for concurrent development with the Narrabri Gas Project.

In summary, the cumulative effects associated with the Narrabri Mine and Narrabri Gas Project are dominated by the impacts from the Narrabri Mine, with negligible impacts, particularly to shallower groundwater sources, associated with the Narrabri Gas Project.

Regional groundwater resources are further protected by NSW and Commonwealth regulatory regimes. The NSW regulatory regime is implemented through water sharing plans under the *Water Management Act 2000*. The Commonwealth regulatory regime is implemented through the *Basin Plan* for the Murray-Darling under the *Water Act 2007*.

The extraction of groundwater from the deep coal seams would require a license in accordance with a water sharing plan under the *Water Management Act 2000*. The objects of the *Water Management Act 2000* are to provide for the sustainable and integrated management of the water resources of the State for the benefit of both present and future generations. Development of water sharing plans and sustainable diversion limits for individual water sources inherently gives consideration to the interrelationship between water sources, and potential cumulative impacts. Or alternatively, if sustainable diversion limits of individual water source are adhered to, adverse cumulative impacts are likely to be negligible.

29.3.2 Surface water quality

The key potential surface water impact of the project with the potential to interact with existing or proposed projects is the managed release of treated water into Bohena Creek.

The managed release of treated water into Bohena Creek would be episodic and coincide with environmental flows. No releases would be made to Bohena Creek if flow rates at the Newell Highway gauging station were below 100 megalitres per day. The peak (assessed) release of 12 megalitres per day would therefore be subject to significant dilution (refer to Appendix G1).

A mixing zone assessment found that treated water would be diluted to one-tenth of its concentration about 10 metres from the release point. Mean concentrations of modelled parameters would comply with the adopted trigger values at this level of dilution.

The potential impacts of the project on the quantity or quality of water entering Bohena Creek and downstream watercourse would be negligible at the distances where interaction with residual impacts of other existing or proposed projects would occur. Identified existing or proposed projects in the vicinity of Bohena Creek are Narrabri Landfill and Inglegreen (refer to Figure 29-1). Both of these projects are more than 3 kilometres from Bohena Creek, more than 15 kilometres upstream from managed release location, and do not involve releases to the creek.

Surface water would be monitored upstream and downstream from the release point on Bohena Creek to verify that residual impacts are minimal. Potential impacts of the beneficial reuse of treated water for dust suppression or irrigation would be localised and are readily manageable using standard management and mitigation strategies as proposed in this EIS.

29.3.3 Hydrology and geomorphology

As discussed in Chapter 13, hydrological and geomorphological impacts from the project would be highly localised. No potential impacts on regional flooding or geomorphology were identified. Due to the highly localised nature of the impacts, no cumulative impacts are expected to occur.

29.3.4 Soils and land contamination

The potential for erosion and sedimentation would be greatest during the peak construction period. These potential impacts would be readily managed with the implementation of the erosion and sedimentation control measures. As such, it is not expected that the project would have a material impact on erosion and sedimentation at a scale where cumulative impacts would occur.

The overall risk of encountering or generating land contamination is low and would be unlikely to generate impacts at a scale that would interact with existing or proposed projects. Potential land contamination impacts are discussed in Chapter 14.

29.3.5 Terrestrial ecology

The key potential cumulative impact on ecology is clearing resulting in loss of native vegetation, and associated flora and fauna habitat values. The project and Narrabri Gas Exploration are both located in the project area and therefore have potential to interact and are assessed in Chapter 15.

Cumulative impacts that consider existing and proposed exploration and production appraisal activities associated with the gas exploration and appraisal program operated by the proponent in the study region were assessed. Additionally, vegetation, fauna habitat and threatened flora directly and indirectly impacted by Narrabri Coal Mine have been included in the cumulative impact assessment as they share similar biodiversity values and are in the same landscape to the study area. A review was undertaken for all other potential developments in the study region; however, no other projects were included as they were located in different landscapes and / or had different biodiversity values to those present in the study area.

