4. Assessment of Environmental Issues

4.1 Introduction

This chapter identifies any new impacts or changes to impacts associated with the project as modified and any new measures to minimise, manage, monitor and/or offset impacts, including how these relate to the requirements of the concept plan / project approval (MP06_0029) and the Statement of Commitments. The Director-General's requirements identified the key issues to be addressed as flora and fauna, indigenous heritage, visual impacts and hazards and risk.

To enable the assessment of those key issues, the proposed development is described in the context of existing and proposed land use along the alignment. As impacts on soils and drainage may in turn result on impacts on biodiversity, a section dealing with the management of impacts on soils and drainage is also considered.

4.2 Land Use

4.2.1 Land Zoning and Local Planning Objectives

The land within the study area is located in the Shoalhaven Local Government Area (LGA) and has been zoned under the *Shoalhaven Local Environmental Plan 1985* (Shoalhaven LEP). The land zonings in the study area comprise agriculture and environmental protection. These zones and their objectives are listed in **Table 4-1** below. The land use zoning is shown in **Figure 4-1**. In addition to land zoning, the LEP classifies certain areas of land as "Scenic Preservation Area" and "Land of Ecological Sensitivity". Of relevance to the proposed transmission line development, a number of the land parcels zoned *1(d) General Rural* located south and west of the Bamarang gas turbine site have been designated as *Land of Ecological Sensitivity*.

The development restrictions applying to each land zoning classification are set out under Clause 9 of the LEP. For the purposes of these development restrictions, transmission lines are considered to constitute 'utility installations'. Notwithstanding any other provisions of the LEP or the provisions of other environmental planning instruments, utility installations are permissible with development consent from Shoalhaven City Council (SCC) in all of the above-listed zones, excluding Zone No. 7 (e) (Environment Protection "E" (Escarpment) Zone). In Zone No. 7 (e) (Environment Protection "E" (Escarpment) Zone), utility installations are classed as prohibited development. The provisions of Clause 9 of the LEP regarding development consent and permissibility are nullified, however, by the application of *State Environmental Planning Policy (Infrastructure) 2007*.

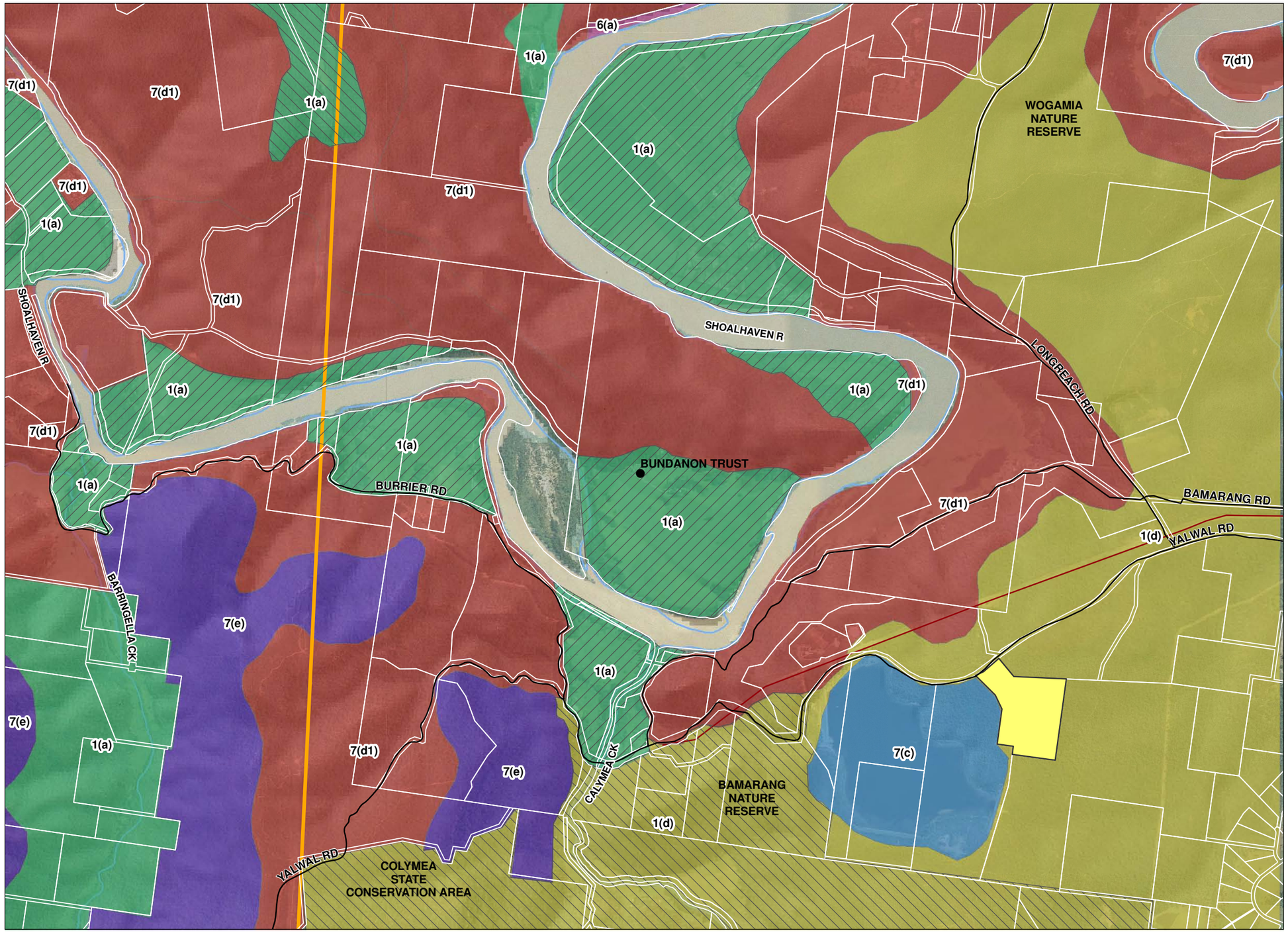
4.2.2 Existing Land Uses

The main land uses along the proposed alignment are:

- General rural and agricultural uses, including cattle grazing along the cleared low-lying areas adjacent to Calymea Creek;
- Environmental protection uses, including:
  - Nature Reserves and conservation areas gazetted under the *National Parks and Wildlife Act 1974* (NPW Act),
  - Unallocated Crown land that has been zoned for environmental protection under the Shoalhaven LEP, and
  - An area of designated water catchment surrounding the Bamarang off-river water supply storage reservoir (Bamarang Reservoir) managed by Shoalhaven City Council (SCC).

Table 4-1: Land Use Zoning

Land use Zoning	Zone Objectives
Zone No. 1(a) (Rural "A" (Agricultural Production) Zone)	To conserve and maintain the productive potential of prime crop and pasture land To ensure that existing or potential agricultural land use is not jeopardised by non-agricultural land uses To conserve cultural landscapes
Zone No. 1(d) (Rural "D" (General Rural) Zone)	To provide opportunities for a range of rural land uses and other development To recognise the potential for high intensity bush fire and ensures that it does not lead to significant risks to life and property To ensure consistency with the protection of important natural and cultural environments, the conservation of renewable natural resources, maintenance of opportunities for economic development of extractive resources and any plans for public infrastructure provision or management.
Zone No. 7(c) (Environment Protection "C" (Water Catchment Areas) Zone)	To protect water quality and ecological integrity within water supply catchment areas
Zone No. 7 (d1) (Environment Protection "D1" (Scenic) Zone)	To conserve and enhance scenic quality To protect natural and cultural features of the landscape which contribute to scenic value To ensure that development is integrated with the landscape values of the area
Zone No. 7 (e) (Environment Protection "E" (Escarpment) Zone)	To protect scenic, ecological, educational and recreational values of escarpment areas To conserve and, where appropriate, reinstate the natural vegetation so as to protect steep slopes from erosion and slippage To maintain the role of escarpments as habitat links between conservation areas



Legend

- 330 kV
- 33 kV
- Roads
- Waterways
- Proposed PS Site

Zoning

- 6(a) (Existing Open Space - Recreation)
- 1(a) (Agricultural Production)
- 1(d) (General Rural)
- 7(c) Water Catchment
- 7(d1) (Scenic)
- 7(e) (Escarpment)
- Scenic Preservation Area
- Land of Ecological Sensitivity

Data Sources

Aerial Photograph - LPI, NSW (2001)
Topodata - Streetworks
Cadastre - LPI, 2007

DISCLAIMER:
Zoning Data - Shoalhaven City Council LEP 1985
Zoning Data digitised from Council website :
http://gis.shoalhaven.nsw.gov.au/maps/
Data just for indicative and information purposes only, not intended to be as per council LEP.

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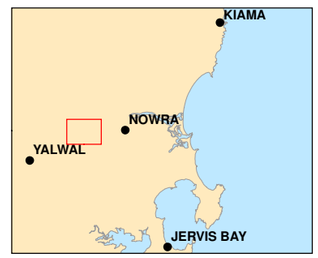

FIGURE 4-1: LAND ZONING

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The nearest urban area to the Bamarang gas turbine site is West Nowra, approximately 5 km to the east. The main changes in land use in the study area since 1999/2000 have been the changes in land tenure resulting from the Southern Forests Regional Forestry Agreement. Under this agreement, a significant amount of land (including that which is now included in Colymea State Conservation Area) was transferred from State Forest and Crown land to lands under the management of the Department of Environment and Climate Change (National Parks). There are no known formal public recreation facilities in the study area, although Bamarang Nature Reserve and Colymea State Conservation Area may be used for recreational activities such as bushwalking and sightseeing. Public infrastructure in the study area is largely limited to minor roads and transmission lines.

