

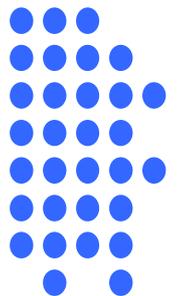
Section 1

Introduction

Preamble

This section introduces the Project that will utilise natural gas being produced from the Bibblewindi and Bohena Coal Seam Gas Pilots to generate electricity at the Wilga Park Power Station. This section includes:

- *an outline of the scope and format of the document;*
- *an introduction to the Proponent and relevant background information;*
- *current approvals, leases, licences and activities;*
- *details about the Project Site;*
- *background information about natural gas and coal seam gas;*
- *the ongoing project documentation; and*
- *identification of the personnel involved in the Project design, document preparation and specialist consultant investigations.*



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1.1 Scope

This *Environmental Assessment* has been prepared by Eastern Star Gas Limited (“the Proponent”) on behalf of the Narrabri Coal Seam Gas Project Joint Venture (“the Joint Venture”) in conjunction with R.W. Corkery & Co. Pty. Limited to accompany the application (see **Appendix 1**) seeking project approval for the development and operation of the Narrabri Coal Seam Gas Utilisation Project (“the Project”). The Project encompasses a gas gathering system, a gas flow line and an expansion of electricity production at the existing Wilga Park Power Station.

Coal Seam Gas (CSG) is to be gathered from the Bibblewindi and Bohena CSG Pilots, located south-southwest of Narrabri and transported via gas flow line to the Wilga Park Power Station, located 16km west of Narrabri. **Figure 1.1** displays the general project location within the context of current exploration and assessment titles notably Petroleum Exploration Licence 238 and Petroleum Assessment Lease 2.

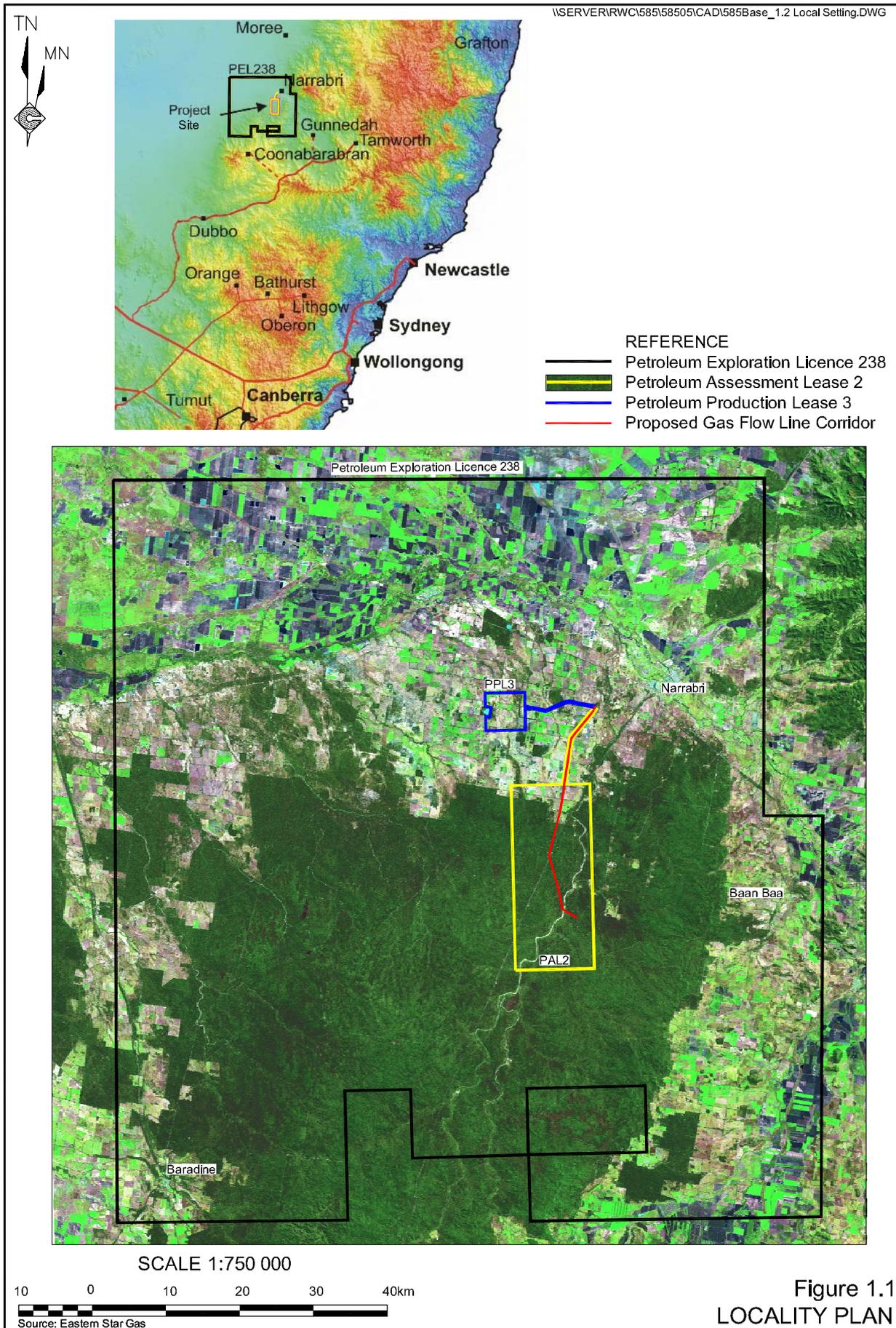
For the purposes of this document, the area incorporating the operational corridor for the gas gathering system, the gas flow line and the Wilga Park Power Station is collectively referred to as “the Project Site”. A majority of the Project Site is located within Petroleum Assessment Lease 2 (PAL 2), as illustrated in **Figure 1.1**. All project components and activities are permissible uses on the land within the Project Site, ie on land zoned “Rural” under *Narrabri Local Environmental Plan 1983*.

