Macquarie Generation

Part 3A Environmental Assessment (Project Application 08_0061)

Gas Pipeline (North-South Route), Liddell Power Station

February 2009

Prepared For Macquarie Generation by:
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Submission of Environmental Assessment
Prepared under the Environmental Planning and Assessment Act 1979, Part 3A, Section 75.

Environmental assessment prepared by:	
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In respect of:	
Project to which Part 3A applies	Gas Pipeline (North-South Route), Liddell Power Station
Project Application No.	08_00061
Applicant name	Macquarie Generation
Contact	Mr Glenn Keevers
Phone	(02) 4968-7426
Address	34 Griffiths Road LAMBTON NSW 2299
Land to be developed	See Table 1 on Page 6.
Proposed development	Macquarie Generation proposes to build a 51km low pressure underground gas pipeline to transport coal seam gas to the Liddell Power Station from surrounding mines in the Hunter Valley (refer Figure 1).
Environmental assessment	An Environmental Assessment is attached that addresses all matters in accordance with Part 3A of the *Environmental Planning and Assessment Act 1979.*
Certificate	I certify that I have prepared the contents of this Environmental Assessment in accordance with the Director-General's requirements dated 5 May 2008 and that, to the best of my knowledge, the information contained in the Environmental Assessment is not false or misleading.
Signature	
Name	Corey Beggs
Date	6-02-09

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Executive Summary

Macquarie Generation engaged CDB Environment Pty Ltd to prepare this Environmental Assessment Report (EAR) in accordance with Part 3A of the *Environmental Planning and Assessment Act 1979* for a proposed low pressure coal seam gas pipeline to supplement fuel usage at the Liddell Power Station in the Hunter Valley, New South Wales.

This Environmental Assessment establishes the development criteria within which the pipeline will be engineered, constructed and operated. This envelope approach was chosen as it provides for the flexible gas capacity needed to conclude commercial gas supply negotiations for a range of possible gas volumes and the time at which their gas becomes available as well as choice of pipe material based on price and delivery lead time. These factors will be confirmed during the detailed design after approval.

The project envelope was determined from a broad study area and was refined with regard for the environmental, social and technical constraints on pipeline construction and operation. Potential impacts were identified and the narrow route corridor (50 m wide) selected gives the best avoidance and mitigation outcome. The pipeline design will conform to established codes of practice, have capacity for the gas volume to be transported and provide for the physical conditions encountered along the route.

The pipeline designer will prepare a detailed design within the development envelope defined in this EAR.

The pipeline will be buried for its length and will primarily follow existing cleared land including roads, existing infrastructure corridors and maintenance tracks.

The proposed pipeline will be approximately 51 kilometres in length and is permissible under the Muswellbrook and Singleton Local Environmental Plans. Land use in the area consists of coal-fired electricity generation and coal mining as well as some grazing that will not be adversely affected by the Project. Crossing of Hunter River and Wollombi Brook will involve under-boring and mitigation measures have been proposed to minimise the potential for impact on waterways.

Alison Hunt & Associates (2008) conducted an ecological assessment of the proposed pipeline corridor. The proposed pipeline corridor is heavily disturbed and is unlikely to contain extensive areas of significant native vegetation or habitat. It is considered that with the implementation of the mitigation measures the Project is unlikely to have a long-term impact on threatened species and/or populations within the pipeline corridor area.

Insite Heritage (2008) completed an assessment of the impact of the Project on cultural heritage in accordance with the draft *Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation.* It is considered that with the implementation of the mitigation measures for the Project is unlikely to have any potential adverse impact on cultural heritage.

A risk assessment conducted by Sleeman Consulting (2008) considered various issues of third party activity, mining operations, explosive contents of pipeline, static build up in the pipelines, pipe failure/overpressure, road and waterway crossings, natural phenomena (such as bushfires) and

inadequate maintenance. The screening risk assessment concluded that a preliminary hazard analysis was not necessary.

Due to the low flow regimes observed within rivers and creeks to be crossed by the pipeline and the methods of construction that are designed to avoid any permanent modification of surface flows the Project is not likely to introduce any specific long term impacts on the quality or quantity of water for downstream or groundwater users, or impact the structural integrity of the creek banks or have any indirect impacts on the ecological function of the water systems.

The disruption to localised traffic flows along the pipeline corridor is expected to be short term and low. The system of existing roads would permit the safe flow of traffic (both light and heavy) into and out of the Project area without any need for alteration to their current condition. Boring below sealed bitumen roads will be used to minimise disruption to traffic movements and prevent any reduction in road surface integrity. Where the working area intersects a road where a sub-surface crossing is required, Macquarie Generation shall implement a suitable traffic control plan in accordance with the RTA's Traffic Control at Worksites Manual.

There is expected to be reduction in some air pollutants as a result of supplementing the use of coal seam gas in the Power Stations generating stream. Coal seam gas is not expected to contain sulfur other than in trace amounts which, due to fuel substitution, will reduce oxides of sulfur formed during combustion. Substitution of methane also has the potential to reduce disposal of ash and dust by-products from coal.

Dust will be created during the construction phase however, dust will be adequately managed through mitigation measures proposed. In terms of noise the operation of the pipeline is unlikely to create significant levels of noise. Given the nature of the locality and surrounding land uses, construction noise is unlikely to create an adverse impact; however, noise emissions will be managed through mitigation measures proposed including compliance with the Environmental Noise Control Manual (EPA, 1994).

Construction activities have the potential to create waste that must be managed. Waste material and disposal activities will be managed in accordance with the provisions of the *Protection of the Environment Operations Act 1997,* the *Waste Avoidance and Resource Recovery Act 2001* and the Department of Environment and Climate Change (DECC 2008) Waste Classification Guidelines.

The Project has the potential to reduce significant levels of greenhouse gas emissions and create abatement certificates under the NSW Greenhouse Gas Abatement Scheme.

Subject to adopting the mitigation measures there will not be any cumulative environmental impact as a result of the proposed pipeline Project. Where potential adverse impact has been identified appropriate mitigation measures will be put in place. The key environmental impacts can be managed through the mitigation measures and preparation of a Construction and Operations Environmental Management Plan.

1 Introduction

In February 2008, Macquarie Generation submitted to the Department of Planning (DoP) a Project Application (08_0061) and Project Application Preliminary Environmental Assessment (PB, 2008) for a proposed coal seam methane gas pipeline (north-south) corridor[1] in the Hunter Valley, New South Wales (NSW) (Figure 1). On the 5 May 2008 the Director-General of the DoP provided Macquarie Generation with the requirements for the environmental assessment (Appendix A).

Macquarie Generation engaged CDB Environment Pty Ltd (CDB) to prepare the Environmental Assessment Report (EAR) in accordance with the Director-Generals requirements and Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This Environmental Assessment establishes the development criteria within which the pipeline will be engineered, constructed and operated. This envelope approach was chosen for the following practical reasons:

- Firstly, it provides for the flexible gas capacity needed to conclude commercial gas supply negotiations with multiple mining companies. The supply outcome is a range of possible gas volumes subject to which mines join the project and the time at which their gas becomes available.
- Secondly, maintaining two pipe material options allows a choice to be made based on volatile factors such as price and delivery lead time closer to the time of project commitment. Each material leads to detail differences in pipeline design. The detailed design will occur after this Environmental Assessment is approved.

The project envelope was determined as follows:

- The route alignment evolved from a broad study area and was refined with regard for the environmental, social and technical constraints on pipeline construction and operation. Potential impacts were identified and the narrow route corridor (50m wide) selected gives the best avoidance and mitigation outcome. The pipeline design will; conform to established codes of practice, have capacity for the gas volume to be transported and provide for the physical conditions encountered along the route.

Design phase update

The pipeline designer will prepare a detailed design within the development envelope defined in this assessment. Should it be necessary in the design phase to vary the envelope limits an update will be submitted for review.

Macquarie Generation is seeking full Project Approval for the Project under Part 3A of the EP&A Act. This report provides an environmental assessment of the Project clearly indicating the scope of the Project (see Section 2).

[1] Pipeline corridor covering a 50 m corridor centred along the proposed pipeline alignment - total area – 255 ha.

This report contains the following sections:

- **Section 1 Introduction** – provides background to the Project, Project objectives and introduces Macquarie Generation.
- **Section 2 Project Description** – provides a detailed description of the Project and site location.
- **Section 3 Planning and Regulatory Context** – provides a description of the statutory planning context.
- **Section 4 Consultation** – outlines the key stakeholders that have been consulted and where issues raised have been addressed in the EAR.
- **Section 5 Key Assessment Requirements** – provides a description of the key environmental issues associated with the Project and recommended environmental safeguards and potential for cumulative effects.
- **Section 6 Other Assessment Aspects** – provides a description of other environmental issues associated with the Project and recommended environmental safeguards.
- **Section 7 Project Justification and Conclusion** – indicates the suitability of the Project within environmental planning constraints.

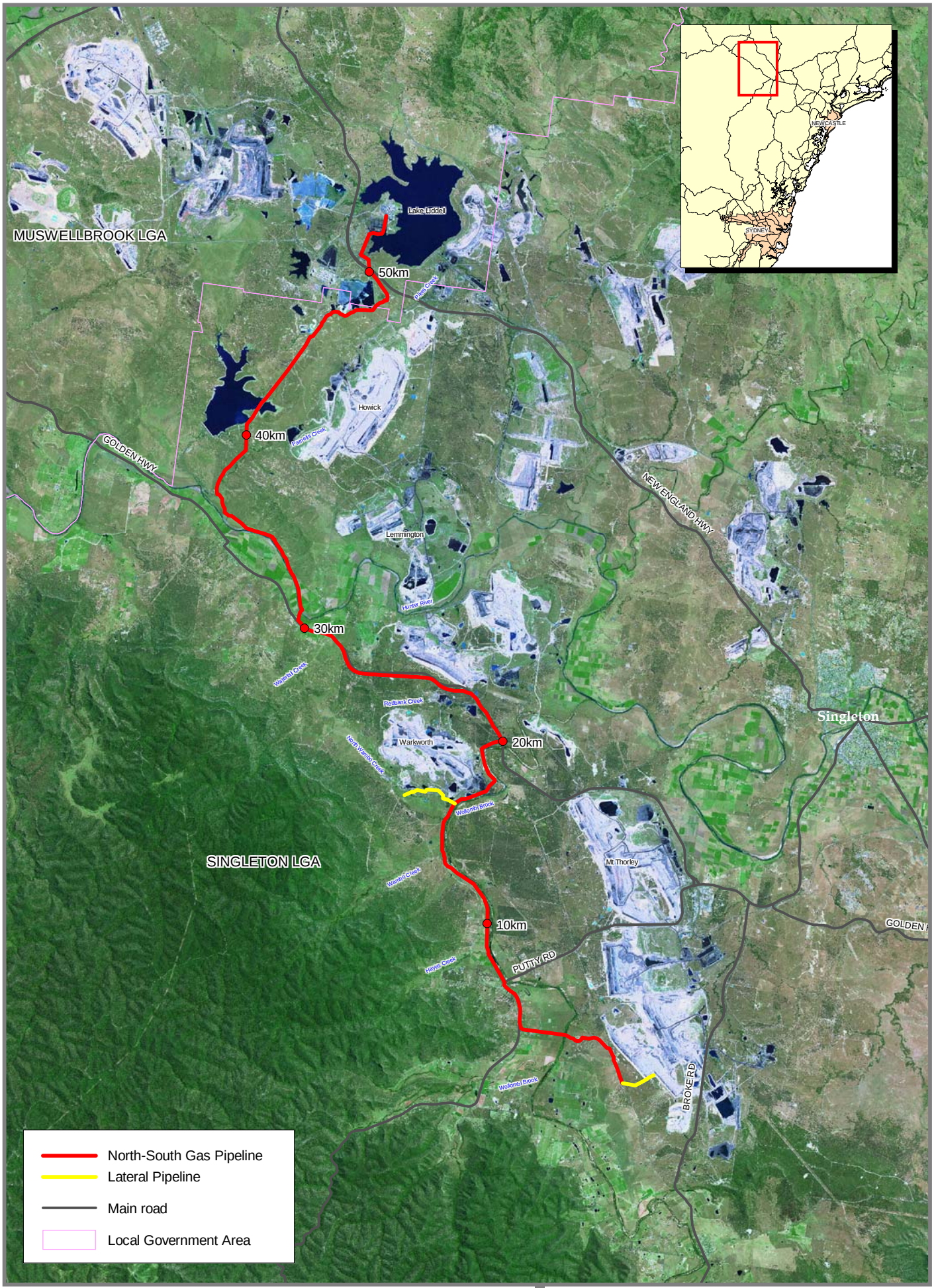

Figure 1 Proposed North-South Gas Pipeline Corridor

CDB Environment Pty Ltd

1.1 Project Proponent

Macquarie Generation is the proponent for the Project. Macquarie Generation is a State Owned Corporation established in 1996 following NSW electricity system reforms. Macquarie Generation owns and operates Liddell and Bayswater Power Stations, which are located between Singleton and Muswellbrook in the Upper Hunter Valley of NSW.

The core business of Macquarie Generation is related to the production and wholesale trading of electricity to the National Electricity Market. Macquarie Generation produces approximately 15% of the electricity needed by the population in Eastern Australia from South Australia to Northern Queensland. Electricity usage equates to 40% of the electricity required by the people of NSW, making Macquarie Generation Australia's largest electricity generator.

1.2 Background to Project

Liddell Power Station was constructed in the early 1970's and is located adjacent to the New England Highway, between Singleton and Muswellbrook. Infrastructure at the power station has been progressively upgraded to improve performance and environmental impact. The power station produces electricity for markets ranging from South Australia to North Queensland.

The venting of large volumes of coal seam gas is an important safety measure that is undertaken before the commencement of mining activities and during the mining operation itself. According to the Australian Greenhouse Office fugitive emissions from Australian black coal mines are estimated to constitute 3.1 per cent of Australia's net greenhouse emissions. In order to help reduce these emissions the Australian government has established and is implementing the Australian Coal Mine Methane Reduction Programme (AGO 2007).

The purpose of this pipeline Project is to utilise coal seam gas of the neighbouring Hunter Valley coal mines. Coal seam gas is of mixed quality with extremely variable composition and delivery rate (quantity), which can restrict the opportunity for use as a fuel in traditional generation technologies such as gas turbines or gas engines. The current management practice is disposal of the waste coal seam gas by venting or flaring into the atmosphere.

In line with principles of this reduction programme, Macquarie Generation proposes an innovative alternative to management of coal seam gas, of which the pipeline is the essential element. The coal seam gas, piped to the power station, would be directly injected into the coal combustion fire-ball within the power station boilers. The coal seam gas Project will be the first known large scale implementation of supplementary gas combustion in coal-fired boilers in Australia. The enabling factor in the Project approach is the coal-fired boilers' unique tolerance of gas inconsistency. The gas as a fuel supplement may displace up to 5% of the coal (by mass) required to generate a given amount of electricity. In addition, Liddell Power Station has gas turbines on site that could also be fuelled by the coal seam gas under certain circumstances.

1.3 Project objectives

The objectives and justification for the Project is to:

- Construct the pipeline to supply coal seam gas fuel to supplement coal-fired electricity generation at Liddell Power Station.
- Provide nearby Hunter Valley coal mines with the means to dispose of coal seam gas, to the extent of up to 270 thousand tonnes per year (or 5 million tonnes carbon dioxide [CO^2] equivalent).
- Reduce the greenhouse impacts of both the coal mining process and electricity generation.
- Offset greenhouse gas production in response to Greenhouse Gas Abatement Scheme (GGAS) obligations.
- Provide an example of innovative use of coal seam gas in coal-fire boilers through the first known large scale implementation of supplementary gas combustion in coal-fired boilers in Australia.

1.4 Management of Specialist Investigations

The preparation of this EAR has been managed by Mr Corey Beggs of CDB Environment Pty Ltd.

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

- Ecological Assessment – Dr Alison Hunt of Alison Hunt & Associates Pty Ltd.
- Heritage Assessment – Ms Angela Basset and Ms Elizabeth Wyatt of Insite Heritage Consultants and representatives of the local Hunter Valley aboriginal groups.
- Risk Assessment – Mr Roland Sleeman of Sleeman Consulting.

2 Project Description

2.1 Site location

The proposed pipeline is approximately 51 km in length and runs completely within the Singleton and Muswellbrook Local Government Areas (see Figure 1). The final pipeline corridor (50 m wide) was chosen and refined to transverse coal mine, public, private or Macquarie Generation properties which have been previously disturbed by past agricultural practices and/or mining operations. It incorporates several public road crossings such as the Golden and New England Highways as well as crossings of major watercourses, such as the Hunter River and Wollombi Brook. The pipeline will also traverse existing property access roads, as well as cleared property boundaries or fence lines.

The point of origin of the corridor is some 51 km south of the Liddell Power Station and 12 km southwest of Singleton and 1 km north of Broke (see Figure 1). The pipeline will terminate at the Liddell Power Station or conclude at the proposed east-west coal seam pipeline corridor assessed under a separate Project application (07_0028) that also connects to Liddell Power Station, located on the New England Highway, south of Muswellbrook. This environmental assessment covers the entire pipeline route through to the termination at the Liddell Power Station.

The proposed pipeline traverses a considerable number of allotments. The proposed development is considered a 'linear infrastructure Project' and Macquarie Generation, a public authority, under clause 8F of the *Environmental Planning and Assessment Regulation 2000,* it is not necessary to detail all relevant allotments nor gain landowner consent to lodge an application under Part 3A of the EP&A Act. Notwithstanding this, Table 1 shows the list prepared by Macquarie Generation covering the land that will be affected by the proposed Project. In Appendix F a set of maps has been provided showing the cadastre for the pipeline corridor. All landowners have been contacted by Macquarie Generation during the consultation phase for the Project (see Section 4).

Table 1: Land ownership details

Corridor Sequence	Deposition Plan	Lot	Owner	Existing Land Use	LGA	LEP Zone
1	DP657988	1	Xstrata	Mining	Singleton	1(a) – Rural
2	Charlton Road		Singleton Shire Council	Road	Singleton	1(a) – Rural
3	DP811613	20	Xstrata	Mining	Singleton	1(a) – Rural
4	Wollombi Brook		Crown Land	Watercourse	Singleton	1(a) – Rural
5	DP10022	7	Xstrata	Agriculture	Singleton	1(a) – Rural
6	DP10022	6	Xstrata	Agriculture	Singleton	1(a) – Rural
7	Putty Road		RTA	Road	Singleton	1(a) – Rural
8	DP753821	64	Crown Land	Agriculture	Singleton	1(a) – Rural
9	DP93633	7001	Crown Land	Agriculture	Singleton	1(a) – Rural
10	DP731921	5	J & V Ferlito	Agriculture	Singleton	1(a) – Rural
11	DP1030910	100	P&J Cooke	Agriculture	Singleton	1(a) – Rural

Corridor Sequence	Deposition Plan	Lot	Owner	Existing Land Use	LGA	LEP Zone
12	Putty Road		RTA	Road	Singleton	1(a) – Rural
13	DP252777	5	D. Gregory	Agriculture	Singleton	1(a) – Rural
14	DP753821	5	I&A Bartholomew	Agriculture	Singleton	1(a) – Rural
15	DP857834	104	L&R Caban	Agriculture	Singleton	1(a) – Rural
16	DP790963	1	M&D Lancaster	Agriculture	Singleton	1(a) – Rural
17	DP571290	282	R&F Bailey	Agriculture	Singleton	1(a) – Rural
18	DP571290	281	P Dunn & S Urwin	Agriculture	Singleton	1(a) – Rural
19	DP586792	91	V. Merrick	Agriculture	Singleton	1(a) – Rural
20	DP579424	312	I&M Circosta	Agriculture	Singleton	1(a) – Rural
21	DP735566	3	A&N Lepisto	Agriculture	Singleton	1(a) – Rural
22	DP735566	1	W&D Lambkin	Agriculture	Singleton	1(a) – Rural
23	DP732501	2	Wambo Coal	Mining	Singleton	1(a) – Rural
24	DP732501	3	Wambo Coal		Singleton	1(a) – Rural
25	DP732501	4	Wambo Coal		Singleton	1(a) – Rural
26	DP732501	5	Wambo Coal		Singleton	1(a) – Rural
27	DP732501	6	Wambo Coal		Singleton	1(a) – Rural
28	DP732501	1	Wambo Coal		Singleton	1(a) – Rural
29	DP110084	1	Wambo Coal		Singleton	1(a) – Rural
30	DP110084	2	Wambo Coal		Singleton	1(a) – Rural
31	Wambo Creek		Crown Land	Watercourse	Singleton	1(a) – Rural
32	DP548749	83	Wambo Coal	Mining	Singleton	1(a) – Rural
33	DP753817	113	Wambo Coal		Singleton	1(a) – Rural
34	DP33149	C	Wambo Coal		Singleton	1(a) – Rural
35	DP33149	B	Wambo Coal		Singleton	1(a) – Rural
36	DP33149	A	Wambo Coal		Singleton	1(a) – Rural
37	Nth Wambo Creek		Crown Land	Watercourse	Singleton	1(a) – Rural
38	DP753817	4	Wambo Coal	Mining	Singleton	1(a) – Rural
39	DP753817	3	Wambo Coal		Singleton	1(a) – Rural
40	DP753817	10	Wambo Coal		Singleton	1(a) – Rural
41	DP753817	11	Wambo Coal		Singleton	1(a) – Rural
42	DP753817	71	Wambo Coal		Singleton	1(a) – Rural
43	DP753817	18	Wambo Coal		Singleton	1(a) – Rural
44	DP753817	58	Wambo Coal		Singleton	1(a) – Rural

Corridor Sequence	Deposition Plan	Lot	Owner	Existing Land Use	LGA	LEP Zone
45	DP753817	57	Wambo Coal		Singleton	1(a) – Rural
46	DP753817	58	Wambo Coal		Singleton	1(a) – Rural
47	Golden Highway		RTA	Road	Singleton	1(a) – Rural
48	DP579587	92	K&C Smith	Agriculture	Singleton	1(a) – Rural
49	Hunter River		Crown Land	Watercourse	Singleton	1(a) – Rural
50	DP1017998	101	R W Moses P/L & Wandewoi P/L	Agriculture	Singleton	1(a) – Rural
51	DP752468	4	R W Moses P/L & Wandewoi P/L		Singleton	1(a) – Rural
52	DP752468	3	R W Moses P/L & Wandewoi P/L		Singleton	1(a) – Rural
53	DP1112847	1	R W Moses P/L & Wandewoi P/L		Singleton	1(a) – Rural
54	DP547864	107	Macquarie Generation	Power Station	Singleton	1(a) – Rural
55	DP234545	1	Macquarie Generation		Singleton	1(a) – Rural
56	DP1059007	112	Macquarie Generation		Singleton	1(a) – Rural
58	DP752468	86	Macquarie Generation		Singleton	1(a) – Rural
59	DP752468	151	Macquarie Generation		Singleton	1(a) – Rural
60	DP700554	10	Macquarie Generation		Singleton	1(a) – Rural
61	DP574168	1	Macquarie Generation		Singleton	1(a) – Rural
62	DP247943	6	Macquarie Generation		Muswellbrook	5(a) – Special Uses
63	DP966589	5	Macquarie Generation		Muswellbrook	5(a) – Special Uses
64	DP247943	6	Macquarie Generation		Muswellbrook	5(a) – Special Uses
65	New England Hwy		RTA	Road	Muswellbrook	5(a) – Special Uses
66	DP1019325	601	Macquarie Generation	Power Station	Muswellbrook	5(a) – Special Uses
67	DP1022827	2	Macquarie		Muswellbrook	5(a) – Special

Corridor Sequence	Deposition Plan	Lot	Owner	Existing Land Use	LGA	LEP Zone
			Generation			Uses

2.2 Existing operations and licences

The power station produces electricity through combustion of coal that is delivered from surrounding coal mines to a stockpile on the site via a series of conveyors or rail. Coal is burned to create steam to drive turbines that generate electricity in the electrical generator. Liddell Power Station produces approximately 10,000 GWhs of electricity, or enough power for over 1 million average Australian family homes (Macquarie Generation, 2007). Lake Liddell was constructed to provide a water storage facility for cooling water to be utilised in the power station. Water storage facilities at Liddell power station do not need to be altered for the pipeline Project.

Liddell power station has an existing environment protection licence (EPL) (Number 2122) that is next due for review in May 2012. The licence allows for coal works, electricity generating works and waste facilities – HIGAB processing.

Products of combustion – Changes to EPA Licence 2122

EPL 2122 requires that an Annual Return, comprising a Statement of Compliance and a summary of any monitoring required by the licence (including the recording of complaints) be submitted to the Department of Environment and Climate Change (DECC).

The coal seam gas to be supplied to the Liddell Power Station is argued to be a 'Standard' fuel under the *Protection of the Environmental Operations (Clean Air) Regulation 2000*, Part 4 Division 1 Clause 20, rather than an "Alternate" fuel. Following discussions with DECC, Macquarie Generation propose to submit a request to vary EPL 2122 to include the handling and burning of coal seam gas fuel at the Liddell Power Station.

Once amendments to the licence are finalised, the emission limits and reporting requirements of the licence are considered suitable for ongoing monitoring of the use of the coal seam gas at the site.

Boiler Emissions

The substitution of fuel supplied to the boiler from solid coal to gaseous methane will directly reduce boiler emissions to both air and land. The expected 'typical' composition of coal gas is methane 75%, carbon dioxide 2%, oxygen 1.5% and nitrogen 21.5%. Boiler emissions must not exceed site EPL 2122 limits of 600ppm SO_2, 700ppm for NO_2 and 20% for opacity (smoke) as measured in the flue gas exit paths of each boiler.

The combustion of coal as a solid fuel is inherently difficult to complete and due to its composition will always require disposal of the ash and dust byproducts. Substitution of methane at 5% of the coal feed rate has the potential to reduce disposal of ash and dust byproducts by some 10,000 tonnes per annum. Liddell EPL 2122 permits coal to have a maximum sulfur content of 1%. Coal seam gas is not expected to contain sulfur other than in trace amounts which, due to fuel substitution, will reduce oxides of sulfur formed during combustion.

The level of nitrous oxide emissions from the Liddell power station are capped and audited under terms of Macquarie Generation's operating licence. Substituting coal seam gas for a portion of the coal will not increase these emissions. The free nitrogen content (roughly 21.5%) contained in the coal seam gas stream is an air dilution component, an inherent factor in its release and collection process at the mine source. Ambient air contains 78% nitrogen. As a very large volume of air is a part of the boiler combustion mix, the nitrogen contained as air in the mine gas will have no impact on emissions.

Hunter Valley Gas Turbine (HVGT) Plant Emissions

The HVGT provide power to a number minor buildings and equipment on site and are at present fuelled from distillate. There is the potential to use gas from the coal seam gas Project to run HVGT plant to produce electricity. Site EPL 2122 condition A3.1 lists the operation of the gas turbine plant as an activity undertaken on site. Emissions are not required to be monitored; however, the plant must comply with the *Protection of the Environment (Clean Air) Regulation 2000* emission limit of 2500mg/m^3 for NO_2. Current emission levels are approximately 350 mg/m^3 with lower levels likely from coal seam gas fuel.

2.3 Proposed Development Summary

Macquarie Generation is proposing to establish a low pressure pipeline to supply gas fuel to supplement coal-fired electricity generation at Liddell Power Station (Figure 1). The pipe material is anticipated to be polyurethane or fibreglass, buried a minimum of 750 below the ground surface, and up to a maximum 500mm in diameter and have a maximum allowable operating pressure (MAOP) of 1050 kilopascals.

The pipeline may need to consist of two separate pipes to address certain processes in a mine's operation, typically the separation of pre-mining gas drainage from post-mining gas drainage. Provision will be made to allow the pipeline to be 'looped' to provide extra capacity if required.

The pipeline is anticipated to be constructed over a period of five (5) months and it is anticipated to commence in April 2009.

Construction activity will be confined to the pipeline corridor and adjoining land to which access is available for construction purposes. The pipeline requires a construction right-of-way (ROW) of approximately 20 metre wide plus temporary work space within the 50m wide assessment corridor. Temporary extra work space will be required in areas such as watercourse and road crossings. The temporary work space will be leased for the duration of the construction phases of the Project. Although a 20m construction ROW is required for the majority of the pipeline length, it is intended wherever possible to confine the high disturbance zone to a 10m to 12m width for trenching, brush and spoil storage and vehicle movement.

Table 2 provides a summary of the Project. These may be subject to minor variation based on the completion of detailed engineering and the finalisation of commercial negotiations.

Table 2: Project summary

Project	Gas Supply Pipeline Liddell Power Station.	
Pipeline Features	Approximate pipeline length	51 km
	Pipeline assessment corridor	50 m
	Approximate construction ROW width	20 m
	Pipe diameter (Max)	500 mm
	Pipeline material	polyethylene or fibreglass
	Mainline valves (approx. number)	Two (estimate)[2]
	Condensate drainage valves	Three (estimate)[3]
	Pig launching/receiving stations (approx. number)	One
	Compressor stations	None
Objectives	To construct a pipeline to supply gas fuel to supplement coal-fired electricity generation at Liddell Power Station.	
Construction	Installing a 51 km polyethylene or fibreglass gas pipeline.	
Any ancillary works	The coal seam gas collection infrastructure associated with supply of coal seam gas to the proposed pipeline will be the responsibility of the individual coal mines.	
Operations	The pipeline shall form an integral part of the Liddell Power Station operation. The coal seam gas will supplement existing coal-fired electricity generating activities. The pipeline shall be in operation 24 hours per day, 7 days per week.	
Location	Hunter Valley NSW (Refer to Figure 1).	
Time Frame	Construction is anticipated to be completed over a five (5) month period. Operation of the pipeline shall occur whilst there is an available supply of gas, and it is anticipated that there would be at least 30 years of mine waste gas available in the foreseeable future. Other commercial sources of gas may also arise in that time frame.	