The principle land use constraints to the installation of a transmission line between the Bamarang gas turbine site and the existing TransGrid 330 kV line are the presence of Bamarang Nature Reserve, Colymea State Conservation Area and Bamarang Reservoir. The development of an alignment in these areas was avoided to the greatest extent possible for the following reasons:

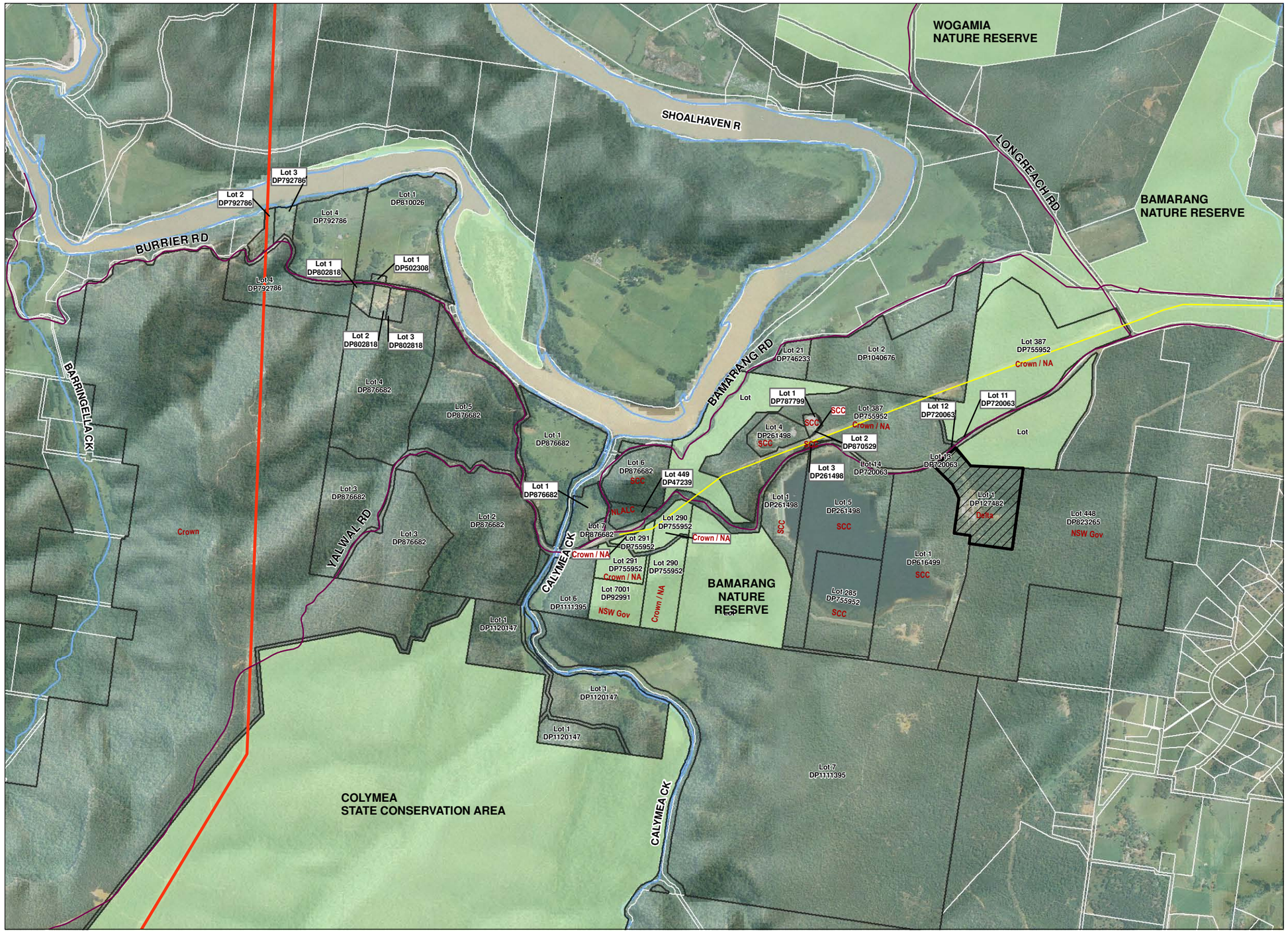
- the granting of new easements within Bamarang Nature Reserve and Colymea State Conservation Area would have the potential for impacts on nature conservation values and would require approval from the Minister for the Environment; and
- development within the zoned water catchment area of Bamarang Reservoir is likely to be considered a risk to water quality supplies for Nowra.

Additional land use considerations for the proposed development are its potential effects on agriculture, residential dwellings and public infrastructure.

4.2.3 Land Tenure

As well as the areas gazetted under the NPW Act and the lands owned by Shoalhaven Council forming the Bamarang Reservoir, the remaining land parcels in the study area comprise a mix of private land holdings and unallocated Crown land. Land tenure is shown in **Figure 4-2**, with full details of Lot/DP, current use and potential impact of the proposal outlined in **Table 4-2**.

As noted in **Table 4-2** a recent subdivision of Private Land 1 has occurred and the land is currently being offered for sale. The subdivision plan is shown in **Figure 4-3**.



Legend

Voltage

- 330 kV
- 33 kV
- Roads
- Waterways
- Proposed PS Site
- National Parks
- Property Searches

Data Sources

Aerial Photograph - LPI, NSW
Topodata - Streetworks
Cadastre - LPI, 2007

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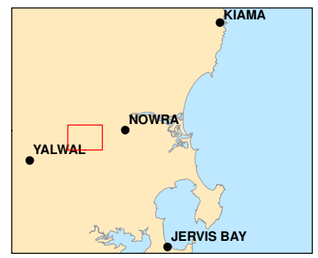

FIGURE 4.2: LAND TENURE

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Table 4-2: Land Tenure, Land Use and Potential Impact

Land Tenure	Land Use	Potential impact
Private Land 1 Lots 6 and 7, DP 1111395 Recently approved subdivision for rural residential lots (see Figure 4-3).	Unoccupied rural residential new lots 1-5 are being offered for sale. Location of the proposed house blocks shown on Figure 4-3. Lot 6 has approval for the construction of a house and land currently has a shed and accommodation on it to support house construction. No agricultural activity	Directly affected by proposal – transmission lines, poles and pylons.
Private Land 2 Lot 1, DP120147	Existing house at western end of property occupied by owner. New house under construction at same site. Farm sheds on property - used for some limited agricultural activity.	Not directly affected. Adjacent to proposal.
Private Land 3 Lot 2 DP 876682	Land unoccupied. No agricultural activity.	Directly affected by proposal – transmission lines, poles and pylons.
Private Land 4 Part of Lot 1 DP876682	Lot 1 has an occupied residence and is used for general agricultural activity. The residence is not on the part of the lot directly affected by the proposal.	Directly affected by proposal – line crossing but no poles or pylons likely on the land.
Private Land 5 Lot 3, DP 876682	Not directly affected but property is near the proposed alignment. Property unoccupied but building approval exists for property	Not directly affected. Adjacent to proposal.
NSW Government Lot 448, DP823265	Land adjoining the Bamarang gas Fired facility site. Occupied by gas pipeline easements. No agricultural use	Directly affected by proposal– transmission lines, poles and pylons.
Crown Land	Land at western end of proposed alignment, over which existing TransGrid Line 6 passes. No other formal use. Crossed by Yalwal Road	Directly affected by proposal– transmission line, poles and pylons.
Crown Land	Bed of Calymea Creek Council road access from Yalwal Road to Lot 1, DP120147	Directly affected by proposal – line crossing but no poles or pylons likely.
Shoalhaven Council Lot 285, DP 755952 Lot 1, DP 616499 Lot 5, DP 261498	Land associated with Bamarang Reservoir	Not directly affected. Adjacent to proposal.
DECC National Parks	Bamarang Nature reserve Colymea State Conservation Area	Not directly affected. Adjacent to proposal