The Project is a stand-alone Project that will contribute to the Proponent’s long term objective to develop a sustainable and commercially viable CSG field in the Narrabri area. All further activities required to advance this objective are subject to further environmental impact assessments and government approval separate of this project application, should they proceed.

The Project is designed to facilitate the delivery of CSG to the Wilga Park Power Station preferentially over the atmospheric venting or induced flaring of gas currently being produced from the Bibblewindi and Bohena CSG Pilots. The avoidance of venting of CSG direct to atmosphere is a key objective of the Project given its high concentration of methane. The greenhouse gas impacts of raw methane have been estimated at 21 to 23 times that posed by carbon dioxide. Furthermore, the operational environment within the Pilliga State Forest strictly limits the use of natural gas flare systems for the combustion of production test gases.

In addition to presenting the Project, this document provides the relevant background information and description of the existing environment and the proposed mitigation strategies designed to limit the cumulative impact associated with the construction and operation of the gas gathering system, gas flow line and expanded power station.

The information presented in this document addresses all aspects of the planning, development, operation and rehabilitation of the Project components and additionally addresses the key issues identified by the Director-General of the Department of Planning (DoP), those raised by other government agencies and those identified during the community consultation process.



1.2 Format of the Environmental Assessment

- Section 1:** introduces the Project and the Proponent and provides an overview of the existing approvals and activities already underway in the Narrabri area. The intended ongoing documentation is profiled and the personnel involved in the preparation of the *Environmental Assessment* are listed.
- Section 2:** provides the strategic justification for the Project and places the Project within the context of the staged development of a sustainable and commercially viable gas field.
- Section 3:** provides a description of the principal components of the overall Project. The section concludes with a description of alternatives considered and a brief overview of Joint Venture's long-term objectives for gas field development.
- Section 4:** provides a description of the process used to identify and prioritise the key issues for assessment with reference to the Director-General's requirements for the Project, stakeholder consultation through the Project planning stages and a general environmental risk analysis undertaken to establish the specific environmental risk(s) posed by the issues identified.
- Section 5:** presents a description of a range of environmental features of the local environment that may or will be influenced by the Project. The design and operational safeguards, and where appropriate, the management procedures that have been incorporated into the Project to protect the local environment, are also presented. This section also analyses the potential impact the Project will have on the physical, biological and social environment once the safeguards and procedures are adopted.
- Section 6:** provides a draft statement of commitments the Proponent is prepared to implement with respect to environmental management and monitoring for the entire Project.
- Section 7:** provides a conclusion to the document which justifies the Project in terms of biophysical, economic and social considerations and considers the consequences of not proceeding with the Project.
- Section 8:** lists the various source documents referred to for information and data used during the preparation of the *Environmental Assessment*.
- Section 9:** presents a glossary of acronyms, symbols and units and technical terms, used throughout the *Environmental Assessment*.
- Appendices:** present the following additional information.
1. A copy of the Proponent's application for project approval.
 2. An itemised and tabulated summary of the Director-General's Requirements, including the requirements provided by the various government agencies consulted, and reference to the section within the *Environmental Assessment* or *Specialist Consultant Studies Compendium* where each is addressed.

