4.3.5 Fauna habitats

The suitability, size and configuration of the vertebrate fauna habitats correlate broadly with the structure, floristics, connectivity and quality of the local vegetation communities described above. The majority (93%) of the study area was dominated by highly disturbed derived grassland or artificially rehabilitated scrub/open forest. These communities provided a very limited array of habitat attributes. Table 4-2 below provides a summary of the observed fauna habitats and their association with the sites vegetation communities.

Table 4-2 Fauna habitats and vegetation associations in the study area

Vegetation Community (this study)	Fauna Habitat Type
Central Hunter Box - Ironbark Woodland	Dry Forest and Woodland, Tree Hollows
Central Hunter Spotted Gum Box Ironbark Open Forest	Dry Forest and Woodland, Tree Hollows
Hunter Lowland Redgum Forest (EEC)	Riparian, Aquatic habitat, Tree Hollows
Central Hunter Swamp Oak Forest	Riparian, Aquatic habitat
Hunter Valley River Oak Forest	Riparian, Aquatic habitat
Narrabeen Footslopes Slaty Box Woodland	Dry Forest and Woodland, Tree Hollows
Planted Rehabilitation Scrub-Open Forest	Regrowth and Planted Scrub
Derived Grassland	Aquatic habitat

The study area's better quality habitats comprised of the small patches of woodland and open forest, with smaller components of riparian forest (see Figure 4-2 a-d). These habitats were wholly, or in part, contiguous with much larger areas of bushland adjoining the study area. Finer-scale habitat features in and near the study area were observed to include limited foraging resources, tree hollows, hollow logs and riparian habitats, including ephemeral drainage lines and dams. These habitats and species associations are discussed below.

Generally, the fauna habitats within the subject site were in very poor condition in terms of their overall structure and the presence of microhabitat features, with evidence of significant levels of disturbance (e.g. clearing and grazing). The majority of the study area showed very poor structural integrity, in terms of upper, mid and groundcover layers, as well as sparse leaf litter and woody debris.

4.3.6 Species of plant

A total of 195 species of plant was recorded in the study area of which 135 species (69%) were native. The most diverse family recorded was the Poaceae (grasses) with 37 species followed by the Fabaceae and Asteraceae with 22 species each.

Seven species of plant listed under the *Noxious Weeds Act 1993* in the study area (see Table 4-3 below).

Table 4-3 Noxious weeds recorded in the study area

Name	*Noxious Weeds Act 1993* control category[1]
Ambrosia artemisiifolia (Annual Ragweed)	Class 5
Lycium ferocissimum (African Box Thorn)	Class 4
Rubus fruticosus (Blackberry)	Class 4
Salix sp. (Willow)	Class 4
Xanthium occidentale ('Noogoora Burr, Cockle Burr')	Class 4
Oxalis spp.	Class 5
Opuntia	Class 4

1. Noxious Weeds Act 1993: Class 4: The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority. Class 5: The requirements in the *Noxious Weeds Act 1993* for a notifiable weed must be complied with.

4.3.7 Threatened species of plant

Nine species of threatened plant listed under the *Threatened Species Conservation Act 1995* and/or the *Environmental Protection and Biodiversity Act 1999* have been recorded, predicted to occur, or have potential habitat in the project locality (see Appendix F). None of these threatened plants were observed within the subject site or considered likely to be affected by the proposal. However, two of these species, *Diuris tricolour* and *Bothriochloa biloba* were unlikely to be flowering during the survey period. Given the presence of potential habitat for these species, significance assessments, as required under the *Threatened Species Conservation Act 1995* and/or the *Environmental Protection and Biodiversity Conservation Act 1999*, have been completed with the summary of the assessment provided in Section 4.3.11.

4.3.8 Species of animal

A total of 70 vertebrate species of animal was recorded within the study area, as summarised in Table 4-4. The most abundant group was birds, followed by mammals. Only four introduced species were recorded, comprising 6% of the total species.

Table 4-4 Summary of fauna recorded in current surveys

Group	Native species	Introduced species	Threatened species
Amphibians	5	0	0
Reptiles	2	0	0
Birds	51	1	1
Mammals	12	3	2
Total	**70**	**4**	**3**

4.3.9 Threatened species of animal

Fifty-four threatened species of vertebrate fauna have been recorded or have the potential to occur within the project locality, including seven species of amphibian, 23 species of bird, 22 species of mammal and two species of reptile (see Appendix F, and Table 4-5). All species are listed under the *Threatened Species Conservation Act 1995* and 10 are listed under the *Environmental Protection and Biodiversity Conservation Act 1999*.

Table 4-5 Number of threatened species recorded or predicted to occur in the project locality

Group	TSC Act[1]	EPBC Act[2]	Total threatened
Amphibians	7	2	7
Birds	23	3	23
Mammals	22	5	22
Reptiles	2	0	2
Total	**54**	**10**	**54**

1. *Threatened Species Conservation Act 1995.*
2. *Environment Protection and Biodiversity Conservation Act 1999.*

It is unlikely that all the species recorded in the locality would be affected by the proposal. Despite the existence of records in the locality, 36 threatened species are considered unlikely to be significantly affected by the project for one or more of the following reasons:

- no habitat was recorded in the study area
- the area is outside the normal range of the species and records are likely to be vagrants or invalid.

Full details of species requirements and reasons for not considering impacts further for the project are provided in Appendix F.

Impact assessments, as required under the *Threatened Species Conservation Act 1995* and/or the *Environmental Protection and Biodiversity Conservation Act 1999*, have been completed for the remaining 18 species. These 18 species comprised:

- one threatened species, Grey-crowned Babbler, recorded during the current survey
- those species with potential habitat recorded in the study area
- those species recorded during detailed fauna studies completed within the study area or immediately adjoining the site (Biosis Research 2007, Umwelt 2006 and 2007, and ERM 2008).

In summary nine additional threatened species previously recorded by these local areas surveys surrounding the site and have been identified in Table 4-6.

Table 4-6 Threatened species recorded within local area studies

Threatened Species	ERM 2008	Umwelt 2006	Umwelt 2007
Speckled Warbler (*Pyrrholaemus sagittatus*)	Y	Y	Y
Grey-crowned Babbler (*Pomatostomus temporalis*)	Y	Y	Y
Brown Treecreeper (*Climacteris picumnus*)	Y		Y
Eastern Bent-wing Bat (*Miniopterus schreibersii*)	Y	Y	Y
Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)	Y		Y
Eastern Freetail-bat (*Mormopterus norfolkensis*)	Y		
Large-footed Myotis (*Myotis adversus*)	Y	Y	
Eastern Cave Bat (*Vespadelus troughtoni*)		Y	
Squirrel Glider (*Petaurus norfolcensis*)	Y	Y	

4.3.10 Migratory species

Migratory species are protected under international agreements to which Australia are a signatory, including the Japan Australia Migratory Bird Agreement (JAMBA), the China Australia Migratory Bird Agreement (CAMBA), the Republic of Korea Australia Migratory Bird Agreement (RoKAMBA) and the Bonn Convention on the Conservation of Migratory Species of Wild Animals. Migratory species are considered to comprise 'Matters of National Environmental Significance' and are protected under the *Environment Protection and Biodiversity Conservation Act 1999*.

A total of 13 migratory species have been predicted to occur within 10 km of the study area, based on the Department of the Environment, Water, Heritage and the Arts Protected Matters Search Tool. Six Migratory species of bird listed under the EPBC Act were recorded flying over or foraging within the subject site and study area.