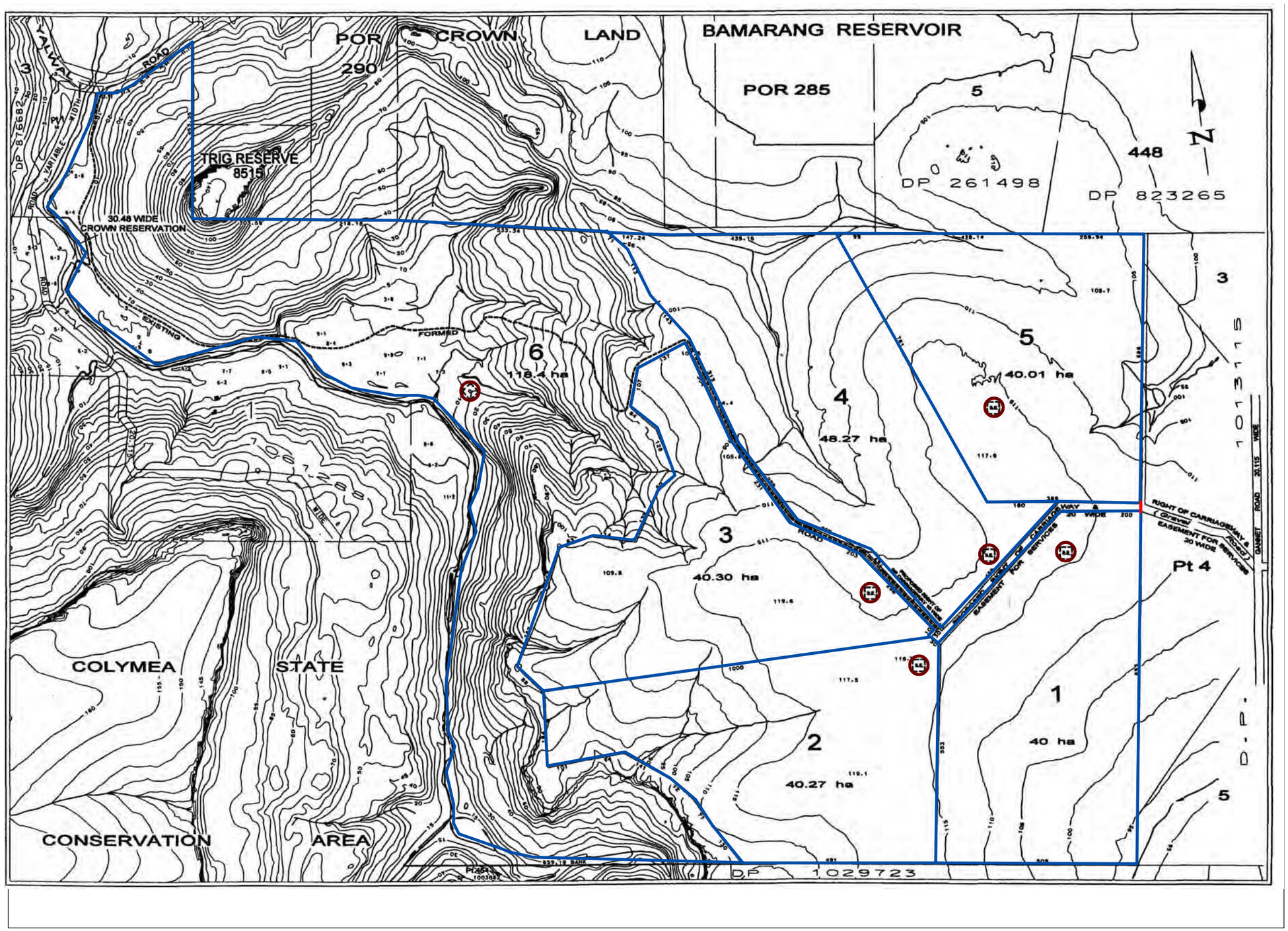

FIGURE 4.3: RECENT SUB-DIVISION OF PRIVATE LAND 1 (Refer to Table 4.2)

BAMARANG GENERATION 330 kV NETWORK CONNECTION

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4.2.4 Impacts on Land Use

Impacts on land zoning, use and tenure may result from the construction and operation of the new transmission line. Land zoning allows utility construction in all zones except 7 (e) Escarpment where it is prohibited. Although this prohibition does not apply to the development, the intent of the zoning still has merit and the crossing of the proposed alignment over land zoning which prohibits it represents an impact.

Land use will change, as land previously used for various purposes will now also be used for the carriage of a transmission line. Land ownership will not change as a result of the proposal, although tenure will change in so much as an easement will need to be negotiated over any land subject to the alignment, and reference to that easement will be noted on the land title. Financial compensation for that easement will be provided under the requirements of the *Land Acquisition (Just Terms Compensation) Act 1991*.

4.3 Flora and Fauna

A study was undertaken to document the methods and results of an assessment of the flora and fauna species, communities and habitats located in the vicinity of the proposed transmission line. The full report is provided in **Appendix B**.

The information presented is based on a review of available ecological data pertaining to the study area and field surveys along the proposed transmission line route. The data were used to assess the significance of potential impacts from the proposal on listed species, ecological communities and populations of local, regional, state and national conservation significance, and their habitats, which are known or considered likely to occur within the study area.

The Project is to be assessed under Part 3A of EP&A Act. In addition, the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) also applies to the Project. Further state legislation and planning policies relevant to the protection of biodiversity include:

- *Threatened Species Conservation Act 1995*
- *Native Vegetation Act 2003*
- *Fisheries Management Act 1994*
- *National Parks and Wildlife Act 1974*
- State Environmental Planning Policy No. 44 – Koala Habitat Protection.

Although licences and approvals under these state Acts and policies are not required in addition to the approval under Part 3A of the EP&A Act, consideration was given to their intent.

4.3.1 Existing Environment

Vegetation Communities

The vegetation communities/fauna habitat types identified in the study area from broad-scale mapping data (Gellie 2005) is described below.

- *Dry Shrub Forests*

Occurs on shallow, infertile soils in moderately exposed areas. This is the most abundant community, occurring as large patches throughout the majority of the study area. This broad vegetation community type is further divided into three separate vegetation map units with varied ecological attributes comprising Coastal Lowland Dry Shrub Forest, Jervis Bay Lowlands Dry Shrub Forest and Shoalhaven Gorge Dry Shrub-Grass Forest.

- *Heath Forests/Mallee Low Forests/Heathlands*

Occurs on exposed plateaus, slopes and escarpments on infertile sediments derived from Permian sandstone or granites. This vegetation community is relatively abundant in the study area, occurring as several medium-sized patches (ca. 60 ha). This broad vegetation community type is further divided into two separate vegetation map units with varied ecological attributes comprising Northern South Coast Hinterland Heath Dry Shrub Forest and Northern Plateau and Escarpment Heath Shrub Dry Forest.

- *Wet Sclerophyll Forest*

Occurs on protected slopes and gullies. This community is restricted to several small-medium areas (20-40 ha) in the study area, and is most extensive to the south of the study area in Colymea State Recreation Area. This broad vegetation community type has only the single vegetation map units in the study area comprising South Coast Foothills Moist Shrub Forest.

Threatened Flora

Of the 22 threatened flora species with potential to occur in the study area, 14 of these have a high potential to occur, two have a moderate-high potential and four have a moderate potential to occur in the study area based on the habitats identified in the broad-scale mapping data (Gellie 2005). The remaining two species have a low potential to occur in the habitats in the study area.

Threatened Ecological Communities

The threatened ecological communities which potentially occur in the study area were considered and, based on the vegetation communities identified by in the study area by Gellie (2005), and by the topography and soils of the study area, none of these threatened ecological communities are likely to occur in the study area. However, vegetation with affinities to river-flat eucalypt forest and Illawarra subtropical rainforests has a Moderate-High chance of occurring around Calymea Creek and rainforest areas may occur on protected escarpment areas.

Threatened Fauna

Of the 41 threatened fauna species with potential to occur in the study area, 34 of these have a high potential to occur in the study area based on the habitats identified in the broad-scale mapping data (Gellie 2005). A further five of these have a moderate-high potential to occur based on predicted suitable habitat attributes within Calymea Creek. The remaining two species have a low potential to occur in the habitats of the study area.

Migratory Species

The results of the EPBC Act 'Protected Matters' database search undertaken for the project indicated that there are 18 listed migratory species that could potentially occur within the study area. Four of these species, the Regent Honeyeater, Swift Parrot, Orange-bellied Parrot and Painted Snipe, are also listed under as threatened species under the EPBC Act and/or the TSC Act.

Critical Habitat

A search was undertaken of the State and Commonwealth critical habitat registers, maintained respectively by the NSW Department of Environment and Climate Change (DECC), the NSW Department of Primary Industries (DPI) and the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA). There is currently no registered critical habitat that is likely to be impacted by the proposed transmission line route. DECC has prepared a recommendation for the identification of critical habitat for the Bomaderry Zieria (*Zieria baeuerlenii*) within the Bomaderry bushland, located to the north east of the study area (DECC). This area would not be impacted upon by the transmission line route.

Conservation Reserves

There are two protected conservation areas within the study area, namely:

- Bamarang Nature Reserve
- Colymea State Conservation Area.

These areas have been gazetted under the *National Parks and Wildlife Act 1974* (NPW Act) and fall under the jurisdiction of the NSW Department of Environment and Climate Change (DECC). Both reserves are located in close proximity to the proposal area and presented constraints to the route selection for the proposed transmission line route.

Surveys undertaken

Site assessments for the proposed transmission route were conducted from the 23-27 February 2009. The extent and quality of native vegetation, fauna habitats and species diversity were recorded from an area approximately 100 metres wide along the proposed route, assessing the presence of endangered ecological communities and threatened species listed previously and

assessing the habitat qualities in the study area for threatened species. General vegetation and habitat data was also collected for the surrounding proximal lands. Full details of the methodology are provided in **Appendix B.** The majority of the proposed transmission line easement is situated within an un-disturbed landscape comprising naturally vegetated lands with little disturbance from agriculture, weed invasion or development. Some areas at the eastern end of the study area include cleared easements/ fire-breaks 10-15 m wide along fence lines.