3. A SEPP 33 hazardous substance and dangerous goods risk screening based on the document entitled *Applying SEPP 33 2nd edition*, (DUAP, 1997).
4. Agreement for construction of an irrigation flow line / channel / drain across a Shire Road.
5. A Plume Rise Assessment

A single volume *Specialist Consultant Studies Compendium* has been placed on exhibition with the *Environmental Assessment* drawing together each of the specialist reports for the Project. The contents of these reports are summarised into the appropriate sections of the *Environmental Assessment*. A full copy of the compendium is included on the CD compiled for the Project.

1.3 The Proponent and Project Background

The Proponent for the Narrabri Coal Seam Gas Utilisation Project is Eastern Star Gas Limited (“Eastern Star”), which listed on the Australian Stock Exchange in February 2001. Shortly after listing, Eastern Star acquired 100% ownership of Petroleum Exploration Licence 238 (“PEL 238”), a 9 100km² licence area covering the highly prospective coal-bearing Bohena Trough area of the Permo-Triassic Gunnedah Basin. Encouraging gas flows had been encountered in the licence area during earlier exploration activity (i.e. prior to its acquisition by Eastern Star) on the Coonarah structure, a conventional natural gas resource located approximately 20km west of Narrabri.

The Coonarah Gas Field underwent appraisal drilling throughout 2001 which culminated in the independent certification of 11.3 petajoules of 2P (proven and probable) gas reserves. As a means to commercialise what was otherwise a stranded gas resource, Eastern Star developed the Narrabri Power Project through the creation of Narrabri Power Limited, a wholly owned subsidiary of Eastern Star Gas Limited.

The power station using gas from the Coonarah Gas Field commenced operation and delivery of power to Country Energy in July 2004. Producing electricity at significantly lower greenhouse intensity than coal-fired generators, the Narrabri Power Project contributes to the NSW Government’s greenhouse gas reduction strategy with additional economic benefits flowing to Narrabri Power through the sale of NSW Greenhouse Abatement Certificates to Country Energy.

In view of Eastern Star’s early focus on conventional natural gas exploration, the rights to the CSG within PEL 238 were assigned under a strata title arrangement to Toronto listed Gastar Exploration Ltd who, along with other joint venture partners, collectively invested in excess of \$39 million on CSG exploration and development activities. The result of sustained exploration efforts at Bohena and Bibblewindi confirmed the presence of very large resources of gas bearing coal seams in two distinct and widespread coal measures and furthermore indicated, on the basis of an independent reserve assessment, a potential 8.7 TCF of Possible CSG reserves within PEL 238.

Recognising that the co-development of CSG and conventional gas provides an attractive scenario for large scale gas developments in an area with no traversing pipeline, Eastern Star negotiated to acquire an interest in the CSG rights from Gastar Exploration Ltd by a combination of cash payments and work program. Under an agreement entered in 2004, Eastern Star together with Hillgrove Resources Limited acquired interest in the CSG resources of PEL 238 through the funding of a fully cored hole at Bohena South, a horizontal well at Bohena 4-L, vertical wells at Bohena South and Bohena-9 and fracture stimulation of the Bohena South-1, Bohena-9 and Bibblewindi-1 wells.

The completion of the 2004 work program and the ongoing operation of the CSG wells throughout 2005 by Eastern Star and Hillgrove resulted in the increase of each partner's respective interest in PEL238's CSG rights to 32.5% with the remaining 35% retained by Gastar Exploration Ltd.

The progression of the CSG project in PEL238 continued throughout 2006 with the development of a closely spaced nine well production pilot at Bibblewindi. In order to establish the pilot, eight new wells were drilled on an approximate 500m spacing to the north of the existing Bibblewindi-1 CSG well. An additional pressure monitoring well was drilled approximately 2km north of the central well in the pilot.

During the 2006/2007 period, and subsequent to the completion of the Bibblewindi CSG Pilot development, Eastern Star commenced the acquisition of Hillgrove Resources Limited's 32.5% interest in PEL238's CSG rights through the issuing of shares, converting notes and options.

In addition to the operation of the Bohena and Bibblewindi CSG pilots, activities in 2007 focused on the certification of gas reserves across PAL2 through further corehole drilling and production data collection and analysis. The receipt of independent certification from Netherland, Sewell and Associates has to date provided certification of 2P reserve of 185PJ and 1P reserves of 21PJ across the Bibblewindi and Bohena CSG pilots. Reserves certification will be an ongoing process as the production pilots develop over time and corehole drilling continues in 2008.