The combined impact of the project, including all existing and proposed exploration and appraisal activities would equal approximately 1,700 hectares of native vegetation and native grassland, or 0.57 per cent of native vegetation in the study region. The clearing would also represent in the order of 0.5 per cent of habitat for a number of fauna species with a maximum of up to 0.76 per cent for the Striped-face Dunnart.

The estimated area of impact is conservative as exploration and some appraisal wells associated with Narrabri Gas Exploration may be converted to production wells for the project, thus not requiring additional clearing. In addition, the partial rehabilitation of well pads and gas field linear infrastructure over the life of the project would re-instate native vegetation further reducing the likelihood of cumulative impacts.

29.3.6 Aquatic ecology

The key potential surface water impact of the project with the potential to interact with existing or proposed projects is the managed release of treated water into Bohena Creek.

The managed release of treated water into Bohena Creek would be episodic and coincide with environmental flows. No releases would be made to Bohena Creek if flow rates at Newell Highway gauging station were below 100 megalitres per day. The peak (assessed) release of 12 megalitres per day would therefore equal approximately one-tenth or less of environmental flows and would be subject to significant dilution and are not expected to have a significant impact on aquatic ecology.

No stygofauna were found in 19 samples collected over three sample periods from the production bores in the Permian strata of the Black Jack Group and Maules Creek Formation, or from monitoring bores in the colluvium at Leewood, or from monitoring bores and pits in the Bohena Creek Alluvium. Extensive stygofauna communities were not expected in the Bohena Creek Alluvium due to the poor development of the aquifer and the frequency with which the aquifer dries out. Therefore, no cumulative impact to stygofauna are anticipated.

No other identified projects release water to Bohena Creek or other creeks in the project area. Existing or proposed projects in the vicinity of Bohena Creek are Narrabri Landfill and Inglegreen (refer to Figure 29-1). Both projects are more than 3 kilometres from Bohena Creek more than 15 kilometres upstream from the managed release location. As such, cumulative impacts are not anticipated.

Other potential impacts associated with construction and decommissioning of gas and water gathering lines and access tracks over Bohena Creek would be adequately managed with routine measures such as erosion and sediment controls and refuelling protocols. The potential impacts of these activities are not expected to be significant or have the potential to interact with other projects.

29.3.7 Property and land use

Impacts on individual properties and landholders would be localised and therefore would not interact with other existing or proposed projects. Impacts on forestry or recreation would likewise be localised primarily to forested areas within the project area, which are not subject to other existing or proposed projects.

29.3.8 Air quality

Emissions to air during the construction and operation of the project have the potential to interact with air emissions from existing or proposed projects. Emissions of dust to air during construction would generally be short-term, transient, localised and readily managed with the implementation of standard dust controls.

The project has committed to meeting air quality criteria and dispersion modelling predicts relatively small separation distances from construction areas are required to meet the criteria. Emissions to air during operation would occur over longer periods from fixed sources; however, no exceedances of air quality criteria at sensitive receivers are predicted during operations, and in fact maximum concentrations would be substantially lower than the criteria for the large majority of emission types. Refer to Chapter 18 and Appendix L for more information. Emissions during the operation of well pads would comply with the

relevant air quality criteria at the boundary of the well pad, so the potential for cumulative impacts with other operating wells would be negligible.

The air emission modelling was undertaken using a cumulative impact assessment approach with background air quality. Existing air quality was described with reference to NSW Office of Environment and Heritage data for regional localities, supplemented by four months of monitoring in the project area.

The inclusion of this background data in the impact assessment of the project, coupled with a generally conservative approach to modelling, means that the assessment accounted for potential cumulative impacts associated with existing projects. Wilga Park Power Station is within the project area and would be a source of background emissions but was not operating at the time of monitoring. To account for this, Wilga Park Power Station was modelled at its approved 40 megawatt capacity and included, in addition to measured background air quality data, in the predicted concentrations during the operation of the project.

Impacts on air quality as a result of the project were found to be localised and low. As such, due to the distance between the project and other projects that may impact on air quality, cumulative air impacts are unlikely to occur.