Vegetation Communities

Eight native vegetation associations and two modified associations were identified along the proposed easement comprising:

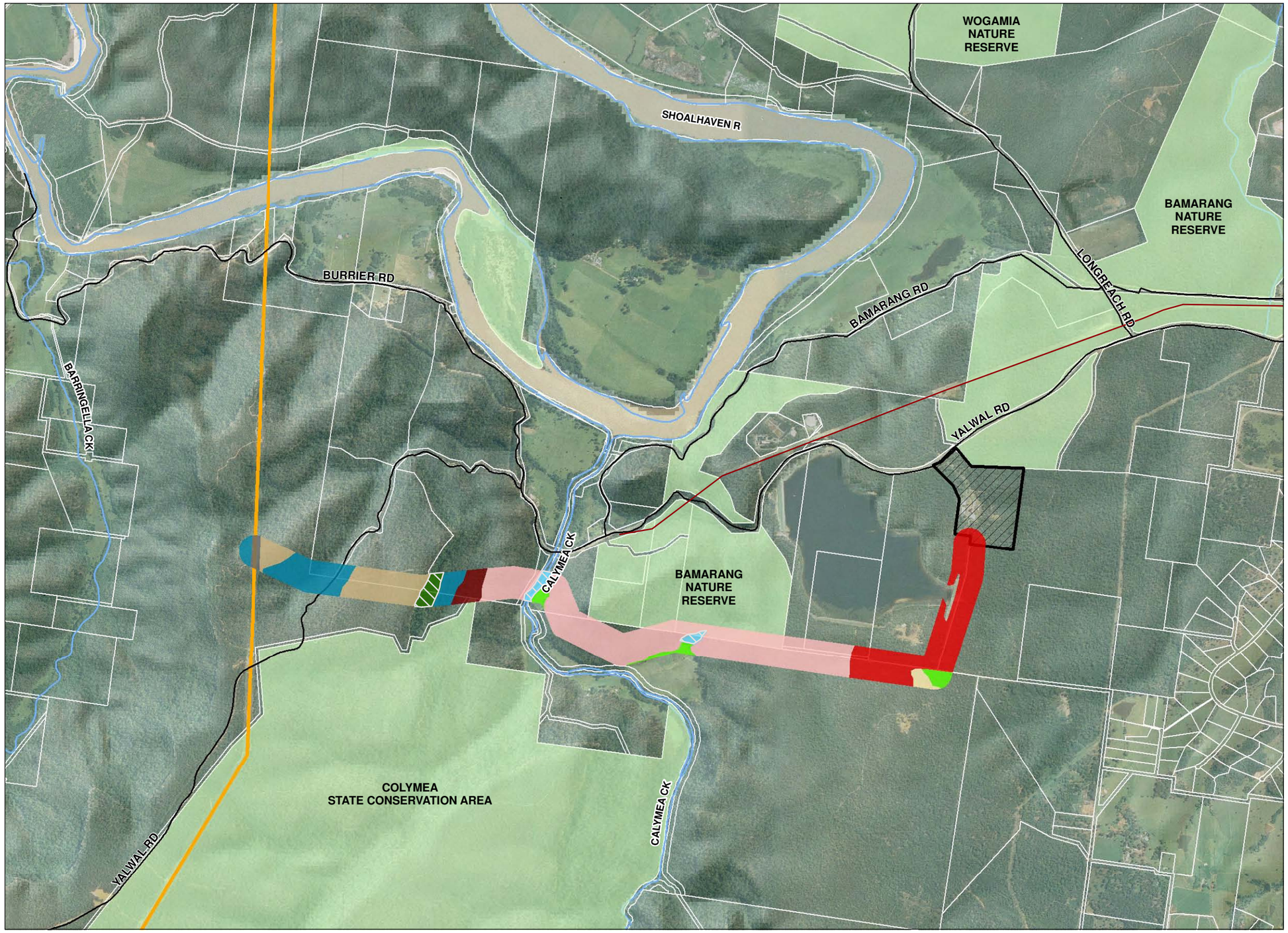
- Map Unit 1: Scribbly Gum - Red Bloodwood Heathy Forest;
- Map Unit 2: Spotted Gum - Red Bloodwood Forest;
- Map Unit 3: Blackbutt - Peppermint Forest;
- Map Unit 4: Wet Heath;
- Map Unit 5: Escarpment Heathy Woodland;
- Map Unit 6: Red Bloodwood - Apple Banksia/Paperbark Forest;
- Map Unit 7: Rainforest;
- Map Unit 8: Blue Gum/Bangalay Riparian Forest;
- Map Unit 9: Cleared - Transmission line Easement;
- Map Unit 10: Cleared – Pasture.

These are shown in **Figure 4-4**.

Fauna habitats

The naturally vegetated areas likely to be affected by the proposal comprise open dry and wet sclerophyll forest habitats with a range of topographic variation from river flat floodplain to steep sandstone escarpment. Much of the vegetation identified is characterised by a dense canopy and dense mid- and understorey strata with high structural and floristic diversity. Tree cover is represented by a diversity of age classes and mature and hollow-bearing trees are well represented in naturally forested areas. Logs and rocks are also abundant.

The habitats present provide a diversity of features for a high diversity of fauna due to the expansive areas of intact vegetation and presence of mature, hollow-bearing trees. The diversity of resources present ranging from the low open canopy of the heathy woodland with dense shrub cover to the rainforest and escarpment forests provide a diversity of habitat suited to a large variety of fauna species.



Legend

- 330 kV
- 33 kV
- Roads
- Waterways
- Proposed PS Site
- National Parks
- Endangered Ecological Communities

Vegetation Communities

- 1 - Scribbly Gum - Red Bloodwood Heathy Forest
- 2 - Spotted Gum - Blackbutt - Red Bloodwood Forest
- 3 - Blackbutt - Peppermint Forest
- 4 - Wet Heath
- 5 - Escarpment Heathy Woodland
- 6 - Red Bloodwood - Apple Banksia/ Paperbark Forest
- 7 - Rainforest
- 8 - Blue Gum/Bangalay Riparian Forest
- 9 - Cleared - Powerline Easement
- 10 - Cleared - Pasture

Data Sources

Aerial Photograph - LPI, NSW
Topodata - Streetworks
Cadastre - LPI, 2007

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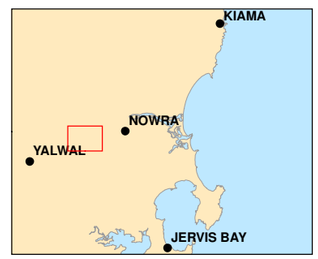

FIGURE 4-4: VEGETATION ASSOCIATIONS

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Calymea Creek and the associated instream vegetation provides potential habitat for the Black Bittern (*Ixobrychus flavicollis*), which has been recorded in the past along the nearby Flat Rock Creek. A complete list of fauna species recorded during the surveys is included in **Appendix B**.

The sandy soils and heathy vegetation provided potential habitat for ground-dwelling mammals such as bandicoots and the threatened Eastern Pygmy Possum (*Cercartetus nanus*). The hollow-bearing trees, extensive areas of Red Bloodwood and intact and connected vegetation also provided habitat for arboreal mammals such as the Greater Glider (*Petauroides volans*), Common Brushtail Possum (*Trichosurus vulpecula*) and Yellow-bellied Gliders (*Petaurus australis*) all of which were recorded from the surveys.

The numerous drainage lines across the study area provide potential habitat for a diversity of common frog species as well as the threatened Giant Burrowing Frog (*Heleioporus australiacus*). Limited habitat was also present for the Green and Golden Bell Frog along Calymea Creek and the adjacent drainage line that supported *Eleocharis sphacelata*. However given that the majority of the riparian vegetation along the creek supported a heath rather than grassy understorey, this is considered marginal habitat for the Green and Golden Bell Frog.

The open and exposed rocky escarpment areas along parts of the proposed easement are likely to provide suitable habitat for a diversity of reptiles including the threatened Broad-headed Snake Vegetation along the proposed easement supported abundant leaf litter, rocky areas and fallen logs and is therefore likely to provide good habitat for common reptiles.

A number of microbats were detected through echolocation recordings which included the Eastern Freetail Bat (*Mormopterus* sp.2), Large-eared Pied Bat (*Chalinolobus dwyeri*) and Gould's Wattled Bat (*Chalinolobus gouldii*).

Threatened Fauna

These habitats provide value to a diversity of bird, mammal, frog and reptile species. Populations of hollow-dependent fauna are expected to be well represented. Indeed the surveys identified the presence of the threatened fauna and potential habitat for threatened species, in particular:

- Grey-headed Flying-fox;
- Yellow-bellied Glider
- Forest Owls;
- Glossy Black Cockatoo;
- Broad-headed Snake;
- Large-eared Pied Bat; and
- Tree-roosting bats.

The Square-tailed Kite (*Lophoictinia isura*) and Regent Honeyeater (*Xanthomyza phrygia*) have been recorded in close proximity to the study area and potentially would occur in the habitats identified along the power easement. Indeed the extensive areas of Spotted Gum (*Corymbia maculata*) present throughout the study area are likely to provide foraging habitat for the latter species as well as the endangered Swift Parrot (*Lathamus discolor*).

Potential habitat is also present throughout the study area for the Bush-stone Curlew (*Burhinus grallarius*) and Eastern Pygmy Possum. This species feeds on pollen and nectar of *Banksia*, Eucalypts and understorey plants. Extensive areas of potential habitat for the Eastern Pygmy Possum are associated with vegetation with a heathy understorey.