While terrestrial migratory species of bird may potentially use the area, the site would not be classed as an 'important habitat' as defined *EPBC Act Policy Statement 1.1 Significant Impact Guidelines* (Department of the Environment and Heritage 2006a), in that the site does not contain:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species
- habitat utilised by a migratory species which is at the limit of the species range
- habitat within an area where the species is declining.

As such, it is unlikely that the project would affect migratory species.

4.3.11 Potential impacts

Vegetation clearing

The project would result in the removal of approximately 2.8 ha of vegetation (see Table 4-7), the majority of which is in poor to very poor condition. This includes approximately 0.02 ha of Endangered Ecological Community.

This extent of vegetation clearance is small in relation to that found within the wider region. For e.g., it represents 0.03% of the similar vegetation available within 10 km of the site.

Table 4-7 Extent of vegetation clearing and buffers of existing vegetation

Vegetation community	20 m corridor[1]	50 m buffer[2]	10 km buffer[3]	% cleared[4]
Central Hunter Box-Ironbark Woodland	0.8	12.8	3056	0.03%
Central Hunter Spotted Gum Ironbark Open Forest	0.1	2.3	5103	0.001%
Hunter Lowland Red Gum Forest[5]	0.0	0.9	95	0.02%
Hunter Valley River Oak Forest	0.3	1.7	176	0.19%
Planted Rehabilitation Scrub-Open Forest	1.5	11.4	380	0.39%
Narrabeen Footslopes Slaty Box Woodland	0.1	0.5	395	0.02%
Central Hunter Swamp Oak Forest	0.0	0.2	330	0.0

Vegetation community	20 m corridor[1]	50 m buffer[2]	10 km buffer[3]	% cleared[4]
Total	**2.8**	**29.8**	**9535**	**0.03%**

1. Area of project site to be cleared, based on ground-truthed vegetation mapping within the study area.
2. Current vegetation at 50 m distances from centreline of project site, based on the ground-truthed vegetation mapping within the study area.
3. Current vegetation at 10 km distances from centreline of project site, based on the Vegetation of the Central Hunter Valley, New South Wales. A Report on the Findings of the Hunter Remnant Vegetation Project. Final Draft Version 1. (Peake 2005).
4. Based on the extent of the community within 10 km of the study area (Peake 2005).
5. Listed as part of Hunter Lowland Redgum Forest, an Endangered Ecological Community under the *Threatened Species Conservation Act 1995*.

The vegetation to be removed contains very limited habitat features as it is predominately roadside regrowth. High quality habitat features such as hollow-bearing trees, are more widely available in the surrounding vegetation. The vegetation provides only limited habitat for a small range of mobile Threatened species.

Habitat fragmentation

Habitat fragmentation is the division of a single area of habitat into two or more smaller areas, with the occurrence of a new habitat type in the area between the fragments. This new dividing habitat type is often artificial and inhospitable to the species remaining within the fragments (Bennett 1990, 1993). Although the newly created habitat is generally used by some species, those species are usually generalists and are often considered aggressive (e.g. Noisy Miners, Grey *et al.* 1998), further decreasing population levels of the species remaining in the fragments. In addition to the loss of total habitat area, the process of fragmentation can impact on the species within the newly created fragments in a number of ways, including barrier effects, genetic isolation and edge effects. The degree to which these potential impacts affect the flora and fauna within the newly created fragments depends on a number of variables, including distance between the fragments, local environmental conditions, the species present and mitigation measures. Some of the potential impacts are summarised below:

- Barrier effects: Barrier effects occur where particular species are either unable or are unwilling to move between suitable areas of fragmented habitat. This could result in either a complete halt to movement or a reduced level of movement between fragments. Species most vulnerable to barrier effects include rare species (even a small reduction in movements can reduce genetic continuity within the population, hence reducing the effective population size), smaller ground-dwelling species and species with low mobility. Species least vulnerable to barrier effects tend to be those that are highly mobile (e.g. birds), although even these species can vary in their response to barriers.
- Genetic isolation: Genetic isolation occurs where individuals from a population within one fragment are unable to interbreed with individuals from populations in adjoining fragments. Genetic isolation can lead to inbreeding and genetic drift problems for populations isolated within a fragment.
- Edge effects: Edge effects are where a zone of changed environmental conditions (i.e. altered light levels, wind speed and/or temperatures) occurs along the edges of habitat fragments (see Section 5.3).

Habitat fragmentation increases the isolation of remnant vegetation and creates barriers to the movement of small and sedentary fauna, such as ground-dwelling mammals, reptiles and amphibians. One species at the site that may be affected by fragmentation is the Threatened Squirrel Glider. A study of the effects of clearing and habitat fragmentation on

Squirrel Gliders in the Wyong Local Government Area (Smith 2002a, 2002b) suggests that there is a strong relationship between Squirrel Glider numbers and density and the distance to the nearest remnant. Squirrel Gliders were found to be abundant in remnants isolated by gaps of up to 100 m, but scarce in remnants isolated by gaps of more than 250 m. The study further classified the remnant isolation as follows (see Figure 4-3):

- Class 1 – remnants connected to other remnants by a narrow corridor (up to 250 m wide).
- Class 2 – remnants separated from other remnants by a cleared gap (e.g. road or clearing) up to 100 m wide, but with a broad area of contact, including native vegetation on both sides of the gaps for a width of at least 250 m.
- Class 3 – as in Class 2 (above), but with a narrow width of contact is narrow (less than 250 m wide).
- Class 4 – remnants separated from other remnants by cleared areas of 100–400 m in rural environments or 100–200 m in urban environments.
- Class 5 – remnants separated by more than 200 m of urban habitat or 400 m of cleared habitat.

Vegetation in the study area is already isolated to a degree by infrastructure, including roads and transmission line easements. This isolation would largely by Class 2 (Figure 4-3). The project is unlikely to further isolate this vegetation, given its location adjacent to already disturbed areas.

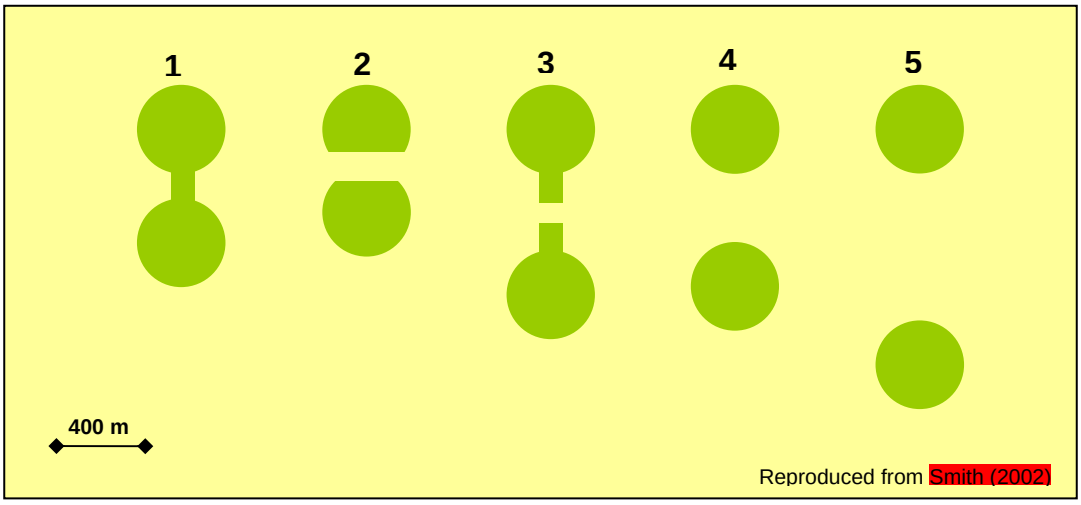


Figure 4-3 Remnant isolation classes

Although Squirrel Gliders were not detected within the study area during the current surveys, potential feeding and dinning habitat exists in vegetation within the subject site and this species has been previously recorded from similar, contiguous habitat adjoining the site (Umwelt 2006).