2.3.1 Source of Gas

The proposed North South pipeline component is accessible to gas collected at multiple coal mines along its route. These include the operations of, Xstrata, Peabody and Rio Tinto. The separate but linked East West pipeline component (Project Application 07-0028) is accessible to BHP Billiton, Anglo Coal, Ashton and Resource Pacific. Macquarie Generation is in various stages of gas procurement negotiations with several of these companies. Final agreements are not yet concluded and depend in part on the necessary infrastructure (eg pipeline) being developed. Given the present NSW Government Greenhouse Abatement Scheme and the proposed Australian Government Carbon Pollution Reduction Scheme it is considered that the project will be viable

[2] To be determined in detailed design.

[3] To be determined in detailed design.

Some of the named companies operate mines at more than one location along the pipeline. There are no current negotiations for some mine sites as these are still in the planning or feasibility process. The number of prospective gas sources for the Liddell project is expected to increase over time as they are expected to become operational during the service life of the pipeline and power station.

It is not necessary for all potential mines to participate to gain project certainty. Modelling will determine the threshold gas volume required to launch the project and the gas will come from large and small sources delivered over separate time spans. The single largest gas source alone can provide sufficient volume. Pipe sizing up to the nominated 500 mm maximum diameter will be established based on the initial gas agreements together with provision for additional gas capacity from new sources in the future.

The mines involved have gas management requirements under their operating licences. The individual coal mines are therefore responsible for operation and maintenance of collection infrastructure to deliver gas to the pipeline. They will install a collection system to divert their gas to a connection point provided on the Macquarie Generation pipeline. At most mines this amounts to extending their existing collection systems that deliver gas to central flaring installations. The final mine site infrastructure includes compression, metering and control systems. The design will conform to the overall project engineering specifications. This aspect is being addressed in the gas supply negotiations and included in agreements.

The mining companies will undertake any new collection infrastructure approvals required. As beneficiaries of the proposed gas disposal the mines seek the same timely implementation as Macquarie Generation.

2.3.2 Composition of Gas

During combustion, methane is converted to CO_2 and water. The global warming potential of CO_2 and water is significantly smaller than that of methane. Burning methane contained in the coal seam gas can deliver a reliable energy source and greenhouse benefits at the same time (Macquarie Generation, 2007).

The coal seam gas delivered to Liddell will be a blend of gases drawn from underground along the pipeline corridor. Each mine source will contribute a different raw gas composition and volume over time. Some of the gas is pre-drained direct from the coal seam before mining operations and will have methane content in the range 80% to 98% by volume. Other gas comes from the sealed post mining voids (goaf gas) with methane ranging from 30% to 70%. The balance of other gases in the mix will be CO_2 at 1% to 7% and nitrogen up to 22%. Humidity at source will be 100% and there will be some dust. The water and dust will be substantially reduced in the compression and transport stages.

There is a high variability of composition of coal seam gas from each mine depending on processes involved, cycle in the mining operations and antecedent development of the coal seam gas in the substrata. Internal modelling by Macquarie Generation indicates the following mid-range coal seam gas composition will be delivered to Liddell Power Station:

- Methane (CH_4) 75%
- Carbon dioxide (CO_2) 2%
- Oxygen (O_2) 1.5%
- Nitrogen (N_2) 21.5%

The above percentages are by volume and provide an indication of the predicted composition of the coal seam gas.

2.3.3 Operation of Liddell Power Station

There are four 500MW generating units at Liddell Power Station that were first placed in service in the early 1970s. Steam turbines on four generating units at Liddell Power Station consist of three sequential stages: High Pressure, Intermediate Pressure and Low Pressure. The coal seam gas will be injected directly into the coal combustion fire-ball within the boilers. Due to the nature of the generating units at the power station there is no requirement for any upgrades. The power station can continue to operate with no down time or reduction in electricity generation. The composition of the coal seam gas and method of combustion is such that use of the coal seam gas in the power station will not require any upgrade to pollution reduction equipment already installed at the site.

This EAR does not include any additional assessment of the electricity generation at Liddell Power Station.

2.4 Alternative Project Options

Three alternative options were considered in the assessment of the proposed coal seam gas pipeline, including:

- Venting or flaring to atmosphere.
- Use the coal seam gas onsite.
- Do nothing.

2.4.1 Venting or flaring to atmosphere

The current practice for disposal of coal seam gas in the Hunter Valley is normally via venting or flaring to the atmosphere. Mines along the proposed pipeline corridor need to vent the gas to allow for extraction of coal. The coal seam gas is commonly burnt in an attempt to reduce subsequent environmental issues such as odour and greenhouse gases. The disadvantage of venting/flaring to the atmosphere is that it results in discharge of a combustible coal seam gas that could be better utilised and also results in increased release of greenhouse gases to the atmosphere.

2.4.2 Use on site

A number of the mines may have sufficient quantities and concentrations of coal seam gas to utilise on site. It is possible that gas turbines or gas engines could be installed in strategic locations at a mine to utilise the coal seam gas as a form of site-specific electricity generation. The disadvantage to use on site is that the coal seam gas is not consistent in terms of quantity and quality and may not be adequate to run a gas turbine for ongoing operation. Macquarie Generation are able to overcome issues of inconsistency through obtaining coal seam gas from various sources that allows for a higher degree of certainty that several mines will provide sufficient coal seam gas supply, rather than relying on a single source.

2.4.3 Do nothing

The "do nothing" option would result in ongoing release of coal seam gas to the atmosphere with no concurrent gain in electricity generation. In doing nothing mine operators are denied the beneficial utilsation of the coal seam gas and therefore would revert back to handling coal seam gas through venting or flaring, use on site, a combination of both or some other form of release of coal seam gas to the atmosphere to allow coal mining to progress. The opportunity to capture and utilise a coal seam gas that would otherwise be released to the environment with no resultant electricity output does not present the do nothing option as a viable option.

2.5 Pipeline Corridor selection

2.5.1 Process Overview

Macquarie Generation together with their consultant Parsons Brinckerhoff (PB) carried out the initial pipeline corridor selection and preliminary environmental assessment for the north-south gas supply pipeline. The assessment involved a review of existing reports, environmental databases and, aerial photography and sensitivity mapping, supported by field reconnaissance at key locations along the main corridor options. PB produced a preliminary application and environmental assessment report in February 2008 (PB, 2008).

Following the submission of the Project application and preliminary environmental assessment report, subsequent field recognisance and consultation with the Department of Planning (DoP), Macquarie Generation saw fit to realign the North-South gas pipeline corridor so as to avoid completely the Warkworth Sands Woodlands area. This realignment forms the final 50 m corridor assessed in this EAR (Figure 1).

2.5.2 Issues Affecting Corridor Selection

Table 3 shows the key criteria considered in selecting the final corridor.

Table 3: Corridor selection criteria

Corridor Selection Criteria	Explanation of Criteria
Length of pipeline	The shortest distance between the start and finish usually has the lowest cost.
Utilisation of Macquarie Generation's land	Existing lands provide a corridor with pre-existing rights to the land and reduce cost of easement acquisition, as well as less impact on previously undisturbed land.
Risk assessment of the safety of the pipeline	Risk assessment determines the depth of burial and other safety factors to be used in designing the pipeline.
Environmental impacts	Impacts on the environment, including heritage issues determine the feasibility of the selected corridor; i.e., the location of sensitive environments, endangered flora and fauna, nature reserves, native vegetation and heritage sites.
Social impacts	Public safety during construction, the impacts of noise, vibration to buildings and occupants, dust, traffic disruption and amenity issues during construction affect the feasibility of the proposed corridor.
Constructability	The pipeline corridor must be selected so that conventional pipeline equipment can be used to construct the pipeline; i.e., there must be

Corridor Selection Criteria	Explanation of Criteria
	sufficient room to allow trench excavation and pipe installation for the majority of the corridor. Special techniques can be used for short crossings such bores and horizontal directional drilling (HDD) where conventional open-cut techniques cannot be used e.g., roads, highways and, if feasible, rivers.
Planning schemes	Existing planning schemes need to be referenced to determine the ongoing land use close to the pipeline as this affects the risk assessment referenced above. Land zoning may also affect the cost of easement acquisition, which impacts on the overall Project cost.
Geological features	Geological issues are reviewed for ground stability, ground water levels and other constructability issues; i.e., amount of rock, etc.
Land use, buildings and infrastructure (existing and planned)	Pipeline corridors try to avoid existing and planned buildings and major infrastructure such as future mining activities, high-voltage powerlines, optical fibre cables, major water or sewerage pipelines that could affect constructability and increase risks.

2.5.3 Preferred Corridor Selection

Existing and potential future land uses have been considered in the final selection of the pipeline assessment corridor. In particular the north-south corridor has been selected to avoid areas of high ecological significance (Namely the Warkworth Sands Woodlands area) or known Cultural Heritage sites and existing or potential mining activities.

Where possible, the north-south pipeline corridor has been selected to utilise existing roads and property access roads, as well as cleared property boundaries or fence lines. Full consideration has been given to interaction with existing approvals or licences in operation for mines or power stations affected by the Project. Representatives of each of the mines that have a section of pipeline within the colliery holding or mining lease have been consulted as to the preferred corridor. The pipeline corridor has been determined with full consideration to current and future mining operations including secondary considerations such as subsidence. Furthermore existing pastoral activities will not be impacted by the pipeline once it is in operation due to the depth of burial of the pipe being greater than 750mm.

Macquarie Generation believes that the final corridor selected provides a good compromise because it avoids known sensitive environmental areas, existing and future mining activities, will utilise existing disturbed land and infrastructure easements where possible, therefore keeping environmental risk manageable and leading to no land sterilisation.

The key benefits are:

- Low level of potential impact to existing and future mining activities and rural properties.
- All impacts identified can be minimised by implementation of proven mitigation measures (see Section 5 and 6).

2.5.4 Final Pipeline Corridor Alignment Travelogue

The proposed pipeline alignment begins at the Bulga Mine Site and terminates at the Liddell Power Station (see Figure 1 and Appendix F for general site reference).

From the Bulga Mine area, the proposed alignment travels in a north-westerly direction, crossing Charlton Road heading west down to Wollombi Brook (Kilometre Point (KP) 6). After crossing to the west side of the Brook it then travels westerly to intersect with Putty Road (KP8). Travelling north, passing by the township of Bulga then continuing parallel with rural property boundaries and Wollombi Brook, it enters the Wombo Mining Area. Continuing in a northerly direction crossing the Wombo and Wombo North Creeks before intersecting the Golden Highway (KP 20). The proposed alignment then runs within Golden Highway for approximately 10km, before turning north to cross the Hunter River (KP30).

From the north side of the Hunter River the proposed pipeline corridor runs within cleared agricultural land parallel with the Hunter River before entering Macquarie Generation owned land. It then crosses Parnells Creek and continues running parallel to existing road access and infrastructure corridors for approximately 8 km before intersecting the New England Highway (KP50).

The alignment then crosses under the New England Highway and joins the existing infrastructure corridor terminating at the Liddell Power Station or proposed east-west pipeline.

The total length of the proposed pipeline alignment is approximately 51 km, the majority of which is within previously cleared land or road reserves. Figure 2 shows a series of photographs taken along the proposed pipeline corridor during the field studies and their associated approximate KP.

1. Mine land near Broke (KP 5)

2. Mine owned land near Bulga (KP 7)

3. Small farm lots along Wollombi Brook, Bulga (KP 12)

4. Mine land along Wollombi Brook, Warkworth (KP 17)

5. Golden Highway reserve (KP 22)

6. Wandewoi Farm & Hunter River (KP 33)

7. Macquarie Generation land (KP 40)

Figure 2: Representative Pipeline Corridor Photographs[4]

[4] All photographs taken by Mr Glenn Keevers (Macquarie Generation)

2.6 Pipeline Construction

2.6.1 General

Construction of the proposed Pipeline will apply proven pipeline construction methods and comply with all relevant codes and standards, in particular, the Australian Standard AS2885 series and the Australian Pipeline Industry Association (APIA) Code of Environmental Practice 2005. Construction of the pipeline is undertaken progressively along the corridor starting with clearing the right-of-way (ROW), trenching, pipeline joining and installing the pipeline, backfilling and then rehabilitating the ROW upon completion.

- *Mainline crew:* Comprising a range of specialist construction personnel who undertake construction within the cross-country sections.
- *Special crossing crews:* Small teams of specialist personnel with diverse skills who undertake construction of special crossings such as watercourses and roads areas.

Other specialists will be employed to undertake hydrostatic testing, install ancillary facilities, undertake ROW reinstatement and fencing and general support for the construction crews.

2.7 Construction Activities

For the majority of the pipeline corridor a mainline construction ROW width of approximately 20 m will be required. In some areas, there is a requirement for additional work area, up to 30 extra metres wide may be needed at HDD sites or pipeline stockpile and laydown areas.

A typical ROW accommodates construction equipment and vehicle travel, along with the storage of trench spoil and topsoil. The width of the ROW ensures that construction activities can be safely performed with minimum risk of accident or injury to construction personnel. The ROW width is a balance of considerations, including safety, timing, environmental and cost criteria. A wider ROW means greater costs for construction earthworks, rehabilitation and compensation, but ensures there is efficient use of space for work place safety and management of topsoils for reinstating the area to its former condition. A narrower ROW reduces environmental impacts but increases the risk of accidents and loss of topsoil due to construction traffic travelling over topsoil stockpiles.

Where construction is to occur within an existing road easement, an additional 10 m of temporary workspace within the 50 m assessment corridor may be required from adjacent landholders if required. In some locations (e.g., watercourse crossings), it will be necessary to work outside of the ROW to ensure a safe workplace is maintained during construction. In these cases, additional temporary work space will be negotiated with the landholder affected.

Mainline crews will generally achieve construction progress in the order of 1 to 2 km per day depending upon conditions (e.g., topography and weather), with relatively minimal disruption to land use. In most instances, the pipeline will be laid and backfilled within a period of three to four days (dependent on weather and site conditions). In areas with higher population densities, difficult terrain and other infrastructure, construction will be slower, typically 0.5 to 1.0 km per day. On average, the duration of construction from initial clear and grade to backfill, at any one point along the mainline ROW, will be approximately eight (8) weeks.

Specifically, pipeline construction involves:

- Surveying.
- Access, including the installation of temporary gateways.
- Clear and grade.
- Pipe transport and stringing.
- Trenching.
- Jointing.
- Lowering-in.
- Backfilling.
- Hydrotesting.
- Restoration of the ROW.

2.7.1 Surveying

Surveying will involved surveying the limits of the proposed construction ROW, any additional work areas and the centreline of the pipeline.

Fences needing to be cut will be pegged by surveyors and the edge of the construction area will be marked with ranging poles to ensure clearing occurs within the designated ROW. Special features not to be disturbed, such as areas of environmental or heritage significance, will also be marked and/or fenced. These areas will be included in the Project inductions.

During construction, the actual location of the pipe along the entire pipeline alignment will be recorded. This 'as-built' survey will also record the location of each ancillary facility, drawings of all crossings (e.g., roads, infrastructure, watercourses) and the profile of the HDD installations.

2.7.2 Access

To facilitate access along the construction ROW, temporary strainer assemblies and gateways are installed at every fence line. This provides continued security for cattle, sheep and other farm stock while construction progresses along the ROW. Access to the ROW and construction sites will generally be via existing tracks and roads, where practicable. It is likely; however, that some existing tracks may require upgrading and ongoing maintenance to accommodate construction vehicles.

2.7.3 Clear and Grade

Where practicable, root stock will be left in the ground to stabilise the area and reduce erosion and large mature trees will be preserved by making small adjustments to the trench line. Where removed vegetation and topsoil will be stockpiled along the edge of the ROW to permit safe and practical construction access, while preserving the topsoil for later reinstatement.

Wherever practicable, vegetation clearing from the ROW will be minimised by reducing the ROW width working around large trees or identified significant species, or by trimming overhanging branches.

The vegetation material is stockpiled separately from the excavated trench material on the working side of the ROW to ensure successful reinstatement of the ROW following construction. Cleared vegetation will be stockpiled and preserved for use during ROW restoration.

2.7.4 Pipe Stringing

Stringing starts with the delivery of pipe to the ROW by semi-trailer. The pipe will be laid end-to-end alongside the trench on raised timber skids that protect the pipe from damage and enable to it be joined into continuous lengths or 'strings.' Gaps will be provided for public and private access including the movement of vehicles, farm equipment and livestock.

2.7.5 Trenching

The trench will be excavated using excavators, to a depth that provides an appropriate cover over the pipe commensurate with the terrain and land use characteristics.

Depth of cover will be increased at road and river crossings as appropriate. Trench spoil will be stockpiled separately on the trench side of the ROW and returned to the trench during the backfilling stage. As a general rule, the minimum cover over the pipeline will be 750 to 900mm.

2.7.6 Jointing

The pipe segments will be joined into continuous lengths or 'strings', with temporary gaps for roads, farm tracks, and fence lines, as well as stock crossings as agreed with land holders. Advice will be sought from the contractor for an appropriate size of the string sections to install in the trench in each excavation. In determining the length of sections, adequate consideration will be given to environmental constraints.

2.7.7 Lowering-in

Lowering-in refers to the placement of the pipe string into the trench by a combination loader/backhoe as they gradually move along the ROW.

Prior to lowering-in the pipe, it may be necessary to de-water the trench (e.g., in areas of high water table or after rain). Any such water will be discharged to land through artificial or natural sediment filters and energy dissipaters to prevent sediment and erosion, and only in accordance with regulatory requirements.

In areas where subsurface ground conditions are rocky and may damage the pipe, either bedding or padding materials may be required. Fine material from the trench spoil may be used for placement around the pipe, or alternatively, quarried clean sand may be used.

2.7.8 Backfilling

Stockpiled trench spoil excavated during trenching will then be backfilled and compacted. Where required marker tape denoting "Buried Low Pressure Pipeline" will be installed during backfill operation. Topsoil removed during grading will be respread over the ROW and contours reinstated. Special care will be taken to ensure that excavated spoil and soil profiles are re-established to avoid soil inversion. Where required, excess spoil shall be removed from site and transported to approved landfill sites or as directed by the property owner on site.

2.7.9 Hydrostatic Testing

The entire pipeline will be hydrostatically tested (i.e., leak tested by pressurising with water), in accordance with the Australian Standard AS2885.5:2002 Pipelines—Gas and liquid petroleum-Field pressure testing, to verify the integrity of the pipeline. Prior to hydrostatic testing, the pipeline will be pre-cleaned to remove debris.

Water required for the hydro-testing activity will be acquired from the Liddell Power Station water supply. After completion of hydro-testing the water will be returned to its source or disposed of to the ground through a water diffusion system set up to minimise the risk of erosion or local inundation (Sleeman Consulting, 2008).

Once the water is removed from the pipe, drying pigs (dense foam 'bullets'), will be inserted into the pipe and pushed through to remove all water residues. After the displacement pigs arrive in the temporary pig receiver, the pipeline end termination valves will be closed and the temporary pig receiver removed.

2.7.10 Clean-up and Restoration

Following backfill and compaction of the pipe trench, clean-up will be undertaken by removing all temporary infrastructure and machinery, re-establishing contours and respreading of stockpiled topsoil.

Clean-up and restoration will be undertaken progressively so as to not lag behind the completed backfill. Any equipment lay-down areas will be ripped to relieve compaction if necessary. Erosion and sediment controls, such as diversion berms and sediment traps, will be put in place as appropriate to protect water quality, namely at small creeks and drainage lines or roadside table drains, and divert run-off away from potentially unstable rehabilitation areas.

Revegetation of the ROW will be undertaken by natural regrowth or broadcasting appropriate seed and fertilizer. Seed mixes, and the use of fertilisers, will be based on specialist advice and consultation with landholders. The success of restoration will continue to be monitored until the ROW is stable.

Once reseeding has been completed, the temporary gates will be removed and the fences reinstated to their original design using new materials.

2.8 Special Crossings

Special crossings refer to areas along the pipeline corridor that cannot easily be constructed by mainline crews. Crossing areas such as significant watercourses or major roads will be completed using under-boring construction techniques.

2.8.1 Watercourse Crossings

The pipeline will cross two (2) significant watercourses being Wollombi Brook (KP6) and the Hunter River (KP30) (See Section 5.4 – Figure 5 for locations). The location of the crossing and techniques to be used is based on a range of criteria including safety, environmental and social sensitivities, watercourse substrate type, bank scour potential, approach slope and bank access, costs, pipeline security requirements, adjacent infrastructure and construction workspace availability.

Watercourse crossings are generally constructed by one of two methods:

- *Open Trenching.* This involves surface excavation across the watercourse. Where practicable, construction is scheduled for periods of nil to low flow. The selection of the crossing location is based on minimising potential impacts and achieving long-term site stability. Sediment and water quality control measures, such as silt curtains, or isolation construction using dam and pump or flume pipe techniques, may be applied as necessary dependent upon site specific sensitivities.
- *Horizontal Directional Drilling (HDD).* This involves boring beneath the invert of the river from bank to bank, then pulling the pipe through the bore hole. This method avoids river bank and in-stream construction activities, but it can pose high technical and environmental risks. Geotechnical (namely hard bedrock, fissures and cracks, unconsolidated substrata and subsurface scour or cavern potential) constraints can preclude the use of this method in some situations. Although these risks are not likely for the Wollombi Brook and Hunter River HDD sites, the open trenched method must remain as a contingency in the event that technical problems developed with HDD. A range of possible measures will be applied to restore and stabilise the open trenched watercourse crossings using methods such as rock rip-rap, geotextile fabric and revegetation depending upon what is most appropriate in the circumstances.

Selection of the watercourse crossing method considers a range of criteria, to strike a balance and derive the most practical solution. Criteria include, but are not limited to, the following:

- Watercourse depth, flow and crossing width.
- Workforce and public safety.
- Environmental sensitivity.
- Geotechnical issues.
- Substrate composition.
- Hydrological data (including seasonal variation and flooding).
- Available construction working space.
- Regulatory constraints.
- Downstream water users.
- Stakeholder issues.
- Engineering constraints.

The Wollombi Brook and Hunter River watercourse crossings will be completed using HDD construction techniques where as all other creeks and drainage lines will be open cut.

2.8.2 Roads

The crossing of public roads is subject to approval from the relevant Government authority, being either local shire councils or NSW Roads and Traffic Authority (RTA). Private roads and track crossings are subject to the conditions of agreements. Mine road crossings will be determined by agreement with the mining companies.

The pipeline corridor makes several crossings of public and private roads (See Section 5.5 – Figure 6). The main sealed roads include:

- Charlton Road (KP2).
- Putty Road (KP8).
- Golden Highway (KP30).
- New England Highway (KP50).

Boring below sealed bitumen roads will be used to minimise disruption to traffic movements and prevent any reduction in road surface integrity. Boring involves drilling from below ground within an enlarged trench area or 'bell hole' on either side of the road. Unsealed roads and tracks will be open trenched and compacted during backfilling to required standards.

2.9 Construction Facilities

A range of temporary construction worksites may be required, including:

- Construction site office.
- Equipment lay-down areas.
- Temporary pipe storage.
- HDD pipe string fabrication.

While it is likely that some of these worksites will be consolidated on the same site, this will be dependent upon construction logistics, to be determined by the selected construction contractor during detailed design and construction planning.

The key principles when selecting worksites will be to avoid or minimise impacts to:

- Native vegetation.
- Aboriginal cultural heritage.
- Historic heritage.
- Water resources.
- Soils.
- Socio-economic aspects (such as farm operations, recreation and traffic).

Where possible areas of previous disturbance within the assessment corridor will be selected to accommodate such facilities.

2.9.1 Ancillary Facilities

The ancillary facilities required for pipeline operation, monitoring and maintenance purposes include[5]:

- End-of-line facilities – New gas regulating stations will be constructed the start of the pipeline as well as within the Liddell Power Station.

[5] The exact location of these ancillary facilities will be determined during the detailed design phase, however they will be placed with the 50 m environmental assessment corridor.

- Intermediate facilities – Intermediate isolation valve stations with local bypass and venting facilities may be required. The pipeline will also be designed for in-line inspection and therefore may require pigging facilities. Condensate drains may also be required along the pipeline. The quantity of intermediate facilities, and their spacing and locations, are to be reviewed during the detailed engineering phase.
- Pipeline marker posts – The location of the buried pipeline will be identified by permanent marker signs. The Australian Standard (AS2885:1-2007) specifies that marker signs are to be designed to a particular specification (size and height). Marker signs are recommended for:
    - Infrastructure and utility crossings (such as roads, water and power services).
    - Watercourse crossings.
    - Horizontal change in direction.
    - Ancillary facility locations.
    - Property boundary fencelines.

2.10 Commissioning

The pipeline will be commissioned at the completion of construction and testing. Commissioning involves completely purging the pipeline of air to ensure safe operation and ensure the achievement of market specifications for gas quality.

2.11 Operation

Once the pipeline has been installed there are a number of operational considerations such as ongoing maintenance and emergency situations. In order to retain access to the pipeline for maintenance a 10 m to 20 m wide ROW may be required. This does not mean that the ROW would remain cleared (vegetation including trees would be allowed to grow back on the easement as long as it does not interfere with the operating integrity of the pipeline) only that the ROW would be accessible for visual inspection by operations personnel. Landholders will resume all pre-construction activities over the pipeline once in operation. The proposed pipeline will be operated in accordance with AS2885.3:2001 Pipelines-gas and liquid petroleum-operation and maintenance.

Emergency situations have been considered as part of a risk assessment and are discussed in Section 5.3.

The pipeline will be controlled and operated remotely from the existing Liddell Power Station Control room using telemetry and other metered control systems. Once the pipeline is installed, the pipeline ROW soon merges with the surrounding farmland and little evidence of the buried pipeline remains with the exception of pipeline marker posts at various intervals along the alignment.

Routine inspections and maintenance (namely removal of condensate or vegetation management) of the pipeline ROW are carried out by ground personnel and aerial patrols that monitor for operation and maintenance issues.

2.12 Decommissioning

The expected economic life of the pipeline will depend on the availability of natural gas and its continued use in the Power Stations. In the event that the pipeline is decommissioned, it will be undertaken in accordance with the regulatory requirements of the day.

3 Planning and Regulatory Context

3.1 State legislation

3.1.1 Environmental Planning and Assessment

The key piece of legislation applying to the Project is the New South Wales *Environmental Planning and Assessment Act 1979* (EP&A Act). Relevant State Environmental Planning Policies (SEPP) include the State Environmental Planning Policy (Major Projects) 2005 and State Environmental Planning Policy (Infrastructure) 2007.

This follows as the proposed pipeline is a Project to which Part 3A of the EP&A Act applies. Part 3A applies to Major Projects identified under SEPP (Major Projects) 2005 or works declared as Critical Infrastructure by the Minister for Planning.

Schedule 1 of SEPP (Major Projects) 2005 identifies a range of developments that would constitute a Major Project and would therefore be assessed under Part 3A of the *EP&A Act* including:

> "*Development for the purposes of a pipeline in respect of which:*
> *(a) a licence is required under the Pipelines Act 1967,*"

(clause 26A of Schedule 1)

A licence is required under section 11 of the *Pipelines Act 1967* in order for a person to construct or operate a 'pipeline[6]' unless the person falls within section 5 of that Act. This section contains various categories of excluded pipelines including a pipeline constructed by a 'public authority', being only those public authorities listed in the definition in section 3 or 'anybody declared by the Minister, by order published in the Gazette'. As Macquarie Generation is not listed as a public authority under the *Pipelines Act 1967* nor has it been published in the Government Gazette to be a public authority under that Act Macquarie Generation will be required by the *Pipeline Act 1967* to obtain a pipeline licence and that requirement means that the Project falls within the "Major Projects' developments under clause 26A of schedule 1 of the *SEPP (Major Projects) 2005* with the result that Part 3A applies.

The DoP has confirmed that the Project can be considered under Part 3A. The Director-General's Requirements for the environmental assessment report relating to the proposed development are provided (Appendix A)

The SEPP (Infrastructure) 2007 will also apply to the Project however the SEPP (Major Projects) 2005 prevails in the event of any inconsistency.

Table 4 discusses the relationship of key NSW legislation to the proposed pipeline Project.

[6] *"pipeline" means a pipe or system of pipes for the conveyance of any substance, whether in a gaseous, liquid or solid state but does not include a pipe or system of pipes for the conveyance of petroleum within the adjacent area, as defined in the Petroleum (Offshore) Act 1982*

Table 4: NSW Legislation

Legislation	Key Requirements	Relevance to the proposed pipeline
Contaminated Land Management Act 1997	Provides a regime for investigating and, where appropriate, remediating land affected by contamination, which represents a significant risk of harm to human health or the environment.	If contaminated land is uncovered by the construction works, it must be assessed and managed in accordance with the Act.
Fisheries Management Act 1974	The objectives of the Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations.	Section 75U(1)(b) of the EP&A Act states that a permit is not required under the *Fisheries Management Act 1974*, for dredging or reclamation work, removal of marine vegetation and blocking passage of fish under a Part 3A approval. Adequate environmental safeguards are proposed for crossing of watercourses as discussed in Section 5.4.
Heritage Act 1977	Approval must be gained from the Heritage Council when making changes to a heritage place listed on the State Heritage Register, or when excavating any land in NSW where you might disturb an archaeological relic.	No known heritage items will be adversely affected by the Project (refer to Section 5.2). The pipeline corridor area is heavily disturbed from past activities it is expected that there will not be any heritage items located along the pipeline corridor. As such, it is anticipated that no impact on heritage items would occur.
National Parks and Wildlife Act 1974	The Act aims to prevent the unnecessary or unwarranted destruction of relics and the active protection and conservation of relics of high cultural significance.	Under Section 75U(1)(d) Part 3A of the EP&A Act, a permit or consent is not required under the *National Parks and Wildlife Act 1974*.
Native Vegetation Act 2003	The Native Vegetation Act 2003 requires development approval from the relevant Catchment Management Authority (Hunter/Central Rivers) for the clearing of any natural vegetation. Approval can only be granted under this act for Projects that improve or maintain environmental outcomes.	Under Part 3A of the EP&A Act, the *Native Vegetation Act* does not apply.