The ongoing production testing activity within PAL2 and the proposed utilisation of CSG produced represents a small but significant step in achieving the primary objective of sustainable indigenous gas supplies in NSW. While further reserves certification activities and production pilot development occurs external to the Project, the existing gas emitted from the Bibblewindi and Bohena CSG Pilots should be utilised for both economic benefit and environmental impact mitigation.

As a means of placing the Project into context, two major announcements by the Joint Venture in 2007 for the supply of gas for electricity generation sit amongst the aforementioned primary objectives of sustainable indigenous gas supplies. Memoranda of Understanding (MOU) have been entered into with the NSW Government owned electricity generator Macquarie Generation and Babcock and Brown Australia Infrastructure Limited for 500PJ and 40PJ/p.a. respectively. In terms of delivering on the key features of each MOU, the existing CSG pilots at Bibblewindi and Bohena play no direct role in the maintenance of the MOU, the reserves certification process or development of adequate gas production wells to underpin a gas sales agreement.

As discussed throughout Sections 2 and 3, the Project is designed to operate in parallel with further field development activities which are subject to separate approvals and impact assessment processes.

1.4 Current Approvals, Leases, Licences and Activities

Since Eastern Star commenced its gas exploration activities in the Narrabri area in 2001, the following approvals, leases and licences have been sought and/or maintained.\

Petroleum Exploration Licence (PEL) 238

Since the renewal of the PEL238 title in August 2001 by Eastern Energy Australia Pty Ltd for a period of 6 years, the Proponent acquired its 100% interest in the licence through the completion of exploration, drilling and development appraisal activities at various locations in the Narrabri region including the Coonarah Gas Field. This licence undergoes the renewal process at the end of each 6 year title period by the Department of Primary Industries – Mineral Resources provided Eastern Star has carried out the level of activity consistent with stated permit commitments. It was most recently renewed for an additional 6 year period in November 2007.

Petroleum Assessment Lease (PAL) 2

The application for a Petroleum Assessment Lease over the 265km² Bohena CSG Project Area was submitted by the Proponent on behalf of the Joint Venture to facilitate the economic and technical assessment of the coal reservoir and the estimated CSG reserves. The *Petroleum (Onshore) Act 1991* states that:

S33 Rights of holders of assessment leases
The holder of an assessment lease has the exclusive right to prospect for petroleum and to assess any petroleum deposit on the land comprised in the lease.

Note. An assessment lease is designed to allow retention of rights over an area in which a significant petroleum deposit has been identified, if mining the deposit is not commercially viable in the short term but there is a reasonable prospect that it will be in the longer term. The holder is allowed to continue prospecting operations and to recover petroleum in the course of assessing the viability of commercial mining.

The PAL was granted over the Bohena CSG Project Area on 20 October, 2007 for a period of 5 years.

Petroleum Production Lease 3 incorporating the Coonarah Gas Field

The Coonarah Gas Field, located approximately 20km west of the Narrabri Township, was fully appraised by drilling in 2001, and has independently accredited 2P reserves of 11.3 PJ. Natural gas is currently being produced from the Early Permian Maules Creek sandstone reservoir to fuel the Wilga Park Power Station.

In December 2003, the NSW Minister for Mineral Resources granted Narrabri Power Limited, as the economic entity's nominated grantee, Petroleum Production Licence 3 ("PPL3"), covering the Coonarah Gas Field and an umbilical easement connecting the field to the power station site at Wilga Park, for a 21 year term commencing from first production.

The installation of the gas gathering system linking the Coonarah Gas Field with the power station occurred during early 2004 under the development consent of the Narrabri Shire Council. The construction, rehabilitation and operation of the project have been guided by the Statement of Environmental Effects prepared by R.W Corkery & Co on behalf of Eastern Star Gas and Narrabri Power Limited. No issues of environmental impact related to the implementation of the project plans occurred during construction nor since operations commenced.

Wilga Park Power Station

Development consent for the construction and operation of the Wilga Park Power Station was issued to Narrabri Power Limited by Narrabri Shire Council on November 14, 2002.

The Narrabri Power Project has been developed by the Company to commercialise the stranded gas reserves at the Coonarah Gas Field. The Project is the sole undertaking of the Company's wholly owned subsidiary Narrabri Power Limited ("NPL") and comprises:

- Petroleum Production Lease 3, including the Coonarah Gas Field;
- a gas gathering and processing system to deliver gas from the Coonarah field, approximately 20 kilometres west of Narrabri, to a power station site at Wilga Park, 12 kilometres west of Narrabri, on land owned by the Company;
- a power station comprising 10 (plus 2 standby) 1MW Jenbacher gas reciprocating engines and generating sets with 4 associated 415V to 11kV transformers;
- a high voltage switchyard, including an 11kV to 66kV step-up transformer to deliver power station output into an existing 66kV transmission line adjacent to the power station site; and
- a 10 year Power Purchase Agreement with Country Energy for the sale of all power station output.