Vegetation in the study area is already significantly fragmented by mine infrastructure, including roads, and land clearing as a result of agricultural activities. The majority of the proposed corridor alignment will be located within existing cleared easements.

Following the definitions outlined by Smith (2002a) isolation of the local vegetation as a result of the proposed pipeline would largely fall in between categories Class 2 and 3

(refer Figure 4-3). However, the proposed pipeline is unlikely to further isolate or fragment this vegetation, given its location adjacent to already highly disturbed and modified areas.

The majority of the proposed pipeline corridor will be restricted to exiting highly disturbed road easements and is unlikely to increase the impact of barrier effects for some species and in some areas, or effectively isolate remaining fauna populations on either side of the pipeline corridor.

Edge effects

Edge effects are zones of changed environmental conditions (i.e. altered light levels, wind speed and/or temperature) occurring along the edges of habitat fragments. These new environmental conditions along the edges can promote the growth of different vegetation types (including weeds) and allow invasion by pest animals specialising in edge habitats. Edge zones can be subject to higher levels of predation by introduced mammalian predators and native avian predators. Edge effects have mainly been recorded adjacent to roads and at distances greater than 1,000 m from the road surface (Forman *et al.* 2000). However Bali (2000), in a comparison of edge effects in a variety of different habitat types, estimated that average edge effects generally occur up to 50 m away from the road edge. The distance of edge effects from a corridor is likely to be much smaller. A study of edge effects of a powerline easement in Eucalypt forest suggested that the easement corridor did not create an edge effect for small mammals like *Antechinus stuartii* and *Rattus fuscipes* (Goldingay & Whelan 1997).

The majority of vegetation within the study areas occurs within small patches, many of which are long and thin and already consist of edge-affected habitats from adjoining disturbances. Using the estimate of 50 m proposed by Bali (2000, 2005), no areas would be newly edge-affected within these remnants.

Erosion

Trenching for the pipeline and construction of the inlet facility would expose soils that have the potential to enter surrounding areas of vegetation and ephemeral waterways, if not properly managed.

Clearing of vegetation within the 20 m construction corridor will largely be restricted to relatively small areas subject to existing disturbance and is unlikely to result in significant areas of exposed soils or potential for significant erosion hazards.

Weeds

Sixty species of weed were observed in the study area, including seven species listed under the *Noxious Weed Act 1993.*

The construction of the pipeline has the potential to disperse weeds into areas of remnant vegetation where weed species do not occur currently. The most likely causes of weed dispersal associated with the project include earthworks, and the movement of soil and attachment of seed (and other propagules) to vehicles and machinery. This could in turn reduce the habitat quality of the site for Threatened species. The majority of the vegetation within the study area already contains significant weed infestations within the understorey.

Invasion of native vegetation communities by exotic perennial grasses is listed as a Key Threatening Process under the *Threatened Species Conservation Act 1995* (NSW National Parks and Wildlife Service 2003c). A variety of exotic perennial grasses species including,

Axonopus affinis, Paspalum dilatatum Hyparrhenia hirta, Eragrostis curvula, Chloris gayana were recorded within the subject site.

Noise

During construction of the project there would be increased noise in the local area. This could cause disturbance to fauna in the area, although, given the proximity of the pipeline to existing roads, mining and infrastructure, it is expected that the impact would be minor. Access for maintenance vehicles could cause intermittent disturbance; however, these impacts are also likely to be minor.

Mortality

Fauna injury or death has the greatest potential to occur during the break-out phase of construction when vegetation and habitats are being cleared. While some mobile species, such as birds, may be able to move away from the path of clearing, other species that are less mobile, or those that are nocturnal and restricted to tree hollows, could find it difficult to move rapidly over relatively large distances. Threatened species that could be affected by the clearing include microchiropteran bats and Squirrel Gliders.

There is a small chance of fauna mortality during the operation of the pipeline through vehicle collision from maintenance vehicles. Generally, rates of vehicle strike mortality are directly proportional to the distance of native vegetation/fauna habitat crossed by a project (Catharinus *et al.* 2006) and the number of vehicles present. Considering the nature of the project, this impact is likely to be very low.

4.3.12 Summary of the significance assessments

Fifteen impact assessments were completed, including tests for one Endangered Ecological Community, one Endangered flora population, two Threatened species of plant, and 20 Threatened fauna species (eight species of bat were considered together as a group and three species of forest owl were considered together). The assessments are presented in Appendix F and are summarised in Table 4-8.

Table 4-8 Summary of impact assessments

Threatened species, or communities	EPBC Act[1]	TSC ACT[2]	Likely significant impact?	Key Reasoning
Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions		E	No,	Small proportional loss considering communities extent in locality. Existing disturbances and condition.
Diuris tricolor (Pine Donkey Orchid) population in the Muswellbrook LGA		E2	No,	Not observed. Unlikely to be present due to existing disturbance of understorey. Small proportional loss of habitat considering extent in locality.
Diuris tricolor	V	V	No	Not observed. Unlikely to be present due to existing disturbance of understorey. Small proportional loss of

Threatened species, or communities	EPBC Act[1]	TSC ACT[2]	Likely significant impact?	Key Reasoning
				habitat considering extent in locality.
Bothriochloa biloba	V		No,	Not observed. Unlikely to be present due to existing disturbance of understorey,. Small proportional loss of habitat considering extent in locality.
Speckled Warbler		V	No	Small proportional loss of habitat considering extent in locality. Existing disturbances and poor condition of habitat.
Grey-crowned Babbler		V	No	Small proportional loss of habitat considering extent in locality. Existing disturbances and poor condition of habitat.
Brown Treecreeper		V	No	Existing disturbances and poor condition of habitat.
Black-chinned Honeyeater		V	No	Small proportional loss of habitat considering extent in locality.
Hooded Robin		V	No	Existing disturbances and poor condition of habitat.
Diamond Firetail		V	No	Small proportional loss of habitat considering extent in locality.
Large Forest Owls		V	No	Existing disturbances and poor condition of habitat.
Squirrel Glider		V	No	Small proportional loss of habitat considering extent in locality.
Grey-headed Flying Fox	V	V	No	Existing disturbances and poor condition of habitat.
Microchiropteran Bats (ex Large-eared Pied Bat)		V	No	Small proportional loss of habitat considering extent in locality.
Large-eared Pied Bat	V	V		Existing disturbances and poor condition of habitat.
Green and Gold Bell Frog	V	V	No	Existing disturbances and poor condition of habitat.

1. Threatened Species Conservation Act 1995, V = Vulnerable, E = Endangered. 2 – Environment Protection and Biodiversity Conservation Act 1999, V = Vulnerable.

The impact assessments conclude that the project is not likely to have a significant impact on Threatened species or communities, nor would it interfere with their recovery, assuming suitable mitigation measures are put in place.

With the implementation of suitable mitigation measures as outlined in this report, it is further unlikely that non-Threatened biodiversity would be placed at risk of local extinction.

The potential for significant impacts on vegetation and fauna habitats has been largely avoided through the route selection process for the pipeline. With appropriate mitigation measures as outlined in this document, it is unlikely that the project will have a significant impact on Threatened biodiversity, as listed under either the *Threatened Species Conservation Act 1995* or the *Environment Protection and Biodiversity Conservation Act 1999*.

4.3.13 Conclusions

Under the draft Guidelines for Threatened Species Assessment under Part 3A of the *Environmental Planning and Assessment Act 1979*, the objective of the biodiversity assessment process is to provide information to enable decision-makers to ensure that developments deliver a number of environmental outcomes. These outcomes have are outlined and discussed below.