Legislation	Key Requirements	Relevance to the proposed pipeline
Pipelines Act 1967	This Act regulates the construction and operation of pipelines within NSW by requiring that a licence is obtained for certain pipelines outlined under the Act.	Macquarie Generation requires a licence under the Pipelines Act 1967.
Protection of the Environment Operations Act 1997	The Act enforces licences and approvals formerly required under separate Acts relating to air, water and noise pollution and waste management with a single integrated licence. Development requires a license under the Act, should it meet the assessment criteria outlined within Schedule 1 of the EPA-licensed activities.	A license under the Act is not considered necessary for the proposed pipeline.
Roads Act 1993	Section 138 of the *Roads Act 1993* requires that a person obtain the consent of the appropriate roads authority for the erection of a structure, or the carrying out of a work in, on or over a public road, or the digging up or disturbance of the surface of a public road. If the applicant is a public authority, the roads authority must consult with the applicant before deciding whether or not to grant consent or concurrence.	The proposed development involves the crossing of several public roads, including the Golden and New England Highway and may therefore require approval from the NSW RTA before commencing work. Under Section 75V of the EP&A Act consent under Section 138 of the *Roads Act 1993* cannot be refused if it is necessary for carrying out an approved Project under Part 3A of the AP&A Act.
Rural Fires Act 1997	The Act provides for management of bush fires through prevention, mitigation and protection of life and property.	According to Section 100B a person must obtain a bush fire safety authority for subdivision of bush fire prone land or development of bush fire prone land for a special fire protection purpose. The proposed pipeline does not require a bush fire safety authority.
Threatened Species Conservation Act 1995	This act requires any threatened plant or animal species, populations or ecological communities associated with a proposed development to be identified and that acceptable recovery and management strategies are implemented a likely	Section 5A of the EP&A Act outlines seven points that must be considered in order to determine the significance of the impact of a development or activity on the habitat of threatened species, populations or ecological communities known or considered

Legislation	Key Requirements	Relevance to the proposed pipeline
	significant impact would occur.	likely to occur in the study area and environs. Further details on assessment of significance and seven part tests are presented in Section 5.1.
Water Management Act 2000, including the Rivers and Foreshores Improvement Act 1948 and Water Act 1912	Approval is required from the consenting authority for development within 40 metres of a declared waterway such as stream, rivers, lake or lagoon, including excavation of land or any works that would detrimentally affect the water flowing in a stream, river, lake or lagoon. Under the Act, a licence would be required if water was to be extracted from a creek or if any waterways were to be realigned during construction. Any groundwater dewatering works that occur during the construction process will require a licence under the Act.	Unser Section 75U(1)(f) and (h) of the EP&A Act, no approval or permit is required for an approved Part 3A Project, under the *Water Management Act 2000* and a permit under the *Rivers and Foreshores Improvement Act 1948*. No groundwater extraction is anticipated as part of the Project due to the separation depth between the pipeline trench and existing aquifers (See Section 5.4)

3.2 Commonwealth legislation

3.2.1 Environmental Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) an action (i.e. Project) will require approval from the Commonwealth Minister for the Environment if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance (NES), including:

- World heritage properties.
- National heritage places.
- Wetlands of international importance.
- Listed threatened species and ecological communities.
- Migratory species protected under international agreements.
- Nuclear actions (including uranium mines).
- Certain activities involving Commonwealth marine area or land.

The action to be considered is the construction and operation of a 51km proposed pipeline to transport coal seam gas for use in the Liddell Power Station.

A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts (DEH, 2006).

A search of the Commonwealth EPBC Protected Matters NES database (DEWHA 2008) was conducted to determine whether any matters of NES would apply to the Project. Table 5 shows the results of this database search considered against the NES matters.

Table 5: NES Matters considered for the Proposed Pipeline

Factor	Impacts
(a). Any environmental impact on a World Heritage property? Comments: No world heritage property in the vicinity of the proposed pipeline corridor.	NA
(b) Any environmental impact on a National Heritage place? Comments: No national heritage place in the vicinity of the proposed pipeline corridor.	NA
(c) Any environmental impact on wetlands of international importance? The pipeline corridor falls with the same catchment as the Hunter Estuary Wetlands, although the distance between the wetlands and the proposed pipeline and mitigation management in place for all creek and river crossing would mean that no significant impacts are likely to occur at the wetlands. Comments: No wetlands of international importance in the vicinity of the proposed pipeline corridor.	NIL
(d) Any environmental impact on Commonwealth listed threatened species or ecological communities? Listed Threatened Species included three (3) birds, two (2) frogs, five (5) mammals and four (4) plants. One (1) Threatened Ecological Community the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland was identified to be in the region of the proposed pipeline. Comments: No listed threatened species or ecological communities are likely to be significantly impacted by the proposed work activities*.	NIL
(e) Any environmental impact on Commonwealth listed migratory species? Listed Migratory Species included six (6) Terrestrial Birds, four (4) Wetland Birds and three (3) Marine Birds. Comments: No listed migratory species are likely to be significantly impacted by the proposed work activities.	NIL
(f) Does any part of the Project involve a nuclear action? Comments: Not a nuclear action.	NO
(g) Any environmental impact on a Commonwealth marine area? Comments: Not in a Commonwealth marine area.	NA
(h) Any direct or indirect effect on Commonwealth land? Comments: Not on Commonwealth Land.	NA

*Threatened species and communities and migratory species – Potential impact of the Project on flora and fauna is discussed in Section 5.1. The ecological assessment concluded that with the implementation of appropriate mitigation measures the Project is unlikely to have a long-term impact on threatened species and/or populations within the study area (AHA, 2008).

Macquarie Generation does not consider that the proposed pipeline Project will adversely impact matters of NES and will thus not submit a referral for assessment or approval under the EPBC Act.

3.3 Local Environmental Planning Instruments

The Project falls within the boundaries of Singleton Shire and Muswellbrook Shire Local Government Areas (LGA) (see Figure 1). Under Section 75J(3)(b) of the EP&A Act the Minister cannot approve of the carrying out of a Project that is wholly prohibited under an environmental planning instrument by the operation of Section 76B.

3.3.1 Singleton LEP

The majority of the proposed pipeline is located within the Singleton LGA (approximately 48km) and traverses land zoned 1(a) (Rural Zone) under the *Singleton Local Environmental Plan 1996* (Singleton LEP).

The objectives of the 1 (a) (Rural Zone) are as follows:

- to protect and conserve agricultural land and to encourage continuing viable and sustainable agricultural land use,
- to promote the protection and preservation of natural ecological systems and processes,
- to allow mining where environmental impacts do not exceed acceptable limits and the land is satisfactorily rehabilitated after mining,
- to maintain the scenic amenity and landscape quality of the area,
- to provide for the proper and co-ordinated use of rivers and water catchment areas,
- to promote provision of roads that are compatible with the nature and intensity of development and the character of the area.

The Rural Zoning Table under Part 3 Rural Development of the Singleton LEP states that any development included in Clause 2 is permissible without consent and any development other than those included within Clause 4 are permissible with consent. The types of development considered prohibited within the zone are listed as follows:

"...advertising structures (other than as would be permitted by clause 33 of the Environmental Planning and Assessment Model Provisions 1980 if they applied); boarding houses; bulk stores; bus depots; business premises; car repair stations; dual occupancy-detached; industries other than offensive or hazardous industries; junk yards; light industries; liquid fuel depots; motor showrooms; residential flat buildings; road transport terminals; shops; warehouses..."

3.3.2 Muswellbrook Draft LEP

A small proportion of the proposed pipeline is located within the Muswellbrook LGA (approximately 3km) and traverses land zoned 5 (a) Special Uses " A" Zone under the Muswellbrook *Local Environmental Plan 1985* (Muswellbrook LEP).

The objectives of the 5(a) Special Uses "A" Zone is:

- To to recognise existing public land uses and to enable their continued operation, growth or expansion to accommodate associated, ancillary or otherwise related uses.

The Muswellbrook LEP under Land Zone 5(a) item 4 states that any purpose ordinarily incidental or subsidiary to a purpose include in Item 3 of the matter relating to this zone; utility installations are permissible only with consent.

3.3.3 Conclusion

Pursuant to the provisions of Singleton LEP and draft Muswellbrook LEP the proposed pipeline does not fall under any of the definitions as a prohibited development and is therefore considered permissible within the zone with development consent. Accordingly the proposed development is not wholly prohibited under the meaning of Part 3A of the E&PA Act.

3.4 State Environmental Planning Policies

There are a number of State Environmental Planning Policies (SEPPs) that have been considered in relation to proposed Project. These include:

- State Environmental Planning Policy No. 33 – Hazardous and Offensive Development.
- State Environmental Planning Policy No. 44 – Koala Habitat Protection.
- State Environmental Planning Policy (Major Projects).
- State Environmental Planning Policy (Infrastructure) 2007.
- State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007.

3.4.1 State Environmental Planning Policy No. 33 – Hazardous and Offensive Development

SEPP No. 33 seeks to reduce any potential impact of hazardous and offensive industries. The coal seam pipeline has the potential to be classified as a hazardous industry under SEPP No. 33 as, in the absence of measures to reduce or minimise its impact on the locality or existing or future likely development of other land, it would pose a significant risk in relation to the locality. However, the Project could not be defined as an industry based on definitions in the Singleton LEP and as such SEPP No.33 does not apply.

Furthermore, a risk assessment was facilitated by Sleeman Consulting (Appendix E) and concluded that a preliminary hazard analysis (PHA) is not required. Further discussion on the risk assessment is presented in Section 5.3.

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

SEPP No. 44 encourages the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range. The SEPP also restricts the granting of development consent for Projects on land identified as core Koala habitat without preparation of a plan of management.

Singleton and Muswellbrook Shire Councils are identified in Schedule 1 of the SEPP as local government areas (LGA) to which the environmental planning instrument applies. SEPP No. 44 relates to Council development consent, as the Project is assessed under Part 3A of the EP&A Act the SEPP does not apply. Notwithstanding the foregoing, further discussion on the likelihood of potential impact on Koala habitat is presented in Section 5.1.

3.4.3 State Environmental Planning Policy (Major Projects) 2005

SEPP (Major Projects) 2005 defines certain developments that are considered major Projects under Part 3A of the EP&A Act, including a development for the purpose of a pipeline in respect of which a licence is required under the *Pipelines Act 1967*. The proposed pipeline will require a licence under the *Pipelines Act 1967* as Macquarie Generation is not listed as a public authority (see section 1.1.1). The DoP has confirmed that the Project constitutes a Major Project and as such the proposed coal seam gas pipeline may be assessed under Part 3A with the Minister as the consent authority.

3.4.4 State Environmental Planning Policy (Infrastructure) 2007

The SEPP (Infrastructure) 2007 applies to certain infrastructure developments that include Electricity Generating Works and Gas Pipelines.

SEPP (Infrastructure) 2007 Part 3 Division 4 clause 34(3), states: *"Development for the purpose of, or resulting in, a change of fuel source of an existing coal or gas fired generating works by a proportion of more than 5 per cent in any 12 month period may only be carried out with consent."*

The proposed changes to the Liddell power station will displace less than 5% (by mass) fuel as a result of the pipeline, therefore development consent for use of the coal seam gas is not required, subject to amendment to existing operating licence arrangements presented in Section 2.2.

According to Part 3 Division 9 Subdivision 1 development for the purpose of a gas pipeline may be carried out by or on behalf of a public authority without consent on any land, with the exception of land zoned National Parks and Nature Reserves,. However in the event of any inconsistency between the SEPP (Major Projects) 2005 and the SEPP (Infrastructure) 2007 the SEPP (Major Projects) 2005 applies which means that a Part 3A approval is required for the proposed Project (Part 1 clause 8).

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

The SEPP provides for proper management and development of mineral, petroleum and extractive material resources. The SEPP provides for development that may be carried out with consent, without consent and is exempt or complying. Removal and transportation of coal seam gas is not affected by the SEPP and as such no further consideration of the SEPP is necessary.

3.5 Regional Environmental Planning

3.5.1 Lower Hunter Regional Strategy 2006

The strategy is an overall plan that has been prepared to ensure the region develops in a strong and sustainable way. The NSW Government's 25-year land use strategy for the region:

- Provides for 115,000 new homes to cater for a projected population growth of 160,000 people.
- Plans for up to 66,000 new jobs and ensures an adequate supply of employment land.
- Promotes growth in centres — a greater choice of housing and jobs in Newcastle's CBD and specified major centres.
- Creates important green corridors of land with high environmental value, which will be managed for conservation purposes. These corridors align with existing public reserves, some of which will be expanded.

- Protects high quality agricultural land, and natural resources such as water aquifers and extractive materials.

The strategy will be reviewed every five years (Department of Planning, 2006). The proposed pipeline allows for a reduction in greenhouse gas emissions with no disruption to the provision of electricity to the lower hunter and wider community and accords with the objectives of the strategy.

3.5.2 Hunter Regional Environmental Plan 1989

The Hunter Regional Environmental Plan 1989 applies to all land within the cities of Cessnock, Greater Taree, Lake Macquarie, Maitland and Newcastle and the Shires of Dungog, Gloucester, Great Lakes, Merriwa, Murrurundi, Muswellbrook, Port Stephens, Scone and Singleton.

The objectives of the plan are:

- To promote the balanced development of the region, the improvement of its urban and rural environments and the orderly and economic development and optimum use of its land and other resources, consistent with conservation of natural and man-made features and so as to meet the needs and aspirations of the community,
- To co-ordinate activities related to development in the region so there is optimum social and economic benefit to the community, and
- To continue a regional planning process that will serve as a framework for identifying priorities for further investigations to be carried out by the department and other agencies.

The plan identifies a range of mechanisms to implement its objectives which generally relate to policies for local environmental plan preparation and development control. The proposed pipeline will provide opportunities to develop resources that would otherwise be treated as a waste stream and in doing so will provide for local employment and economic benefits as well as reduce local greenhouse gas emissions. The proposed development is therefore consistent with the objectives of the Hunter Regional Environmental Plan 1989.

4 Consultation

Macquarie Generation has been actively consulting with key stakeholders in relation to the proposed pipeline Project since January 2007. The stakeholder consultation strategy specific to the pipeline builds on Macquarie Generation's prior activities in the region as an existing power station operator.

A stakeholder is defined as a group or individual that may have an interest in the Project or may be affected, in any way, by the Project.

4.1 Objectives of Stakeholder Consultation

The principal objectives of stakeholder consultation for the Project are to:

- Identify interested and affected individuals and groups.
- Understand the nature of stakeholder interests in the Project.
- Build understanding among stakeholders, thereby reducing the potential for stakeholder disaffection.
- Ensure that stakeholders are correctly informed about the Project and this is done in a timely fashion.
- Provide a structure for stakeholders to input into planning process and express any issues, difficulties or concerns.
- Manage potential interactions or confusion with other unrelated Projects.
- Identify, collate and utilise information from stakeholders that will enhance the design and acceptance of the Project.
- Provide appropriate opportunities to resolve issues with stakeholders by their involvement and effective communication.
- Minimise disruption to the environmental approval process so as to deliver approval as quickly as possible by ensuring that issues or concerns are appropriately dealt with during the planning process.
- Establish opportunities for continuing interaction with interested stakeholders.

4.2 Consultation Process

Macquarie Generation has implemented a program of pro-active consultation to ensure open lines of communication between stakeholders and the Project team. The consultation process has utilised a number of communication mechanisms; both formal (e.g., scheduled presentations and meetings) and informal (e.g., visits to landholders, telephone conversations). Mechanisms for stakeholder consultation during the Project include:

- Project briefings and advertisement: Project briefings and issue-specific meetings or advertisement.
- One-on-one technical discussions: Organising and attending one-on-one meetings with stakeholders for information dissemination, obtaining stakeholder input to Project planning, discussions relating to technical issues (as required).
- Meetings: With individual land owners, occupiers, land managers, local aboriginal communities in relation to land issues (See Appendix D for Aboriginal community consultation), including corridor selection and assessment processes.

- 24 hour toll-free telephone line: A complaints hotline to be established prior to construction for all stakeholders to call with concerns or questions about the Project.

4.3 Stakeholders

4.3.1 Government Agency

Table 6 summarises the consultation undertaken by Macquarie Generation with Government Agencies related to the pipeline Project.

Table 6: Government Agency Consultation

Agency	Nature of Consultation	Issues Raised	Issues Addressed
Department of the Environment, Water, Heritage and the Arts (Commonwealth)	Letter written to notify the agency about the Project.	No ongoing consultation occurred.	-
Department of Planning (NSW)	In February 2008, Macquarie Generation submitted to the Department of Planning (DoP) a Project Application (08_00061) and Project Application Preliminary Environmental Assessment Gas Supply Pipeline Liddell Power Station (PB, 2008) covering a preliminary assessment of the key environmental issues.	On the 5 May 2008 the Director-General of the DoP provided Macquarie Generation with the requirements for the environmental assessment (Appendix A).	EAR
Department of Water and Energy (NSW)	Macquarie Generation has in a meeting briefed the Department on the Project.	Action arising was a meeting with IPART where it was established that NGAC accreditation for gas delivered by the Project would be incorporated into an existing Liddell Power Station accreditation. A project overview presented at meetings included and described the approach to water crossings along the route. The ensuing discussion and matters arising focused on avoiding impact on mining and NGAC accreditation. There was no specific	-

Agency	Nature of Consultation	Issues Raised	Issues Addressed
		response to proposed water crossings.	
NSW Roads and Traffic Authority	Preliminary pipeline corridor details were submitted for review and comment.	The RTA responded to Macquarie Generation in a letter dated 22 April 2008 cover their standard requirements for consideration during the planning and inception of the Project. RTA requires detailed drawings for all works carried out within the State Road Reserves and that all road crossings that are either under-bored or use an existing underpass are acceptable subject to prior approval being granted by the Authority.	Traffic Impacts 5.5
NSW Department of Primary Industries – Mineral Resources	The corridor Project was reviewed at a meeting and ongoing conversation between the parties.	The outcome of discussion is that the corridor should avoid potential conflict with any future open cut coal mining. The corridor in this application takes into account the guidelines proposed in these discussions.	-
Mine Subsidence Board	The corridor Project was reviewed at a meeting of the parties at Singleton.	The main pipeline corridor almost exclusively uses established infrastructure corridors. Mining is excluded in these areas so they are not subject to mine subsidence.	Where the potential for the pipeline to be undermined in the future exists detailed pipeline design will take into account the impact of subsidence and will, when available, be submitted to the Mine Subsidence Board for approval.
NSW Department of Lands	Written letter to advise the agency of the Project (Nov 2007).	No ongoing consultation	-

Agency	Nature of Consultation	Issues Raised	Issues Addressed
NSW Department of Environment and Climate Change	Written letter to advise the agency of the Project (Nov 2007).	No ongoing consultation	-

4.3.2 Local Council

Macquarie Generation made their initial Project briefing to the Singleton Council in a meeting held on 7 May 2007. Since that meeting, Macquarie Generation has presented project updates at two council meetings on 28 May 2007 and 12 May 2008.

For the Muswellbrook Council the initial Project briefing meetings were held on 8 May 2007 and 17 May 2007. As the entire Project falls on Macquarie Generation owned land within the Muswellbrook Council LGA, no council meeting presentations were requested. Macquarie Generation provided a revised briefing document to the Muswellbrook Council for the proposed north-south pipeline Project in May 2008.

Neither council has rejected the Project, however appropriate community consultation was requested to ensure the general public and local communities likely to be affected by the Project were informed about the Project.

4.3.3 Community

Community information session were advertised in the Muswellbrook Chronicle and Singleton Argus and held in Muswellbrook on 29 May 2007 and in Singleton on 29 May 2007 and again on the 13 May 2008. There were no negative comments from the community as a result of the consultation. Many members of the community work in mining and mining-related activities and as such the proposed pipeline is a typical activity in the locality that is generally accepted by the community, provided adequate environmental and safety safeguards are incorporated into the design.

4.3.4 Mining operations

Extensive consultation has occurred with holders of existing mining licenses along the proposed corridor. Where the pipeline crosses a mining lease or land owned by a mining company appropriate negotiations for access have occurred and easement agreements will be established. The Project should not impact on existing approvals or licences. However, the corridor has been selected to provide the opportunity for coal mines in the local area to utilise the pipeline to de-gas coal prior to mining and post mining removal of fugitive methane emission where possible. The proposed pipeline will give mines a potential avenue to reduce their methane emissions through a beneficial use Project.

4.4 Ongoing Project Consultation

Stakeholder consultation will continue while Macquarie Generation gains Project approvals, starts construction and moves into the operational phase of the Project. The consultation program will maintain the same goals and principles as outlined above to ensure that stakeholders are kept informed of Project development. Macquarie Generation will build on the relationships fostered during this initial consultation phase and continue to liaise regularly with directly-affected stakeholders.

4.4.1 Community Consultative Committee

Under the auspices of Muswellbrook Shire Council Macquarie Generation operate a Community Consultative Committee, which meets quarterly either at Muswellbrook Council or our power stations. Macquarie Generation will maintain contact through the Community Consultative Committee for the remaining special interest groups prior to the start of construction and during operations.

The Committee discusses issues regarding environmental compliance with licences, conditions of development consent and other relevant approvals for Macquarie Generation activities, progress of current developments and more general matters concerning power station operation. The Committee also assesses community concerns and seek responses from Macquarie Generation on relevant issues.

The Committee comprises representatives from Muswellbrook and Singleton councils and community representatives from both council areas. Under Muswellbrook Shire guidelines the Committee reports on its deliberations in formal Minutes presented to Muswellbrook, Singleton and Upper Hunter Shire Councils.

The Committee comprises:

- Muswellbrook Council
    - Cr Jennifer Lecky
    - Cr Malcolm Ogg
    - Mr Chris Gidney
- Muswellbrook Community
    - Mr John Morris
- Singleton Council
    - Cr Fred Harvison
- Singleton Community
    - Mr Peter Brennan
- Macquarie Generation
    - Mr John Neely, Manager Bayswater Power Station
    - Mr Peter Sewell, Manager Liddell Power Station
    - Mr Rob Cooper

Under Muswellbrook Shire guidelines, the Committee will meet at least quarterly and report on its deliberations in formal Minutes presented to Muswellbrook, Singleton and Upper Hunter Shire Councils.

5 Key Assessment Requirements

5.1 Ecological Impacts

Alison Hunt & Associates Pty Ltd (AHA) (2008) undertook a flora and fauna assessment for the proposed 51 km pipeline corridor in accordance with the DECC *Threatened Species Assessment Guidelines* (DECC 2007). A summary of that report is provided below and the full report is attached in Appendix D.

The Director General requirements (Appendix A) specifically identified the need for the Project to consider and assess the impacts on the endangered ecological community (ECC), Warkworth Sands Woodlands. This requirement specifically relates to an area of the Warkworth Sands Woodlands adjoining the original 2007 North-South gas pipeline route. No remnants of Warkworth Sands Woodland are present within or adjoining the proposed North-South gas pipeline corridor (Figure 3). As such Warkworth Sands Woodland is not considered further by this assessment.

The proposed pipeline corridor supports various alluvial and clay based plant communities typical of the Central Hunter and Upper Hunter Valley. Key ecological issues that were assessed by AHA (2008) included:

- The potential for endangered ecological communities, threatened species and / or their habitat listed under the NSW *Threatened Species and Conservation Act* (TSC Act) and Fisheries Management Act (FM Act) to occur within the pipeline corridor.
- The potential presence of any matters of NES listed under the Commonwealth EPBC Act.
- Assessment of the likely impacts of the Project on the ecology of the site with particular reference to threatened species, populations and / or ecological communities.
- An assessment of the Project against the aims of the *State Environmental Planning Policy No. 44 Koala Habitat* (SEPP 44).
- Preliminary recommendations to mitigate and ameliorate potential impacts associated with this Project.

Study Methodology

The assessment was undertaken to describe the biodiversity of the proposed pipeline corridor and locality (search region) to determine the likely potential impacts associated with the Project. Tasks completed included:

- A review of available literature and databases to assist with the identification of the pipeline corridor values especially in relation to threatened species, populations and endangered ecological communities.
- Field investigations to ascertain the current site condition and the presence or likely presence of threatened or protected species.
- An impact assessment to determine the likely effects of the Project on the terrestrial and aquatic ecology of the site with particular reference to threatened species, populations and / or ecological communities.
- Preparation of mitigation measures to ameliorate and mitigate potential impacts.

Spatial Definitions

The following spatial definitions apply:

- Pipeline corridor: Covering a 50 m corridor centred along the proposed pipeline alignment (Total area – 255 ha).
- Search region: A 10 kilometre corridor centred along the proposed pipeline alignment (Total area – 51 000 ha). Database accessed within the search region covering known records of flora, fauna and protected matters, included:
    - NSW Threatened Species database: a public database administered by the DECC.
    - EPBC Act Protected Matters Search Tool (PMST): an online search tool administered by the DEWHA.

Limitations

All ecological assessments have limitations to the efficacy of the study. Those of particular relevance to this study include.

- Not all properties could be accessed and hence assessment was undertaken from neighbouring fence lines. In all instances those properties which could not be accessed were highly modified agricultural lands.
- At the time of assessment a number of unresolved issues with the preferred pipeline corridor still existed and on occasion the corridor assessed was not necessarily the exact corridor currently proposed for the pipeline. In most cases this has resulted in the corridor being realigned to avoid vegetation (in particular trees) and drainage lines and to follow tracks and or cleared paddocks. On one occasion 1.25 km of the corridor was shifted south along the boundary of woodland (see Appendix F Figure F1 for route alignment change, approximately KP 3). This 1.25km section of the proposed pipeline corridor has not been ground verified but was assessed through review of desktop studies.
- This assessment was undertaken over a short time period and during a single season so not all species would have been recorded as species may either be resident or transitory whilst some species may have been inactive, dormant or with cryptic habits, and some may be nomadic or migratory in nature. Additionally, some fauna species are mobile or transient in their use of resources. Therefore, not all species, either resident or transitory, would have been recorded during the single event assessment. This assessment was aimed at providing an overall assessment of the ecological values of the proposed corridor with particular emphasis on threatened species.

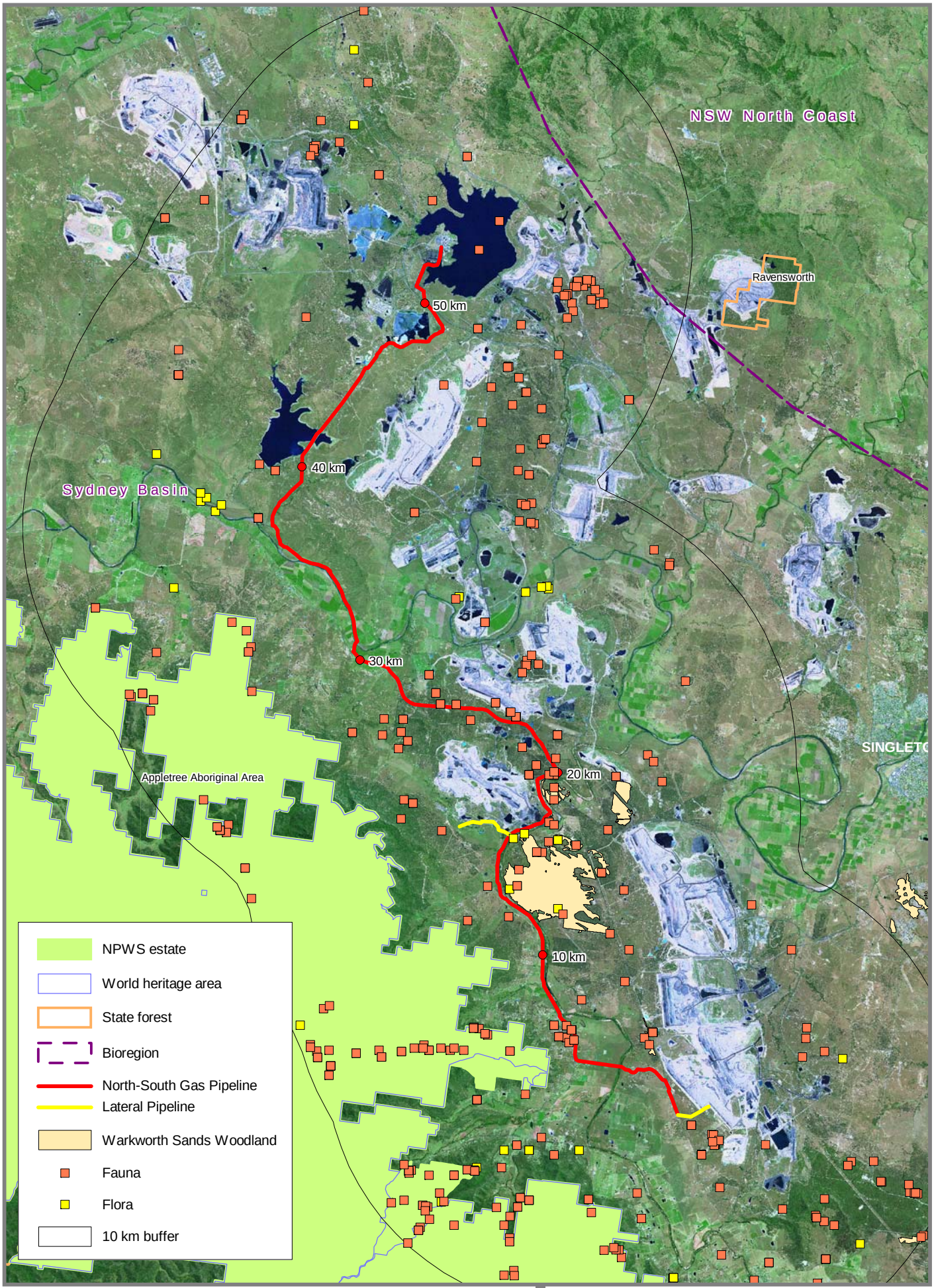

Figure 3

Protected Areas and Recorded Threatened Species

CDB Environment Pty Ltd

5.1.1 Existing Environment

Bioregions

The study area lies within the northern boundary of the Sydney Basin Bioregion. Sydney Basin Bioregion lies on the central east coast of New South Wales (Figure 3). The bioregion extends from just north of Batemans Bay to Nelson Bay, and almost as far west as Mudgee.

The Sydney Basin Bioregion is dominated by a temperate climate characterised by warm summers with no dry season. A sub-humid climate occurs across significant areas in the northeast of the bioregion. A small area in the west of the bioregion around the Blue Mountains falls in a montane climate zone.