Following 12 months of sustained gas production from the Coonarah Gas Field, during which there was a noticeable decline in gas deliverability, a multifaceted review of the Coonarah reserves status was carried out. Unfortunately, the review led to a significant downgrade of the proven gas reserves of the Coonarah field, from 11 Petajoules originally estimated to 5.8 Petajoules. As a result of the reserves downgrade, and in the absence of new sources of gas supply, the operating lifespan of the Wilga Park Power Station is likely to be the equivalent of only 4 to 5 years, or less. The power station is now being operated intermittently and at part load.

Narrabri Office

The Proponent has sought development consent from the Narrabri Shire Council for the development of a maintenance and operations support facility in the Narrabri West Industrial Area. This consent was received by the Proponent on 5 December 2007.

1.5 The Project Site

The area of land covered by the Proponent's application for project approval is referred to through this document as the "Project Site". The "Project Site" refers to the following component areas.

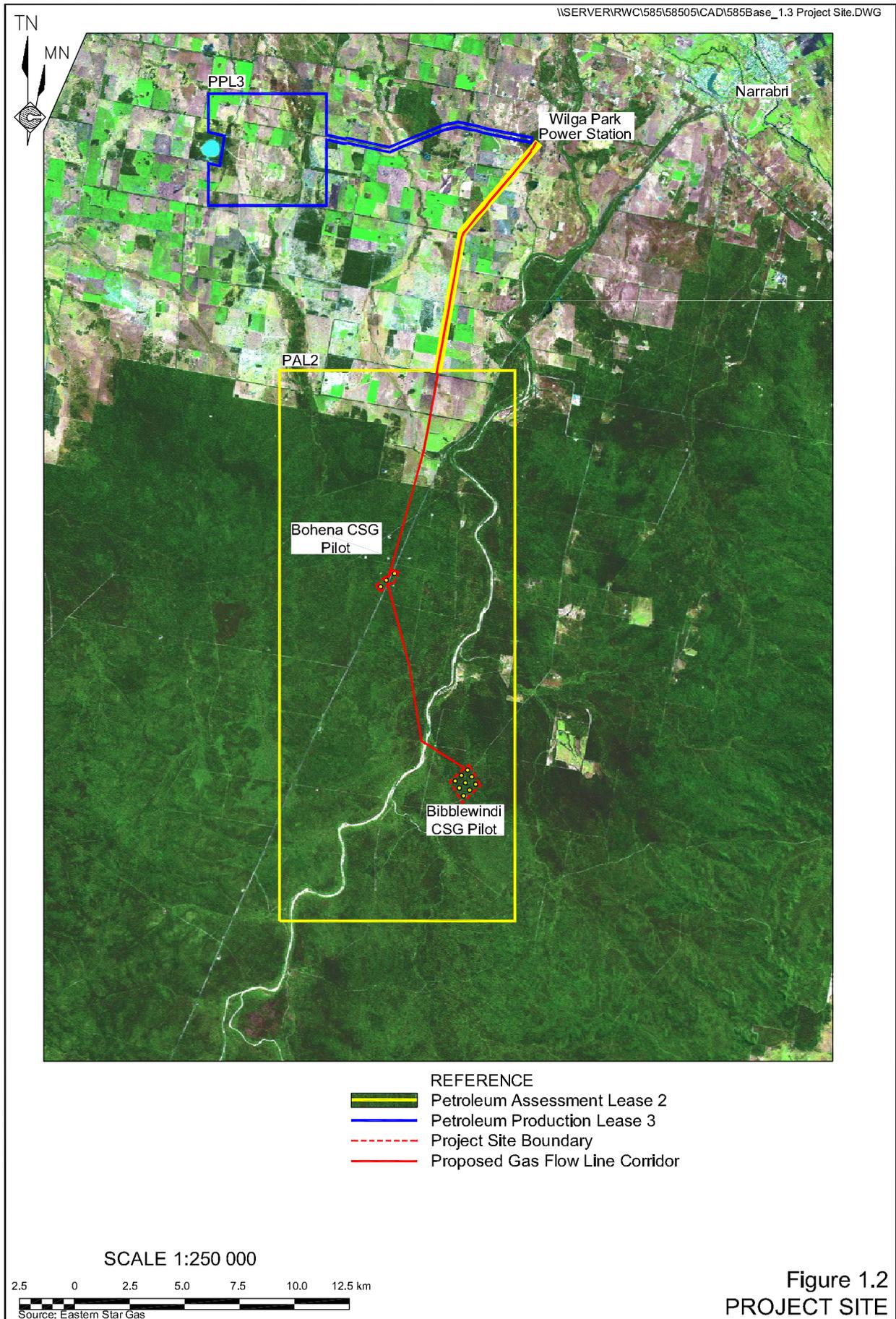
- A 86.6ha area incorporating the Bibblewindi CSG Pilot and Gas Gathering System : Located wholly within the Bibblewindi State Forest.
- A 14.0ha area incorporating the Bohena CSG Pilot and Gas Gathering System : Located wholly within the Pilliga East State Forest.
- A 20m wide easement corridor for the gas flow line : Located across 10 separate freehold land titles and crossing beneath road reserves for the Newell Highway and local roads. The freehold titles comprise the following.