Maintain or improve biodiversity values (i.e. there is no net impact on threatened species or native vegetation)

The Project will result in clearing of a very small area (2.8 ha) of largely disturbed native vegetation, including an Endangered Ecological Community and habitat for Threatened species. Given the proposed mitigation measures and the relatively small proportion of vegetation to be impacted within the locality (<0.03%), it is not considered necessary to develop offset strategies to fulfil this outcome.

Conserve biological diversity and promote ecologically sustainable development

The project has been designed to maintain vegetation in key areas along its length and restrict the development areas to areas of exiting disturbance. Biodiversity was a key consideration in the location of the proposed alignment.

Protect areas of high conservation value (including areas of critical habitat)

There is no critical habitat defined within the Project locality. The majority of the subject site is considered to consist of highly disturbed environments of little conservation value. The Project has been designed to maintain vegetation where possible, particularly at key locations, along its length.

A very small area (0.02 ha) of vegetation within the subject site does have high conservation value, given its listing as Endangered under the Threatened *Species Conservation Act 1995*. The Project has been redesigned to minimise the impacts on this vegetation and the mitigation measures recommended will ensure that this community will be suitably protected.

Prevent the extinction of threatened species

No Threatened species will become extinct as a result of the Project. Mitigation measures have been included to minimise impacts on Threatened species.

Protect the long-term viability of local populations of a species, population or ecological community

Mitigation measures have been recommended in this assessment to avoid and minimise impacts to local biodiversity. As a result, the long-term viability of most biodiversity will be protected.

Protect aspects of the environment that are matters of National Environmental Significance

The Project will not have a significant and long-lasting impact on any matters of National Significance.

4.3.14 Mitigation measures

A general principle of environmental management is to, in order of preference:

- avoid environmental impacts
- minimise impacts
- mitigate the impacts
- as a last resort, once the above options have been investigated, compensate for the residual impacts.

Impacts of the project on local flora and fauna have been significantly avoided and minimised through the route selection process.

In order to further minimise and mitigate impacts on the ecological values of the site, the mitigation measures in Table 4-9 are proposed to be implemented.

Table 4-9 Proposed mitigation measures

Mitigation measure
Prior to construction
▪ Prior to construction the route would be marked on the ground and walked by a trained ecologist and the design team in order to mark specific areas that should be avoided, either through minimising the construction zone or by modifying the alignment. The aim of this would be to avoid significant habitat features, such as large mature trees or threatened species and communities where possible.
Construction
▪ Suitable fixed fencing (e.g. colour tape or 'parawebbing' would be used to delineate the maximum width of work area permitted. This would be implemented prior to any work commencing on-site. If any tape is disturbed, it would be immediately replaced along the appropriate alignment. Construction work outside this area would constitute a non-conformance with the contract terms.
▪ Except for trenching, vegetation clearing would involve only the removal of above-ground plant parts, with root systems and the soil profile left undisturbed.
▪ Directional drilling launch and receiving pad areas would be carefully planned in order to avoid removal of mature trees or intact vegetation. If this is not possible, the number of trees to be affected would be minimised. It is envisaged, however, that any directional drilling would take place from within the cleared easement.
▪ Any dead logs within the development footprint would be moved to an adjacent area that is outside the construction footprint, thus minimising the loss of habitat structures.
▪ Vegetation clearing would be done during September/October or in March/May to avoid summer breeding seasons and the winter hibernation for hollow-dependent species.

Mitigation measure
▪ For any habitat trees to be removed, clearing protocols would be put in place. These protocols would include: ▸ All habitat trees in the area to be cleared should be identified (by survey) and marked. ▸ Marked habitat trees should be left standing after initial vegetation clearing for 2 nights (to encourage animals to disperse into adjacent uncleared habitat). ▸ All habitat trees should be shaken prior to feeling to allow potentially resident fauna to move on. ▸ All contractors should have the contact numbers of wildlife rescue groups should animals be injured during clearing.
▪ Compensatory nest boxes would be attached to trees with consideration of aspect, height and location appropriate for the target fauna species. The location of each relocated nest box should be recorded using GPS equipment during installation.
▪ Areas not necessary for the operation of the pipeline would be rehabilitated in a progressive manner as construction proceeds. This would include: ▸ Planting of a range of locally occurring and sourced native shrubs, trees and groundcover plants (Discussion would be held with Department of the Environment and Climate Change regarding the choice of species, particularly in areas where the revegetation would be adjacent to existing patches of native vegetation, including Endangered Ecological Communities). ▸ Inclusion of logs, dead trees and stumps in the landscaping works. ▸ Inclusion of foraging species, such as Allocasuarina for Glossy Black-cockatoos. ▸ Incorporation of existing natural vegetation where possible. ▸ Maintenance of plantings through a revegetation plan included in the Construction Environmental Management Plan.
▪ Soil that may contain seeds of exotic species would be stockpiled away from drainage lines, and vegetated areas and weed-free soil stockpiles. Weed infested stockpiles would be covered to eliminate the spread of the soil and seed during rainfall and high wind events.
▪ Where possible, branches overhanging the easement that are in the way of construction activities would be tied back for the duration of the construction rather than being cut.
▪ No materials, spoil or machinery would be stored or parked within the drip-line of any trees.
▪ Excavations around tree roots would be backfilled with soils that are free from weeds and harmful materials (including activated acid sulfate soils).
▪ Topsoil removed during trenching would be stockpiled nearby within the easement and replaced once the pipe has been laid. Care should be taken not to transfer topsoil between areas.
▪ Vegetative material removed along the easements would be retained in the area it is removed from to maintain the nutrient balance. The material would be chipped and spread over the cleared areas to assist in the prevention of regrowth, unless otherwise requested or agreed by the Department of Environment and Climate Change. Weeds would not be mulched, but rather bagged and removed from the site.
▪ Potential acid sulfate soils would be appropriately managed following suitable guidelines (e.g. Stone 1993).
▪ The amount of open trenching would be generally limited to 100 m per crew at any one time.
▪ Trenches would be backfilled so as to cover as much open trench as practicable by the end of each day's work. If this is not possible, the ends of the open trenches would be graded to allow escape for any animals that may venture into the trench.
▪ Excavated material would not be placed within 20 m of any drainage line.
▪ When accessing construction sites, contractors would use only designated access tracks.

Mitigation measure
Management and operations
▪ A flora and fauna management sub plan should be prepared for the operation of the pipeline. This plan would be prepared in conjunction with the flora and fauna management plan for construction of the pipeline. Completion of the flora and fauna management plan would form one of the licence conditions and therefore be finalised prior to the commencement of construction. This would include: ‣ Undertaking ongoing management of weed invasion in the easement to ensure weeds do not spread.

4.4 Heritage

4.4.1 Indigenous heritage

The aboriginal archaeological assessment conducted by Insite Heritage (attached in Appendix H), identified 15 archaeological sites in the vicinity of the proposed pipeline route. The majority of identified sites were of low significance, comprising of low density open artefact scatters or isolated finds. One large site Liddell EW 14 was identified in the pathway of the proposed route. Discussions with the project manager during the survey indicated that it will be possible to avoid the site and thus no known sites will be disturbed during construction.