29.3.9 Noise and vibration

Noise emissions during construction and operation would generally be managed to be below the relevant noise criteria at occupied sensitive receivers with the implementation of mitigation and management measures, or otherwise managed through private negotiated agreements with landholders.

An amenity criterion of 40 dB(A) $L_{Aeq(period)}$ for sensitive receivers has been set to gauge cumulative impacts involving the project, in accordance with the *Industrial Noise Policy* (NSW EPA 2000).

As the project has committed to meeting the relevant noise criteria at occupied sensitive receivers, and the distance between the project area and other projects that may have noise impacts would be large, there are no anticipated cumulative impacts in relation to noise.

29.3.10 Aboriginal heritage

Potential impacts on items or places of Aboriginal cultural heritage significance would be managed through complete avoidance of all currently known sites and complete avoidance of the most sensitive site types. Pre-clearance surveys would be undertaken with the Aboriginal community.

The assessment concluded that by application of the 'avoidance principle' the project would have an impact on four categories of site however there would be no impact on cultural heritage sites that have been assessed as high significance.

In relation to Aboriginal cultural values, the impact of the project would either be non-existent for some, or minimal for others, and operate in the short to medium term. Noting that the avoidance principle to be implemented directly aligns with best practice for cultural heritage management (as described in such instruments as the Burra Charter), and with complete avoidance of the most sensitive site types, significant cumulative impacts are not anticipated.

29.3.11 Historic heritage

There are 53 sites of potential historic heritage significance in the project area (refer to Chapter 21). The identified sites include components of the Sydney University Giant Air-shower Recorders array and numerous timber extraction areas, sawmills, camp sites and access tracks associated with historic logging.

The majority of sites were found to be of local significance as part of a collection, referred to as the Pilliga East Logging Cultural Landscape, which demonstrate the pattern and course of the development of logging in the forests. The proponent has committed to preserving the heritage value of the Pilliga East Logging Cultural Landscape through the implementation of surface development exclusion zones across a proportion of the identified sites. In addition, a number of unrelated identified historic sites would also remain undisturbed by creating surface development exclusion zones around them. A Historic Heritage Management Plan would be implemented to further mitigate and manage impacts from the project on historic heritage. As a result, the project would have a low impact on historic heritage.

Due to their location, it is not expected that the assessed projects have the potential to impact on the Pilliga East Cultural Logging Landscape.

29.3.12 Traffic and transport

Traffic from existing projects would be reflected in traffic counts undertaken for the project (refer to Chapter 22). The inclusion of this background data in the impact assessment of the project, coupled with a generally conservative approach to impact assessment, means that the potential impacts identified in Chapter 22 would account for potential cumulative impacts associated with existing projects.

The following projects were considered for potential cumulative impacts:

- Boggabri Mine – This project has approval to increase the rate of mining. Based on a review of the traffic and transport assessment for the approval (Parsons Brinckerhoff 2010), there would be limited potential for the potential impacts of Boggabri Mine and the project to interact.
- Maules Creek Mine – This project was not under construction during traffic counts. The traffic and transport assessment for the mine (Hyder Consulting 2010) indicated that 90 per cent of employees during operation would be transported by shuttle bus from the township of Boggabri, whereas produced coal would be transported via rail. As such, the volume of traffic associated with Maules Creek Mine that would interact with the project would be minimal.
- Vickery Mine – Based on a review of the traffic and transport assessment for the mine (GTA Consultants 2012), the project would generate approximately 18 light vehicle trips and three heavy vehicle trips to and from Narrabri during its operation. The cumulative impacts of the project and Vickery Mine would therefore be minimal.
- Watermark Mine – Based on a review of the traffic and transport assessment for the mine (DC Traffic Engineering 2013), potential traffic impacts would be restricted to roads south of Gunnedah. As such, the potential impacts of the project and Watermark Mine are not expected to interact.
- Inglegreen – A detailed assessment of potential traffic and transport impacts is not available for this project. However, cumulative impacts between the project and Inglegreen are expected to be limited given the nature of the project and uncertainty regarding timing of its construction.
- Caroon Mine – A detailed assessment of potential traffic and transport impacts is not available for this project. However, cumulative impacts between the project and Caroon Mine are not expected given the distance between the two project areas.