Potential habitat for the Southern Brown Bandicoot is also present throughout the majority of the study area. The dense heathy understorey, sandy soils and presence of groundcover species such as Spiny Mat Rush and Grass trees (*Xanthorrhoea* sp.) have the potential to provide breeding habitat for this species while the areas of grassy understorey would provide foraging habitat.

Similarly, the Long-nosed Potoroo has the potential to occur across the study area and particularly in areas where there is a mosaic of heath for shelter and open areas for foraging.

Potential habitat for the White-footed Dunnart is present throughout the study area and in particular in areas where there was an open understorey.

Extensive areas of potential feeding habitat for the Glossy Black Cockatoo were recorded within and adjacent to the proposed power easement.

The study area provides extensive habitat for threatened forest owls including Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*) and Sooty Owl (*Tyto tenebricosa*).

Potential habitat for threatened bats occurs throughout the study area as evidence by the abundance of tree hollows and sandstone cave overhang.

Wildlife corridors and fragmentation

While there are no obvious wildlife corridors represented in the study area, the large expanse of connective habitat suggests that the proposed easement has potential to cause a degree of fragmentation which may impact on small ground-dwelling fauna. Mobile and wide-ranging species are not expected to be impacted significantly and in fact the opening up of an easement may benefit some species of fauna, such as edge and opening adapted species including the Masked Owl and microchiropteran bats.

Habitat trees

Hollow-bearing trees are present across the majority of the study corridor and mostly represented in Scribbly Gums with hollows also present in Grey Gum, Red Bloodwood and stags.

4.3.2 Impact Assessment

General Impacts

The proposed transmission line easement will require the partial removal/modification of approximately 30 ha of remnant vegetation based on the establishment of a 60 m wide easement and the substation site (similar in size but different location) in the power station lands. The areas of each vegetation community that will be removed are specified in **Table 4-3**. There is some scope to limit the amount of clearing in areas where vegetation will be below the required buffer distance between the vegetation and the proposed transmission lines.

Table 4-3: Potential removal / modification of vegetation communities

Map Unit	Community	Potential Removal / Modification (ha)
1	Scribbly Gum - Red Bloodwood Heathy Forest	6.6
2	Spotted Gum - Red Bloodwood Forest	13.57
3	Blackbutt - Peppermint Forest	3.25
4	Wet Heath	0.38
5	Escarpment Heathy Woodland	3.58
6	Red Bloodwood - Apple Banksia/Paperbark Forest	0.97
7	Rainforest (EEC)	0.67
8	Blue Gum/Bangalay Riparian Forest (EEC)	0.98
Total		**30 ha**

Areas where minimal vegetation disturbance can be achieved include:

- Clearing of the rainforest area below the cliff line (Map Unit 7) could be avoided by spanning across this area from the top of the cliff area, as an adequate buffer is likely to be achieved between the spanning transmission lines and the rainforest canopy;
- The Escarpment Heathy Woodland area (Map Unit 5) west of the cliff area which supports a sparse canopy approximately 10-12 m high and a dense shrub layer including several rare species. Clearing in this area could be restricted to taller trees and leaving the shrub layer intact, maintaining some biodiversity values;

- Gully areas where the transmission lines can span across above the existing canopy minimising the need for clearing such as Calymea Creek.

Rare and Threatened Flora Species

Impacts to rare flora species recorded in the study area will be limited to any individuals in the vicinity of the proposed pole locations and access trails provided the shrub layer can be retained within the proposed easement. Similarly, for threatened species, which potentially occur in the study area as many of these are shrub, herb or orchid species which can be retained within the easement, with direct impacts limited to the proposed pole locations and access trails. However, it is likely that clearing of the canopy and larger shrubs will result in changes to the species composition and vegetation structure of the understorey, which may or may not advantage some of these species.

Endangered Ecological Communities

The proposal will potentially result in impacts to up to 0.7 ha of Lowland Rainforest and 0.3 ha of River-flat Eucalypt Forest. There is potential for the transmission lines to span across these EECs as the topography surrounding these areas is likely to provide adequate height between the existing canopies and the spanning transmission lines. To present the worst case, this assessment assumes that these areas will be impacted upon.

Threatened Fauna Species

The proposal will remove approximately 30 ha of habitat which is potentially occupied by populations of several threatened fauna in particular the Grey-headed Flying-fox, Yellow-bellied Glider, Glossy Black Cockatoo, Eastern Pygmy Possum, Forest Owls, Ground-dwelling mammals and threatened microchiroperan bats. The loss of habitat will also remove hollow-bearing trees used by hollow-dependent fauna and important foraging resources for birds as well as fragment currently continuous areas of intact habitat.

Of particular consideration is the potential level of impact on local populations of the Grey-headed Flying-fox. The potential for impact on this species exists due to the presence of transmission lines and not the associated small loss of foraging habitat which is widespread and expansive in the region. Indeed continued use of the habitat surrounding the easement is expected and this will bring bats in potential contact with the overhead wires, a known threat to the species through contact and electrocution.

The location of the transmission line itself will not occur in close proximity to an identified roost camp such that frequent collisions and interruption to movements in the vicinity of a roost site will not occur. However, there is a risk associated with bats colliding and being electrocuted on the newly established overhead transmission lines while accessing foraging habitat. This risk can

potentially be mitigated if the transmission lines are constructed so that the wires are not arranged in one plane or are greater than 1.6 metres apart, that is, greater than the wingspan of a flying-fox.

Erosion and Sedimentation

The sloping topography in the proposal area suggests there could be impacts from erosion of disturbed soils during rainfall. Sedimentation and erosion controls are to be used during construction proposed easement and transmission lines and maintained where applicable. These structures should aim to limit excess nutrients and sediment leaving the proposed easement area. This is addressed in greater detail in Section 4.7.

Impacts to National Park Estates

The proposal will potentially have impacts to the following National Park Estates:

- Bamarang Nature Reserve to the south of the proposed easement area in the central area of the study area east of Calymea Creek;
- Colymea State Conservation Area to the west of Calymea Creek.

Clearing would be required to establish the proposed easement along the boundary of Bamarang Nature Reserve. This may potentially result in edge effects on Bamarang Nature Reserve, although the lack of weed invasion prevalent in this area suggests edge effects would not be significant. Weed management mitigation measures would be implemented with the proposal to ensure weeds are not spread along the proposed easement. The proposed easement is downslope of Bamarang Nature Reserve and therefore indirect impacts from erosion and run-off are not anticipated.

No impacts to Colymea State Conservation Area are anticipated with the proposed easement being located to the north of the park boundary.

Key Threatening Processes

A number of Key Threatening Processes are likely or have potential to be activated with the proposal including:

- Clearing of native vegetation;
- Removal of dead wood and trees;
- Predation by the European Red Fox and Feral Cats;
- Bush rock removal;
- Infection of native plants by *Phytophthora cinnamomi.*

Many of these key threatening processes can be avoided through implementation of the proposed mitigation measures. However, several cannot be avoided only minimised such as clearing of native vegetation, removal of hollow trees and predation by foxes.

Comparison of Alternative Transmission Lines

The differences in biodiversity impacts between the two alternatives comprise:

- the loss of 2.7 ha of vegetation for the 132 kV line, whereas the 330 kV line will result in about 30 ha lost;
- the associated relative impact of those losses on threatened fauna habitat;
- no direct loss of threatened flora species for either alternative;
- the potential loss in EECs of up to 0.7 ha of Lowland Rainforest and 0.3 ha of River-flat Eucalypt Forest for the 330 kV alternative compared with no direct effects for 132 kV line.

Environmental Planning and Assessment Act 1979

An assessment of the impacts of this proposal on species, populations and ecological communities listed under Schedules 1, and 2 of the TSC Act was undertaken. The proposal would be assessed under Part 3A of the EP&A Act and consequently this impact assessment was undertaken in accordance with the Draft *Guidelines for Threatened Species Assessment* (DEC 2005). This is provided in **Appendix B**.

The assessment has concluded that the proposed development is unlikely to impose a 'significant impact' on local populations of threatened species, endangered communities or their habitats as listed under the TSC Act, provided the recommendations of this report are adequately implemented.

This conclusion is based on the premise that the proposed development would not significantly reduce the area of land currently occupied by Endangered Ecological Communities and threatened species in the local area given its narrow linear footprint. The high conservation value of remnant vegetation in the area has been recognised and the proposed infrastructure associated with the project has been located where possible to minimise impacts on native vegetation including threatened flora, fauna and ecological communities.

Environment Protection and Biodiversity Conservation Act, 1999

The Proponent has a statutory responsibility to comply with the requirements and intent of the Commonwealth *Environment Protection and Biodiversity Conservation Act*, 1999 (EPBC Act) in relation to the protection and management of threatened species. This assessment deals specifically with the significance of impacts from the Proposal on nationally threatened species and commonwealth migratory species.

The assessment of nationally threatened species present within or known to utilise the study area has been undertaken in accordance with the significant impact criteria for endangered and vulnerable species as outlined in the Significant Impact Guidelines relating to matters of national environmental significance (DEH 2006) to determine whether the proposal would have a significant impact on any of these species, and hence on a matter of national environmental significance. The assessment is provided in **Appendix B**.

The assessment has concluded that the proposed development is unlikely to impose a 'significant impact' on local populations of national threatened species or their habitats as listed under the EPBC Act, provided the recommendations of this report are adequately implemented.