Table 4-10 Significance assessment

Site Name	Site Type	Scientific Significance	Public Significance	Representative Significance
Liddell EW 1	Isolated Artefact	Low	Low	Low
Liddell EW 2	Artefact Scatter	Low	Low	Low
Liddell EW 3	Isolated Artefact	Low	Low	Low
Liddell EW 4	Isolated Artefact	Low	Low	Low
Liddell EW 5	Artefact Scatter	Low	Low	Low
Liddell EW 6	Isolated Artefact	Low	Low	Low
Liddell EW 7	Isolated Artefact	Low	Low	Low
Liddell EW 8	Artefact Scatter	Low	Low	Low
Liddell EW 9	Isolated Artefact	Low	Low	Low
Liddell EW 10	Artefact Scatter	Low	Low	Low
Liddell EW 11	Isolated Artefact	Low	Low	Low
Liddell EW 12	Isolated Artefact	Low	Low	Low
Liddell EW 13	Isolated Artefact	Low	Low	Low
Liddell EW 14	Artefact Scatter	Moderate-High	Moderate	Moderate-High
Liddell EW 15	Artefact Scatter	Low	Low	Low

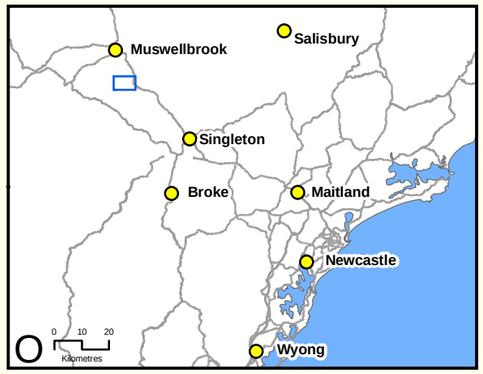
Given the heavily disturbed nature of the land over the remainder of the route and the Statement of Commitments that include specific procedures for Indigenous heritage management, no further archaeological investigation is considered necessary.

Mitigation measures

The following management recommendations are applicable to the route as surveyed at the time. Deviations from the surveyed route would require an additional assessment.

- Isolated finds and small scatters should be avoided by pegging of the site location and appropriate adjustment to the route.
- In order to avoid impacting site Liddell EW 2 it is recommended that the route be diverted around the site at this point. The community may wish to participate in monitoring of works at this point and to relocate any new artefacts disturbed by the works to the southern portion of the site.
- Due to the low visibility and the proximity to Tinkers Creek, the community may wish to monitor earthworks along the two drainage channels which flow east to Tinkers Creek.
- More artefacts are likely to be located around Liddell EW 7, 8, 9 & 10, but were not able to be located due to visibility constraints. The community may wish to participate in monitoring of works at this point and to relocate any new artefacts disturbed by the works.
- The preferred route option in the area of Survey Section 2 is to follow the transmission line easement across Chilcotts Gully, across the coal conveyor and along the vehicle track way to the point where the pipe line crosses the New England Highway. If the pipeline proceeds in the cleared eastern edge of the transmission line easement as proposed during the survey, impact on sites Liddell EW 7, 8, 9, 10 and 11 would be avoided. The immediate landscape context indicates an area of potential archaeological sensitivity. The impact on this area can be substantially reduced by placing the pipeline adjacent to the transmission line easement. This portion of the route, as close as feasible to the transmission line, should also be monitored by the Aboriginal community.
- Due to its significance it is recommended that the proposed works avoid Liddell EW 14. It is recommended that the route proceed as close as possible along the along the fence line of the New England Highway reserve, to the N-NE of the site. As the route crosses Bayswater Creek at this location, and due to the poor surface visibility and the recording of Liddell EW 14, it is recommended that this section be monitored by an archaeologist and the Aboriginal community.
- Liddell EW 15 can be easily avoided by the proposed works and therefore no further mitigation is required.
- The flood plain and terraces adjacent to Bowman's Creek have been previously identified as areas of archaeological sensitivity. It is recommended that under boring of the creek commence 35-40 m back from the creek edge to avoid trenching through the creek terraces. Due to the lack of visibility, no sites were identified by the survey in this area, however, it is recommended that the community be allowed to undertake monitoring of earthworks in the area from Brunkers Lane to Bowman's Creek.
- Previously recorded sites 37-3-0496 and 37-3-0499 were not re-identified by the survey but are located in the immediate proximity of the proposed pipeline route. It is recommended that the sites be staked prior to the proposed works and that impact on these sites be avoided by diverting the route around them.
- The community may wish to undertake monitoring in additional areas not previously mentioned due to the low visibility of a large proportion of the survey route.

In general if these mitigation measures are undertaken the development of the pipeline should have minimal impact on the archaeological resource of the area.



Liddell EW1
Liddell EW2
Liddell EW3
Liddell EW4
Liddell EW5
Liddell EW6
Liddell EW7
Liddell EW8
Liddell EW9
Liddell EW10
Liddell EW11
Liddell EW12

Bayswater Power Station

0 250 500 1,000
Meters

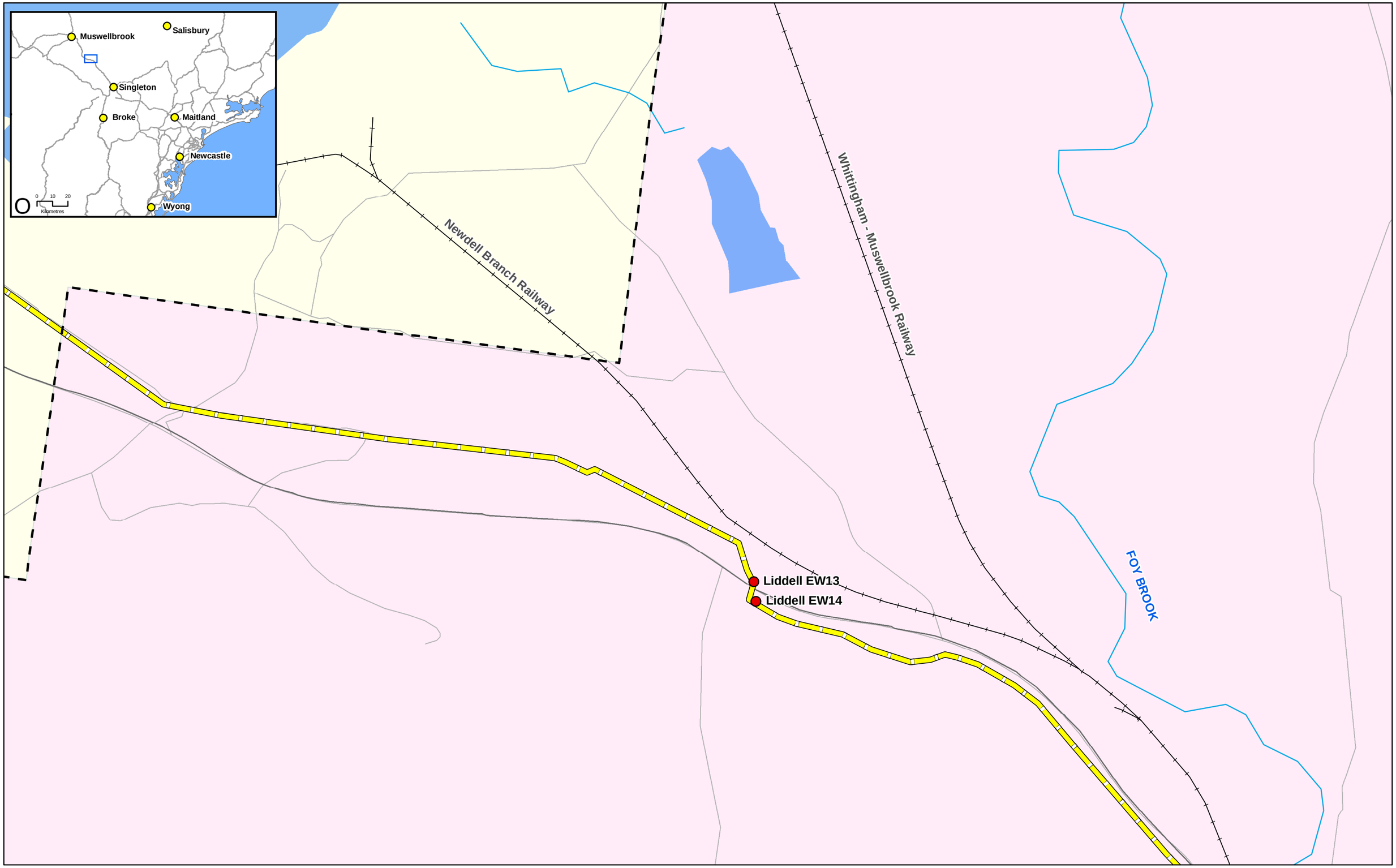
PDF Address: J:\A237 - HUN\PROJ\2122755C__UPL_MacGen_EW_\10_GIS\Maps\Month_Year\0918_Feb
PDF File: 2122755C_2001_Loc_Archaeological_sites