- Inland Rail Project – A detailed assessment of potential traffic and transport impacts during construction was not available for this project. However, as the proponent is proposing a construction period between 2018 and 2021 (peaking in 2019), it is expected that the construction timing will not align with the construction of Inland Rail.

Due to the location and relatively low volume of traffic potentially generated by the above projects in relation to the project, the potential for cumulative impacts is considered negligible.

29.3.13 Landscape and visual

The identified existing projects would form part of the existing viewshed included in the assessment of the project (refer to Chapter 23). The inclusion of this background information in the impact assessment of the project means that the potential impacts identified in Chapter 23 would account for potential cumulative impacts associated with existing projects.

Cumulative impacts between the project and Carroona Mine, Vickery Mine and Watermark Mine are not expected given the distance between the project areas. There is potential for cumulative impacts to occur with the construction and operation of Inglegreen. However, as Inglegreen is the site of an existing piggery that has operated for 85 years, these impacts are considered negligible and would not represent a significant change to the existing viewshed.

29.3.14 Greenhouse gas

The potential cumulative impacts of greenhouse gas are a global issue, not a local issue. As discussed in Chapter 24, it is more appropriate to consider the emissions from the project in the context of national and global annual emissions. The direct emissions from the project are less than 0.2 per cent of Australia's current annual emissions and less than 0.002 per cent of current global annual emissions.

Electricity produced from combustion of gas is less emissions intensive than the average electricity supplied to the National Electricity Market. As such, downstream combustion of project gas to meet future energy demand could result in relatively fewer emissions being generated, essentially lowering the greenhouse gas intensity of current energy supplies.

29.3.15 Hazard and risk

Potential hazards presented by the project relate to events that by their definition would not form part of the ordinary operation of the project. The likelihood of multiple hazardous events occurring, such as a produced water pond failure at the same time as a coal fines tailings dam failing, from one or more projects identified in Section 29.2 is remote. The closest coal mine tailings dam is located at Narrabri Coal Mine, some 27.5 kilometres away.

The single most notable hazardous event identified in Chapter 25 would be the occurrence of bushfire in the project area. This hazardous event is a function of standing fuel in forested parts of the project area and as such is not a predicted impact of the project. A Bushfire Management Plan would be prepared to guide the response of workers in the event of fire occurring in the project area.

29.3.16 Social and health

The project has the potential to compete with other industries for employees, especially mining projects, in the region due to similar skill requirements—particularly during the peak construction period. Furthermore, projects that are under construction would generally generate higher volumes of demand for labour and accommodation facilities than existing and operating projects.

Maules Creek Mine commenced construction in January 2014, with first coal in December 2014. The separation distance of the project from Vickery Mine and Watermark Mine means that these projects would to some extent draw labour from different regional localities however, cumulative impacts are possible.

The timing of the project may coincide with that of Watermark, potentially resulting in competition for construction labour, however, the operational workforces require different specific skill sets and therefore would not compete at the same level. Some 1,015 direct and indirect jobs were estimated for the regional economy from the Watermark project (Hansen Bailey 2013).

The non-residential workforce and workers relocating into the Narrabri region to pursue employment opportunities have the potential to place excessive demand on the existing private workers camp accommodation facilities, as well as open housing in Narrabri town, despite the proposed expansion of Westport to around 200 beds. This may potentially reduce the availability and affordability of housing and accommodation in Narrabri.

The proponent would implement a range of policies, strategies and initiatives to maximise potential benefits and opportunities of the project, while minimising negative social and health impacts. These would include:

- the involvement of local business and contractors in the project would be supported through a procurement and logistics policy
- Aboriginal employment would be maximised within the scope of the project in accordance with an Aboriginal engagement policy.