Biblewindi State Forest 1424, Lot 7/DP 757126, Pilliga East State Forest 532, Lot 1/DP 771141, Lot 9/DP 705417, Lot 1/DP 790376, Lot 15/DP 757084, Lot 1/DP 248407, Lot 22/DP 757086, Lot 32/ DP 1034772, Lot 31/DP 1034772, Lot 2 /DP 860120, Lot 22/ DP 757086, Lot 1/DP 660118 and Lot 17/DP 757086.
- A 1.59 ha area for the existing and extended Wilga Park Power Station : Located wholly within the freehold title of Lot 1 / DP 1064422, owned by Narrabri Power Limited

The detailed location of each of the project components are presented in Section 3.2. The ownership of the various land titles within and surrounding the Project Site are provided in Section 5.1.

The Bibblewindi CSG Pilot is located approximately 35km south of Narrabri and approximately 7km east of the Newell Highway. The Bohena CSG Pilot is located approximately 25km south-southwest of Narrabri and is bisected by the Newell Highway.

Encompassing 265km², PAL 2 shown on **Figure 1.2** was declared by the Minister for Primary Industries on 20 October 2007 to facilitate the commercial appraisal of the CSG resource within the area.



1.6 Natural Gas and Coal Seam Gas – Its Occurrence and Potential Production

1.6.1 Introduction

This subsection provides introductory information for readers to appreciate the occurrence of both natural gas and CSG throughout PEL 238 and the potential methods by which the gas is extracted, distributed and utilised.

1.6.2 Natural Gas

Natural gas is a combustible mixture of hydrocarbon gases (*Source: naturalgas.org*). While natural gas is formed primarily of methane, it can also contain various other single chain alkanes including ethane, propane, butane and pentane. Natural gas is generally accepted as being formed through diagenesis and catagenesis of organic matter that have been covered by sediments over long periods. Over time, the decay of organic matter under high pressures and temperatures break form various analogues of oil and natural gas. Generally speaking, higher pressures, temperature and depths play a role in determining what type and the relative composition of hydrocarbons that are produced. Lower temperatures and pressure and shallower deposition may increase rates of oil production whilst the opposite is thought to impact on the gasification of the hydrocarbons into natural gas. The origin of the hydrocarbon source, that is the location where the organic matter was originally deposited and subsequently covered by sediments, is termed the “source rock”.

As gaseous hydrocarbons have a lower density than the water that fills the permeable sedimentary rocks, it will rise towards the surface of the earth through similarly permeable sediments and fractured and faulted pathways. A majority of the gases will simply continue to rise to the surface and dissipate into the air. However, it is very possible that during migration, these gases may encounter suitably shaped, impermeable geological formations that assist in trapping the gas underground. If these formations are large enough, they can trap a great deal of natural gas underground within the porous sediments. This is known as a hydrocarbon or petroleum reservoir.

With natural gas trapped under the earth in this fashion, it can be recovered by drilling a well down through the overlying impermeable rock and into the reservoir. Gas in these reservoirs is typically under the high pressure exerted by the water saturated rocks overlying it which allows it to flow up to the surface without any assistance. Gaseous hydrocarbons formed and extracted in this manner are often termed “conventional” natural gas. As an example of this, the Coonarah Gas Field located in PEL238 is a conventional natural gas discovery that produces gas from a porous sandstone reservoir of Jurassic, Triassic and Permian age.

1.6.3 Coal Seam Gas

The characteristic difference between the conventional natural gas reservoir described in the preceding section and a CSG reservoir is that the coal is both the reservoir rock and source rock for methane.