Localities
Drainage
Proposed Pipeline
Local Government Boundary
Archaeological Sites

Title: Location of Archaeological Sites

PARSONS BRINCKERHOFF

		Datum: MGA 94 / Zone 56	Scale: 1:20,000
Project: Gas Supply Pipeline		Drawn: JSR	Date: 18 Feb 2009
Client: Macquarie Generation		Designed: JSR	Date: 18 Feb 2009
Proj. No. 2122755C	Layout Size: A3	Checked: BG	Date: 18 Feb 2009
GIS Proj: J:\A237 - HUN\PROJ\2122755C__UPL_MacGen_EW_\10_GIS\Projects\Archaeological Maps		DWG. No: 2001	Fig. No. 4-4



0 250 500 1,000

Meters

Localities

Drainage

Proposed Pipeline

Local Government Boundary

Archaeological Sites

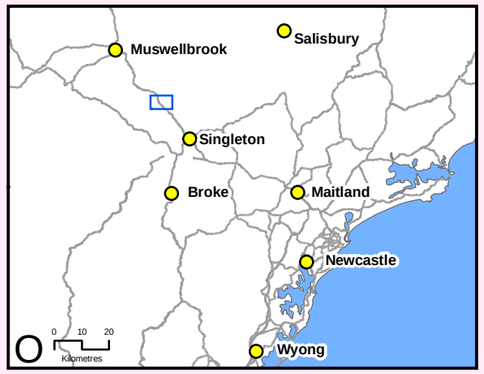
PDF Address: J:\A237 - HUN\PROJ\2122755C__UPL_MacGen_EW_\10_GIS\Maps\Month_Year\0918_Feb

PDF File: 2122755C_2002_Loc_Archaeological_sites

Title: Location of Archaeological Sites

PARSONS BRINCKERHOFF

Datum: MGA 94 / Zone 56		Scale: 1:20,000	
Project: Gas Supply Pipeline		Drawn: JSR	Date: 18 Feb 2009
Client: Macquarie Generation		Designed: JSR	Date: 18 Feb 2009
Proj. No. 2122755C	Layout Size: A3	Checked: BG	Date: 18 Feb 2009
GIS Proj: J:\A237 - HUN\PROJ\2122755C__UPL_MacGen_EW_\10_GIS\Projects\Archaeological Maps		DWG. No: 2002	Fig. No. 4-5



Ravensworth

Liddell EW15

FAL BROOK

0 250 500 1,000

Meters

PDF Address: J:\A237 - HUN\PROJ\2122755C__UPL_MacGen_EW_\10_GIS\Maps\Month_Year\0918_Feb

PDF File: 2122755C_2003_Loc_Archaeological_sites

- Localities
- Drainage
- Proposed Pipeline
- Local Government Boundary
- Archaeological Sites

Title: Location of Archaeological Sites

PARSONS BRINCKERHOFF

		Datum: MGA 94 / Zone 56	Scale: 1:20,000
Project: Gas Supply Pipeline		Drawn: JSR	Date: 18 Feb 2009
Client: Macquarie Generation		Designed: JSR	Date: 18 Feb 2009
Proj. No. 2122755C	Layout Size: A3	Checked: BG	Date: 18 Feb 2009
GIS Proj: J:\A237 - HUN\PROJ\2122755C__UPL_MacGen_EW_\10_GIS\Projects\Archaeological Maps		DWG. No: 2003	Fig. No. 4-6

4.4.2 Non-Indigenous heritage

According to the Singleton LEP there are a number of items of significance in the study area. Items of state, regional and local significance are presented in Table 4-11.

Table 4-11 Items of significance

Significance	Location	Item
State	Liddell, Old Singleton Road	Former Chain of Ponds Hotel
Regional	Rixs Creek, New England Highway	Rixs Creek Coke Ovens
Local	Ravensworth	Ravensworth Homestead

- National Heritage – Foybrook Cross Beds, New England Highway, Ravensworth. The cross beds are listed on the Register of the National Estate. The Statement of significance states:

  > The high walls of these two abandoned open cut mines expose a continuous formation of gain heterolithic crossbeds that are the deposits of a very large Gilbert type delta. Of the few other examples of such giant crossbeds known from the ancient rock record elsewhere in the world, the Foybrook exposures are regarded as the best example, unrivalled in scale and structure simplicity and, moreover, are unmatched in respect of their intimate stratigraphic association with coal seams (DEWR, 2007).

  The pipeline route will avoid the crossbeds and there is no potential for construction activities to have an adverse impact. No further consideration of the crossbeds is necessary.

Mitigation measures

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.

The Foybrook Cross Beds, located at Ravensworth, are on the Register of the National Estate. The proposed pipeline will be at least 150 m from the cross beds and thus it is seen that no items of local, regional or state significance will be impacted by the project.

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

4.5 Air quality

There are a number of land use activities in the locality that impact on ambient air quality. The local air quality is consistent with that of a mining community and is impacted by dust, noise, vehicle emissions and odours from mining and associated activities.

4.5.1 Products of combustion

As a part of determining the appropriateness of the proposed Project, various aspects of the Liddell Power Station operation have been reviewed. Each of the various aspects is discussed in detail in the following sections.

Changes to EPA License 2122

Liddell Power Station has an existing EPL (no. 2122). The EPL 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 DECC.

The gas to be supplied to the Liddell Power Station is classified as a 'Standard' fuel rather than an 'Alternate' fuel under the Protection of the Environmental Operations (Clean Air) Regulation 2000, Part 4 Division 1 Clause 20, Following Project discussions with the DECC, it is proposed that a request be submitted to vary EPL 2122 to include the handling and burning of coal gas fuel at the Liddell Power Station (Macquarie Generation, 2007c).

Once licence amendments are finalised, emission limits and licence reporting requirements 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 and thus it is seen that there will be no increase in the emissions rates for nitrogen oxides, methane and carbon dioxide under the current proposal. 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 600 ppm SO_2, 700 ppm for NO_2 and 20% for opacity (smoke) as measured in the flue gas exit paths of each boiler (Macquarie Generation, 2007c).

The combustion of coal as a solid fuel is inherently difficult to complete and due to its composition will always require disposal of 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 approximately 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 nitrogen within the coal gas (21.5%) is lower than in air (78%); therefore, using the gas as fuel should assist in lowering overall emission of oxides of nitrogen following combustion through dilution and changes to flame propagation (Macquarie Generation, 2007c).

Hunter Valley Gas Turbine (HVGT) plant emissions

The HVGT is powered by distillate and provides power to a number minor buildings and equipment on site. There remains the potential to use gas from the Project to fuel the 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. Emission monitoring is not required; however, the plant must comply with the Protection of the Environment (Clean Air) Regulation 2000 emission limit of 2500 mg/m^3 for NO_2. Current emission levels are approximately 350 mg/m^3 with lower levels likely by using coal seam gas as fuel (Macquarie Generation, 2007c).