The proponent would monitor social impacts throughout the construction and operation of the project, and would implement the mitigation and management measures described above in a manner that is adaptive to changed conditions or emergent social impacts, including cumulative impacts.

29.3.17 Economics

As discussed in Chapter 27, the gross regional product of the Narrabri LGA was around \$821 million in 2010-11 – with the main contributors being agriculture, forestry and fishing (\$240 million) and mining (\$141 million). Mining is also the fastest growing economic sector in Narrabri, with various gas and mining projects in the region expected to generate diverse job and business opportunities. This economic growth is anticipated by Narrabri Shire Council in their *Narrabri Shire Economic Profile* (2016).

The Narrabri Gas Project and other existing and proposed projects in region would contribute to this economic shift and anticipated growth. The specific contributions of the Narrabri Gas Project are detailed in Chapter 27 and include significant investment and contribution to economic output and income in the Narrabri LGA. Multiple other existing or proposed projects in the region are expected to generate similarly significant economic benefits – such as Maules Creek Mine and Watermark Mine producing value-add to the NSW Economy in the order of \$1 billion to 1.5 billion respectively while generating jobs in the regional economies of Gunnedah, Tamworth, Liverpool Plains, Upper Hunter and Narrabri.

Narrabri Shire Council has stated the Narrabri economy is in a “robust position [and] projected to grow in future as the economy diversifies and broadens from its agrarian base into vertically integrated industries” (Narrabri Shire Council 2016). Although the direct economic impact of the Narrabri Gas Project and other existing or proposed projects is positive overall, the broader economic change has the potential to impact incumbent local industries or individuals through indirect effects such as increased costs or competition. However, these potential indirect impacts would be generally outstripped by the economic benefits.

29.3.18 Waste management

As assessed in Chapter 28, the project would produce a range of waste with volumes peaking around the first three years in line with construction activity. The main waste streams would include drill-cuttings, drill fluids, cement slurry, produced water, salt and general solid waste.

These wastes would be managed in accordance with the Waste Management Plan that would seek to avoid, reduce, reuse, recycle and/or treat waste prior to opting for disposal. Some of the more substantial waste streams such as produced water and some drill cuttings would be managed on site as described in Chapter 7 and Chapter 28 respectively. However, it is reasonable to assume that a substantial volume of waste would require management or disposal involving third party facilities, which would present the risk of cumulative impacts occurring with other existing or proposed projects.

The potential for cumulative impacts with other existing or proposed projects would depend on the timing of their construction and operation and their proximity to the Narrabri Gas Project. Construction activities in particular would have higher potential for cumulative impacts given the typically larger waste volumes. Where construction occurs at the same time, or operational waste is significant, cumulative impacts may also be avoided where the separation distance between the Narrabri Gas Project and other existing or proposed projects means separate regional waste management facilities would be utilised.

Lastly, the specific waste management facilities utilised by the Narrabri Gas Project have not been determined as they would depend on multiple factors at the time of construction and operation, including the availability and capacity of the facilities. The potential for interaction with other projects or existing uses of waste management facilities would be a necessary consideration in Waste Management Plan for the project to ensure the long term operability of the project.

29.4 Conclusion

Potential cumulative impacts from the project combined with other existing and proposed projects in the study region are not anticipated to result in significant impacts (Table 29-2). The impact assessment for the project considered all existing projects as part of the baseline assessment and proposed changes to these projects were also considered.

Table 29-2 Summary of cumulative impact qualitative assessment findings

Environmental value	Potential cumulative impact
Groundwater and geology	Negligible
Surface water	Negligible
Hydrology and geomorphology	None
Soils and land contamination	None
Terrestrial ecology	Negligible
Aquatic ecology	None
Property and land use	None
Air quality	Negligible
Noise and vibration	None
Aboriginal heritage	Negligible
Historic heritage	Negligible
Traffic and transport	Negligible
Landscape and visual	Negligible
Greenhouse gas	Low
Hazard and risk	Low
Social and health	Possible
Economics	Positive
Waste	Low