Coal is formed in much the same manner as gaseous and liquid hydrocarbons in that organic biomass is deposited under sediments and is transformed by high temperature and pressure over long periods of time. The process of coalification begins when biomass is deposited in anaerobic aquatic environments such as streams, rivers and swamps where low oxygen levels prevent complete decay. The deposition of large amounts of biomass and relatively little sediments permits the formation of large, thick deposits of undecayed organic matter. Eventually, a disturbance that deposits large quantities of sediments will break the deposition cycle and permit the ongoing transformation into various coal precursors.

The process of decay continues as the organic matter is covered by sediments and subjected to higher temperatures and pressures. The conversion of the carbon and hydrogen rich organic matter into hydrocarbons can occur as a result of biogenic (anaerobic bacterial decomposition) or thermogenic (heat related cracking of organic molecules into simple hydrocarbons) processes. The gaseous hydrocarbons formed during these processes are readily held or adsorbed on the surfaces of the coal and held in place by the continual exertion of hydrostatic pressure of the water saturated rocks overlying it.

Only certain ranks of coal are suitable for the extraction of CSG. Early analogues of coal such as peat and lignite carry little or no potential as a CSG reservoir due to their thermal immaturity. Because methane generation (methanogenesis) is a function of maceral (the organic constituents of coal) and thermal maturation, as temperature and pressure increase, so does the coal rank and its ability to generate and store methane (see **Figure 1.3**).

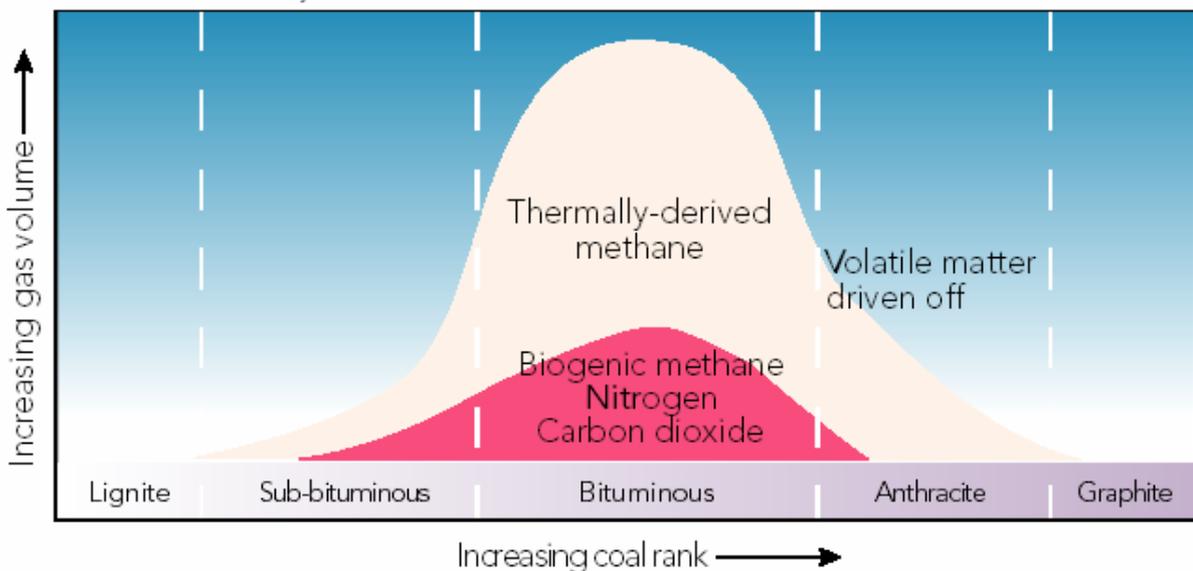


Figure 1.3
Methane Generation

Source: Oilfield Review (Autumn 2003) from Fox-Davies Capital Limited, 2007

The extraction of CSG generally requires the penetration of the reservoir by the drilling of a well in much the same manner as a conventional gas play. However, as the gas is adsorbed onto the coal matrix and held in place by water pressure, a reduction of this pressure through the removal (pumping) of the water will permit the coincident generation of methane and water up through the CSG well. Again differing from conventional gas reservoirs which typically exhibit a decline in pressure and hence rates of production once established, the production profile of a CSG reservoir is characterised by higher initial rates of water production and little or no gas generation before water production decrease and gas production increases. This typical profile can continue over a number of years before maximum rates of gas production are reached and the profile begins shallow rate of decline (see Figure 1.4)