Rainfall can occur throughout the year, but varies across the bioregion in relation to altitude and distance from the coast, with wetter areas located closer to the coast or in higher altitudes.

Temperature varies across the bioregion, with areas of higher temperature occurring along the coast and in the Hunter valley, while areas of lower temperature are located on the higher plateaux and western edge.

The Sydney Basin Bioregion is one of the most species diverse in Australia. The region is dominated by a large range of vegetation types including eucalypt woodlands and open forests, scattered patches of eucalypt, low open forests, tall open forests and woodland, heath, mallee, rainforest, mangroves, grasslands and samphire communities.

General threats to species in the bioregion include broad-scale vegetation clearing (agriculture and coal mining related), loss of remnants, as well as grazing by stock. In historically cleared areas remnant vegetation occurs along creek and river banks, property boundaries and road reserves, with some larger forested areas like the Wollemi National Park (located outside of the study area) protecting many species as well as species whose distribution is restricted entirely to the bioregion.

Protected Areas

Predictably much of the pre-settlement biodiversity has been lost from the Hunter Catchment Management Area. Nonetheless, the Hunter Catchment Management Area still supports 116 threatened species and 13 endangered ecological communities (EEC) and some of these species and communities are known to have very restricted distributions, namely Kurri Sand Swamp Woodland and Warkworth Sands Woodland. Furthermore, vegetation of the Hunter River valley is restricted to fragmented and isolated patches, riparian vegetation and areas unsuitable for farming and / or coal mining.

The conservation areas of the Wollemi National Park and Yengo National Park are located to the west and south-west of the proposed pipeline corridor. Wollemi National Park comes to within 1 km of the pipeline corridor near Bulga and Yengo National Park is located around 6 km south and south-west from Bulga. Both areas form a part of the Greater Blue Mountains World Heritage Area (Figure 3).

Vegetation Communities

The vast majority of the proposed pipeline corridor traverses exotic pastures and this is reflected in the number of weed species recorded along the corridor. Ninety four (94) flora species were identified in the pipeline corridor. Of the 94 species recorded, 44 % were weed species (either exotic or planted natives occurring outside their natural range). Vegetation communities occurring along the pipeline corridor include:

- Pasturelands.
- Planted areas.
- Bulloak (*Allocasuarina luehmannii*) / Narrow-leaved Ironbark (*Eucalyptus crebra*) Open Woodland.
- Spotted Gum (*Corymbia maculata*) / Narrow-leaved Ironbark (*Eucalyptus crebra*) Open Grassy Woodland.
- Hunter Valley River Oak Forest.

Fauna and Fauna Habitat

Fauna habitat value is generally related to complexity of landscape features as these offer a greater number of habitat opportunities for a range of species. The fauna habitats along the proposed pipeline corridor lack complexity such as trees, tree hollows, stags, shrubs, rocky areas, ponds and fallen timber, along most of its length. Table 7 shows available habitat along the pipeline corridor.

Table 7: Terrestrial fauna habitat along the proposed pipeline corridor

Habitat Type / Resource	Location	Species
Introduced grasslands	The majority of pipeline corridor.	Introduced small mammals, macropods, raptors.
Drainage lines / creeks / rivers	Wollombi Brook, Hunter River, several creeks and small drainage lines.	Amphibians, birds, microchiropteran bats.
Woodland patches	KP 7 KP 15	Woodland birds, arboreal mammals, ground-dwelling mammals, reptiles, microchiropteran and megachiropteran bats.
Paddock trees	Scattered across along the corridor.	Breeding and foraging resources for birds, hollow-dependent bird species and microchiropteran bats.

Thirty-nine fauna species (mainly birds) were incidentally recorded during the field assessment (Full list provided in Appendix C). Commonly recorded ground-dwelling mammals included the Common Wombat (*Vombatus ursinus*) and mobs of the Eastern Grey Kangaroo (*Macropus giganteus*). Habitat was limited for arboreal mammals as there were few hollow-bearing trees except as paddock trees and these were generally isolated from neighbouring habitat. However, the area would provide a habitat for a range of microchiropteran bats as these are highly mobile species and are able to move between habitat patches. Reptile habitat was also limited as exposed rocks and fallen timber were

not common along the corridor. Amphibian habitat was patchily distributed across the pipeline corridor. The majority of the drainage line / creek crossings were dry, eroded and weed infested none of which are likely to provide quality habitat for frogs although there are several waterbodies nearby that would provide good habitat for a range of amphibians. The Hunter River and Wollombi Brook would provide good aquatic habitat for a number of aquatic and terrestrial species, however the crossing of both of these would be undertaken through HDD and consequently the waterbody or riparian vegetation would not be disturbed.

Domestic and feral animals would occur along the proposed pipeline corridor due to its location near to agricultural and urbanised areas.

Endangered Ecological Communities

EPBC Act Communities

One critically endangered community is predicted to occur within the locality and this is White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland (DEWHA 2008a). The proposed pipeline corridor does not traverse woodland areas with the characteristic species of White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and / or Blakely's Red Gum (*E. blakelyi*) and consequently this EEC is unlikely to occur along, or adjacent to the corridor.

EPBC Act Species

Predictive modelling indicates that 11 fauna, 6 flora and 10 migratory terrestrial species listed under the EPBC Act have the potential to occur within the locality of the pipeline corridor (namely 10 km) (DEWHA 2008a):

- Spotted-tailed Quoll (Dasyurus maculatus maculatus);
- Regent Honeyeater (Xanthomyza phrygia);
- Swift Parrot (Lathamus discolor);
- Giant Burrowing Frog (Heleioporus australiacus);
- Green and Golden Bell Frog (Litoria aurea);
- Grey-headed Flying-fox (Pteropus poliocephalus);
- Large-eared Pied Bat (Chalinolobus dwyeri);
- Pine Donkey Orchid (Diuris tricolor);
- Slaty Red Gum (Eucalyptus glaucina);
- Cattle Egret (Ardea ibis);
- Latham's Snipe (Gallinago hardwickii);
- Painted Snipe (Rostratula benghalensis);
- Rainbow Bee-eater (Merops ornatus); and
- White-throated Needletail (Hirundapus caudacutus).

The pipeline corridor provides limited habitat for threatened species but the areas adjacent could potentially provide habitat for a range of species especially for those species that are highly mobile.

NSW *Threatened Species Conservation Act 1995*

TSC Act Communities

Thirteen endangered ecological communities (EEC) listed under the TSC Act are known, or are predicted, to occur within the Hunter CMA sub-region (DECC 2008a). Given the soil, other ecological requirements and characteristic species of the listed EECs, AHA (2008) concluded that none of these would occur along the proposed pipeline corridor or in directly adjacent areas.

TSC Act Populations

There are three endangered flora populations listed under the TSC Act that have been recorded within the locality (DECC 2008) of the pipeline corridor and one population was recorded along the proposed pipeline corridor. River Red Gum (*Eucalyptus camaldulensis*) was recorded at the Wambo Creek crossing and this species is a part of the *River Red Gum Population in the Hunter Catchment* protected under the TSC Act as an endangered population (Appendix C Figure 2). Very old and large River Red Gums were also recorded in the most southerly of a very degraded drainage line which would flow into Wollombi Brook just north of Bulga (Appendix C Figure 2). In both cases these remnant trees occur within highly eroded and weed infested gullies. There was no evidence to suggest that there was any recruitment of this species / population into these areas which is most likely due to grazing, weed invasion and erosion.

TSC Act Species

There have been 11 flora and 43 fauna species listed under the TSC Act which have been recorded within the search area (namely 10 km radius) (DECC 2008a).

The majority of the proposed pipeline corridor traverses highly modified habitats which are unlikely to provide high quality flora and fauna habitat for the majority of species unless the species are highly mobile, such as the Grey-crowned Babbler (*Pomatostomus temporalis temporalis).* This species was recorded in a planted area where Xstrata Mining Area intersects Charlton Road (Appendix C Figure 2). Several records of this species have previously been made in close proximity to this site and it is likely that the individual recorded would belong to a previously recorded family group (Umwelt 2007). There are also a number of other highly mobile species with the strong potential of occurring within habitat adjacent to and along the pipeline corridor (namely Masked Owl (*Tyto novaehollandiae*), Regent Honeyeater (*Xanthomyza phrygia*) and Squirrel Glider (*Petaurus norfolcensis*)).

Table 9 shows the list species, populations and ecological communities listed under Schedules 1, 1A and 2 of the TSC Act for which an assessment was undertaken in accordance with the *Part 3A Guidelines for Threatened Species Assessment* (DECC 2007).

Table 8: Species, populations and ecological communities listed under Schedules 1, 1A and 2 of the TSC Act.

Group	Listed species, populations and ecological communities
Endangered Populations	*Cymbidium canaliculatum* population in the Hunter Catchment. River Red Gum population in the Hunter Catchment.
Flora	Slaty Red Gum (Eucalyptus glaucina). Pine Donkey Orchid (*Diuris tricolor*) (also an Endangered Population).

Group	Listed species, populations and ecological communities
Amphibian	Giant Burrowing Frog (*Heleioporus australiacus*). Green and Golden Bell Frog (*Litoria aurea*).
Water-dependent Birds	Painted Snipe (Rostratula benghalensis).
Woodland Birds	Swift Parrot (Lathamus discolor). Hooded Robin (Melanodryas cucullata). Black-chinned Honeyeater (*Melithreptus gularis gularis*). Turquoise Parrot (*Neophema pulchella*). Grey-crowned Babbler (Pomatostomus temporalis temporalis). Speckled Warbler (Pyrrholaemus saggitatus). Diamond Firetail (Stagonopleura guttata). Regent Honeyeater (*Xanthomyza phrygia*). Glossy Black-cockatoo (*Calyptorhynchus lathami*).
Owl	Barking Owl (*Ninox connivens*).
Mammals (other than bats)	Squirrel Glider (Petaurus norfolcensis). Brush-tailed Phascogale (*Phascogale tapoatafa*). Spotted-tailed Quoll (Dasyurus maculatus maculatus).
Microchiropteran Bats	Little Bent Wing Bat (*Miniopterus australis*). Eastern Bent-wing Bat (Miniopterus schreibersii oceanensis). Eastern Freetail-bat (*Mormopterus norfolkensis*). Large-footed Myotis (*Myotis adversus*). Eastern Cave Bat (Vespadelus troughtoni). Large-eared Pied Bat (*Chalinolobus dwyeri).*
Microchiropteran Bats	Grey-headed Flying-fox (*Pteropus poliocephalus*).

RoTAP Species

Three *Rare or Threatened Australian Plants* (RoTAP) are listed as occurring within the Muswellbrook and Singletons LGAs (plantNET 2008).

- Slaty Red Gum (*Eucalyptus glaucina*);
- *Gonocarpus longifolia*; and
- *Grevillea montana*.

AHA 2008 recorded none of the RoTAP species on the pipeline corridor and whilst the pipeline corridor provides limited potential for the occurrence of these species, adjacent areas could provide potential habitat for a number of these plants.

Noxious Weeds

In NSW the identification, classification and control of noxious weeds is governed by the *Noxious Weeds Act 1993* (NW Act). Plants that have been declared as noxious weeds are classified into specific control classes in each Local Control Area. Table 9 shows the plants listed as Noxious weeds for the Upper Hunter County Council which includes local council areas of Muswellbrook and Singleton that were found along the pipeline corridor.

Table 9: Noxious weeds recorded along the study area.

Botanic Name	Common Name	Noxious Weed Control Class
Xanthium spinosum	Bathurst Burr	4
Echium plantagineum	Paterson's Curse	4
Opuntia stricta	Common Prickly Pear	4
Cuscuta campestris	Golden Dodder	5
Nassella trichotoma	Serrated Tussock	3
Rubus fruiticosus	Blackberry	4
Salix babylonica	Weeping Willow	5
Solanum rostratum	Buffalo Burr	4

The control requirements for each of these classes are:

- Class 3 - Regionally Controlled Weeds: Plants that pose a serious threat to primary production or the environment of an area to which the order applies, and are likely to spread in the area or to another area. Legal requirements are that the plant must be fully and continuously suppressed and destroyed.
- Class 4 - Locally Controlled Weeds: Plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area. Legal requirements are that the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local authority.
- Class 5 - Restricted Plants: Plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State. Legal requirements are that the requirements in the NW Act for a notifiable weed must be complied with.

Blackberry is also listed as a Weed of National Significance and the plans and controls associated with this listing should also be implemented for control of this weed.

5.1.2 Potential Impacts

Potential impacts as a consequence of the Project are likely to be minimal as the corridor has been designed to avoid areas of high conservation, such as the Warkworth Sands Woodland area. Nonetheless, a number of direct and indirect impacts have the potential to occur as a consequence of construction and operation.

Potential direct impacts include:

- Vegetation Clearance.
- Loss of Fauna Habitat.
- Impacts on aquatic habitats.

Potential indirect Impacts include:

- Edge Effects.
- Disturbance of fauna.

Vegetation Clearance

The clearing of native vegetation may result in:

- Destruction of habitat causing a loss of biological diversity, and may result in total extinction of species or loss of local genotypes.
- Fragmentation of populations resulting in limited gene flow between small isolated populations, reduced potential to adapt to environmental change and loss or severe modification of the interactions between species.
- Riparian zone degradation, such as bank erosion leading to sedimentation that affects aquatic communities.
- Disturbed habitat which may permit the establishment and spread of exotic species which may displace native species.
- Loss of leaf litter, removing habitat for a wide variety of vertebrates and invertebrates.

Table 10 shows the anticipated vegetation removal along the length of the pipeline corridor.

Table 10 Vegetation clearance along the proposed pipeline corridor

Vegetation Community	Direct Impacts
Pasturelands	20 m ROW along the vast majority of the proposed pipeline corridor.
Planted areas	None – will be avoided
Central Hunter Box – Ironbark Woodland	1.02 ha
Central Hunter Ironbark – Spotted Gum – Grey Box Forest	0.57 ha
Hunter Valley River Oak Forest	None – area would be under bored from outside of vegetated area.

Loss of Fauna Habitat

The majority of fauna habitat which would be removed is that provided by introduced pasturelands. This may temporarily affect species such as the Eastern Grey Kangaroo and Common Wombat, both of which are prevalent in this area. This is unlikely to have a long term impact on these species as the trench would be backfilled simultaneously with laying of the pipe and so movement for foraging and dispersal throughout the area would not be restricted long term.

All paddock trees would be avoided as would substantial vegetation within drainage lines thereby ensuring that trees with hollows are retained. It is unlikely that amphibian habitat would be substantially disturbed as the majority of drainage lines traversed by the pipeline are ephemeral and they lack native vegetation. Farm and / or mine dams would not be impacted by this Project.

Some fauna habitat would be removed with the clearance of 1.02 ha Central Hunter Box – Ironbark Woodland and 0.57 ha Central Hunter Ironbark – Spotted Gum – Grey Box Forest. This habitat primarily consists of small trees with a very sparse groundlayer and open gravelly soils lacking in fallen timber and basking sites for reptiles. Whilst these areas would not provide high quality fauna habitat due to lack of habitat complexity they would provide potential habitat for a range of woodland birds, small mammals and common reptiles.

Impacts on aquatic habitats

Changes to hydrological regimes along the pipeline corridor have the potential to occur. Changes to hydrological processes can have a number of potential effects including:

- Alteration of the ecology of an area including the vegetational composition and loss of fauna habitat.
- Increased run off rates and hence erosion.
- Changes in soil moisture content.
- May create conditions conducive to invasion by exotic species.

Potential impacts on aquatic habitats are likely to be spatially and temporally limited. The major river crossings (namely Hunter River and Wollombi Brook) would be under bored and consequently direct impacts on these waterways are unlikely to occur. Compounds housing the drill rig and associated infrastructure would also be placed well clear of the riparian zones further reducing potential impacts.

The more minor crossings, including Wambo Creek and ephemeral drainage lines, would be trenched at locations which do not require removal of substantial native vegetation or emergent aquatic vegetation. This would be achievable as the drainage lines and creeks are largely highly eroded, weed infested and ephemeral in nature. To ensure that water quality is not further impacted through erosion and sedimentation, measures such as silt curtains, would be used to control impacts. The trench would be backfilled once the pipeline is laid and hence any disruption to flow or fauna movement would not be long term.

Edge Effects

Clearance of vegetation along the length of the pipeline corridor would increase edge effects. Edge effects are known to increase the chances of weed establishment, cause changes in microclimates

along the edges of vegetation communities and allow for ease of movement of feral animals (e.g. European Red Fox) through an area.

Disturbance of fauna

Disturbance of fauna during construction could occur through an increase in noise and activity levels along the pipeline corridor. Disturbances many occur as a consequence of vehicular traffic causing noise and an increased risk of vehicle strike, and HDD causing noise and vibration. Disturbance of fauna can result in changes to the behaviour and patterns of usage of resources by certain fauna species and / or increases in roadkill.

Key Threatening Processes

Key threatening processes (KTP) listed under the TSC Act / EPBC Act which may be relevant to this Project includes:

- Clearing of native vegetation / land clearance.
- Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands.
- Predation by the European Red Fox (*Vulpes vulpes*).
- Corridors and Connectivity.

5.1.3 Mitigation Measures

Mitigation measures should be applied during construction which would specifically protect threatened species, populations and endangered ecological communities along the proposed pipeline corridor and in adjacent areas, including:

- Preparation and implementation of a CEMP, including provisions for a sediment and erosion control plan (see Section 0).
- The Project induction to include environmental awareness to advise machinery operators and other on-site personal on ways of minimising ecological impacts.
- Appropriately delineated construction ROW, to ensure that large machinery or other construction activities do not impact on adjacent vegetation.
- Installation of sediment and water quality control measures, such as silt curtains, or where open cut crossing techniques are used isolation using dam and pump or flume pipe techniques should be used.
- Top soil (< 100 mm) should be stockpiled when clearing within patches of native vegetation communities. This should then be spread over the surface during restoration.
- Pre-trenching surface levels should be restored to retain current surface hydrology.
- Trimming of native vegetation rather than removal where practicable.
- Where required, removed native vegetation should be stockpiled and spread back over the ROW during restoration.
- Weedy vegetation should not be re-spread over the ROW during restoration.
- Paddock trees should be avoided.
- A no impact zone around River Red Gums twice the radius of the tree canopy should be maintained.
- Use designated pipeline access tracks to limit the impact on native vegetation, reduce soil disturbance and weed spread.

- The areas of the proposed pipeline corridor which have not been assessed should be before construction begins.
- Replacing surface rocks after construction works to reinstate habitat for native fauna where appropriate and approved by the landholders.
- Undertake weed control along the ROW after construction to control any weed outbreaks.

5.1.4 Impact Assessment

The proposed pipeline corridor has been chosen to avoid intact remnant or regrowth vegetation and areas of high conservation significance including the Warkworth Sands Woodland which is listed as an EEC under the TSC Act and EPBC Act. Consequently the corridor traverses highly modified environments including coal mines, agricultural lands, road reserves (predominately mown grassy strips) and terminates in a power station.

Vegetation and land clearance

The proposed pipeline corridor is characterised by cleared land which has been used for agriculture and mining activities over many decades. A key aim of the Project has been to locate the pipeline and associated infrastructure in such a way as to avoid the removal of important vegetation and this has been achieved. A total of 1.59 ha of native vegetation communities would be removed as a consequence of the Project. Furthermore the use of a flexible pipe means that all paddock trees could be avoided as would all substantial vegetation within drainage lines including River Red Gums which are a part of an endangered population.

The nature of the Project is unlikely to result in total extinction of species or loss of local genotypes as the area to be cleared is a narrow strip of mostly introduced species, which is unlikely to provide the important habitat for a species or to impede gene flow through this area even for small isolated populations. Major waterways would be under bored while more minor creeks and drainage lines would be trenched in areas that lack native vegetation. A CEMP would be prepared and this would address measures to avoid further erosion and sedimentation. The vast majority of sites are weed infested. However, the two native woodland areas being traversed by the pipeline are relatively weed free and these should be monitored to ensure that weed species do not become established along the ROW.

Edge Effects

The proposed pipeline corridor is currently impacted by clearing and fragmentation which has significantly increased edge effects throughout the general Hunter Valley area. It is unlikely that the Project would substantially increase these effects.

Disturbance of fauna

As the majority of construction activities would be within the highly modified paddock areas it is anticipated that the Project would provide few risks to fauna above current levels.

Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands

Riparian zone degradation may occur where changes to flows increases erosion, leading to sedimentation impacts on aquatic communities. This Project would not result in long term changes

to flows as works associated with trenching would be temporary and the banks would be reinstated to ensure that further erosion and degradation does not occur. Measures to prevent erosion and sedimentation would be detailed in the CEMP which would be prepared before commencement of works.

Predation by the European Red Fox (*Vulpes vulpes*)

It is possible that this Project may result in increased predation by the European Red Fox due to the creation of the pipeline corridor. The creation of linear tracks allows increased movement of this species as the European Red Fox prefers to move through landscapes along tracks and along edges of habitat. Considering the extent of current modification of this landscape it is unlikely that this Project would substantially exacerbate this KTP.

Corridors and Connectivity

Linear structures can cause disruptions to movement corridors as some fauna and the propagules of some plants are unable to move across areas which are cleared and / or have barriers that physically hinder movement thereby creating isolation and fragmentation of landscapes.

However, it is unlikely that this Project would substantially disrupt large scale corridors and fragment connectivity as the proposed pipeline corridor is generally introduced pastures and the ROW required for construction is narrow (namely 20 m wide within the 50m assessment corridor). It may marginally disrupt fine scale movement corridors for less mobile species but this would largely be over a very short time frame as backfilling of the trench would take place directly after laying the pipe.

The proposed pipeline corridor traverses the Hunter River valley floor. Wollemi National Park, Yengo National Park and Pokolbin State Forest are located to the west, southwest and south, respectively. It is unlikely that the proposed pipeline corridor would be a part of a major connecting corridor as patches of vegetation are severely fragmented as a consequence of many years of clearing. It is more likely that most of the movement by fauna and flora would occur through the vegetated areas of the nearby national parks and state forest. However, the proposed pipeline corridor may be important on a small scale for less mobile species as some fauna and flora are disrupted by small gaps in vegetation.

State Environmental Planning Policy 44 - Koala Habitat Protection

The aim of SEPP 44 is:

- To encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline by:
    - Requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat.
    - Encouraging the identification of areas of core koala habitat.
    - Encouraging the inclusion of areas of core koala habitat in environment protection zones.

Muswellbrook and Singleton are listed as local government areas subject to the provisions of SEPP 44. A number of Koala records exist within the study area and search region. Two species of Koala feed trees listed on Schedule 2 of SEPP 44, (namely Forest Red Gum (*Eucalyptus tereticornis*) and River Red Gum (*Eucalyptus camaldulensis*)) were recorded along the proposed pipeline corridor. For a study area to be considered as potential Core Koala Habitat, Schedule 2 tree species must occur at densities greater than 15%. The recorded species occurred as isolated paddock and / or riparian trees not at densities greater than 15%. Therefore it is unlikely that the proposed pipeline corridor would be Core Koala Habitat and consequently no further provisions of SEPP 44 need apply.

Cumulative Impacts

Construction of this Project is not likely to not substantially increase cumulative impacts within the Hunter Valley. The corridor selected for the proposed pipeline is predominately through pastures and only small amounts of native vegetation would be removed and these are along the edges of existing tracks and roads. Therefore, it is considered that the scale of the Project is small and impacts associated with construction and operations are predicted to be relatively minor and manageable.

Conclusion

The proposed pipeline corridor was designed specifically to avoid intact remnant or regrowth vegetation and areas of high conservation significance including the Warkworth Sands Woodland which is listed as an EEC under the TSC Act and EPBC Act. Consequently the corridor traverses highly modified environments including coal mines, a power station, road reserves (predominately mown grassy strips) and agricultural lands. It crosses a number of shallow drainage lines and these would be trenched through in locations which would allow trees to be retained. The major drainage line crossings, including the Hunter River and Wollombi Brook which are substantial and important rivers and these would be under bored using horizontal directional drilling (HDD).

AHA 2008, concluded that it is unlikely that the Project would significantly affect any ecological community, threatened population or species listed under the TSC Act or EPBC Act which occurs or with the potential to occur, along the proposed pipeline corridor as:

- The pipeline corridor was selected so as to avoid areas of biodiversity which would be likely to provide habitat to biodiversity of conservation significance.
- The disturbance would be temporary and confined to a narrow and currently degraded ROW.
- The potential impacts on those species which do occur could be adequately managed and mitigated.

5.2 Heritage Impacts

5.2.1 Indigenous heritage

Insite Heritage (IH) undertook a cultural heritage assessment of the Project corridor in August and September 2008 (full report attached in Appendix D). The assessment consisted of a desktop study and a field assessment of the entire proposed pipeline corridor. The assessment was carried out in accordance with draft Guidelines for Aboriginal Cultural Heritage Assessment and Community Consultation (DEC 2005).

The proposed pipeline corridor is heavily disturbed and has over a long period been subject to a range of clearing and earthmoving activities associated with power generation, mining and agriculture.

Sensitivity Mapping

Due to the lack of visibility across parts of the surveyed corridor, and to assist in the formulation of the management recommendations for areas of the proposed corridor where archaeological sites were not identified, the proposed corridor was designated into areas of archaeological sensitivity (see Figure 4). The classification of the corridor into areas of low – moderate or moderate – high archaeological sensitivity was based on surface visibility noted during the survey, the level of disturbance, the archaeological potential of landform units, and the site types identified in the area.

Where the sensitivity is low to moderate this generally indicates that the sites are in a disturbed context or shallow A1 soil horizons and are not indicative of intact subsurface deposits.

Areas of moderate to high sensitivity are mapped on the basis of surface recording of artefacts, the soil landscape characteristics and the potential for in-situ subsurface deposits. These areas include the sensitive Wollombi Brook and Hunter River terraces some of which may be Pleistocene in origin.

Within these sections of archaeological potential, each site identified is given a scientific significance rating (Table 11 and Table 12).

The Project area and surrounds have been affected by a variety of human activities that may have impacted the survival rate of both Aboriginal and non-Aboriginal archaeological deposits. These include vegetation and rock clearance, coal mining, agriculture and grazing, drainage works and road construction.

Aboriginal Archaeological Sites and Historic Places

The common types of sites in the Project area are isolated stone artefacts and artefact scatters, primarily of silcrete and mudstone. Other site types include scarred trees, grinding grooves, ceremonial sites, hearths, and rock art sites. Single or scatters of stone tools may be found in the topsoil or in cultural deposits buried within the sub-soil. Stone artefacts are distributed widely across the Project area and can be found the majority of landform contexts.

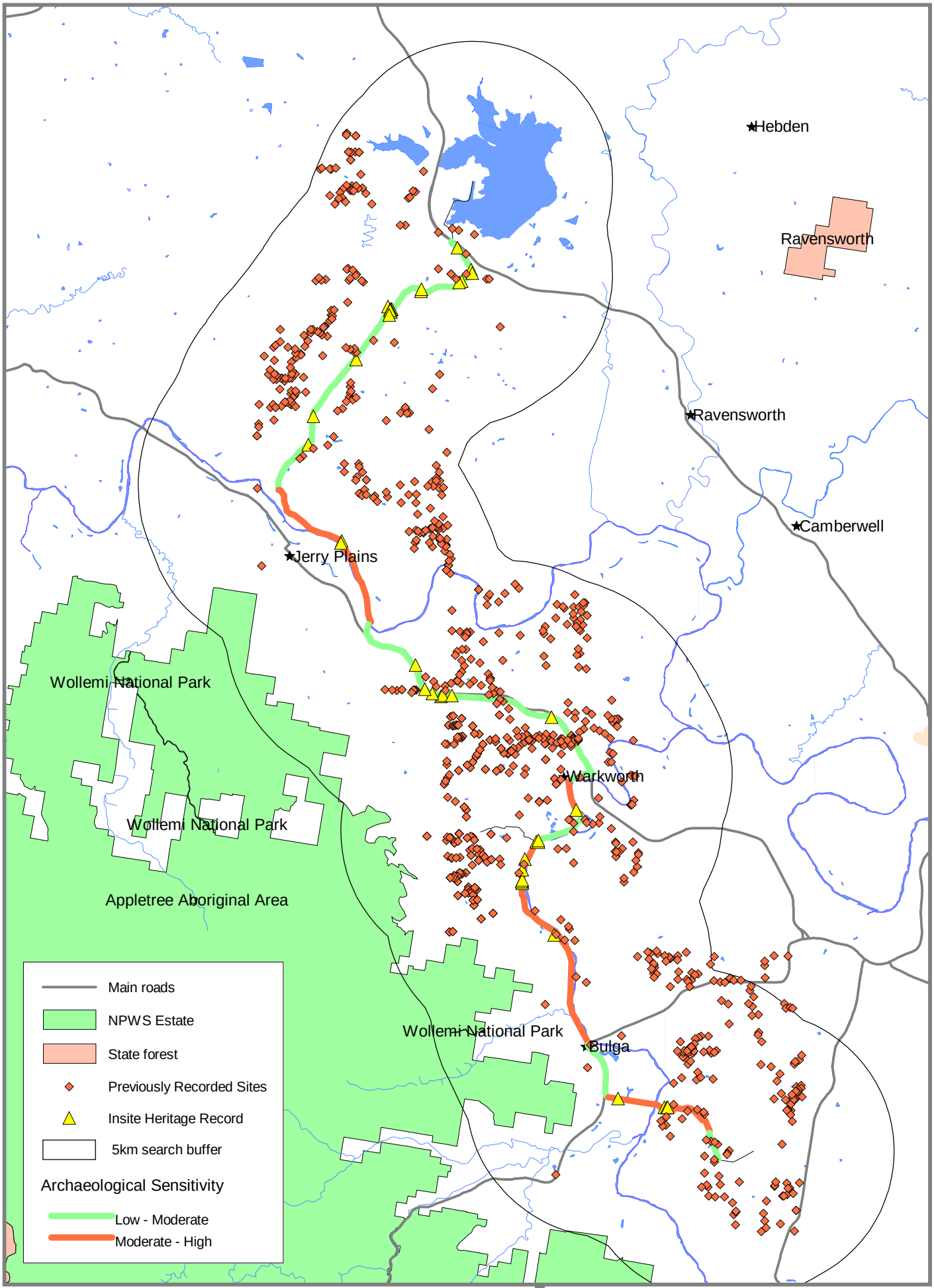

Figure 4 Archaeological Sensitivity and Recorded Sites

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Table 11: Previously registered Aboriginal sites located within or adjacent the proposed pipeline corridor.