A number of listed migratory bird species have been recorded from the South Coast region which constitutes a part of the range area for migratory species such as the Satin Flycatcher, and Black-faced Monarch.

In regards to other migratory species, the areas proposed for upgrade of the power transmission project do not provide unique or critical habitat, preferred habitat, or habitat of significance for any of these species, and as discussed previously there would be very minimal impact on native vegetation resulting from the project. Construction of the proposed works would not affect the visitation rates and behaviours of these migratory species in the region.

4.3.3 Management and Mitigation

Vegetation Clearance

Where possible vegetation clearance would be minimised as much as practicable:

- By pruning of tree branches being preferred over full removal;
- By utilising existing trails and disturbed areas for access to power pole locations; and
- In gully areas and other topographic situations, which allow for sufficient distance between the existing vegetation and the proposed transmission lines, by retaining vegetation untouched.

Endangered Ecological Communities

The topographic elements surrounding the EECs in the study area provide opportunities to avoid clearing in these areas.

- River-flat eucalypt Forest along Calymea Creek would be retained through spanning the proposed transmission lines from pole/tower locations higher on adjacent slopes above the existing vegetation;

- The area of Lowland Rainforest is located beneath a steep escarpment area providing sufficient height to span across this area.

Fauna Habitat

Individual habitat features of conservation significance within the study area that would be avoided where possible by the proposed easement clearing include:

- Trees with hollows;
- Trees with a trunk diameter greater than 20 cm;
- Standing dead trees greater than 3 metres in height;
- Trees with bird nests;
- Riparian vegetation zones.

General habitat features of importance and appropriate management practices in the study area include:

- Fallen logs encountered within the works corridor would be pushed aside and retained in their natural state. Unless the area is required for access, timber felled for clearing would be retained on the ground as cover for terrestrial fauna;
- Minimising the loss of shrub cover and ameliorating any impact by the retention of felled vegetation to facilitate natural regeneration.

Large mature trees and trees with hollow cavities are considered significant microhabitat features for fauna as they provide shelter and breeding resources for species from all groups including birds, mammals, reptiles and frogs. The removal of hollow-bearing trees and hollow logs would be supervised by an ecologist to minimise direct impacts to fauna potentially sheltering in these habitats.

Weed and Pathogen Management

Although weed species are limited to areas adjacent to paddock areas surrounding Calymea Creek, weed management will need to be implemented during the construction phase of the proposal to limit the spread of exotic weed species. This would include:

- All construction machinery would be thoroughly washed down and sterilised as much as practicable to ensure weed propagules and pathogens such as Root Rot Fungus (*Phytophora cinnamomi*) are removed from equipment; and
- Any exotic species cleared during construction to be disposed of appropriately.

Vegetation Offset

To offset the impacts of vegetation clearance of this proposal, Delta Electricity will investigate compensatory habitat offset options in compliance with Clause 2.31 of the Stage 1 Project Approval (06_0029) and Clause 2.27 of the Stage 2 Project Approval (08_0021). The compensatory habitat package would consist of no fewer than two hectares of compensatory habitat for each hectare of vegetation removed as part of the project or as otherwise agreed by the DECC. Comparable habitats are widespread in the locality, providing a number of options for offsetting impacts. Specifications for the compensatory habitat, including location, composition, quality and management of the habitat would be determined in consultation with the DECC.

Minimising impacts to Grey-headed Flying-fox

This potential for impact on this species exists due to the presence of transmission lines and not the small loss of foraging habitat which is widespread and expansive in the region. Indeed, continued use of the habitat surrounding the easement is expected and this would potentially bring bats into contact with the overhead wires, a known threat through electrocution.

The location of the power line itself would not occur in close proximity to an identified roost camp such that frequent collisions and interruption to movements in the vicinity of a roost site will not occur. There is, however, a risk associated with bats colliding and being electrocuted on the newly established overhead power lines while seeking foraging habitat. This risk would be mitigated by the transmission lines being constructed so that the wires are not arranged in one plane or are greater than 1.6 metres apart, that is, greater than the wingspan of a flying-fox. The wires would generally be about 9m apart.

Induction of construction personnel

Construction personnel should be aware of the importance of the vegetation and habitats in the area and other sensitive features including hollow-bearing trees, standing dead trees, trees with bird nests, fallen logs, and shrub cover. All construction personnel would be inducted to the study corridor and be aware of their environmental responsibilities, including the preservation of endangered ecological communities, threatened species, tree cover and riparian habitats.

Construction personnel should inspect the trunk, foliage and limbs of any trees that require removal to prevent fauna mortality. If fauna species are present, these would be given the opportunity to move away from the construction zone prior to felling. Any animal injured during construction would be appropriately handled and transported to an animal care authority for attention. A stewardship would be encouraged over all fauna encountered, including poisonous snakes and no mortality of fauna should result knowingly from the construction.

4.4 Indigenous heritage

4.4.1 Introduction

An assessment of Indigenous heritage issues arising from the proposal was undertaken by OzArk and their report is attached as **Appendix C.** This investigation included the following aspects:

- A search of all relevant registers of information for both Indigenous and non-Indigenous heritage: the NSW Department of Environment and Climate Change (DECC) Aboriginal Heritage Information Management System (AHIMS); the NSW Heritage Office State Heritage Register and State Heritage Inventory; the National Trust of Australia (NSW) Register; the Australian Heritage Database and the Shoalhaven Local Government Area LEP;
- Review of the relevant literature including previous consulting reports, academic theses and articles and heritage studies undertaken for local councils;
- Consultation with the Nowra Local Aboriginal Land Council (LALC) and other registered stakeholders as per the *DECC Interim Community Consultation Requirements (*ICCRs) guidelines;
- Pedestrian field survey to identify and record cultural heritage sites along the proposed easement for the transmission line. This field inspection was undertaken between GPS points of proposed tower locations along the alignment where access was feasible. The specific survey methodology is described below;
- Assessment of the significance of recorded sites, the potential significance of the heritage resource along the corridor and the formulation of general and specific management options; and
- Completion of documentary evidence (e.g. DECC AHIMS Site Cards, NSW Heritage Council Inventory sheets for any sites/objects located during the survey for the notification of relevant authorities.

The results of the study are summarised in this subsection.

4.4.2 Indigenous consultation

The study corridor falls within the boundaries of the Nowra Local Aboriginal Land Council (LALC). Following the *DECC* ICCRs an advertisement seeking expressions of interest from Indigenous community organisations or individuals was placed in the South Coast Register on the 12th of March 2009. Letters were also issued to Aboriginal groups, individuals or organisations known to have an interest in Indigenous heritage within the Study Area. As a result of the notification phase, several more groups were identified and contacted regarding the project.

The Nowra LALC and Jason Davison replied and now form the Registered Stakeholder group for this project. Letters regarding the proposed assessment methodology for the upcoming heritage survey were sent to the registered stakeholder groups on the 5th of May 2009. Jason Davison

representing the Nowra LALC accompanied OzArk in the field on the 13th and 14th of May 2009. Discussions were held in the field along the easement between the archaeologist and the Indigenous representatives to develop potential requirements for mitigation or management measures.

4.4.3 Local Context and Desktop Results

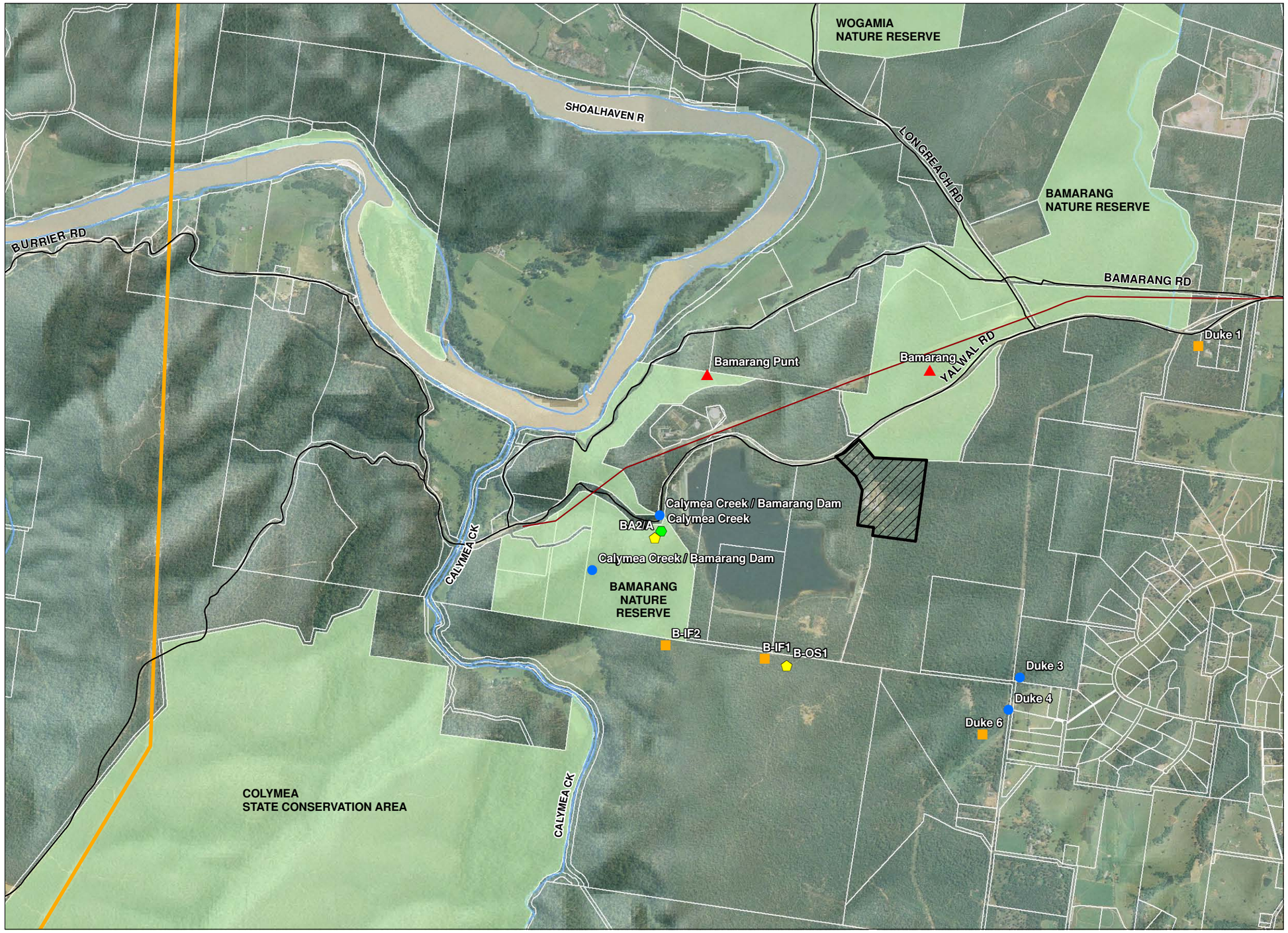
A search was undertaken of the DECC AHIMS database encompassing an area of c. 15 x 15 kms. This search revealed forty one (41) previously recorded sites. Shelters and open camp sites are the most frequently recorded, although there is a diversity of site types known for the area. Sites previously recorded from the area are shown in **Figure 4-5**.