4.5.2 Dust

Dust is a key issue in the study area due to cleared land, use of explosives, operation of earthmoving machinery, transportation by road and rail, and general agricultural activities such as cattle and crop rotation. Activities associated with the proposed pipeline that are most likely to generate dust include the following:

- removal of vegetation

- tracking of vehicles
- positioning the pipeline
- backfilling operations.

Following pipeline installation, the main activity likely to generate dust is vehicular movement along the route for monitoring and maintenance purposes. The construction period for each section of pipeline is expected to be minimal, with dust control measures implemented to minimise potential dust impacts.

Mitigation measures

Dust control will be considered as part of the CEMP produced by the contractor and is likely to consider measures such as the following:

- backfill each section of the pipeline trench as soon as practicable
- progressive rehabilitation of exposed surfaces
- minimise disturbance to existing vegetation
- monitor weather conditions for potential to generate dust
- utilise a water cart if required
- limit the work area to minimise disturbance at any one time.

4.6 Noise

The local environment has varied background noise levels based on proximity to the New England Highway, local roads, mines, and other associated activities. A significant portion of the pipeline route traverses existing coal mine land or Macquarie Generation properties that will not contain sensitive receptors. If at any time the construction works is audible by a sensitive receptor all construction activities within this area must be limited to the hours of 7 am to 6 pm Monday to Friday and at no time on Saturday, Sunday or public holidays. The normal working hours will be from 7 am to 6 pm Monday to Friday, 8 am to 1 pm on Saturday and at no time on a Sunday or public holidays.

4.6.1 Construction

Potential sources of noise during construction of the pipeline include vehicles, under-boring and trenching equipment and general earthmoving machinery. Impacts of construction and operation of the pipeline on local flora and fauna has been considered in Section 4.5. Due to the short-term impact of the pipeline construction and lack of sensitive users in the locality, it is not envisaged that construction noise will have a significant adverse impact on users in the pipeline route.

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. Table 4-12 details noise target levels from Chapter 171 of the ENCM which provides acoustic design objectives for construction activities.

Table 4-12 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).

It has been assumed that the construction period will be approximately 26 weeks in duration over the 25 km length of the pipeline; therefore, the acoustic design objective is Received $L_{A10} \leq L_{A90}$ + 10 dB(A). To mitigate any possible impacts of construction noise it is proposed that if construction works is audible by a sensitive receptor all construction activities within this area must be limited to the hours of 7 am to 6 pm Monday to Friday and at no time on Saturday, Sunday or public holiday.

4.6.2 Operation

Potential sources of noise during operation of the pipeline include vehicles traversing the route for general observation and maintenance. It is unlikely that movement of gas in the pipeline will cause an increase in ambient noise levels, particularly as the pipe will be covered with soil that will provide noise attenuation.

Mitigation measures

As previously stated, the pipeline route contains existing mines and associated operations. It is therefore likely that the low volume of vehicular movement along the route for general maintenance will not create a significant increase in noise emissions. No further consideration of operational noise is required.

4.7 Traffic

The pipeline route makes several crossings of public and private roads as follows:

- New England Highway at an existing services underpass near Liddell Power Station.
- Pikes Creek haul road (under-bore).
- The New England Highway near Ravensworth (under-bore).

There will be no interference with, or interruption to, normal traffic flows, either during construction or during ongoing operations. The exact construction traffic volumes will not be known until detailed design phase. There should not be any need for special arrangements with the delivery of materials and the proposed 500 mm diameter pipe is a common across different infrastructure areas. There will be no disruption to traffic on the New England Highway as existing structures or under-boring will be utilised for the ultimate highway crossings of pipe.

Once the pipeline is operational, a four wheel drive vehicle will likely traverse the route approximately twice per annum to inspect for any obvious maintenance requirements.

Mitigation measures

A traffic management plan will be prepared for any road crossings or work within road corridors. The traffic management plan will form a component of the CEMP. All necessary approvals will be gained from the RTA prior to works commencing.

4.8 Visual amenity

The pipeline will not be visible for most of its length once it is in place. The pipeline will only come to the subsurface where it connects to the power stations and at the delivery points. Remaining sections of the pipe will be buried with a cover of not less than 750 mm, with the route being identified by markers visible above ground. No additional infrastructure or above ground structures will be required. The visual amenity of the study area will be unchanged as the pipe will generally not be visible above ground and will traverse land that is already heavily disturbed.

Mitigation measures

Visual impact will be short term and minor as the pipe will be buried along its route. Where soil is exposed, it will be reinstated once the pipe is installed. Excess soil will be uniformly spread across the site to provide appropriate drainage along the pipeline route. Where the pipe crosses the highway it will be connected to existing infrastructure and will not create a significant visual impact. No further consideration of visual impact is required.

4.9 Waste management

There is the potential for impact on waterways and the terrestrial environment during construction and operation of the pipeline and as such the CEMP developed by the contractor will manage all construction waste. Waste management post-construction will involve minor maintenance works and removal of condensate from low points in the pipe.

Mitigation measures

The CEMP will consider issues such as:

- Manage all waste material and disposal activities in accordance with the provisions of the *Protection of the Environment Operations Act* 1997, the *Waste Avoidance and Resource Recovery Act 2001* and the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes* (DECC, 1999).
- Ensuring construction work sites remain clean and free of rubbish at the completion of the proposed construction works.
- Providing on-site emergency spill kits and training all staff in their use.
- Establish a designated waste disposal point to be cleared daily.
- Ensure all contractors are aware of their requirements in terms of environmental management.
- All measures should be taken to minimise the volume of waste generated and reuse the waste products where possible.

4.9.1 Condensate

Condensate forms due to changes in temperature and pressure of the gas and accumulates in low points in the pipeline. Removal of condensation 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.

Mitigation measures

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.

4.10 Bushfire

Sections of the proposed route can be considered bushfire prone due to proximity to existing vegetation, including the Warkworth Sands Woodland. Bushfire prone land is assessed under the *Rural Fires Act 1997* and *Planning for Bushfire Protection* guidelines. Pursuant to Section 75(U) of the EP&A Act, as the installation of a gas pipeline is not for a subdivision and is not considered a special fire protection purpose, it does not require a bushfire safety authority under Section 100B of the *Rural Fires Act 1997*.

Mitigation measures

The pipeline will be largely buried with a cover of not less than 750 mm and therefore not exposed to the elements for the majority of its length. The risk assessment conducted by Sleeman Consulting (Appendix D) concluded that there is potential for bushfires at isolated locations along the pipeline route. It was concluded in the risk assessment that as the pipeline is buried for its entire length with no combustible material present above ground bushfires are of no consequence (Sleeman Consulting, 2007).

4.11 Greenhouse gas

Australia is one of many countries experiencing 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 shifts 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 Partnership on Clean Development and Climate, Australia has agreed to support the development and deployment of cleaner, more efficient technologies to combat climate change. Major initiatives relevant to this application will begin to emerge during 2008.

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. The 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 (DECC, 2007a).

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 established annual state-wide greenhouse gas reduction targets. It also 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 (DECC, 2007a).

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

- Electricity generated at emission intensity lower than that of the designated NSW pool coefficient, referred to as the 'Relative Intensity Approach'.
- 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 (Greenhouse Gas Reduction Scheme, 2007).