Site Number	Archaeological Sensitivity	Site Scientific Significance	Site Type	Site Context	Site Contents
37-2-0048 (Liddell NS 2 and 3)	Low-Moderate	Low	Artefact Scatter	Located on ants nest, disturbed by vehicle track on eastern boundary, land clearing and erosion.	Site originally recorded as numerous artefacts scattered along the south bank of Pikes Gully. Site card notes a collection of cores was made at the site. Survey traversed a portion of the site and identified 3 flakes of mudstone, tuff and silcrete. Pipeline will partially impact site
37-2-0035 (Liddell NS 12)	Low-Moderate	Low	Artefact Scatter	Adjacent to Parnells Ck and its tributaries. Disturbed by Jerrys Plains water pipeline, clearing and erosion.	Site described as located on both sides of Parnells Ck, extending for 100m on both banks. Surface collection made at the site. Considered to be same site as 37-2-0190. Proposed pipeline will partially impact site. Survey relocated a portion of the site and identified two artefacts. The same site is registered as 37-2-0190
37-2-0190 (double recording of the same site above)	Low-Moderate	Low	Artefact Scatter	Adjacent to Parnells Ck and its tributaries. Disturbed by Jerrys Plains water pipeline and erosion	Site described as being located on open paddock along the pipeline and road to a gate near the pumping station. Surface collection of artefacts carried out at site. Proposed pipeline will partially impact site.
37-5-0034	Moderate-High	Moderate-High	Artefact Scatter, PAD	On NW side of confluence of Wollombi Brook and North Wambo Creek	n/a – Survey did not relocate site due to low visibility. Proposed pipeline will impact on eastern portion of site
"G1" (Liddell NS 28 & NS27)	Moderate-High	Moderate	Artefact Scatter	Located on low spur above the E terrace of Wollombi Brook.	Artefact scatter. Site disturbed by grazing and clearing. The proposed pipeline will impact on the site.
37-6-0429	Low	Low	Artefact Scatter	Excavated	This site "Bulga 7" is a loci within site 37-6-1401 as noted below. The site has been removed by excavation under AHIP 2998

Site Number	Archaeological Sensitivity	Site Scientific Significance	Site Type	Site Context	Site Contents
37-6-1401	Moderate-High	n/a	Artefact Scatter	n/a	BCO10. Portion of the site was located in the proposed corridor. However from information supplied by Beltana Mine the site has been salvaged under AHIP 2998 (Aug 2008). Salvage of this site includes artefacts located at loci G6, G7, G8, GIF-IF2, GIF-IF3 & Bulga 7 (37-6-0429). Therefore the pipeline should not impact on this site.
37-6-1404	Low	Low	Isolated find	Cleared plain adjacent to unformed track	Isolated artefact. Not relocated in the field.
37-6-0965	Low-Moderate	n/a	Artefact Scatter	n/a	Was located in the proposed corridor. Site could not be relocated as it was salvaged in 2003 Permit#1748
37-6-0547	Low-Moderate	n/a	Artefact Scatter	n/a	Was located in the proposed corridor. Site could not be relocated as it was salvaged in 2003 Permit#1748
37-6-0142	Low-Moderate	n/a	Artefact Scatter	n/a	Was located in the proposed corridor. Salvaged in 2003 Permit#1748
37-6-1843	Moderate-High	n/a	Artefact Scatter	n/a	Was located in the proposed corridor. Site salvaged in 2008 AHIP #2998
37-6-1842	Moderate-High	n/a	Artefact Scatter	n/a	Was located in the proposed corridor. Salvaged in 2008 AHIPt#2998

n/a – information unavailable as the sites were not able to be relocated/unable to be visited due to access restrictions.

Table 12: Previously unregistered sites or loci associated with a registered site identified within the Project area.

Site Name	Archaeological Sensitivity	Site Type	Notes	Scientific Significance	Comments
37-5-0248	Low	Isolated artefact	Site HVS 24 located on an access track below a 320kv powerline.	Low	One broken chert flake – see comments below for 37-5-0249
37-5-0249	Low	Artefact scatter	As above	low	Two artefacts located on an access track. Impact potential low as pipeline lies adjacent to powerline easement
Liddell NS 1	Low-Moderate	Isolated Artefact	Located in vehicle track, site, disturbed pugged by hooves, track approx. 5m wide	Low	
Liddell NS 2 Also known a 37-2-0048[7]	Low-Moderate	Artefact Scatter	Located adjacent to creek line/swamp/spillway area of Pikes Creek. Site approx 30m x 45m. Two main loci of artefacts. Plastic fragments, imported gravels, conduit frags also noted. SE end of site more disturbed also decrease in concentration of artefacts. In a 1m² in area of highest artefact concentration, 10 artefacts were recorded. Also on constructed mound to E at 6413158, 309593 in 3m x 3m exposure mudstone flake 4.4x1.8x8.6 also located. Original site number for sites located on N side of Pikes Gully unable to be located.	Low	Site disturbed. Highly likely collection made at the site in the 1980s
Liddell NS 3 Also known as 37-2-0048	Low	Artefact Scatter	See Table 11.	Low	Only two artefacts. Collection already conducted at the site in the 1980s.
Liddell NS 4	Low-Moderate	Isolated Artefact	Located in exposure under tree vis 60 - 70%, exposure approx. 6 x5m.	Low	

[7] The site card for 37-2-0048 notes that a separate card was lodged for sites located on the north bank of Pikes Gully, however the site card/site no. could not be found (IH, 2008).

Site Name	Archaeological Sensitivity	Site Type	Notes	Scientific Significance	Comments
Liddell NS 5	Low-Moderate	Isolated Artefact	At SE end of Bayswater Ash Dam embankment, on E slope facing W in ants nest exposure approx. 1.5 x 0.5m.	Low	
Liddell NS 6	Low-Moderate	Isolated Artefact	Located in large dozed exposure SW corner of Bayswater Ash Dam. SV 100%, AV 20% due to disturbance. Exposure size approx 15 x 20m.	Low	Highly disturbed
Liddell NS 7	Low-Moderate	Artefact Scatter	Low density scatter 20-10m NE of fence, site length approx. 12m. Break of slope approx. 5m SE offence line.	Low	Eroded context, low density
Liddell NS 8	Low-Moderate	Artefact Scatter	Site located at junction of Wisemans Creek and two unnamed tributaries. Artefacts located on both E and W banks of N tributary from N and in eroded exposure on S bank of Wisemans Creek. Liddell NS 9 possible extension of site complex. Area disturbed by water pipeline and River Rd to the west, clearing, cattle, erosion. On E side of N trib exposure in ants nest 6m x 1m (6 artefacts identified). Artefacts still located 8m N. On W side of N tributary artefacts located in exposures approx. 45m long but may extend further. On S side of Wisemans Ck artefacts located in eroded exposure on creek bank approx 20-25m long. Actual site size likely to be larger, but encompasses the junction of these tributaries, visibility hindered by ground cover. On W side of creek artefact density approx 3/m². On S bank of Wisemans Ck artefact density also approx 3/m². Artefacts listed opposite located on ants nest 6 x 1.5m in size.	Moderate	Visibility hindered further identification of artefacts, site effected by erosion.
Liddell NS 9	Low-Moderate	Artefact scatter	In 40m x 12m exposure. On edge of eroded gully on NE side of tributary flowing NNW into Wisemans Creek.	Low-Moderate	Possibly part of Liddell NS 8

Site Name	Archaeological Sensitivity	Site Type	Notes	Scientific Significance	Comments
Liddell NS 10	Low-Moderate	Artefact Scatter	Located in exposure on possible pipeline mound, approx. 200m long and 0.5-2m wide. Site commences just below crest of hill and running down slope. Low density. Artefacts listed opposite located in 1m². Other artefacts noted in scatter included Mudstone broken core, Mudstone Broken Flake, heat treated fragments of Mudstone.	Low	Due to disturbed context on top of existing pipeline mound.
Liddell NS 11	Low-Moderate	Isolated Artefact	Located at the S end of the causeway embankment for the Plashett Reservoir in exposure 15m x 0.5m. SV 60%, AV 80%.	Low	
Liddell NS 12 37-2-0035 & 0190	Low	Artefact Scatter	See Table 11. Also known as site 37-2-0035 and 37-2-0190	Low	Due to disturbed context – existing water pipeline located adjacent.
Liddell NS 13	Moderate-High	Isolated Artefact	Small artefact scatter (2 x artefacts) in exposure on ants nest adjacent to vehicle track way running mid slope on the E side of Hunter Rive in 'Wondewoi Farm'. Also adjacent to drainage line running down slope. Disturbances from track construction, clearing, rubbish dumping.	Low	2 artefacts identified, area disturbed by rubbish dumping and track way.
Liddell NS 14	Moderate-High	Artefact Scatter	Site comprises of two mudstone flakes located on the W edge of a vehicle track way running NW-SE on mid slope on E side of Hunter River in 'Wondewoi Farm'.	Low	2 artefacts in disturbed context.
Liddell NS 15	Low-Moderate	Isolated Artefact	Located in small drainage channel for highway, disturbed by drainage channel and road embankment immediately adjacent. Less disturbed land located on S side offence line to S. Visibility in exposure up to 50%.	Low	Disturbed context, less disturbed area likely to contain artefacts located adjacent outside of area of impact

Site Name	Archaeological Sensitivity	Site Type	Notes	Scientific Significance	Comments
Liddell NS 16	Low-Moderate	Artefact Scatter	Small scatter of 2 x artefacts located in eroded exposure approx. 2m N of fence line on top of small rise.	Low	2 artefacts recorded, more artefacts in less disturbed context likely to be located adjacent outside of area of impact.
Liddell NS 17	Low-Moderate	Isolated Artefact	Located in eroded exposure, probably washed down slope from top of slope on the southern side of adjacent fence line. Located in exposure approx 1.5 x 1.5m.	Low	2 artefacts recorded, more artefacts in less disturbed context likely to be located adjacent outside of area of impact
Liddell NS 18	Moderate-High	Artefact Scatter	Site in erosion scour on top W terrace of Wollombi Brook. Site located approx. 70m W of brook bank. Approx. 10m x 20m. Artefacts recorded in a 1m². Additional artefacts observed included retouched flakes, large mudstone scraper, silcrete pebble tool. Quartz fragments also noted. Artefacts eroding out of orange A1/A2 horizon. Site should not be impacted by proposed development as located approx. 50m W of edge of proposed impact area.	Moderate - High	Located on high terrace above Wollombi Brook
Liddell NS 19	Moderate-High	Grinding Grooves Artefact Scatter	Site located on large sandstone exposure adjacent to the Wollombi Brook on the N side of the junction of Wambo Ck and Wollombi Brook. Site located both sides of EW running fence line. Loci 1-10 artefacts recorded in exposure on outcrop 5 x 5m. Artefacts in fine grained alluvium concentrated in depressions of sandstone. Loci 2- 1 grinding groove in sandstone 23cm x 4cm wide, approx. 2cm deep. Loci 3-1 silcrete core, 8 negative scars, coarse silcrete. Loci 4- Approx 50N of Loci 3, 2 artefacts Sandstone outcrop continues to 6391506 311839 Highly probable more artefacts and grinding grooves may be located at site.	Moderate - High	More artefacts/grinding grooves likely to be located under vegetation

Site Name	Archaeological Sensitivity	Site Type	Notes	Scientific Significance	Comments
Liddell NS 20	Moderate-High	Artefact Scatter	Located in sandy soil on slight rise adjacent to terrace approx 15m west of proposed corridor. Exposure approx 10x 6m. Located at area identified on map supplied by Wambo as an archaeological site, however this site was not located by the AHIMS search.	Low-Moderate	
Liddell NS 21	Moderate-High	Scarred Tree	Coolamon scar on felled tree located Nth bank of Nth Wambo Ck. According to accompanying Ecologist tree over 100yrs old at time of felling. Has been felled some time ago. Current scar dimensions 8 x 20 x 5cm.	Moderate	Tree has been felled some time ago, more scars may be possible on reverse side
Liddell NS 22	Moderate-High	Artefact Scatter	2 silcrete flakes, also fragment of silcrete noted in ants nest exposure 6 x 3m. Located at area identified on map supplied by Wambo as an archaeological site, however this site was not located by the AHIMS search.	Low	
Liddell NS 23	Moderate-High	Artefact Scatter	Located to the N of L NS 22 in large eroded exposure 15 x 5m. Located at area identified on map supplied by Wambo as being an archaeological site, however this site was not located by the AHIMS search.	Low	
Liddell NS 24	Moderate-High	Artefact Scatter	Located on N bank of small drainage line, in ants nest exposure above erosion scar.	Low	
Liddell NS 25	Moderate-High	Isolated Artefact	Located approx 20m W offence running adjacent to Wollombi Brook. Located in yellow-brown sand on terrace. Artefact has retouch on margins, approx 10% cortex.	Low-Moderate	More artefacts may be located in surrounding sandy soil
Liddell NS 26	Low-Moderate	Artefact Scatter	3 artefacts located in eroded exposure on edge of small tributary of Waterfall Ck, approx. 20m from fence line of Wambo Mine land. Artefacts eroding out of A2 horizon	Low	Low density, adjacent to Hwy.

Site Name	Archaeological Sensitivity	Site Type	Notes	Scientific Significance	Comments
Liddell NS 27 Also known as G1	Moderate-High	Artefact Scatter	Located in exposure S edge of dam in vehicle track. SV 80 - 90% AV 90%. Maximum dimension of exposure 11 x 9m. Artefacts recorded in a 1m². Site likely to be extension of G1 site recorded by Umwelt which also encompasses Liddell NS 28.	Moderate	Associated with Liddell NS 28/G1
Liddell NS 28 Also known as G1	Moderate-High	Artefact Scatter	In exposure adjacent to S side of homestead from track S to low spur. Re location/extension of recorded site G1, approx 50m W of pegged loci of G1. Also probable Liddell NS 27 more W extension of G1. Artefacts identified in track way (approx 25m) and to the area immediately S. SV adjacent to track 30-60%. Artefacts listed located in a 1m². FGS Broken flake possible scarper also noted in track @6383438 317200	Moderate	Relocated G1 site. Associated with highly significant sites nearby
Liddell NS 29	Moderate-High	Isolated Artefact	Located in animal track way adjacent to fence line approx. 1m wide.	Low	
Liddell NS 30	Low-Moderate	Artefact Scatter	Located just S of RTA Golden Highway sign in road reserve. Site size 3 x 5m. Angular fragments of yellow silcrete also noted.	Low	In disturbed Hwy reserve
Liddell NS 31	Moderate-High	Artefact Scatter	2 x artefacts located in road reserve N of adjacent fence line to United Collieries. Area of exposure 10m x 4m. Large amount of background gravel.	Low	In disturbed Hwy reserve
Liddell NS 32	Moderate-High	Artefact Scatter	Site located on top of small hill N of Pinegrove Rd, cut by Hwy. Site extends for approximately 15m either side of GPS reading. Angular fragments of silcrete and heat treated mudstone also notes. Site also likely to extend S into adjacent property.	Low-Moderate	Less disturbed site likely to be located over adjacent fence line out of area of impact.
Liddell NS 33	Moderate-High	Artefact Scatter	Top of rise above Hwy in 3 x 1.5m exposure. SV80%, AV 80%	Low	

Signs of Aboriginal activity is generally located in the vicinity of old river terraces (e.g. along the Hunter River or Wollombi Brook) and along creeks and drainage lines. Ridge tops and spurs have also been known areas of Aboriginal occupation.

The uncommon site types in the Project area consist of burials, midden, scarred trees and stone arrangements.

A total of forty-four (4) previously registered (including a double recording) and recently identified (G1) Aboriginal sites occur along or adjacent to the proposed pipeline corridor (see Figure 4).

Previously Registered Sites

A review of the AHIMS databases revealed 44 previously registered sites within 200 metres of the study area. The desktop review identified 24 recorded sites that may be impacted by the development. Fieldwork and review of the site cards clarified the locations of the sites and reduced the number of those that may be impacted by the development to sixteen (16), (see Table 11). Details of the eight (8) sites that fall out of the actual pipeline easement can be seen Appendix D (p 50 Table 8).

Four (4) of the sixteen (16) sites were relocated during the field assessment. Four (4) sites were unable to be relocated due to poor visibility (as a result of thick vegetation cover) or as a result of access restrictions. Three of these had been subject to surface collection in the 1980's. Eight (8) sites had been subject to salvage under Aboriginal Heritage Impact Permits (AHIP) system in 2003 and 2008. Two sites had been recorded twice (37-2-0035 & 37-2-0190, 37-6-0429 & 37-6-1401).

New Sites

During the field assessment, thirty-three (33) sites were identified within the Project area. Five (5) of these sites were considered to be loci of previously recorded sites. The sites consist of stone artefacts in isolated contexts and in scatters, one scar tree and a grinding groove located within or adjacent to the proposed pipeline corridor (see Table 12).

5.2.2 Potential Impact

Impacts on Known Sites

The results of the desktop study and the field assessment has shown that the proposed pipeline corridor traverses areas of low to moderate and moderate to high sensitivity (see Figure 4). Where areas moderate to high sensitivity occur, investigation of these areas has not identified areas of demonstrably high sensitivity or sites of high significance. It should be noted; however, that further detailed investigations may change the current understanding if further artefacts are discovered.

In summary, the results of the desktop study and the field assessment show that the impacts of the proposed pipeline alignment are as follows:

- Twenty eight (28) new Aboriginal sites and five (5) previously registered Aboriginal are located along or adjacent to the proposed pipeline corridor and will be directly impacted. An additional two (2) may be impacted should the pipeline easement transgress into the power line easement (37-5-0248 & 249).

- Four (4) areas of predicted moderate to high archaeological sensitivity predominantly associated with drainage corridors will be impacted by the proposed pipeline corridor.
- Five (5) areas of predicted low to moderate archaeological sensitivity predominantly associated with areas of moderate to high disturbance will be impacted by the proposed pipeline corridor.

Impacts on Unknown Sites

It is possible that currently unknown sites will be discovered during further investigations or during construction, and measures will be in place to manage such artefacts should they be discovered during construction, in line with the APIA Code of Environmental Practice (2005) and mitigation measures detailed in Section 5.2.3.

5.2.3 Mitigation Measures

The mitigation measures recommended are based upon the perceived archaeological sensitivity of the various sections of the corridor.

The mitigation measures are subject to review and approval of the registered community stakeholder groups. The draft report has been distributed to all registered stakeholders. A twenty one (21) day review period closed on the third of December 2008. Two written responses were received from Wannarua Local Aboriginal Land Council and Gidaawa Walang. A verbal response was received from Ungooroo (Mr Alan Paget) on the 5th February 2009. The reports can be seen in Appendix C of Appendix D. In general the responses were supportive of the draft management recommendations. Mr Alan Paget (Ungooroo) did also comment that avoidance of the grinding groove supported instead of underboring. He also requested additional analysis of the scarred tree.

Measures to mitigate the impacts to both the known and unknown Aboriginal sites during construction are as follows:

Cultural Awareness Training

- All personnel will be trained to ensure that they are aware of their responsibilities and procedures for managing Aboriginal sites and places. Personnel will be advised of the location of Aboriginal archaeological sites so that the likelihood of damage is reduced.

Management of Known Sites

- All know sites will be identified and pegged on the ground prior to construction.
- Where the sensitivity is low to moderate this generally indicates that the sites are in a disturbed context or shallow A1 soil horizons and are not indicative of intact subsurface deposits. In this case the appropriate mitigation measure is considered to be a combination of artefact collection and community monitoring in a structured program that ensures recording of activities undertaken.
- Areas of high sensitivity are mapped on the basis of surface recording of artefacts, the soil landscape characteristics and the potential for in-situ subsurface deposits. These areas include the sensitive Wollombi Brook and Hunter River terraces some of which may be Pleistocene in origin. In these areas mitigation measures considered appropriate are testing of the corridor to

determine the most sensitive loci of deposits, the salvage of these loci and the monitoring of earthworks.

- There are site specific mitigation measures such as Liddell N/S 19 where grinding grooves on a large rock outcrop were located. Measures to be considered at the detailed design stage will include to under-bore or re-routeing the pipeline around the site to ensure that no impacts occur at the time of installation or in the course of pipeline maintenance activities or pipeline removal. Consultation with the Aboriginal community indicates that avoidance is the preferred option (see consultation log entry 5th February 2009 Appendix D).
- Disturbance caused from infrastructure prior to, and during, the construction and operation phase will be minimised, including the contraction of surface disturbing works in the ROW in proximity to known sites, as far as is practicable.

Identification and Management of New Sites

- If cultural material is discovered at a location, work will cease immediately at the location and the site secured from interference. If suspected human remains are discovered, the area will be treated as a crime scene and the Coroner and Police will be notified immediately. If there are reasonable grounds to suspect they are Aboriginal remains, they will not be touched or interfered with, other than to safeguard them from further disturbance.
- Subsurface testing to establish the boundaries and nature of the new Aboriginal sites.
- Zones of moderate to high archaeological sensitivity will be managed to ensure that disturbance by infrastructure, vehicle traffic, road diversions (etc.) is avoided.
- An archaeologist will assess the new site and work with the local Aboriginal group representatives to establish management measures as and when required.
- In areas of moderate to high archaeological sensitivity, such as occurrences of stone artefacts within a disturbed environment, the initial topsoil stripping process will be monitored by members of the Aboriginal community drawn from the stakeholder register.
- DECC will be notified of the finding to ensure the local Aboriginal community is informed of the discovery.
- Macquarie Generation will continue to consult with the Aboriginal community to further ensure the planning and construction of the Project is undertaken in accordance with the obligations to protect Aboriginal heritage sites.

5.2.4 Impact Assessment

The pipeline Project will involve ground-disturbing activities along the relatively narrow corridors of the gas pipeline. The long history of intensive land use in the region has reduced the likelihood of intact Aboriginal archaeological sites existing in the study area.

Once Macquarie Generation's management procedures are implemented, residual impacts on Aboriginal cultural heritage, whether known or currently unknown, is likely to be variable.

Where sites in the low – moderate sensitivity zones are located in eroded and or disturbed contexts with no associated sub surface deposits, they may be avoided or mitigated by collection recording and replacement adjacent to the pipeline.

There are likely to be sites in disturbed contexts within the high sensitivity zones also, as the corridor is lengthy and many minor impacts can reduce the integrity of an individual site. Again these may be

sufficiently mitigated by the method above. Where the pipeline traverses relatively undisturbed river terraces that are likely to contain in-situ subsurface deposits the pipeline is likely to truncate sites. Indeed these areas are likely to contain a continuum of artefacts in varying densities. The archaeological sensitivity is high where deposits are stratified and in Pleistocene contexts significant archaeological information may be retrieved.
To mitigate against impact upon these sites it is essential to archaeologically excavate them prior to disturbance by the pipeline. To locate such deposits test probes would be required at regular intervals in the most undisturbed deposits selected on the basis of geomorphic characteristics. The pipeline corridor would then be archaeologically excavated and care would have to be taken to ensure containment of impact to the excavated zone.

The narrow pipeline excavation may provide an opportunity to sample these areas whilst leaving intact deposits adjacent. However, these areas should be avoided when planning pipeline duplication or 'snaking'.

5.2.5 Non-Indigenous heritage

A search of the Commonwealth register of National Estate (Commonwealth of Australia, 2008) sites found no sites located within the pipeline assessment corridor. Notwithstanding this, the majority of National Estate registered sites are most likely to be found within town boundaries or Nature Reserves and National Parks. These areas will be avoided by the assessment corridor.

The New South Wales Heritage Register for Singleton and Muswellbrook local government areas has identified twenty one (21) items listed under the New South Wales Heritage Act (NSW Department of Planning, 2008). The only two sites likely to be in the vicinity of the proposed pipeline project are the Bulga Bridge over the Woolombi Brook and Wambo Homestead. Neither of these sites are located within the pipeline assessment corridor.

The pipeline is of such minor impact and sufficiently removed from the items that there will not be any adverse impact as a result of construction activities. Furthermore, as the pipeline is buried, there is no potential for it to adversely impact the visual landscape surrounding any items of heritage significance.

No further consideration of non-Indigenous heritage is considered necessary.

5.3 Hazards and Risk Impacts

5.3.1 Existing Environment

Sleeman Consulting (2008) prepared a hazard and risk screening report for Macquarie Generation as part of the Environmental Assessment requirements (Appendix A) and ascertain whether a Preliminary Hazard Assessment needs to be carried out in support of applications for project approvals.

The objective of the screening process is to:

- Identify whether off-site impacts are likely to occur; and
- Determine whether a more comprehensive preliminary hazard analysis should be carried out.

With these objectives in mind, based upon the description of the Project components (Section Project Description) and the range of design and operational safeguards presented in Section 5 and 6, it is possible to review the various hazards and residual risks attributed to the Project.

The preliminary screening of potential hazards was carried out using a methodology that takes into account the provisions of AS 2885.1-2007. This involved:

- Identification of general and location specific threats to the integrity of the proposed pipelines.
- Assessment of the risk associated with each threat through consideration of the likelihood of occurrence and the consequences should they occur.

Consequences associated with each threat were considered from public, employee, environmental and economic perspectives taking account of risk mitigation methods that will be employed during design, construction and ongoing operation of the gas pipelines.

The preliminary screening process was carried out on the basis of information obtained from maps and photographs, complemented by input from personnel familiar with the area through which the pipelines will pass.

5.3.2 Potential Impacts

Table 13 shows the potential impacts associated with the proposed pipeline that comes from the threats assessed by Sleeman, 2008.

Table 13: Project Threats and Potential Impacts

Threat	Potential Impact
Third Party Interference:	Accidental or intentional uncontrolled gas release.
Underground Coal Mining Activity and Subsidence.	Ground movement that can induce stress on the pipeline resulting from subsidence or blasting.
Open-cut Coal Mining Activity.	Ground movement that can induce stress on the pipeline resulting from blasting causing ground shockwaves.
Failure of Pipe Material.	Accidental uncontrolled gas release.
Over-pressure of Pipeline.	Accidental uncontrolled gas release.
Static electricity build up on the inside surface	Explosive gas release.

Threat	Potential Impact
of the pipe.	
Explosive Pipeline Contents.	Explosive gas release.
Road Crossings.	Pipeline exposure/rupture causing an accidental or intentional uncontrolled gas release.
Waterway Crossings.	Pipeline exposure/rupture causing an accidental or intentional uncontrolled gas release.
Natural Phenomena such as erosion of pipeline cover, earthquakes or bushfires	Pipeline exposure/rupture causing an accidental or intentional uncontrolled gas release.
Inadequate Maintenance.	Loss of pipeline integrity leading accidental or intentional uncontrolled gas release.

These threats are discussed in detail in Appendix E and reflect the activity itself and the features of the local environment where the coal seam gas pipeline will be placed.

5.3.3 Mitigation Measures

The following key (but not necessarily exclusive) measures will be adopted to mitigate risks associated with the proposed pipeline Project.

The pipeline will (apart from specific locations located on mining and Macquarie Generation land) be buried for its entire length. The depth of burial may vary from location to location, having regard for land use and the outcomes of risk assessments carried out during detailed design. The principles of AS 2885.1 will be applied in determining the appropriate depth of burial.

If necessary on the basis of risk assessments carried out during detailed design, sections of the pipeline in areas near residential and commercial premises may incorporate additional protection. In the event this is required, mitigation will be addressed by adopting one or more of the following measures:

- Substitution of a single pipeline.
- Reduction in pipe diameter.
- Concrete barriers laid above the pipeline.
- Increased depth of burial.
- Increased wall thickness.

The wall thickness of the pipe will be specifically selected to withstand not only internal pressure requirements but also external loads associated with burial depth, surface interference (such as vehicular loads), construction stresses and open-cut mining activities.

Clear signage will be erected along the route of the gas pipelines. There will always be at least one sign visible from any location along the pipeline route. In addition, signs will be erected at each side of road crossings.

Routine patrols of the pipeline corridor will be conducted during operations.

5.3.4 Impact Assessment

Sleeman (2008) identified the threats to the integrity of the proposed pipeline and assigned an assessment of the level of risk (or 'risk ranking') associated with each threat (Table 14 taken from Appendix E – Attachment 1).

Table 14: Risk Ranking

Threat	Location	Protection/Mitigation	Risk Assessment[8]		
			Frequency	Severity	Risk Ranking
Third party activity resulting in gas leak	Above ground inlets to pipelines	Inlets will be located on coal company sites. Inlets will be fenced Fail-safe overpressure protection installed	Improbable	Severe	Low
	Along pipeline route	Pipeline buried (min 750 mm cover) Clear signage Landowner liaison Routine patrols Pipeline in easement over private land Increased penetration resistance where appropriate Land-use unlikely to cause interference	Unlikely	Severe	Low
	Underground road crossings	Pipeline buried (1,900 mm cover) Clear signage Routine patrols	Unlikely	Severe	Low
	New England Highway underpass	Restricted access Pipe material selection	Unlikely	Severe	Low
	Waterway crossings	Pipeline buried (2,000 mm minimum cover)	Unlikely	Severe	Low
	Water drains	Clear signage Routine patrols Restricted access	Unlikely	Severe	Low

[8] Risk Assessment determined using the guidelines provided in Section 4.5, 4.6 and 4.7 of the Sleeman 2008 report (Appendix E).