In 1963 an archaeological study in the Calymea Creek / punt area on the edge of Bamarang Dam and recorded a large rock shelter site complex (DECC # 52-5-0005) including rock engravings, stone arrangements, rock paintings, axe grooves, carved trees and a quarry. The shelter has two well preserved paintings as well as Bondaian period points. Also recorded (a couple of miles west) were a few points and microscrapers at another site near Bundanon Punt. Near this site, a large rock shelf along the river with a number of axe grinding grooves was also recorded (#52-5-0093 and #52-5-0094).

A survey along Calymea creek in 1976 noted a large rock shelter which has since been amalgamated into the previously recorded site complex (#52-5-0005) and is two km from the Shoalhaven River. Slabs on the floor of the shelter have marks consistent with anvil usage.

The Bamarang Reservoir area was originally surveyed in 1981. Two sites (#52-5-0146 and #52-5-0158), both shelters with deposits, were recorded and both occur north of the Study Area. The shelters are located 1.5 km south of the Shoalhaven River over a low ridge. These sites are associated with other previously discussed sites; the shelter with art, occupation deposit and two axe grinding grooves located around 100 m on the opposite side of the creek (#52-5-0005) and a shelter with occupation deposit (on the opposite side of the creek).

An archaeological study of the Eastern Gas Pipeline (EGP) route in 1995 traversed part of the current study area near Yalwal Road. Three Indigenous sites were recorded as a result of this survey (sites #52-5-0304 to #52-5-0306) being a scarred tree, shelter with deposit and an open artefact scatter. Changes to the EGP easement led to other archaeological surveys close to the study area. These assessments recorded an isolated find (‘Duke 1’ #52-5-0371) and shelter with deposit (‘Duke 2’ #52-5-0368), although the coordinates pertaining to the shelter are in error as no sandstone exposures are present at the GPS location. The other ‘Duke’ sites are all east of the Study Area.



Legend

- 330 kV
- 33 kV
- Roads
- Waterways
- Proposed PS Site
- National Parks

Heritage Site Type

- Grinding grooves
- Isolated find
- Open camp site
- Shelter with Art & Deposit & Grinding grooves
- Shelter with Deposit

Data Sources

Heritage - AHIMS, DECC, NSW

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Kilometres

1:25,000 @ A3

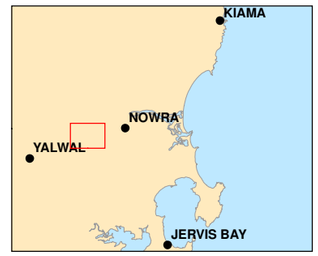

FIGURE 4-5: INDIGENOUS HERITAGE SITES

BAMARANG GENERATION 330 kV NETWORK CONNECTION

GDA 94 MGA 56

June 3, 2009
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An Aboriginal heritage and cultural mapping project for Nature Reserve Management was undertaken in 2006. Several sites were recorded within the Bamarang Nature Reserve with one open site with artefacts located within the current Study Area (#52-5-0457). The two artefacts were located on top of a spur crest south of Calymea Creek.

The Bamarang gas turbine facility and its proposed 132kV transmission line and pipeline easements were the subject of a review and surveys. It was noted that there is a high potential for artefact scatters to be located in undisturbed areas with rockshelters present in areas of sandstone outcropping and a survey of this area in 2005 recorded three aboriginal sites, an artefact scatter with potential archaeological deposit, an isolated find and a possible foothold / toehold tree. The artefact scatter included flakes, cores and a possible hammerstone / grinding stone.

Predictive Model for Indigenous Site Location

Using the concept of stream ordering, the following general predictions were made regarding the nature of sites and their location in the current study area (not taking into account factors of site preservation):

- The area surrounding first order streams and headwaters (i.e. first line drainage gullies) may contain evidence of sporadic occupation that may consist of little more than a background scatter of artefact material;
- In the vicinity of second order creeks, archaeological evidence may be sparse, but may indicate focussed activity (one-off camp sites and knapping events);
- In the lower reaches of tributary creeks (third order, Calymea Creek), archaeological evidence may be more frequent and intense, indicating more permanent or repeated occupation by small groups and may show evidence of concentrated activities;
- On major creek lines and rivers (fourth order, the Shoalhaven River) more permanent and repeated occupation may be evidenced by a more diverse stone tool assemblage indicating a greater range of lithic activities. Sites in this location may even be stratified;
- Creek junctions also provide a popular location for occupation and the size of the confluence (in terms of stream ranking nodes) may influence the size of the site; and
- Ridgetop locations between drainage lines are likely to contain limited archaeological evidence in the form of one-off activities, although can be home to stone arrangements or ceremonial sites.

From the known sites of the region outlined previously, it is possible to say that the most likely sites to be encountered in the study area are:

- Scarred trees (frequently close to creeks and rivers but also found further afield). Few mature trees of an age to bear cultural scars are likely to remain in the study area (due to logging),

although some remnant individuals may be present. Rarely, carved trees may also be present (unlikely, although two have been previously recorded in the area);

- Open camp sites are likely (on elevated terraces and low spurs close to water);
- Isolated finds may occur anywhere, especially in disturbed locations near water sources on red soil or in areas close to ephemeral water – i.e. headwaters;
- Rock shelter sites may occur wherever there are suitable overhangs / caves. The quality and extent of such features will determine the nature and type of potential occupation. The geomorphology of the Bamarang area lends itself to the occurrence of rockshelters on deeply incised gullies or near creek lines where sandstone is exposed;
- Midden deposits may occur in level, well drained rockshelters / terraces relatively close to an estuary or on elevated river banks;
- Natural mythological or cultural / ceremonial sites may occur anywhere, although are less likely on significant slopes; and
- Grinding grooves may be recorded in areas where appropriate sandstone is present, particularly near water and are known to occur in the mountain escarpment and close to Calymea Creek.

For the purposes of the current study, the site type definitions are presented in **Appendix C.** Finally, where ground surface disturbance and clearing are minimal, sites that may be present will be better preserved and hence have greater integrity and possibly therefore greater significance. These sites may be more important to preserve than sites that have been heavily affected already. Hence, in terms of Indigenous heritage preservation, agricultural land is more appropriate than undisturbed natural landscapes for potential developments.

4.4.4 Survey Methodology

The field survey methodology is described in detail in **Appendix C**. In general, using desktop predictive modelling as described above, aerial photographs of the area were examined to detect landscape features (including vegetation), waterways and potential food resources. This process identified areas of potentially high archaeological sensitivity (including creek lines and escarpments) to be targeted for assessment, although full pedestrian survey of the easement was attempted.

Landform hazards and property access meant that the entire easement was not surveyed. The usual survey efficacy issue of visibility remained a key factor of survey effectiveness and overall visibility was extremely low. The portions of the easement surveyed included from tower structure 21 through to 75 m east of tower structure 14, between tower structure 12 and half way between tower structure 8 and 9, and between tower structures 1 and 6. The portions not surveyed were left due to the challenging nature of the topography. These small unsurveyed portions would need to be assessed prior to construction, along with proposed access tracks and

compound areas, to ensure any sites identified would be able to be avoided in the design and construction works. Any Indigenous sites present are likely to be small and manageable within the development context or able to be avoided by project impacts. The same principles of management as developed within the current assessment can then be applied to newly recorded sites.