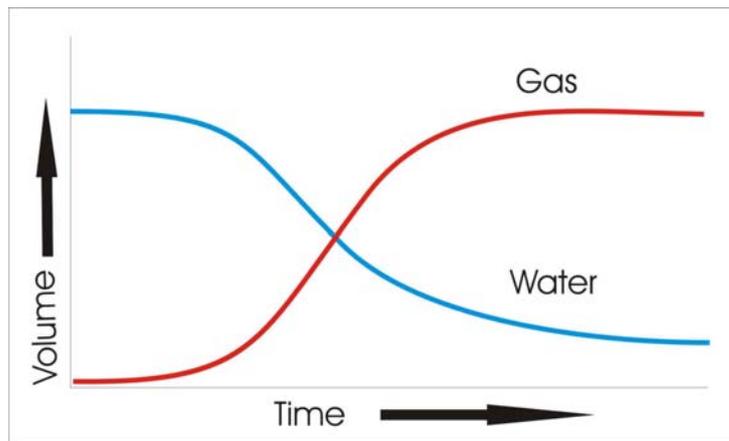


Figure 1.4
Typical Production Profile for a Coal Seam Gas Well

In terms of achieving maximum rates of gas production, production testing carried out in PEL238 confirms that there is a period from the commencement of production until the CSG wells reach maximum rates of production. During this period, the gas that is produced is not insignificant in a cumulative sense and rather than continually vent the gas to atmosphere or otherwise flare the gas in situ, the opportunity to realise an economic benefit from gas-fired power generation remains an attractive alternative to venting and/or flaring. The collection and transportation of the production test gas from the existing and future CSG wells to the Wilga Park Power Station represents an ideal solution to the undesirable venting or flaring strategies and compliments the development of an operational gas field supplying major sales contracts and large volume gas transmission flow lines.

1.7 Environmental Management and Project Documentation

1.7.1 Environmental Management

On-going environmental management at the Narrabri Coal Seam Gas Utilisation Project, including the Proponent's performance with respect to this document and the implementation of any lease, licence or project approval conditions, will be the responsibility of the Environmental Manager and Engineering Operations Manager who are full time employees of the Proponent.

They will be jointly responsible for the co-ordination of day-to-day on-site supervision including the integrated implementation of all environmental safeguards identified in this document and additional documentation developed throughout the life of the Project. Assistance will be provided by the project construction contractors and specialist consultants, as and when required.

The Proponent is committed to undertaking all component activities in a responsible and proactive manner which:

- minimises the impacts upon the surrounding land uses in the area;
- is environmentally and socially responsible; and
- minimises any real or perceived impacts on other members of the community.

1.7.2 Project Documentation

Successful environmental management invariably involves regular, organised documentation to ensure that, irrespective of personnel changes, all aspects of planning, environmental control, monitoring and responses to problems are properly recorded.

Following the receipt of project approval, the Proponent will prepare the following documents to guide the planned construction and operational stages of the Project.

- Comprehensive site-based work plans and schedules specifying the safeguards and environmental considerations of the Project;
- Site induction procedures specifying the environmental considerations of the Project;

The Proponent would also submit an Annual Environmental Management Report (AEMR) to record operational progress and all relevant environmental issues on an annual basis.

1.8 Management of Investigations

The preparation of this *Environmental Assessment* has been managed by Tim Donnan, (B.Sc, M.Env Mgmt) Environmental Officer of Eastern Star Gas Limited with the assistance of Mr Rob Corkery M.App.Sc, B.Sc (Hons) Principal of R.W. Corkery & Co. Pty Limited.

The SEPP 33 screening and risk assessment was guided by Mr Denis Ward of Eastern Star Gas Ltd.

The following external consultants were employed to prepare independent specialist assessment reports for the Project.

- Fauna Studies – Mr Keith Kendall and Mr Russell Jago of Kendall & Kendall.
- Flora Studies – Mr Greg Elks of Idyll Spaces.
- Air Quality and Greenhouse Gas Assessment – Dr Martin Doyle of Heggies Pty Ltd.
- Noise and Vibration Assessment – Dr Neil Pennington of Spectrum Acoustics Pty Ltd.
- Strategic Project Development and flow line risk assessment – Mr Roland Sleeman of Sleeman Consulting.
- Cultural Heritage Assessment – Mr. Eddie Trindall and Mr. Matt Trindall, representatives of the Pilliga Forest Aboriginal Management Committee.
- Soils and Land Capability Assessment – Mr Geoff Cunningham of Geoff Cunningham Natural Resource Consultants Pty Ltd.