Threat	Location	Protection/Mitigation	Risk Assessment[8]		
			Frequency	Severity	Risk Ranking
Underground coal mine subsidence	Possible underground activity at several locations	Design to accommodate subsidence Monitor induced stresses, remedial action if necessary	Occasional	Minor	Low
Open-cut coal mine blasting	Possible blasting adjacent to pipeline route	Design pipeline to accommodate peak particle velocities. Possible operational constraints during blasting	Occasional	Minor	Low
Failure of pipe material	Any location	Rigorous application of relevant standards, codes and procedures	Improbable	Severe	Low
Over-pressure of Pipeline	Any location	Duplicated, fail-safe facilities	Hypothetical	Severe	Low
Static electricity build up	Any location, normal operations	Pipeline contents are not flammable so there is no risk during normal operations	Hypothetical	Minor	Low
	Any location, gas leakage	Provisions of AS/NZS 1020:1995 will be rigorously applied	Hypothetical	Minor	Low
Explosive pipeline contents	Any location	Pipeline is buried with no source of ignition In the event of leakage gas will dissipate	Occasional	Minor	Low
Road Crossings - mechanical damage	Crossings on minor roads	Pipeline buried (minimum 1,900 mm cover) Clear signage	Hypothetical	Severe	Low
Waterway crossings - exposure of pipe		Pipeline buried (minimum 2,000 cover) Regular patrols	Remote	Severe	Low
Natural phenomena	Any location	Pipeline buried Regular patrols Erosion control measures employed	Unlikely	Severe	Low
Inadequate maintenance	Any location	Trained and qualified personnel Operation and maintenance procedures formalised	Improbable	Severe	Low

Conclusion

Sleeman, 2008 concluded that due to the implementation of industry standard practices for the management of hazards associated with the proposed pipeline that the risks arising from construction and operation of the pipeline are deemed to be low. Therefore, it is not necessary to undertake a Preliminary Hazard Assessment for the Project.

5.4 Surface and Groundwater Impacts

5.4.1 Existing Environment

The project falls entirely within the Hunter River catchment area one of the largest in NSW, covering an area of approximately 22,000 km^2. Originating in the Mount Royal Range, the Hunter River is over 300 km long and meanders through the Hunter Valley where it enters the sea at Newcastle. The tidal limit of the Hunter River is located 4 km upstream of Maitland at Oakhampton, 45 km from the sea. For the Project area the other major drainage feature is the Wollombi Brook sub-catchment covering an area of 400km^2. A number of smaller ephemeral creeks are also intersected by the proposed pipeline corridor.

Surface Water

The proposed pipeline corridor crosses two major watercourses (see Figure 5):

- Wollombi Brook (KP4) – characterised by 3-5 metre-high banks that slope at 10 to 20 degrees to the horizontal. There is little vegetation on the stream banks and weeds make up a high proportion of the existing vegetation. Stream banks are stable with some signs of erosion. Overall, the condition of the Wollombi Brook at the crossing is fair. The Wollombi Brook is a stressed environment, primarily as a result of recent low flow conditions.
- Hunter River (KP30) – characterised by ten to fifteen metre-high banks that slope from 20 to 45 degrees to the horizontal. Vegetation on the river banks is dominated by weeds or is cleared. Stream banks are stable with some sign of erosion on the northern side. Overall, the condition of the Hunter River at the crossing is fair to good. The river is a highly stressed environment, primarily as a result of recent dry years and changes to natural flood conditions as a result of water uses up stream.

Several smaller ephemeral watercourses[9] are crossed by the pipeline including:

- Hayes Creek (KP9).
- Wombo Creek (KP12).
- Wombo North Creek (KP16).
- Parnells Creek (KP36).

For the Project two watercourse crossings methods and associated environmental controls have been selected (discussed in Section 2.8.1). The majority of the watercourses to be crossed are ephemeral streams that most likely will not be flowing at the time of construction. In ephemeral streams an open trench crossing techniques will be used. This means that they will be dug with a

[9] As seen on the Department of Lands 1:25,000 scale topographic maps for the Project area.

backhoe and potentially anchored down by concrete collars and/or course crushed rock. The Wollombi Brook and Hunter River crossings will be completed by HDD to avoid disturbing the banks or riparian vegetation at the watercourse.

Groundwater

Groundwater along the pipeline corridor will range in depth from shallow in areas near watercourses and the river to deep in higher terrain areas. According to historical water bore data groundwater depths vary from approximately 1 m to 40 m over the proposed pipeline alignment (NSW Government 2008). Fluctuations in groundwater levels can be expected through seasonal variations in rainfall and other local factors (including water usage) as well as the geology of the substrata. Localised perched water tables may also occur, particularly associated with river Alluvium materials or paleo-channels associated with current waterways. Groundwater quality is unknown for most of the area however beneficial uses of groundwater are occurring along the entire length of the proposed pipeline (used for agriculture and mining).

5.4.2 Potential Impacts

Surface Water

The pipeline alignment will intersect waterways, and depending on construction technique used, has the potential to temporarily alter existing surface water flow regimes.

HDD techniques are being used at the two major crossing locations (See Section 2.8.1) to minimise this potential. HDD is a proven pipeline crossing practice that will minimise the bank and bed disturbance within the river/creek and therefore not impact on the surface water flow regime.

Erosion of exposed soils on the ROW has the potential to cause downstream sedimentation if heavy rain occurs.

Once pipeline construction is complete and the pipe trench is backfilled and compacted, there is a period of time when subsidence along the trench line may occur as the backfill material settles. The risk of this happening depends on soil type, soil moisture and the degree of backfill compaction.

Potential exists for fuels, lubricants and chemicals to be spilled during construction, which may contaminate surface water and groundwater (Main risk associated with HDD or refuelling activities).

During construction, up to 10,000 m^3 of water will be required for hydrostatic testing of the pipeline for structural integrity. The water will be sourced from Liddell Power Station water supplies and disposed back into the water supply after the hydrotest is complete or to the ground so as not to cause erosion or reused in local storage for pastoral or mining activities.

Groundwater

The pipeline may intersect shallow aquifers (less than 2 metres deep) which could affect safety and trench wall stability, and result in increased construction time and increased costs associated with dewatering the trench.

The pipeline is not expected to intersect any deep aquifers (greater than 2 metres deep).

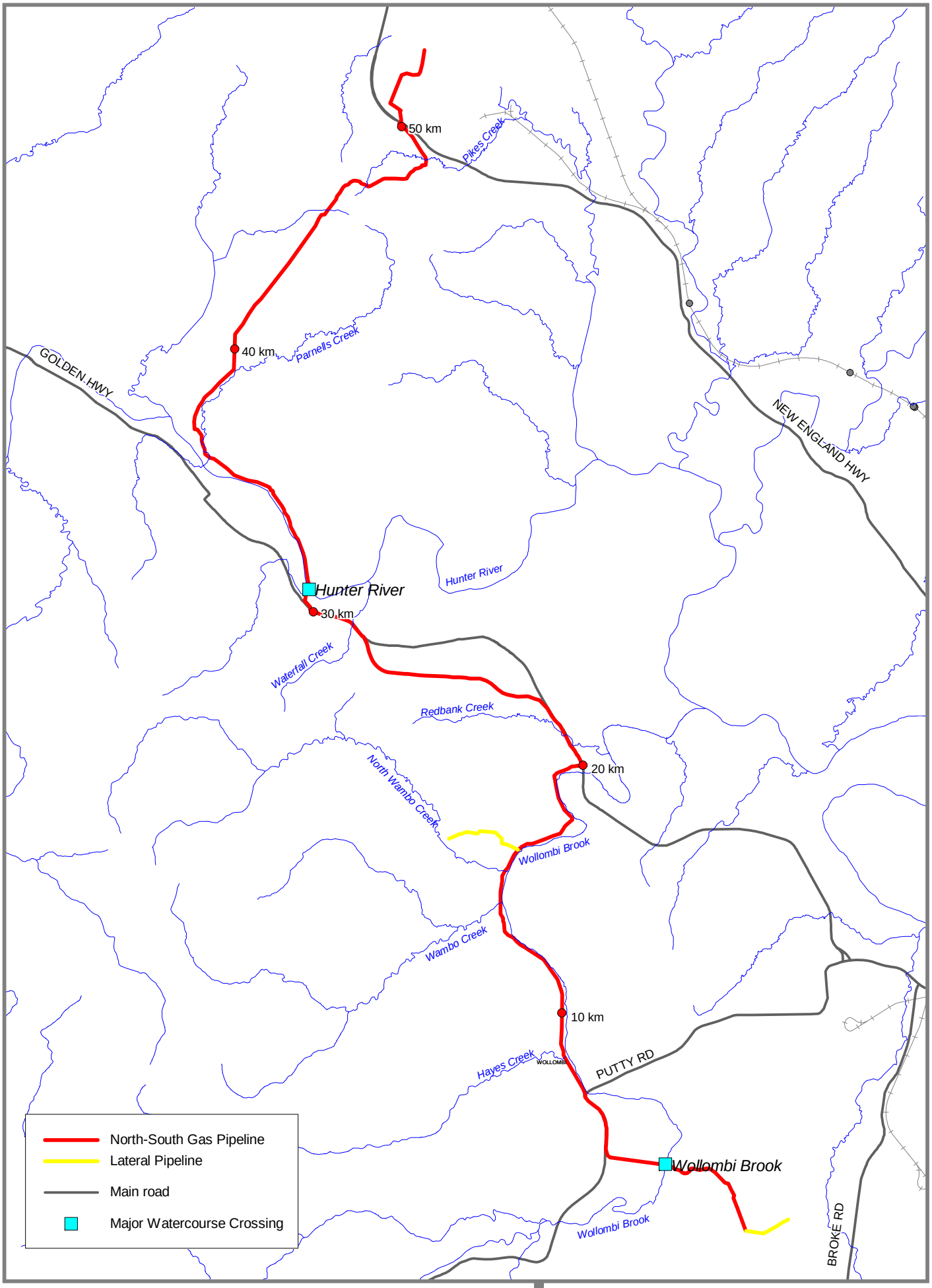

Figure 5 Major Watercourse Crossings

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5.4.3 Mitigation Measures

Surface Water

The mitigation measures to be adopted to reduce the potential for surface water impacts include:

- The appropriate water crossing construction method will be chosen based on ecology, heritage and geotechnical information to ensure minimum impacts and costs.
- Where open-cut trenching is chosen, flow diversion techniques will be employed where the waterway is flowing or where water is present.
- Activity specific water crossing construction method statements (HDD or open-cut) will be developed prior to construction.
- Ongoing monitoring of the creek crossing locations post construction will include:
    - Visual inspection to ensure that no scouring or subsidence is occurring; and
    - Riparian vegetation is re-establishing to stabilise the banks.
- Trench breakers and slight trench crown will prevent erosion along the pipeline; however, additional topsoil may be required to repair localised subsidence during the defects liability period after construction.
- Appropriate placement and construction of diversion berms and control structures so that they are stable and drain to the downstream side of the ROW. The principal goal of control structures will be to prevent sediment entering waterways or waterbodies.
- The disposal of hydrotest water will be managed by ensuring that:
    - The use of hydrostatic test water additives such as oxygen scavengers is minimised and where required, they will be selected to ensure that they degrade rapidly under aeration treatment.
    - Water is only discharged if there is negligible risk of contamination to the receiving water and that hydrostatic test water will be filtered through a geotextile fabric or retained in a temporary sediment retention basin prior to discharge, to remove the majority of solid materials.
    - Discharge points for hydrotest water will have a splash pad or similar structure to reduce the erosive potential of the discharging water.
- To ensure any spillages of fuels, lubricants and chemicals do not contaminate surface water and groundwater the following measures will be put into place:
    - Hazardous materials will not be stored, handled or used where any spillage could enter any watercourse.
    - Hydrocarbon products (including petroleum and diesel fuel, lubricating oil, hydraulic oil and waste oil) will be stored in bunded areas capable of holding 125% of contained liquids and in accordance with AS1940:2004 The storage and handling of flammable and combustible liquids.
    - A spill contingency response plan will be developed for the construction addressing fuels, lubricants and chemicals. The plan will include spill response equipment being located in vehicles and at the watercourse crossing sites. In the event of a spill, all equipment will be shut down and the spill response plan will be activated.
    - All spills will be contained and managed as soon as they occur in accordance with a spill contingency response plan.

Groundwater

The mitigation measures to be adopted to reduce the potential for groundwater impacts include:

- Where the pipeline trench intersects shallow groundwater aquifers:
    - Dewatering devices such as spears and pump sets to remove groundwater from the pipeline trench will be used, where required.
    - The pipeline will be laid and the trench backfilled as quickly as possible, to minimise the amount of water removed from the trench.
    - Stabilised backfill and trench breakers will be used to control groundwater flow within the trench, in areas of shallow groundwater aquifers.

5.4.4 Impact Assessment

Due to the low flow regimes observed within rivers and creeks to be crossed by the pipeline and the methods of construction (specifically HDD) that are designed to avoid any permanent modification of surface flows, the likelihood of the Project activities causing any measurable impacts on the surface water drainage systems would be low.

The pipeline will have a minimum cover of 750 and therefore it is unlikely that groundwater will be encountered along the corridor. Where the pipeline may intersect shallow aquifers this could affect safety and trench wall stability, and result in increased construction time and increased costs associated with dewatering the trench however it will not impact on groundwater availability or quality. Furthermore the pipe material, being either fibreglass or polyethylene, will not be susceptible to corrosion nor will it cause contamination of the groundwater.

The pipeline is not expected to intersect any deep aquifers – greater than 2 metres deep.

The implementation mitigation measures will ensure that the potential impacts to surface water and groundwater from the Project would be low. The Project is not likely to introduce any specific long term impacts on the quality or quantity of water for downstream or groundwater users, or impact the structural integrity of the creek banks or have any indirect impacts on the ecological function of the water systems.

5.5 Traffic Impacts

5.5.1 Existing Environment

The road network in the Project area has an array of road types from a multi-lane, high-volume national highway to unsealed, single-lane country roads. The network includes NSW RTA controlled roads and local roads under the control of local councils (see Figure 6).

Traffic types and volumes vary along the proposed pipeline corridor depending on the local land use and size of the road. The majority of the proposed pipeline corridor lies in rural or semi-rural areas where traffic numbers are low and related to agriculture or mining activities. However, high traffic volumes will be expected where the pipeline runs alongside the Golden Highway (KP20 to KP30).

The pipeline corridor makes several crossings of public and private roads. The main sealed roads crossed by the pipeline corridor include:

- Charlton Road (KP2).
- Putty Road (KP8).
- Golden Highway (KP30).
- New England Highway (KP50).

Figure 6 shows the main road access network to be used for construction and operations.

5.5.2 Potential Impacts

Potential impacts from the Project traffic relate to the presence of additional local traffic, and disruption to roads and traffic flows due to construction activities. The greatest impacts will occur during construction when a fleet of both heavy and utility vehicles will be present. During the operational phase of the pipeline, only light vehicles will be used and thus, potential impacts from traffic will be low.

Construction Traffic

Construction of the pipeline will bring additional light and heavy vehicle traffic to the Project area, which may impact on:

- Road safety.
- Local amenity.
- Other road use.

The highest traffic numbers will occur during construction with the transport of equipment, plant, materials and personnel to and from the Project area, as well as within the Project area.

The following equipment and materials will be transported by semi-trailer or low-loader to the Project area:

- Sections of pipe – there will be approximately 250 trailer loads of pipe delivered to site over 10 week period.
- Plant, equipment and material.
- HDD rig and support equipment.

Pipeline Road Crossings

The use of conventional horizontal boring to cross under sealed roads will minimise disruption to traffic movements and prevent any degradation of road surface integrity, however in the event damage is caused to any road or access track, remediation of damage would occur as soon as practicable to a level considered satisfactory to NSW RTA or Local Shire Council.

The pipeline will cross unsealed roads (namely property access), resulting in temporary traffic delays for each crossing. Alternate access will be provided to landholders were required to minimise disruption.

Operations Traffic

Operations traffic will be limited to periodic inspections of the pipeline by personnel in 4WD-passenger vehicles. Vehicles will not frequently travel over the ROW except during maintenance activities, hence, traffic volumes are expected to be minimal.

5.5.3 Mitigation Measures

The NSW RTA has provided initial comments on the overall Project (letter dated 8 May 2008 Appendix B). The issues raised by the NSW RTA have been addressed in the preparation of the following mitigation measures.

The mitigation of the impacts associated with increases in traffic during the construction period would be achieved to a significant extent through the implementation of the traffic management plan including:

- Project safety requirements (e.g., identifying Project speed limits and other transport protocols).
- Preferred transport routes and procedures (e.g., avoiding heavy, oversized vehicle transport wherever possible on single-lane country roads or other high-risk routes; use of convoys of trucks and heavy vehicles will minimise delays).
- Protocols for the notification to road users of impending construction activities (e.g., road signage in accordance with NSW RTA and local government requirements).
- A dust suppression program for all access and egress pathways during high traffic volume periods.
- During the construction period, Macquarie Generation would contact the landowners to inform them about the program and use of local roads and tracks.

Pipeline Road Crossings or working within a Road Reserve

Where the proposed pipeline is required to cross sealed main roads, horizontal boring will be used, thereby avoiding the need to close the road to cut a trench through the road seal. All relevant approvals are to be obtained prior to works commencing within the road reserve. The crossing of sealed roads will have a minimum cover of 1900mm to the top of the casing under the road pavement and 900mm cover elsewhere within the road reserve.

Traffic control requirements associated with the Project will be undertaken in accordance with the NSW RTA “Traffic Control at Work Sites Manual” including the provision of pedestrian movement in accordance with AS 1742.10-1990: Manual of Uniform Traffic Control Devices – Pedestrian Control and Protection.

No lane closures are permitted without the NSW RTA Traffic Commanders authority. Temporary road closure; however, will be required to allow pipeline construction equipment to travel across the road. The passage of individual vehicles will require closures lasting only a few minutes.

Some pipeline construction equipment travels on steel tracks, which has the potential to damage road seal. During road crossings, tyres/matting will be laid across the road for tracked equipment to travel on, thereby avoiding damage to road seal. Where road seal is damaged, it will be repaired in accordance with the NSW RTA road maintenance standards.

A special crossing crew will complete the open-trench crossings of unsealed roads. Road closures during trenching will be kept to a minimum. Road closures will be undertaken in accordance with the construction EMP.

5.5.4 Impact Assessment

Boring below sealed bitumen roads will be used to minimise disruption to traffic movements and prevent any reduction in road surface integrity. Boring involves drilling from below ground within an enlarged trench area or 'bell hole' on either side of the road. Unsealed roads and tracks will be open trenched and compacted during backfilling to required standards.

The location of road crossing will be determined in the final design, however the entry and exit pits will be appropriately placed so as not to interfere with traffic flow on the roads. Where roads are to be open cut these will be completed within the day of opening. Minimal traffic delays are expects while work is going on within the road reserve as the road (or lanes) will not be required to be closed off for extended periods of time.

The proposed mitigation measure to reduce the potential traffic impacts along the pipeline corridor will minimise the disruption to local traffic flows and mitigate the risk of road damage caused by construction.

The disruption to localised traffic flows along the pipeline corridor is expected to be short term and low. The system of existing roads would permit the safe flow of traffic (both light and heavy) into and out of the Project area without any need for alteration to their current condition.

Where mine roads crossings are required Macquarie Generation has consulted relevant mine manager to minimise potential impacts to mine traffic. This consultation will continue through construction.

Where the working area intersects a road where a sub-surface crossing is required, Macquarie Generation shall implement a suitable traffic control plan in accordance with the RTA's Traffic Control at Worksites Manual.

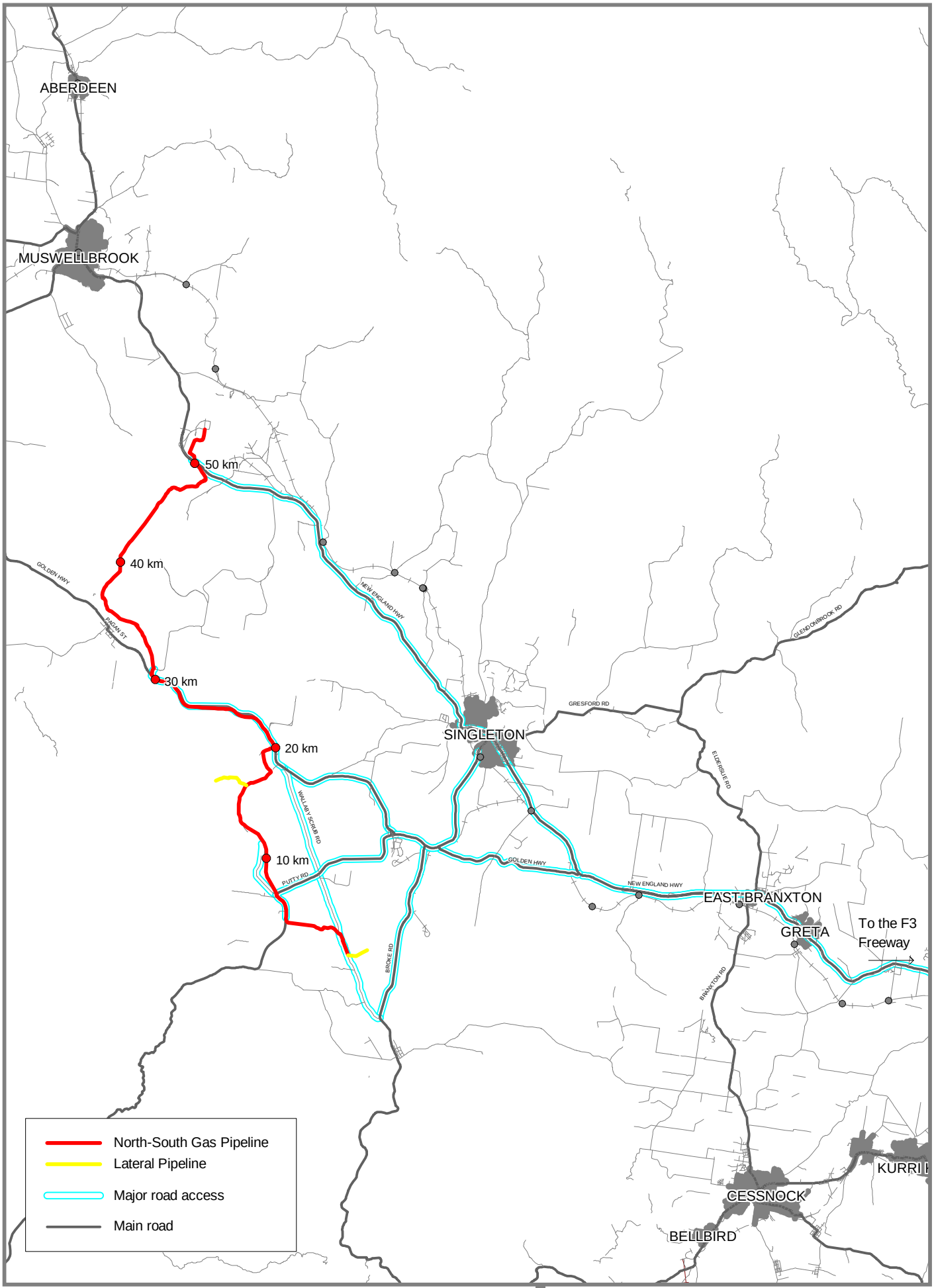

Figure 6 Major Access Road Network to the Project Area

CDB Environment Pty Ltd

5.6 General Environmental Risk Analysis

This environmental risk assessment of the proposed pipeline construction and operation activities was undertaken in accordance with the residual risk matrix set out in Table 15 (based on AS4360-2004 Risk Management) and industry experience, with the identification of the potential impacts based on knowledge of the existing environment, experience with similar pipeline Projects elsewhere and issues of concern raised by key stakeholders.

5.6.1 Residual Risk Ranking

The assessment was undertaken by examining the potential consequence and likelihood that environmental impacts will occur with management controls in place = Residual Risk. Residual risk can be either:

- **Unacceptable** – Any hazard that has this risk ranking is beyond effective administrative management and must be avoided by the adoption of elimination, substitution, isolation or engineering control.
- **High** – Significant environmental issues requiring intervention by management and workforce consultation to control methods of work performance, design, employment conditions and other project-controlled matters.
- **Medium** – Risk is low as reasonably practicable. Risk has been reduced by use of appropriate environmental management controls.
- **Low** – Any hazard that has this risk ranking is generally acceptable. The work environment and methodology presents minimal risks to the environment.

Table 15: Residual Risk Matrix

Consequence of occurrence	Likelihood of occurrence			
	Very likely Could happen any time	Likely Could possibly occur sometime	Unlikely Could possibly occur but very rarely	Very unlikely May possibly occur but probably never will
Major Destruction of sensitive environmental features. Severe impact on ecosystem. Widespread and persistent damage to a significant area of land and/or surface or groundwater resources.	Unacceptable	Unacceptable	High	Medium
Serious Long term impact of regional significance on sensitive environmental features. Significant medium-long term impacts to fauna and flora populations or habitat with negative impact on ecosystem.	Unacceptable	High	Medium	Low
Moderate Short term impact on sensitive environmental features. Significant short term changes to flora and fauna populations, habitat and/or aquatic ecosystems. Non-persistent but possibly widespread damage to land; damage than can be remediated without longterm impacts. Short term impacts on water resources.	High	Medium	Low	Low
Minor Impact on fauna and flora populations and/or habitat but no negative effects on ecosystem. No significant impact on water resources or sensitive environmental features.	Medium	Low	Low	Low

(Source: Modified from AS4360:2004)

Table 16 shows a summary of the level of residual risk for all aspects considered in the preparation of this EAR. No environmental aspect scored a residual risk ranking of high or unacceptable, therefore with the appropriate mitigation measures in place the Project residual risk was assessed to be as low as reasonably practical.

Table 16: Summary of residual impact assessment

Aspect	Potential Impact	Proposed Mitigation	Consequence	Likelihood	Level of Risk
Air Quality	Decrease in local air quality due to dust emissions	Section 6.1.3	Minor	Very likely	Medium
	Decrease in air quality due to vehicle or machinery emissions		Minor	Very likely	Medium
Ecology	Significant impacts to threatened species	Section 5.1	Serious	Unlikely	Medium
	Reduced conditions favourable for plant growth due to disturbance		Minor	Likely	Low
	Introduction of new weeds or increased weed density and distribution		Moderate	Likely	Medium
Groundwater	Reduced groundwater availability for other users due to trench dewatering	Section 5.4.3	Minor	Very unlikely	Low
	Deterioration in groundwater quality affecting suitability for water uses		Moderate	Very unlikely	Low
Greenhouse Gases	Increase in greenhouse gas emissions	Section 0	Minor	Likely	Low
Cultural Heritage	Disturbance to known Aboriginal or non-aboriginal sites of significance [without prior approval]	Section 5.2.3	Serious	Very unlikely	Low
	Disturbance to unknown Aboriginal or non-aboriginal sites of significance		Serious	Unlikely	Medium
Land Use	Soil contamination from fuel spill	Section 6.3.3 and 6.7.3	Minor	Likely	Low
	Decrease in available agriculture land		Minor	Very likely	Low
Noise and Vibration	Disturbance to sensitive receptor from noise and vibration	Section 6.4.3	Minor	Likely	Low
Socio-economic State	Decrease in pastoralists/agriculturalist income	Section 6.7.3	Moderate	Unlikely	Low
	Disruption to existing lifestyle and community wellbeing		Moderate	Unlikely	Low
Surface Water	Adverse effects on aquatic fauna and habitats due to the generation of fugitive sediment	Section 5.4.3	Moderate	Likely	Medium

Aspect	Potential Impact	Proposed Mitigation	Consequence	Likelihood	Level of Risk
	Adverse effects on aquatic fauna and riparian vegetation due to altered flow regime		Minor	Unlikely	Low
Traffic and Transport	Road and traffic disruption during construction	Section 5.5.3	Moderate	Likely	Medium
	Road and traffic disruption during operations		Minor	Unlikely	Low
Visual Amenity	Reduced visual amenity short-term	Section 6.5.3	Minor	Very likely	Medium
	Reduced visual amenity long-term		Minor	Unlikely	Low

6 Other Environmental Aspects

6.1 Air quality

6.1.1 Existing Environment

Throughout the Project area, there are a number of land use activities that impact on the ambient air quality. Particulate matter (dust) resulting from coal mining operations is the major source of air pollution in the lower Hunter Valley region (DEWHA, 2008b). In the National Pollution Inventory reporting year of 2006-07 coal mining operation contribute 38,000,000 kg/year of particulate matter in the region. General air quality within the Project area is therefore expected to range from moderate to poor depending on the prevailing weather conditions.

During pipeline construction some activities will generate localised visible dust clouds, including:

- Clearing – removal and management of topsoil and vegetation.
- Trenching – digging and handling of sub-soil.
- Traffic and transport – project vehicles movements.
- Backfilling/restoration – movement and management of loose spoil and topsoil material.

Once the pipe has been installed the only activity that is likely to generate dust is the movement of vehicles along the corridor for routine monitoring and maintenance. The construction period for each section of pipeline will be minimal and dust control measures will be instigated to ameliorate potential dust impacts.

Another source of air pollution is greenhouse gas emissions and these are discussed in Section 6.2.

6.1.2 Potential Impacts

Potential air quality impacts associated with the project are limited to construction activities that may generate dust or exhaust emissions, including:

- Vegetation and topsoil removal.
- Movement (exhaust emissions and generation of dust on unsealed roads, construction sites and the ROW) and operation of vehicles and heavy machinery.
- Wind erosion from exposed soil surfaces and spoil stockpiles.
- Purging the pipeline (namely at commissioning or in an emergency).

Sensitive receptors for nuisance dust (i.e., dust that settles on surfaces) and suspended particulates (i.e., dust likely to be inhaled into the lungs) include:

- Areas of individual residences. The residences within 200 m of the proposed pipeline alignment could potentially experience temporary nuisance from dust during construction.
- Roads where there is a potential to create nuisance dust.

Minimal dust will be generated once the proposed pipeline is installed and the ROW is revegetated.

6.1.3 Mitigation Measures

The following mitigation measures will be implemented for the Project:

- Vehicle speeds on unsealed construction access roads will be restricted to 60 km/h to reduce dust generation. Further speed restrictions may be required close to houses, regularly used public roads or other sensitive receptors, and close to construction activities.
- Construction vehicle access will be limited to designated access tracks.
- Where required, excess spoil, topsoil or padding material will be transported in a manner that avoids dust exiting from the tray or container (e.g., cover or wet-down loads).
- Periods of exposure of soil stockpiles will be kept to the minimum time necessary.
- The ROW and unsealed access roads will be watered as required to reduce dust generation. The extent and frequency of watering may be increased close to houses and regularly-used public roads or other sensitive receptors, and close to construction activities.
- Planned releases of gas from the pipeline will be minimised (including the flaring of purged gas), to reduce greenhouse gas emissions.