Mitigation measures

The proposal involves utilising coal seam gas as a fuel in the generation of steam to produce electricity. The gas will otherwise be vented or flared to the atmosphere with no concurrent production of electricity. According to Macquarie Generation, reduced levels of coal will be required to produce electricity as the proposal will involve displacement of up to 5 million tonnes CO_2 equivalent by inclusion of coal seam gas in the boiler. The proposal has the potential to reduce levels of greenhouse gas emissions and thereby generate abatement certificates for the proponent through improved efficiencies.

4.12 General environmental risk assessment

An environmental risk assessment has been conducted for the proposed pipeline construction and ongoing operational activities. The assessment is of the residual risk in that the potential consequence and likelihood that environmental impacts will occur with the mitigation measures in place.

See Tables 4-13 and 4-14 below for a breakdown of the residual risk matrix and the environmental risk assessment.

Table 4-13 Risk assessment matrix

Consequence of Occurrence	Likelihood of Occurrence			
	Very Likely (could happen at any time)	**Likely** (could possibly occur sometime)	**Unlikely** (could possibly occur but vary 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 flora and fauna 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, habitats and/or aquatic ecosystems. Non-persistent but possibly widespread damage to land that can be remediated without lasting impacts to the land. Short term impacts on water resources.	High	Medium	Low	Low
Minor Impact on flora and fauna populations and/or habitat but no negative effects on ecosystem. No significant impact on water resources or sensitive environmental features.	Medium	Low	Low	Low

Table 4-14 Environmental risk assessment

Aspect	Potential Impacts	Consequence	Likelihood	Level of Risk
Air Quality	Temporary decrease in local air quality due to dust emissions.	Minor	Very Likely	Medium
	Temporary decrease in local air quality due to vehicle or machinery emissions.	Minor	Very Likely	Medium
Ecology	Significant impacts to threatened species.	Serious	Very Unlikely	Low
	Reduced conditions favourable for plant growth due to the construction disturbance.	Minor	Likely	Low

Aspect	Potential Impacts	Consequence	Likelihood	Level of Risk
	The introduction of weeds into the temporary disturbed area.	Moderate	Likely	Medium
Groundwater	Reduced groundwater availability for others users due to possible trench dewatering.	Minor	Very Unlikely	Low
	Deterioration in groundwater quality.	Moderate	Very Unlikely	Low
Greenhouse Gases	Increase in greenhouse gasses.	Minor	Likely	Low
Cultural Heritage	Disturbance to known Aboriginal sites of significance.	Serious	Very Unlikely	Low
	Disturbance to unknown Aboriginal sites of significance.	Serious	Unlikely	Medium
Land Use	Soil contamination form machinery fluid spill.	Minor	Likely	Low
	Decrease in available agriculture land.	Minor	Very Likely	Low
Noise and Vibration	Disturbance to sensitive receptor from noise and vibration.	Minor	Likely	Low
Socio-economic State	Decrease in pastoralist/agriculturalist income.	Moderate	Unlikely	Low

4.13 Hazard analysis and risk assessment

Risk exists in the form of risk to human health and the biophysical environment. As the coal seam gas is currently vented or flared to the atmosphere from various mines the main consideration is the release of unburnt gas in a pressurised form or explosive potential of the pressurised gas.

The pipeline does not require licensing by the EPA, notwithstanding the existing licensing of the Liddell Power Station. Therefore, measurable compliance standards must be established by the proponent such as leaks, emergency situations and/or construction standards for example.

4.13.1 Risk assessment

A risk assessment conducted by Sleeman Consulting (2008) found that industry standard practices are available for management of hazards associated with the proposed coal seam gas supply system. Risks arising from development and operation of the system are low. The risk assessment concluded it is not necessary to undertake a preliminary hazard assessment (Sleeman Consulting, 2008).

Issues considered in the risk assessment included third party activity resulting in gas leak, coal mine subsidence, open-cut coal mine blasting, failure of pipe material, over-pressure of pipeline, explosive pipeline contents, road and waterway crossings, natural phenomena and inadequate maintenance. Standard risk assessment classifications were utilised in terms of frequency and severity of a risk to provide a risk ranking. Risk rankings for all issues were low (Table 4-15). Therefore, no further analysis of risks considered in the assessment is necessary (Sleeman Consulting, 2008).

Table 4-15 Screening of hazards

Threat	Location	Protection/mitigation	Risk Assessment		
			Frequency	Severity	Risk Ranking
Third party activity resulting in gas leak	Above ground inlets to pipelines	Inlets will be located on coal company sites.	Improbable	Severe	Low
		Inlets will be fenced.			
		Fail-safe overpressure protection installed.			
	Along pipeline route	Pipeline buried (750 mm min. cover).	Unlikely	Severe	Low
		Clear signage.			
		Landowner liaison.			
		Routine patrols.			
		Pipeline in easement over private land.			
		Land use unlikely to cause interference.			
	Underground road crossings	Pipeline buried (1,200 mm min. cover).	Unlikely	Severe	Low
		Clear signage.			
		Routine patrols.			
	New England Highway underpass	Restricted access.	Unlikely	Severe	Low
		Pipe material selection.			
	Waterway crossings	Pipeline buried (2,000 mm min. cover).	Unlikely	Severe	Low
		Clear signage.			
		Routine patrols.			
	Water drains	Restricted access.	Unlikely	Severe	Low
Underground coal mine subsidence	Possible underground activity at several locations	Design to accommodate subsidence.	Occasional	Minor	Low
		Monitor induced stresses, remedial action if necessary.			
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
Explosive pipeline contents	Any location	Pipeline is buried with no source of ignition.	Occasional	Minor	Low
		In the event of leakage gas will dissipate.			

Threat	Location	Protection/mitigation	Risk Assessment		
			Frequency	Severity	Risk Ranking
Road crossings – mechanical damage	Crossings other than New England Highway	Pipeline buried (1,200 mm min. cover).	Hypothetical	Severe	Low
		Clear signage.			
Waterway crossings – exposure of pipe		Pipeline buried (1,200 mm min. cover).	Remote	Severe	Low
		Regular patrols.			
Natural phenomena	Any location	Pipeline buried.	Unlikely	Severe	Low
		Regular patrols.			
		Erosion control measures employed.			
Inadequate maintenance	Any location	Trained and qualified personnel.	Improbable	Severe	Low
		O&M procedures formalised.			
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

Source: Sleeman Consulting, 2008

4.14 Cumulative impact

Operation of the coal seam gas pipeline will not result in a cumulative environmental impact as it will involve minimal maintenance and the risk assessment concluded that there was a low risk on all threats. The route of the proposed pipeline traverses highly disturbed land that is unlikely to contain any items of heritage or ecological value.

Construction activities have the potential to cause adverse environmental impact. Potential environmental impacts during construction include noise, erosion and sedimentation, water quality, ecology, heritage and waste management. Where potential negative environmental impacts have been identified, appropriate mitigation measures are proposed. Subject to adopting the mitigation measures, it is unlikely any cumulative environmental impacts will occur as a result of the proposed coal seam gas supply pipeline.

5. Conclusion

The environmental issues highlighted in the EA, and the mitigation strategies suggested, suggest that the proposed Project may be approved under Part 3A of the EP&A Act, 1979. One key element is that the highly disturbed nature of the pipeline route significantly reduces the likelihood of additional adverse impacts on the existing environment. The history of disturbance along the route includes previous and current land use activities including power generation and coal mining. Native vegetation has been extensively cleared in the area and existing infrastructure along the route, in the form of access roads, pipes and conveyors, negates the potential for adverse environmental harm.

Where potential adverse impacts have been identified, appropriate mitigation measures will be utilised. Any key potential environmental impacts may be appropriately managed through implementing the mitigation measures included in this EA, and by the preparation and use of a CEMP.

6. References

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