6.1.4 Impact Assessment

The adoption of these mitigation measures during construction will minimise adverse human health or amenity impacts from airborne particles (dust). Any increase in regional airborne dust generation from the Project is expected to be low.

6.2 Greenhouse Gas

6.2.1 Background

Australia is one of the many regions experiencing significant climate change as a result of global emissions of greenhouse gases from human activities. The average surface air temperature of Australia increased by 0.7°C over the past century – warming that has been accompanied by marked declines in regional precipitation, particularly along the east and west coasts of the continent (CSIRO, 2007).

Australia has international greenhouse obligations. Under the United Nations Framework Convention on Climate Change Australia has committed to limit emissions and the production of greenhouse gases. Additionally, through its membership of the Asia-Pacific Partership on Clean Development and Climate, Australia has agreed to support the development and deployment of cleaner, more efficient technologies to combat climate change.

The NSW Greenhouse Gas Abatement Scheme (GGAS) commenced on 1 January 2003. The scheme is one of the first mandatory greenhouse gas emissions trading schemes in the world. GGAS aims to reduce greenhouse gas emissions associated with the production and use of electricity. Reductions in greenhouse gas emissions are achieved by using Project-based activities to offset the production of greenhouse gas emissions (IPART, 2008).

In November 2005, the Premier confirmed the Government's commitment to extend the NSW GGAS to 2020 and beyond. The decision to extend the scheme recognises the need to provide certainty to investors in greenhouse gas abatement activities. The GGAS establishes annual state wide greenhouse gas reduction targets and then requires individual electricity retailers and certain other parties who buy or sell electricity in NSW to meet mandatory benchmarks based on the size of their

share of the electricity market. If these parties, known as benchmark participants, fail to meet their benchmarks, then a penalty is assigned. Monitoring the performance of benchmark participants is undertaken by the Independent Pricing and Regulatory Tribunal of NSW in its role as Compliance Regulator (IPART, 2008).

Furthermore, greenhouse gas abatement certificates may be attached to the Project. The *Greenhouse Gas Benchmark Rule (Generation) No. 2 of 2003* allows for electricity generators to create abatement certificates for:

- Electricity generated at an emissions intensity lower than that of the designated NSW pool coefficient, referred to as the "Relative Intensity Approach", and/or
- Efficiency improvements to a generating system (that is generally operating at an emissions intensity above that of the NSW pool coefficient), referred to as the "Efficiency Improvement Approach".

The extent to which abatement certificates are created under either, or both, of these approaches is dictated by the generating system's assigned Category (A, B, C or D) of generation and its accordant designated NSW Production Baseline (IPART, 2008).

6.2.2 Potential Impacts

Greenhouse gases identified under the Kyoto Protocol United Nations Framework Convention on climate change are:

- Carbon dioxide (CO_2).
- Methane (CH_4).
- Nitrous oxide (N_2O).
- Hydrofluorocarbons (HFCs).
- Perfluorocarbons (PFCs).
- Sulfur hexafluoride (SF_6).

The Project will generate minor amounts of greenhouse gases during its construction and operation.

During construction of the project, sources of greenhouse gas emissions will include:

- Vehicular emissions (CO_2, N_2O).
- Venting natural gas during pipeline purging on commissioning (CH_4).

During the operation of the pipeline there will be emissions from:

- Vehicles involved in pipeline and ROW maintenance (CO_2, N_2O).
- Low-level fugitive emissions (CH_4) from the gas pipeline facilities (e.g., seals, flanges and valves).
- Emergency venting of the pipeline (CH_4).

The end-use of the gas is the other stage in the product life (rather than project life) where greenhouse gas emissions occur as a result of gas consumed as a source of energy.

6.2.3 Mitigation Measures

Macquarie Generation recognises the importance of pursuing strategies to address greenhouse gas emissions from all its operations. The mitigation measures to reduce greenhouse gas emissions during the Project will include:

- Development and application of policies and procedures for efficient pipeline operation.
- Minimise pipe haul distances.
- Ensuring that vehicles and equipment are mechanically sound, serviced regularly and fitted with appropriate emission control equipment.
- Implement an operations maintenance program that aims to minimise fugitive emissions from the pipeline system.
- Minimise quantities of vented coal seam gas during commissioning and operations.
- Design and operate of the pipeline to achieve as low as reasonably practicable a risk of an event which may lead to a gas rupture and/or an emergency release of gas.
- Supplement/displacement of coal with gas in the Liddell Power Station boilers.

6.2.4 Impact Assessment

Emissions of greenhouse gases due to project development will occur; however, the emissions will be relatively low, short-term and largely associated with pipeline construction. These adverse impacts will be insignificant compared to the large, net reductions in emissions as a result of utilising coal seam gas as a fuel in the generation of steam to produce electricity. Otherwise the mine gas would otherwise be vented or flared to the atmosphere with no concurrent production of electricity.

According to Macquarie Generation reduced levels of coal would be required to produce electricity as the Project would involve displacement of up to 5 million tonnes CO_2 equivalent by inclusion of the coal seam gas in the boiler. The Project therefore has the potential to reduce significant levels of greenhouse gas emissions and create abatement certificates for Macquarie Generation through improved efficiencies.

6.3 Geology and soils

6.3.1 Existing Environment

The 1:250 000 Singleton Soil Landscape sheet was used to identify the underlying soils and geology for the propose pipeline corridor. The pipeline corridor crossing eight (8) soil landscapes from Bulga (KP0) to Liddell (KP51) define by Kovac and Lawrie in 1991. Table 17 summarises the key elements for each of the eight soil landscapes.

Table 17: Soil Landscapes within the Project Area.

Soil Landscape	Underlying Geology	Soil Types	Landform	Elevations	Slope Gradients	Vegetation Type	Predominant Species
Bayswater	Permain sandstone, shale, mudstone, conglomerate and coal.	Yellow Solodic soils on slopes, with Alluvial Soils in drainage lines. Intergrades of Yellow Solodic Soil-Red-brown Earths. Brown and Yellow Earths and Prarie Soils in some drainage lines. Red, Yellow & Brown Podzolic Soils on slopes.	Undulating low hills	40-60m	3-10%	Predominant cleared woodland	Remanets of forest red gum, and forest oak occur with some Broad-leaved red ironbark, narrow-leaved red ironbark, bull oak, grey box and swamp oak
Branxton	Permain sandstone, shale, mudstone, siltstone, tuff and coal seams	Yellow Podzolic Soils on mid slopes, Red Podzolic Soils on crests. Yellow Soloths on lower slopes and in drainage lines . Alluvial Soils in some creeks.	Undulating rises – low hills	10-40m	Up to 5%	Mainly cleared for grazing. Some areas of uncleared native bushland	Spotted gum, red ironbark, narrow leaved red ironbark, swamp oak in drainage lines.
Brays Hill	Permian calcareous shale and sandstone, Tertiary basalt.	Red clays on mid slopes with Black Earths on steeper slopes. Grey and Brown Clays and yellow Solodic Soils on some lower slopes. Alluvial soils in drainage lines. Red-brown Earths on some crests and upper slopes.	Undulating low hills	60-120m	6-10%	Savannah woodlands, largely cleared.	White box, yellow box and kurrajong.
Bulga	Permian sandstone, conglomerate, claystone, shale, mudstone and coal seams.	Yellow Soloths on upper to mid slopes with Brown Earths on lower slopes.	Smooth slopes with sandstone colluvium	20-40m	Slopes to 10%	Woodland. Much of landscape cleared for grazing /horticulture.	Yellow box, forest red gum, narrow-leaved red ironbark. Also some rough barked apple, cabbage gum and deans gum.

Soil Landscape	Underlying Geology	Soil Types	Landform	Elevations	Slope Gradients	Vegetation Type	Predominant Species
Hunter	Alluvial plains and terraces of the Hunter River and its tributaries.	Brown Clays and Black Earths on prior stream channels and tributary flats. Chernozems on former channels adjacent to Dartbrook and Brays Hill soil landscape . Alluvial Soils on levees and flats adjacent to the current channel. Red Podzolic Soils and Lateritic Podzolic Soils on old terraces. Non-calcic Brown Soils on terraces with Yellow Solodic soils in drainage lines.	Alluvial plains and terraces	To 10m	Up to 3%	Cleared for intensive agriculture	No native vegetation remaining.
Jerrys PLains	Permian lithic sandstone, mudstone, siltstone and conglomerate.	Soloths on crests to midslopes with Solodic Soils on lower slopes and in drainage lines. Brown clays in midslopes and depressions. Red Earths on some upper slopes.	Undulating low hills	60m	2-10%	Woodland	Narrow-leaved red ironbark with forest red gum, grey gum and bull oak in drainage lines.
Liddell	Permian sandstone, shale, mudstone, conglomerate and coal.	Yellow Soloths an Yellow Solodic Soils on slopes. Earthy and Siliceous Sands on slopes on siliceous parent rock.	Undulating low hills – undulating hills	60-120m	4-7%	Open-woodland	Narrow-leaved red ironbark, yellow box, white box, spotted gum. Minor blakelys red gum, roughed barked apple, kurrajong and bull and swamp oak.
Wollombi	Alluvium	Layered Alluvial Soils.	Alluvial flats - and undulating rises	To 20m	To 3%	Some cleared for grazing on unimproved pastures.	Forest oak with some river oak

Acid Sulfate Soils

Potential exists for soil and water quality to be reduced by acid formation or mobilisation of metal ions following exposure of acid sulfate soils to oxygen. In NSW, the identification of the location and extent of potential acid sulphate soils were mapped at 1:25,000 scale by the NSW Government.

6.3.2 Potential Impacts

Project related activities affecting geology and soils within the project area include:

- Clearing and grading.
- Trenching.
- Backfilling.
- Reinstatement.
- Construction vehicle movement.

Potential impacts of these project construction activities include:

- Erosion and sedimentation.
- Slope instability.
- Soil loss, inversion, compaction and subsidence.

Erosion and Sedimentation

Construction activities for the project may cause erosion and sedimentation if not properly managed, particularly for pipeline construction in, and near, watercourses. The potential impacts of erosion and sedimentation include:

- Soil loss, especially topsoil, which could result in limited revegetation success, future erosion and degradation of land quality.
- Sediment input to watercourses (see Section 5.4.2), affecting the water quality and aquatic ecosystems (e.g., excess nutrient inputs, increased turbidity, smothering of habitat and river bed flora and fauna).
- Slope failure and landslips.

Factors that may influence erosion and sedimentation are:

- Topography (watershed velocity).
- Geology and soil types (drainage, permeability, and dispersive and consolidation characteristics).
- Climate (rainfall, wind speed and seasonal conditions).
- Vegetation cover and type (deep rooted vegetation, extensive coverage, soil binding capability).
- Extent, area and period of exposure of subsoils.

Slope Instability

Slope instability (or mass movement) is of concern during pipeline construction for a number of reasons:

- Safety hazards of slope failure during and after construction.
- Risk of pipe exposure and damage to the pipe.

- Erosion of soil profiles, particularly topsoil, reducing the success of revegetation.
- Sedimentation of watercourses resulting from bank erosion (only where open cut crossing methods are used).
- Delays in construction progress and ongoing maintenance.

Topsoil Loss

Topsoil loss can occur through wind and water erosion. Topsoil may also be lost in pipeline construction if it is mixed with trench spoil during stockpiling or dispersed by construction vehicles driving on it.

Soil Inversion

Inversion of soil profiles may occur if topsoil, trench spoil or other materials associated with construction are not stockpiled separately when excavated. It may also occur as a result of respreading trench spoil over the topsoil during ROW reinstatement works if topsoil is mixed with other materials.

Subsidence

Subsidence along the pipeline trench line may occur as the trench backfill material settles over time. This will vary depending on the soil type, the moisture and quality of compaction of material returned to the trench.

Soil Compaction

Compaction of soil profiles may occur in areas that have experienced heavy traffic during construction.

Soil Contamination

Due to the long linear nature of the Project it is impractical to sample soil along the length of the corridor. Potentially contaminated soils may exist along the pipeline corridor due to the historic land use in the area. The region has a history of agriculture, mining, mining-related and rural residential activities. Soils may be contaminated with chemicals such as herbicides, pesticides, oils, flocculants and heavy metals as a result of a range of current and previous activities.

Potential exists for soils to also become contaminated during construction, particularly through fuel spills from construction equipment.

Acid Sulfate Soils

Acid sulfate soils are unlikely to be encountered during construction of the pipeline, according to the NSW Acid Sulfate Soils risk mapping (DLWC 1997).

Mine subsidence

The area contains several historical and current open-cut and underground coal mines. Underground coal mining has the potential to create subsidence that may result in crack and/or sinking of at the

ground surface. Subsidence may cause variations in the morphology of the terrain along the pipeline corridor that has the potential to cause cracking or other physical damage to the pipe.

6.3.3 Mitigation Measures

Erosion and Sedimentation

Measures to be implemented to minimise erosion and sedimentation impacts will include:

- Promptly revegetating. Revegetation will occur as soon as practicable after reinstatement earthworks to secure and settle disturbed soils.
- Respreading topsoil and subsoil separately to prevent mixing that may lead to soil dispersion and inversion.
- During rehabilitation, where the soil surface has been excessively compacted due to construction traffic, lightly scarifying or ripping the soils to aid water infiltration.
- Minimising the time between clearing and grading of the mainline ROW, and trenching and backfilling, to limit the time of exposure of bare soil and rock to the weather.
- Placement and construction of diversion berms and, erosion and sediment (ERSED) control structures such as hay bales or shade cloth, to drain to the downstream side of the ROW.
- ERSED control structures will be installed to prevent sediment entering waterways or water bodies. Where open trenching is used as a water crossing method, the ERSED control structures will be installed to ensure that water turbidity is reduced during construction.
- The pipeline ROW will be monitored during operations for erosion and sedimentation.

Slope Instability

Mitigation and management measures to address impacts associated with slope instability in relation to the proposed gas pipeline will include:

- Undertaking appropriate engineering design of potentially vulnerable sections of the gas pipeline to counteract unstable slopes.
- Use of trench breakers at regular intervals on slopes to slow water flow along the pipe trench and prevent mass soil erosion.
- A suitable level of compaction over the backfilled trench.
- Adopting appropriate ERSED control structures, with particular attention to the construction of water diversion and sediment control berms.
- Prompt revegetation with appropriate species for pasture and plantation areas.
- Pipeline ROW to be monitored during operations for stability.
- Where the trench is greater than 1.5 m depth and personnel are required to enter the trench, trench walls will be battered back, or alternatively, the trench walls will be supported. Unsupported batters will be no steeper than 1 horizontal : 1 vertical in dry to moist clays and no steeper than 1.5 horizontal : 1 vertical in dry to moist sand.

Soil Issues

Management measures to mitigate impacts of general construction on soils will include:

- Pre-construction stripping and stockpiling of topsoil in a stable area away from drainage lines for the pipeline corridor and proposed facilities sites. The pipeline corridor will have a suitable buffer from the trench spoil (subsoil).
- Stockpiling topsoil and subsoil as separate windrows to avoid mixing. Precautions will be taken to prevent construction vehicles driving over topsoil stockpiles.
- Compacted areas of the ROW or other work sites will be ripped prior to respreading topsoil, to promote successful revegetation where appropriate.
- The use of existing tracks to be maximised to avoid creating new tracks or unnecessarily compacting the ROW.
- Topsoil to be respread evenly over the ROW and not mixed with subsoil.
- Erosion and sediment controls to be constructed to divert runoff from potentially unstable rehabilitation areas, where necessary.
- Reseeding, weed control and fertilising in pasture areas to be undertaken in consultation with the landowner. Pasture species and fertiliser application to be subject to prior agreement with the landholder.

Excess Material/Rock

If encountered, surplus material/rock will be disposed of at landfill sites, re-used in quarries to make crushed rock or where appropriate, in accordance with the property owners' directions and in accordance relevant waste management and environmental protection requirements.

Mine subsidence

Suitable engineering controls will be integral to the design of the pipeline to ensure that the potential for subsidence is considered and ameliorated. The options for pipeline material of polyethylene or fibreglass have been selected as they are appropriate in areas affected by mine subsidence. Detailed engineering design will further consider potential impacts of subsidence. The risk assessment conducted by Sleeman Consulting (2008) provides the following recommendations for subsidence:

- In the course of detailed pipeline design appropriately qualified specialists will be engaged to prepare subsidence predictions. The predictions will be taken into account to design pipeline configurations that minimise the impact of subsidence. For example, 'snaking' of the pipeline across areas of subsidence (to reduce induced gradients and stresses) is possible; and
- During the operating phase, if mining activity takes place below the pipeline and subsidence could occur, induced stresses will be monitored and management regimes implemented as necessary to ensure the integrity of the gas pipelines is not compromised. For example, should predetermined stress limits be reached during subsidence, action can be taken to prevent the limit from being exceeded. The most reliable approach to dealing with flexural strains is to expose and then raise or lower portions of the pipeline to reduce curvature. This can be completed without taking the pipeline out of service.

In addition, Macquarie Generation will confer with the Mine Subsidence Board to develop an ongoing pipeline management plan. Risks associated with the impact of subsidence on the proposed gas pipeline are readily manageable through design and ongoing monitoring initiatives (Sleeman Consulting, 2008).

6.3.4 Impact Assessment

The physical effects on land from excavation will be minor, as disturbance associated with pipeline construction will be over a relatively short time frame. Mitigation measures will be adopted to stabilise disturbed areas and contain erosion, followed by rehabilitation, monitoring and remedial works as required. These measures are intended to confine impacts to the vicinity of active work areas and promote recovery from the short-term impact of construction.

Therefore, the impact of the Project on geology and soils following the application of the mitigation measures is expected to be low.

6.4 Noise and Vibration

6.4.1 Existing Environment

Existing noise and vibration levels along the proposed pipeline alignment are at levels expected for mining and rural areas. Noise levels are elevated due to heavy machinery operating at nearby coal mines. In predominately rural areas, common noise sources are farm machinery as well as animals (i.e., cattle, sheep, birds, frogs and insects) and to a lesser extent the wind. Adjacent the Golden Highway noise from high speed vehicles contribute to locally moderate levels of ambient noise. Overall, noise levels are generally higher during the day than at night, corresponding to increased human activity during the daylight hours.

Thirty (30) residences are located within or adjacent to the cadastral boundaries that the pipeline assessment corridor traverses (See Appendix F for locations). No residence is located within the 50 m pipeline assessment corridor. Twelve (12) are located between 50 to 100m away and the remainder are located greater than 100m. The main bulk of residences between 50 to 100m are located at the township of Bulga (Appendix F - Figure F2).

6.4.2 Potential Impacts

Construction

Construction of the proposed pipeline will generate a variety of different noise and vibration levels. The proximity of residential buildings along the proposed pipeline corridor is indicative of the potential for impacts on the community. The origin of noise and vibration during construction includes:

- Machinery noise.
- Regenerated noise.
- Machinery vibration.

Machinery Noise

A range of heavy machinery will be used to construct the proposed pipeline. These will be used to strip topsoil, excavate trenches, deliver pipe, lower-in pipe, transport sand and remove the waste spoil. The specific number and type of each vehicle to be used in construction is not yet known at this time; however, Table 18 highlights the typical mobile plant used for pipeline construction.

Table 18: Typical mobile plant used for pipeline construction

Description of Plant	Plant Function
On-road truck and dog	Pipe and sand haulage
Grader	Topsoil stripping
Excavator	Trench excavation / Loading and unloading pipe / Lower-in pipe
Articulated off-road dump truck	Sand, equipment & spoil haulage along ROW
Front-end loader	Sand and spoil loading

Equipment sound power levels are maximum noise emissions levels of plant that would be used on this project during typical operations. Indicative construction equipment sound power levels for the project are shown in Table 19.

Table 19: Indicative construction equipment sound power levels

Equipment	Range of indicative sound power levels (dB(A))	Range of indicative sound pressure levels at 10 metres (dB(A))
Dozer	102–114	74–86
Dump Truck	117	89
Excavator	97–117	69–89
Truck	107	79

Sourced from DECC 2008c.

Regenerated Noise

Regenerated noise is noise that is initially transferred into the ground by machinery as vibration and re-emerges elsewhere as audible noise. For example, vibration can travel through the ground to a building, and into the foundations to emerge as audible noise from the vibration of the walls, floor or ceiling.

Unlike noise that is transmitted through the air only, regenerated noise is more difficult to predict. This is primarily due to the variability in ground strata and the structure and internal acoustic characteristics of buildings in which regenerated noise is being considered.

Machinery Vibration

Typical ground vibration levels from construction activities would range from 1mm/s to 2mm/s at a distance of approximately 5m. Project specific vibration criteria would be less than 5mm/s at any sensitive location based on guidelines for cosmetic building damage and human comfort (DECC 2006). The primary source of vibration from the construction of the proposed pipeline will be from rock breaking. The level of vibration generated during this process is dependent on the excavation method, depth below surface, the structure of surface strata, the rate at which construction activities progress and ground (rock) hardness. It is difficult to predict the exact vibration levels that may be experienced during construction, as there is limited strata information available. Macquarie Generation expects minimal rock breaking during construction and no such works required adjacent to residences.

Operations

Potential sources of noise during operation of the pipeline include vehicles traversing the corridor for general observation and maintenance. It is unlikely that movement of gas in the pipeline will cause an increase in ambient noise levels with the exception of an emergency gas release. The likelihood of emergency venting is extremely low, if at all, and will only be required in response to a significant emergency particularly as the pipe will be covered with soil that will provide noise attenuation. No vibration impacts will occur during operations.

6.4.3 Mitigation Measures

Construction noise limits will be based on the *NSW EPA Environmental Noise Control Manual 1994* (ENCM) for management and mitigation of noise from construction works. Level restrictions, time restrictions and silencing requirements (where all practical measures are to be taken) are outlined in the ENCM. Chapter 171 of the ENCM provides the following acoustic design objectives for construction activities.

Table 20: Acoustic design objectives for construction activities

Construction Period	Acoustic Design Objective
<4 weeks	Received $L_{A10} \leq L_{A90}$+ 20 dB(A)
>4 weeks and <26 weeks	Received $L_{A10} \leq L_{A90}$ + 10 dB(A)
>26 weeks	Received $L_{A10} \leq L_{A90}$ + 5 dB(A)

Notes: L_{A10} = Noise level exceeded 10% of time; L_{A90} = Noise level exceeded 90% of time (background).

Mitigation measures to be specifically applied during the construction to meet the acoustic design objectives at sensitive receptors are:

- Pneumatic tools operated near a sensitive receiver will be fitted with an effective air-exhaust-port silencer.
- Mechanical plant will be silenced by the best practical means using current technology.
- Noise suppression devices will be maintained to manufacturer specifications.
- Internal combustion engines will be fitted with a suitable muffler and maintained in good working order.
- Where possible, no truck associated with the work will be left standing with its engine operating when located near a sensitive receiver.

- Access roads will be positioned such that minimum acoustic disturbance.
- All vehicular movements to and from the site will only be made during the scheduled normal working hours.
- Construction access will be located away from houses, where practicable.
- Local residents will be informed on a regular basis about the progress of the construction of the proposed pipeline, the duration of works, and noise that may be expected.
- Complaints of excess noise from local residents will be promptly investigated and appropriately addressed.
- The 24 Toll-free hotline number will be provided and a register of any such complaints will be maintained.
- Blasting will only be used in exceptional circumstances.
- The normal working hours for construction where an audible noise would generate at any residential premise will be from 7 am to 6 pm Monday to Friday. 8 am to 1 pm Saturday. No work on Sunday.

6.4.4 Impact Assessment

Potential sources of noise during construction of the pipeline include vehicles, under-boring and trenching equipment and general earthmoving machinery. Impact of construction and operation of the pipeline on local flora and fauna has been considered in Section5.1. Due to the short-term impact of the pipeline construction and minimal sensitive receptors in close proximity, it is not envisaged that construction noise will have a significant adverse impact on receptors in the pipeline corridor.

It has been assumed that the construction period will be between 4 and 26 weeks in duration over the 51 km of pipeline and as such the acoustic design objective is Received $L_{A10} \leq L_{A90} + 10$ dB(A). All construction activities will be limited near sensitive receptors to 7 am to 6 pm Monday to Friday; 8 am to 1 pm Saturday and no work on Sunday.

No vibration impacts are anticipated due to the short nature of the work and distance to residences being greater than 50m from the pipeline corridor.

As stated previously the Project area is generally occupied by mines and associated operations such that the small amount of vehicle movement along the corridor for general maintenance will not create a significant increase in noise emissions during operations.

6.5 Visual amenity

6.5.1 Existing Environment

During construction the pipeline will be highly visible to the local community, however once in place the pipeline will not be visible for its entire length. Remaining sections of the pipe will be buried with a cover of not less than 750mm and the corridor will be identified by indication markers visible above ground.

6.5.2 Potential Impacts

The main visual impacts of gas pipelines relate to construction and are therefore, short-term. Potential visual impacts associated with the construction component of the pipeline Project include:

- The presence of a fleet of large construction vehicles along the ROW.

- Clearance of soil and vegetation along the pipeline corridor until restoration is complete.
- Flagging tape and signage used for construction safety purposes.
- Temporary work sites for road and watercourse crossings.

The majority of these impacts will be temporary in nature. The construction of the pipeline will be most visible where the corridor runs parallel with the along the Golden Highway (KP20 to KP30).

Permanent pipeline marker signs will be visible at regular intervals along the alignment to warn of the buried pipeline. This is a safety requirement of AS2885.1:2007 Pipelines - Gas and Liquid Petroleum, Design and Construction. Signs will be placed at property boundaries, pipeline bends and will be intervisible along the pipeline.

6.5.3 Mitigation Measures

Careful selection of the pipeline corridor is the principal means of minimising impacts on visual amenity. Additional measures to avoid, minimise or mitigate impacts to visual amenity include:

- Aligning the pipeline minimises vegetation clearance, particularly at roadsides.
- Boring of sealed roads avoids vegetation clearance and road disruptions, and therefore, reduces impacts to visual amenity.
- All construction sites, including the ROW, will be maintained in an orderly manner and free of litter.
- Construction equipment and infrastructure will be removed from site as soon as practicable, and all non-permanent flagging and signage will be removed at the completion of construction.
- The ROW will be rehabilitated as soon as practicable (i.e., restoration of original contours and pasture planting) to minimise the time of bare-earth exposure.
- Native vegetation will be rehabilitated over the ROW (excluding deep-rooted vegetation directly over the pipeline) in appropriate areas. Additional plantings of locally-endemic native species will be established where native vegetation has been cleared at roadsides and waterways.

6.5.4 Impact Assessment

Residual visual impacts of pipeline construction are expected to be low. The only long-term evidence of the pipeline operation will be the presence of pipeline marker posts, mid-line valves and occasional gaps in vegetation. In the long term, the pipeline is expected to be unnoticed in this largely cleared landscape that already features several similar infrastructure corridors.

6.6 Waste management

In general, relatively small amounts of wastes will be generated during the construction and operation of the Pipeline. Waste management will be based on a hierarchy beginning with waste avoidance, reuse and recycling before disposal in line with the principles embodied in the NSW *Waste Avoidance and Resource Recovery Act 2001*.

General construction waste

Typical wastes generated during construction activities include:

- Packaging – ropes, cardboard, pallets.
- Used oils or chemicals – e.g. lube oil, spent chemicals, used tins from solvents or primer.
- Office wastes – food scraps, glass and plastic drinking containers, paper, printer cartridges.

General operational waste

General waste management post-construction will involve minor maintenance works and removal of condensate from low points in the pipe. Condensate forms due to changes in temperature and pressure of the gas and accumulates in low points in the pipeline. Removal of condensate in low points will typically involve flushing a vertical vent shaft connected to the pipeline using gas pressure to force the water out to ground level, which is released by a valve.

6.6.1 Potential impacts

Construction

The potential impacts resulting from poor waste management could include:

- Contamination of soil and water – due to poor management and disposal of waste lube oils or fuels spills or ablution waste including waste from portable toilets.
- Visual impact – due to an untidy site resulting from poor management and disposal of domestic waste including food scraps, aluminium cans, glass or plastic bottles and containers.

Operational waste

The potential impacts resulting from poor waste management could include:

- Contamination of soil and water – due to poor management and disposal of condensate collected during routine operations.

6.6.2 Mitigation measures

All waste related to the Project, would be managed in accordance with the Waste Classification Guidelines issued by DECC (DECC 2008).

Construction

Waste management would include:

- No on-site waste disposal.
- Provide and locate appropriate refuse containers at the worksite for use by the work crews.
- Stockpile and salvage reusable and recyclable wastes, such as timber skids, fibre/nylon rope spacers, pallets, drums and scrap metals.
- Undertake maintenance of machinery and equipment at appropriate locations on-site (namely away from watercourses or sensitive receptors) or off-site where available.
- No storage of bulk oils or fuels on-site unless it is within a portable impervious bund.
- Collect and remove waste oil for recycling, reuse or disposal at facility licensed to accept such wastes.
- Providing on-site emergency spill kits and training appropriate staff in their use.
- Establish a designated waste disposal points to be cleared daily.
- Ensure all contractors are aware of their requirements in terms of waste management.

Operations

- All litter and general waste disposal will be taken to a licensed disposal facility.
- Condensate will be captured and disposed of by a waste contractor that will be required to comply with existing environmental legislation that prohibits discharge to the environment in the absence of a licence. Removal of the condensate will also occur via a "pig" that will be utilised to scour the pipeline and will have the added benefit of removing residual moisture.

6.6.3 Impact assessment

The waste streams generated by the Project are considered non-toxic and non hazardous and therefore able to be managed and disposed in accordance with the DECC guidelines (DECC 2008) at appropriate waste handling facilities.

Waste streams are not likely to significantly affect the environment, provided the mitigation measures are implemented for the Project.

6.7 Socio-economic

6.7.1 Existing Environment

Profile of Towns and Communities

The proposed pipeline alignment is located between two of the Hunter Valley's largest urban centres, Singleton and Muswellbrook. The rural areas potentially affected by the proposed pipeline alignment include Bulga, Warkworth and Jerrys Plains. The proposed pipeline corridor runs adjacent to the Golden Highway between Warkworth and Jerrys Plains (KP20 to KP30).

Singleton's economy and settlement provide a contrast between the large coal mining operations of the lower hunter and its rural areas. The shire also has some of Australia's best equestrian facilities and vineyards. The proposed pipeline alignment avoids all these areas.

Within the Muswellbrook Shire Council area, the pipeline is located entirely on Macquarie Generation owned land. No residence or industry will be impacted by the pipeline.

Demography, Occupation and Income

The follow data is taken from the 2006 Census held on 8th August 2006(ABS, 2006).

Singleton Local Government Area

- There were 21,937 persons usually resident in Singleton LGA: 51.2% were males and 48.8% were females. Of the total population 2.7% were Indigenous persons, compared with 2.3% Indigenous persons in Australia.
- 24.4% were children aged between 0-14 years, and 19.4% were persons aged 55 years and over. The median age of persons was 34 years, compared with 37 years for persons in Australia.
- 91.5% of were Australian citizens, 7.3% were born overseas and 0.3% were overseas visitors.
- English was stated as the only language spoken at home by 94.0% of persons. The most common languages other than English spoken at home were: German 0.2%, Cantonese 0.2%, Afrikaans 0.1%, Arabic 0.1% and Maltese 0.1%.

- 10,767 people aged 15 years were in the labour force. Of these, 63.2% were employed full-time, 26.5% were employed part-time, 3.5% were employed but away from work, 2.6% were employed but did not state their hours worked and 4.2% were unemployed. There were 4,958 usual residents aged 15 years and over not in the labour force.
- The most common responses for occupation for employed persons were Technicians and Trades Workers 19.8%, Machinery Operators and Drivers 16.4%, Managers 12.0%, Clerical and Administrative Workers 11.8% and Professionals 11.7%.
- The most common industries of employment for persons aged 15 years were Coal Mining 16.5%, School Education 3.6%, Cafes, Restaurants and Takeaway Food Services 3.3%, Defence 2.9% and Machinery and Equipment Repair and Maintenance 2.4%.
- The median weekly individual income for persons aged 15 years was $487, compared with $466 in Australia. The median weekly household income was $1,258, compared with $1,027 in Australia. The median weekly family income was $1,458, compared with $1,171 in Australia.

Muswellbrook Local Government Area

- There were 15,236 persons usually resident in the Muswellbrook LGA: 51.3% were males and 48.7% were females. Of the total population 4.8% were Indigenous persons, compared with 2.3% Indigenous persons in Australia.
- 24.2% were children aged between 0-14 years, and 20.4% were persons aged 55 years and over. The median age was 34 years, compared with 37 years for persons in Australia.
- 89.2% were Australian citizens, 5.6% were born overseas and 0.3% were overseas visitors.
- English was stated as the only language spoken at home by 91.8%. The most common languages other than English spoken at home were: Cantonese 0.1%, Italian 0.1%, Thai 0.1%, Mandarin 0.1% and German 0.1%.
- 50.3% of persons aged 15 years were married, 33.4% never married, 11.0% separated or divorced and 5.4% widowed.
- 7,102 people aged 15 years and over were in the labour force. Of these, 62.7% were employed full-time, 25.7% were employed part-time, 3.2% were employed but away from work, 3.0% were employed but did not state their hours worked and 5.4% were unemployed. There were 3,788 usual residents aged 15 years and over not in the labour force.
- The most common responses for occupation for employed persons were Technicians and Trades Workers 20.7%, Machinery Operators and Drivers 14.5%, Labourers 14.4%, Managers 11.8% and Professionals 10.8%.
- The most common industries of employment for persons aged 15 years were Coal Mining 13.8%, School Education 4.2%, Cafes, Restaurants and Takeaway Food Services 3.6%, Electricity Generation 3.2% and Other Livestock Farming 3.2%.
- The median weekly individual income for persons aged 15 years was $453, compared with $466 in Australia. The median weekly household income was $1,060, compared with $1,027 in Australia. The median weekly family income was $1,213, compared with $1,171 in Australia.

6.7.2 Potential Impacts

Impacts on Individual Landholders

The planning and design of the proposed pipeline alignment has considered proximity to residences (see Section 2.5) to ensure minimal impacts on dwellings, in accordance with the criteria specified in the Australian Standard AS2885:2007.

During the construction phase, there is potential for residential houses, shops, commercial buildings and factories to experience increased noise, dust, and traffic levels. These impacts will be intermittent and temporary for the duration of the construction in at any particular location.

Fundamental to the construction of this project is the access to land through which the proposed pipeline will be constructed. The land is held in various tenures, with the large majority being freehold land (privately owned).

Easements provide protection to the pipeline and the community by restricting work that can occur within it. This includes matters affecting access for maintenance. Restricted activities include erecting permanent buildings or undertaking excavation without prior notification to Macquarie Generation. Consequently, there are perceived impacts on property values.

Impacts on Communities

The community may experience some impacts during the construction phase. Construction takes approximately four to eight weeks at any given point along the corridor and therefore, reductions in amenity will be short-term.

The impacts of large, linear-style projects are mostly localised whilst the benefits are shared with the broader population. Consequently, local communities may feel the inequity of such circumstances. Local expenditure during construction; however, will provide some, limited direct and indirect benefits to local communities.

To support the high degree of cultural diversity and consequently, the high variance in social background, lifestyles and communication needs, an intimate level of community liaison will be needed to maintain cultural awareness. It may be necessary to engage personnel with experience in relevant cultures to act as interpreters, as different cultural groups have distinct forms of expression. Therefore, the construction of the proposed pipeline will need to take into account events in the community that have cultural significance, such as worship times, festivals and community events.

To understand the potential impacts of the project on the community, values need to be developed to describe dimensions of amenity and social sustainability. Based on experience of previous gas pipelines, perceived community values are described in Table 21.

Table 21: Community Values

Dimension of Amenity	Value
Household security	Safety at home and in public areas. Protection of property values and incomes. Harmony between neighbouring land uses.

Dimension of Amenity	Value
Residential amenity	Access to roads. Access to bike and pedestrian paths. Peaceful enjoyment of private and public space. Visual amenity.
Health, Safety and Environment	Good air quality. Safe driving conditions. Convenient and safe access to social and recreational infrastructure. Environmental quality (noise and other impacts i.e. vibration). Access to emergency services and hospitals. Protection of existing environmental features (trees, native vegetation etc).

Local Economic and Employment Impacts

Macquarie Generation is committed to enhancing the opportunities of the region through which the proposed pipeline will pass. Therefore, some limited, economic and employment benefits may occur as a result of improved opportunities for new business and an increased demand for existing local businesses (i.e., supply of goods and services to the project and its contactors).

At a more strategic level, the gas pipeline will minimise the waste of mine gas and maximise the reduction in coal fired electricity generation.

Pipeline construction is a specialised activity and requires skilled and experienced construction personnel and contract service companies. These are unlikely to be found locally; however, temporary, local employment opportunities exist in areas such as ROW rehabilitation, fencing, and weed control.

Community Facilities Impacts

There will be minimal impact on demand for public infrastructure (i.e., medical and retail services). The establishment of accommodation for the construction workforce will not be required as the proposed pipeline Project is in close proximity to Singleton where there is ample existing infrastructure to accommodate the workforce and commuting is relatively easy.

Impacts on Tourism and Recreation

In the short term, the impact of the project on tourism (vineyards) and recreation (horse industry) will amount to increased traffic for pipe haulage and other construction vehicles.

6.7.3 Mitigation Measures

The potential negative socio-economic impacts resulting from the proposed pipeline alignment will be mitigated and managed as follows:

- Throughout project development and operation, Macquarie Generation shall continue to liaise with relevant stakeholders and provide project updates to the wider community through appropriate communication.

- Macquarie Generation will maximise the opportunity for local employment and the engagement of local contract services along the alignment. Similarly, the construction contractor shall be encouraged to do likewise.
- Agreements shall be established with landholders, which incorporate fair and just compensation for potential losses.
- The ROW shall be promptly reinstated and revegetated with appropriate species to ensure impacts to public amenity are minimised.

6.7.4 Impact Assessment

Potential socio-economic impacts will predominantly occur during the construction phase of the Project. At the local level, impacts to individual landholders are managed through an appropriate process of ongoing consultation and negotiation. At a regional level, the impacts will be dissipated throughout the Hunter Valley area.

7 Project Justification and Conclusion

7.1 Strategic Justification

The proposed pipeline will potentially take gas from multiple coal mines south and west of Liddell Power Station. Gathering lateral pipelines will extend from the main pipeline to relevant gas wells. The location of these lateral pipelines will be determined by the final mine plan of each coal mine and as such form part of a "local gas collection network" that does not form part of this Project. The coal seam gas, to be supplied by the pipeline to Liddell Power Station, contains methane diluted mainly with air and is primarily sourced as a by-product of underground longwall operations. The gas is of mixed quality with extremely variable composition and delivery rate (quantity), which can restrict the opportunity for use as fuel in traditional generation technologies such as gas turbines or gas engines. The current practice is to dispose of coal seam gas by venting or flaring into the atmosphere.

Operation of the pipeline shall occur whilst there is an available supply of gas and it is anticipated that there would be in the order of at least 30 years of mine waste gas available. Other commercial sources of gas may also arise in that time frame, adding to the pipeline's long-term productivity.

The proposed pipeline will provide nearby Hunter Valley mines with the means to dispose of methane gas, as required in their consent conditions, to the extent of up to 270 thousand tonnes per year (or 5.6 million tonnes CO_2 equivalent). At each of the gas supply points, on coal mine or Macquarie Generation land, a compression station will bring the gas up to the pipeline operating pressure required for its delivery to the power station. A typical compression station is a compact skid mounted enclosure similar in size and appearance to a 'shipping' container. It will emit low level electric motor and fan noise. The magnitude of compression station emissions will be small and vary from mine to mine, depending on the gas volume involved.

At low points along the pipeline there will be drain points where accumulated condensed water vapour will be periodically removed. Typically a vertical vent shaft connected to the pipeline would be flushed using gas pressure to force the water out to ground level, which is released by a valve. Such waste will most likely be captured and disposed of by a waste contractor (Section 6.6).

The pipeline will also enable Macquarie Generation to extract the otherwise wasted energy-rich methane component of the neighbouring Hunter valley mines gas. The Project will avoid emitting up to 5 million tonnes of greenhouse gas per year. As such, the key Project outcome is the strong environmental benefits of both the coal mining process and electricity generation.

7.2 Ecologically sustainable development

Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* makes specific mention of resource development and impact assessment in terms of Ecologically Sustainable Development (ESD) principles and as such, the proposed development has duly considered these principles throughout all stages of planning.

The principles of ESD recognise the importance of development that meets the needs of the present generations without compromising the ability of future generations to meet their own needs.

The four principals that underpin ESD include:

- The precautionary principle.
- The principle of intergenerational equity.
- The principal of biological diversity and ecological integrity.
- The principal of improved valuation of environmental resources.

These principals are designed to place greater importance on the biophysical and socio-economic environment and how a development is likely to modify the local and regional environment in both positive and negative terms.

7.2.1 Precautionary principle

The precautionary principle states that:

If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

(a) In the application of the precautionary principle, public and private decisions should be guided by: careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment;

(b) and an assessment of the risk-weighted consequences of various options.

In order to satisfy the precautionary principle of ESD, emphasis must be placed on the anticipation and prevention of environmental damage, rather than a reaction to it. During the planning phase for the Project and throughout the preparation of the EAR, Macquarie Generation engaged specialist consultants to examine the existing environment, predict possible impacts and recommend mitigation measures in order to ensure that the level of impact satisfies statutory requirements or reasonable community expectations or as low as reasonable practical.

Throughout the development of the Project, Macquarie Generation and its consultants have adopted an the precautionary approach to the potential, likely and actual environmental impacts particularly in regard to the ecological damage, by undertaking an analysis of the risks posed by the Project and carrying out appropriate baseline investigations and environmental evaluation. The mitigation measures have therefore been planned with a comprehensive knowledge of the existing environment and the potential risk of environmental degradation posed by Project activities.

The implementation of the mitigation measures has been formalised by Macquarie Generation as the draft Statement of Commitments (see Section 7.6).

The Project has been designed with the principal objective being to utilise the gas produced during mine drainage activities in a safe and environmentally responsible manner. Macquarie Generation recognises that this approach can assist in the minimisation of unnecessary harm to the local and regional environment.

The precautionary principle has been considered during all stages of the design and assessment of the Project. The approach as adopted, i.e. risk analysis, initial assessment, consultation, specialist investigations and safeguard design, provides a high degree of certainty that the Project would not result in any major unforeseen impacts.

7.2.2 Principle of inter-generational equity

The principle of inter-generational equity states that:

> *The present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.*

The proposed pipeline corridor land is appropriately zoned and has support infrastructure that is suitable for the Project. The Project would not result in any impacts that are likely to impact on the health, diversity or productivity of the Hunter Valley region for future generations.

The Project has been specifically designed to reduce potential environmental risks and mitigation measures would be implemented to minimise adverse affects on the environment. The Project is therefore considered to be consistent with the principle of inter-generational equity.

7.2.3 Principle of biological diversity and ecological integrity

The principle of biological diversity and ecological integrity state that:

> *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*

The Project has been designed to avoid impacts on biological diversity and ecological integrity wherever possible. In particular, Macquarie Generation moved the pipeline corridor so as to avoid completely the Warkworth Sands Woodland which represents an important natural feature in terms of biodiversity and habitat.

The Project corridor has generally been sited on previously cleared and disturbed land and is not recognised as having significant ecological value or habitat potential for a diverse flora and fauna community. Modification and alteration of native vegetation and habitat for faunal species has been reduced to the smallest extent possible in light of the Project design components and rehabilitation objectives. No threatened species have been identified as likely to be impacted by the Project.

Therefore the Project is considered to be consistent with the principle of biological diversity and ecological integrity.

7.2.4 Improved valuation of environmental resources

The principle of improved valuation of environmental resources state that:

> *Environmental factors should be included in the valuation of assets and services, such as:*

(i) polluter pays – that is, those who generate pollution and waste should bear the cost of containment, avoidance and abatement;

(ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste; and

(iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to minimise benefits and minimise cost to develop their own solutions and responses to environmental problems.

The potential environmental benefits that the Project would offer to future generations are considered significant and include:

- Reduce greenhouse emissions from power generation.
- Improve local air quality.
- Investment in a sustainable use of coal seam gas.
- Potential economic advantages.

Macquarie Generations principal objective for this Project is to utilise a valuable resource in an environmentally responsible manner, which would otherwise be wasted. Given the importance to the State of securing energy supplies in light of the continued growth of domestic and industrial markets, Macquarie Generation is confident that the Project design demonstrates that an appropriate value has been placed on the natural resources in question and to those elements of the existing environment likely to be impacted by the Project.

The value placed by Macquarie Generation on natural resources is evident in the identification of Project objectives, extent of site-specific research, planning and mitigation measures to be implemented to prevent permanent environment impacts being realised.

The economic rationalisation behind the Project indicates that the utilisation of the gas resources in the proposed manner will assist in the ongoing development of cleaner electricity generation whilst increasing the operation and hence profitability of the existing Liddell Power Station. The net environmental benefits realised by the successful implementation of the Project compliment Macquarie Generation's commitments to the region with due consideration of the operating environment and within the terms of all approvals, leases and licences awarded to it.

The impact of the Project on the local and regional socio-economic environment has been determined as positive, with measurable increases in direct and indirect employment opportunities and the utilisation of the region's extensive network of retail and industrial service providers.

The Project is an integral part of Macquarie Generations objectives for the reduction of greenhouse gas emissions. Therefore the Project is considered to be consistent with the principle of improved valuation of environmental resources.

7.3 Cumulative impacts

Cumulative environmental impacts arise when the Project is considered in conjunction with existing or ongoing development, and the potential negative impacts and positive benefits that the Project would create when considered in this form. All development projects have potential negative and positive cumulative impacts.

Examples of potential positive cumulative impacts of the Project include:

- The use of coal seam gas as a fuel for electricity generation in the Hunter Valley and associated positive environmental impacts, such as reduced air emissions.
- Increase economic activity and hence additional jobs and general economic productivity.
- Increase awareness of coal seam gas opportunities in the Hunter Valley and hence increased confidence in the alternate management of coal seam gas.

Where Macquarie Generation has direct control over potential negative cumulative impacts, it is considered that the proposed mitigation measures will reduce the impact to as low as reasonable practicable.

It is considered that negative indirect impacts are beyond the ability of Macquarie Generation to reasonably and fairly influence directly in order to entirely avoid such impacts. However, Macquarie Generation would influence such impacts where it can reasonably do so and is expected to, for example by ensuring appropriate procedures are followed for working within a NSW RTA road reserve.

7.4 Conclusions

The Project presents a feasible option for the consumption of coal seam gas produced from various mines in the Hunter Region. The Project has been designed to address the key issues raised by all levels of Government, landholders affected by the Project and the wider community. The Project provides a pathway for the consumption of coal seam gas produced during the mine drainage process in preference to the venting or flaring the gases to atmosphere.

This environmental assessment has been prepared in accordance with Part 3A of the EP&A Act 1979 to assess the potential environmental impacts associated with the Project.

In accordance with the NSW DoP Director-General's Requirements a range of environmental investigations were undertaken to assess the potential environmental impacts of the Project. These included assessment on key issues involving potential environmental impacts on ecology, heritage, hazards and risks, surface and groundwater and traffic (Sections 5.1 to 5.5). In addition, a general environmental risks analysis was undertaken (Section 5.6) and an assessment of the Project against the principles of Ecologically Sustainable Development was completed (Section 7.2).

The EAR found that the Project can be approved under Part 3A of the EP&A Act, 1979. The Project is consistent in context and character with its land use zoning. Furthermore, the highly disturbed nature of the pipeline corridor significantly reduces the likelihood of adverse environmental impact.

Where the pipeline construction activities have the potential to cause minor short term environmental impacts, proposed mitigation measures will reduce that impact to as low as reasonably practical.

Operation of the pipeline will not result in any significant environmental impact as it will involve minimal maintenance and the risk assessment concluded that there was a low risk on all threats (Sleeman 2008).

Since the Project is unlikely to significantly affect the environment and a number of benefits have been identified, it is therefore recommended that the Project receive approval, subject to the implementation of the statement of commitments (Section 7.6).

7.5 Construction and operational environmental management plans

An environmental management plan outlines the environmental goals of a Project, the mitigation measures to be implemented, the timing of implementation, responsibilities for implementation and management, and a review process to determine the effectiveness of the strategies.

A construction environment management plan (CEMP) would be prepared by Macquarie Generation (or nominated contractor). For operations the Project aspects will be included in the existing Macquarie Generation operational environmental management plan (OEMP).

The objectives of the plans are to:

- Ensure that the works are carried out in accordance with statutory requirements and relevant non-statutory policies.
- Ensure that the works are carried out in accordance with the assessments detailed in this EAR to mitigate the potential for adverse environmental impacts.
- Ensure that employees engaged to undertake the works comply with the conditions detailed in the CEMP/OEMP, as well as occupational, health, safety & rehabilitation requirements.
- Identify management responsibilities and reporting requirements to demonstrate compliance with the CEMP/OEMP

7.6 Draft Statement of Commitments

Section 75F(6) of the EP&A Act states that the Director-General may require the proponent to include in an EAR a statement of the commitments the proponent is prepared to make for environmental management and mitigation and management measures on the site.

The draft statement of commitments is designed to effectively manage and mitigate the environmental effects of the Project. These commitments will form part of the contractual documentation for the contractor undertaking the pipeline installation.

Table 22 shows the draft commitments and identifies the desired outcomes, actions and timing of the stated commitments.

Notwithstanding the commitments made in Table 22, Macquarie Generation is committed to implementing all mitigation measures set out in Section 5 and 6 of this Environmental Assessment.

Table 22: Draft Statement of Commitments

#	Outcomes		Action	Timing	EAR Reference
1	Ecological Management				
	Minimise impacts of on flora and fauna across the Project corridor and surrounding area.	1.1	Maintain strict control on clearance envelope. Ensure no clearing to occur outside of surveyed pipeline corridor. A no impact zone around River Red Gums twice the radius of the tree canopy should be maintained.	Prior to and during corridor preparation	2.6 and 5.1
		1.2	Minimise extent of vegetation clearance where possible.	During corridor surveying and clearing activity	
		1.3	Avoid unnecessary removal of hollow bearing trees identified during corridor surveying.	During corridor surveying and clearing activity	
		1.4	Retain all understorey and groundcover vegetation from pipeline corridor to ensure retention of natural seed stocks to facilitate rehabilitation program.	During corridor preparation	
		1.5	The areas of the proposed pipeline corridor which have not been assessed should be before construction begins.	Prior to construction	
		1.6	Undertake weed monitoring and management program along pipeline corridor.	Post rehabilitation	
		1.7	Consult with landholders regularly to ensure rehabilitation objectives are being achieved.	Ongoing (periodic)	
2	Cultural Heritage				
	Employees and contractors aware and respectful of Aboriginal heritage values of Project Site and surrounding area	2.1	Include specific Aboriginal heritage awareness items in Project induction program.	Site induction process	5.2.3
	Protect Sites of Aboriginal and non-aboriginal heritage significance	2.2	Insure pipeline corridor observes adequate buffer surrounding sites and items of significance and known sites are clearly marked on the ground prior to and during construction.	Corridor surveying	

#	Outcomes		Action	Timing	EAR Reference
		2.3	CEMP to include specific action should unknown sites or items be discovered during corridor creation or any other period. Consult with DECC and stakeholders as required.	Construction period	
		2.4	Undertake pre-clearance Aboriginal heritage surveying where moderate to high significance has been identified (Section 5.2.3) or where the corridor of the pipeline corridor is amended for any reason.	Prior to and including clearance activity	
3	Surface and Groundwater Management				
	Maintenance of soil value for rehabilitation and minimisation of soil loss through erosion	3.1	Observe strict controls over the stripping stockpiling and protection of topsoils and trench spoil during pipeline installation.	All stages	2.8.1 and 5.4
		3.2	Replace trench spoil and topsoils as soon as practicable.	Completion of backfilling activities	
		3.3	Install silt fencing or otherwise to protect topsoil stocks where delays prevent replacement.	Construction period	
		3.4	Re-establish soil conservation systems (where applicable) on freehold lands to agreed condition.	Rehabilitation period	
		3.5	HDD the Hunter River and Wollombi Brook.	Construction period	
		3.6	Prepare activity specific water crossing construction method statements.	Prior to construction	
4	Traffic Management				
	Minimise the impact of the Project on the areas of normal traffic flow	4.1	Prepare a Traffic Management Plan to appropriate NSW RTA standard. Remediate any damage to roads/access tracks caused by the construction of the pipeline.	Planning stages	5.5
	Traffic safety considerations	4.2	Erect appropriate road signage along Project Site as per NSW RTA requirements.	Construction period	
		4.3	Minimise overall impacts of Project on major traffic flows	Construction period	

#	Outcomes		Action	Timing	EAR Reference
			along Golden Highway.		
		4.4	Inform all potentially affected residents adjoining the gas pipeline corridor of proposed traffic arrangements. Provide alternate access to landholders where access is disrupted.	Construction period	
5	Air Quality				
	Complete proposed development without exceeding DECC air quality criteria objectives	5.1	Suppress dust along unsealed site access roads. Restrict project vehicle speeds along the ROW.	When required	6.1
		5.2	Limit topsoil stripping and trenching during high winds.	When required	
6	Documentation				
	Documents governing planning, construction and operation	6.1	Prepare and implement a CEMP and OEMP for the Project.	Pre-commencement	0
		6.2	Encourage strict observation of published construction plans and site specific work procedures.	All stages	
		6.3	Ensure all construction and operating conditions are available to personnel.	Pre-commencement	
7	Overall Project				
	All approved activities to occur within the defined corridor boundaries.	7.1	Survey and clearly mark the boundary of the pipeline construction corridor.	Prior to commencement of disturbances	2.6
		7.2	Construction plans and induction program clearly state responsibilities of contractors to observe disturbance limitations.	During tender process and contractor inductions	
		7.3	Construct and operate in accordance with Australian Standard AS2885 series and the Australian Pipeline Industry Association (APIA) Code of Environmental Practice 2005.	During construction and operations	
8	Operating Hours				
	Management of construction activities in accordance with approved operating hours.	8.1	Undertake all construction activities associated with the project that would generate an audible noise at any residential premises between 7am-6pm	Duration of construction period	6.4

#	Outcomes		Action	Timing	EAR Reference
			Monday to Friday; 8am to 1pm on Saturday; No wok on Sunday.		
		8.2	Limit construction materials deliveries along gas pipeline to operating hours as above.	Duration of construction period	
9	Noise and Vibration				
	All construction activities undertaken in appropriate manner to minimise noise and vibration impacts on surrounding environment	9.1	Publish working hours clearly in all site induction documents.	Pre-commencement	6.4
		9.2	Observe stated operating hours.	Construction period	
		9.3	Encourage all employees and contractors to drive in courteous manner and avoid undue generation of traffic noise.	All stages	
		9.4	Ensure all equipment is good working order and noise attenuation equipment installed on all machinery.	All stages	
		9.5	Ensure deliveries of construction materials and equipment occur within operating hours.	Construction period	
10	Rehabilitation				
	Rehabilitation of gas pipeline corridor as soon as practicable post construction.	10.1	Ensure topsoil and trench spoil are clearly segregated within pipeline corridor.	Duration of construction period	2.7.10, 5.1 and 6.3
		10.2	Ensure topsoil is not placed back across working area until trench is adequately compacted to avoid settling.	Rehabilitation period	
		10.3	Stabilise topsoil with retained vegetation as soon as practicable to encourage natural regeneration of disturbed corridor.	Rehabilitation period	
		10.4	Re-establish previous land uses as soon as practicable after trench backfilling.	As area becomes available	
		10.5	Ensure land profile is re-established to previous or agreed condition.	Ongoing with periodic monitoring	
		10.6	Conduct ongoing monitoring and	Ongoing	

#	Outcomes		Action	Timing	EAR Reference
			maintenance of disturbed lands and subsidence.		
		10.7	Monitor corridor for weed species growth.	Ongoing	
		10.8	Undertake weed control and eradication where needs identified.	Ongoing/Project life	
11	Waste Management				
	Management of waste materials produced during construction phase.	11.1	Waste generated during construction is collected at staging points for regular removal by contractor.	Duration of construction period	6.6
		11.2	Waste materials collected for recycling where possible.	Duration of construction period	
	Management of waste materials during operational phase.	11.3	Condensate collected and disposed of appropriately.	Ongoing	
12	Consultation				
	All stakeholders are satisfied with the outcomes of consultation.	12.1	Establish a 24 hour toll-free complaints telephone line.	Prior to construction period	4
		12.2	Advertise to the community that construction is going to commence and provide regular updates of Project details.	Duration of construction period	
		12.3	Put the Project as an Agenda item for the Community Consultative Committee.	Ongoing	

8 Glossary and abbreviations

8.1 Glossary

Term	Definition
Acid sulphate soils	Soils containing iron sulphides that, when exposed to air, may oxidize and produce sulphuric acid.
Berm	A level space or raised barrier such as a mound of soil, that separates two areas, usually created for a specific purpose.
Carbon dioxide equivalent (CO_2 -e)	The amount of carbon dioxide in a mixture that would have the same global warming potential when measured over a certain timescale. It is calculated by multiplying the unit of gas by the global warming potential.
Community Consultative Committee	Standing meeting for the community to pass on or receive information relating to Macquarie Generation's existing activities and or upcoming Projects.
Corridor	An area for purpose of this EAR within which the pipeline alignment would be situated (50 m wide).
Director General's Requirements (DGRs)	The required considerations and inclusions for an Environmental Assessment under Part 3A of the *Environmental Planning and Assessment Act 1979*, and as outlined in documentation put forward by the Director General from the NSW DoP.
Easement	A right legally possessed by Macquarie Generation to use an area that will be designated for the operation of a pipeline.
Ephemeral	Temporary state or condition in nature; such as wetlands during the wet season.
Horizontal directional drilling (HDD)	Drilling a hole at a shallow angle through which a pipe is threaded. Employed in generally silty or gravely soil conditions, such as under a watercourse.
Hydrostatic testing	A method used to identify any leaks within the pipeline.
Lateral	A smaller diameter sized pipe that extends from the main pipeline to service a particular area or operation.
Right of way (ROW)	The area required for construction of the pipeline.
Riparian	Describes vegetation along watercourses.
Socio-economic	Describes the impacts or issues upon both society and the economy.
Spoil	Soil material, produced after an excavation.
Subsoil	Describes the soil layer that is situated directly beneath the topsoil layer.
Trench	A pipeline installation method that involves an exposed linear depression or cut in the ground.
Visual amenity	The visual and aesthetic quality of a public or privately owned property.

8.2 Abbreviations

Abbreviation	Definition
AGO	Australian Greenhouse Office
AHIMS	Aboriginal Heritage Information Management System
APIA	Australian Pipeline Industrial Association
CO2 e-	Carbon dioxide equivalent
DECC	Department of Environment and Climate Change (NSW)
DGRs	Director General requirements
DoP	Department of Planning (NSW)
DNR	Department of Natural Resources
DPI	Department of Primary Industries (NSW)
DWE	Department of Water and Energy (NSW)
DEWHA	Department of Environment, Water, Heritage and the Arts (Commonwealth)
EAR	Environmental assessment report
EMP	Environmental management plan (Construction/Operation)
ERSED	Erosion and sediment control structures
EP&A Act	Environmental Planning & Assessment Act 1979
EPA	Environment Protection Authority (NSW)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ESD	Ecologically sustainable development
HDD	Horizontal direction drilling
KP	Kilometre point
LEP	Local Environment Plan
LGA	Local government area
NES	National environmental significance
NSW	New South Wales
ROW	Right of way
RTA	Roads and Traffic Authority (NSW)
SEPP	State environmental planning policies

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