4.4.5 Survey Results

One open site and two isolated finds were recorded as a result of the field survey. The location of these sites is shown in **Figure 4-5**.

B-OS1 Nowra 1:50k 56 GDA 273127 E 6133985 N. Open site B-OS1 is located along an access track on private property (Lot 7 DP 1111395). The site lies near angle position 17 for the Bamarang 330kV transmission line and is located on an exposed vehicle track within a tall eucalyptus forest at an elevation of 99 m. Two artefacts were recorded within the 2 by 2 m track area with 80 % visibility on the track exposure and 5 % visibility off the exposure. It is considered likely that more artefacts may occur in the surrounding area though limited ground surface visibility prevents their discovery and thin topsoil make sub surface deposits unlikely. The first artefact measures 2.6 x 2.6 x 1cm and is made from silcrete. The second artefact measures 2.5 x 1.5 x .05 cm and is made from indurated mudstone.

B-IF1 Nowra 1:50k 56 GDA 2723127 E 6134030 N. Isolated find B-IF1 is located along an access track on private property (Lot 7 DP 1111395). The site lies near angle position 17 for the Bamarang 330kV transmission line and is located on an exposed vehicle track within a tall eucalyptus forest at an elevation of 99 m. This isolated find is a chert broken flake with three negative scars on the dorsal surface and small platform development. This isolated find is located approximately 150 m west of B-OS1 and may be considered associated.

B-IF2 Nowra 1:50k 56 GDA 273207 E 6133966 N. Isolated Find B-IF2 is located along an access track on private property (Lot 7 DP 1111395). The site lies near angle position 15 for the Bamarang 330kV transmission line and is located on an exposed, rarely used vehicle track on an elevated ridge top in a tall eucalyptus forest at an elevation of 107 m. This isolated find is a silcrete flake with two negative scars on the dorsal surface and small platform development. The silcrete has a stone inclusion within the material. It is likely that the artefact is not *in situ* and may be a drop artefact rather than part of a formal campsite. There is therefore a low likelihood for sub-surface archaeological deposits to be present in the immediate vicinity of the find due to the skeletal nature of the soils.

4.4.6 Aboriginal Site Distribution

The location of sites recorded during the present survey overall conforms to the predictive model set out above. The predominance of artefact related sites, which comprise all of the recorded sites (albeit a small sample) is thought to reflect the enduring nature of Aboriginal stone artefacts in the face of land use practices that can be very deleterious to other site types, e.g. scarred trees; stone arrangements, bora grounds etc. as well as the fact that these would have been the most common site types along with scarred trees.

The main factor influencing Aboriginal site detection was visibility. There were few areas that had high visibility and these were often on low potential landforms, generally some distance from permanent water (over 600 m) and on low potential of landform for long term occupation sites.

Overall the proposed alignment traverses landforms such as slopes / wooded spurs that have a low potential for occupation sites and are relatively distant from permanent water.

The topography of the easement between proposed tower structures 6 and 8 comprises a high sandstone escarpment dropping off to the east into Calymea Creek. Consequently, due to proximity to water and possibly appropriate landform, these locations are preliminarily assessed as having moderate archaeological sensitivity for the presence of Aboriginal sites including shelters or grinding grooves. This assessment of potential Aboriginal sites is further supported by several rock shelters with deposits or art previously recorded in the immediate vicinity in congruent sandstone escarpment.

4.4.7 Assessment and Management of Potential Impacts

Aboriginal Site Assessment

This area of assessment concerns the importance of a site or features to the relevant cultural group - in this case the Aboriginal community. Aspects of cultural significance include assessment of sites, items, and landscapes that are traditionally significant or that have contemporary importance to the Aboriginal community. This importance involves both traditional links with specific areas as well as an overall concern by Aboriginal people for their sites generally and the continued protection of these. This type of significance may not necessarily be in accord with interpretations made by the archaeologist.

The significance of the archaeological sites located within the Study Area was addressed with the community representatives during survey. Conversations held with the representatives of the Nowra LALC determined that all site types are culturally significant to the Aboriginal community because they provide physical evidence of Aboriginal occupation of the local area. In this respect, all Aboriginal sites located on this survey are considered to be of high significance to the Aboriginal community and potentially the community at large.

Scientific significance

Assessing a site in this context involves placing it into a broader regional framework, as well as assessing the site's individual merits in view of current archaeological discourse. This type of significance relates to the ability of a site to answer current research questions and is also based on a site's condition (integrity), content and representativeness.

The overriding aim of cultural heritage management is to preserve a representative sample of the archaeological resource. This will ensure that future research within the discipline can be based on a valid sample of the past. Establishing whether or not a site can contribute to current research also involves defining 'research potential' and 'representativeness'.

The scientific assessment of sites, as described above, revolves around the known local context of the site type (i.e. are there many, some or no such features known locally). The overall location of sites discovered during the current survey conforms to the general archaeological settlement pattern that has already been established throughout the broader region.

The small open camp site and isolated finds recorded along disturbed access tracks, provided few artefacts, which impacts upon their on their scientific significance because it is a limiting factor in the amount of information they may be able to provide. Overall the scientific significance of isolated finds is low unless they are, in some way, rare. Both isolated finds are not rare examples of artefact types or materials and are assessed as having low scientific significance.

Both the open site and isolated find located during the present survey are also assessed as having low public significance due to their small artefact manifestation on eroded unmapped tracks. They are also all located on privately owned land causing them to be inaccessible to the general public. Sites such these are difficult for the lay person to interpret or access.

4.4.8 Mitigation and Management Measures

Although the general impacts of this project are known through the description of proposed works, the precise location of tower structures in relation to indigenous sites recorded is not yet known. Thus, exact impacts of the proposal are unknown until final design has been undertaken. It is important, however, that the design should take into account the location of these sites and attempts to avoid them. In terms of the small portions of the alignment not assessed, these would require survey work to be undertaken before design is completed and construction begun. The study area covers a variety of landforms including gullies with associated ephemeral drainage features, spurs and ridgelines as well as some small areas of escarpment, creeks and floodplain. Based on the broader regional archaeological context and local recordings, it is considered that the study area has the potential to have a number of different site types depending on the local environmental conditions. As a result, the following recommendations by the heritage consultant will be implemented:

- All proposed works are to remain within the area assessed in this report;
- Of the three recorded Indigenous sites along the proposed alignment, all will be avoided by the project impacts, although they may require the implementation of appropriate site management measures to ensure no inadvertent impacts occur;
- All management of Indigenous sites in relation to the proposal would form part of the Statement of Commitments for the project which will eventually be embodied into an AHMP or CEMP. Development of these management documents would occur in consultation with the Indigenous community. Management measures may include that:
  - If identified sites can be avoided, they would be identified in the field prior to any construction impacts occurring. An appropriate curtilage would be delineated around these sites using a highly visual physical barrier (i.e. 1 m high orange roadwork fencing). This would ensure all sites can be easily identified and protected from inadvertent machinery impacts. Should sites be in areas where tracks are required, mitigation may include protecting sites from the impacts of vehicles through the use of geofabrics, matting and materials imported to cover site areas for the construction period;
  - If sites cannot be avoided, depending on the assessed level of significance, their management may include the test/salvage excavation of these sites, or simply the collection of artefacts prior to construction impacts occurring;
- In defining the remaining project impacts, the following guiding principles will help reduce impact to the Indigenous heritage resource:
  - Attempts to avoid direct impacts within 100 m of any waterway that the proposed line transects, as these are ‘sensitive’ in terms of Indigenous site location. Such areas should be spanned where possible;
  - Avoid any sandstone overhangs. Although most of the line surveyed to date did not possess overhangs suitable for human habitation, the area east of the proposed structure 6 (unsurveyed) has potential;
  - Ensure that the inaccessible portions of the line are assessed once design detail has determined where impacts in these areas may be; and
  - Ensure survey is undertaken for all access tracks – existing, those to be upgraded and newly proposed;
- Members of the construction team, including sub-contractors, machine operators and truck drivers would be required to undergo site induction concerning cultural heritage issues, prior to working on the site. This would preferably be undertaken by an individual who has a good working knowledge of Indigenous sites and of the legislation protecting them. This induction should inform workers/contractors of the location of nearby sites, and of their legislative protection under Section 90 of the NSW *National Parks and Wildlife Act 1974*. These

inductions would be recorded in a register, with all those present signing their complicity with these guidelines and the Conservation Environmental Management Plan (CEMP).

- Should any previously unidentified Indigenous 'objects' or other Aboriginal sites (such as burials) be uncovered during the course of construction, work in that area would cease and the DECC Regional Archaeologist (Queanbeyan Office), and the Nowra Local Aboriginal Land Council would be contacted to discuss how to proceed.

4.5 Visual Impacts

4.5.1 Introduction

The study area is an area of high scenic value. A number of land parcels within and adjacent to the study area have been classified as "Scenic Preservation Area" under the Shoalhaven LEP in recognition of their scenic qualities. Visual impacts are therefore recognised as a key issue for transmission line route location and design. In terms of visual impacts, the main constraints to transmission line route selection and design are the potential visibility of the line in or from:

- land classified as "Scenic Preservation Area" under the Shoalhaven LEP (**Figure 4-1**);
- Bundanon homestead and surrounding landscape (**Figure 4-6**); and
- private dwellings, public recreation areas and public roads. The locations of private residences are shown in **Figure 4-6**.

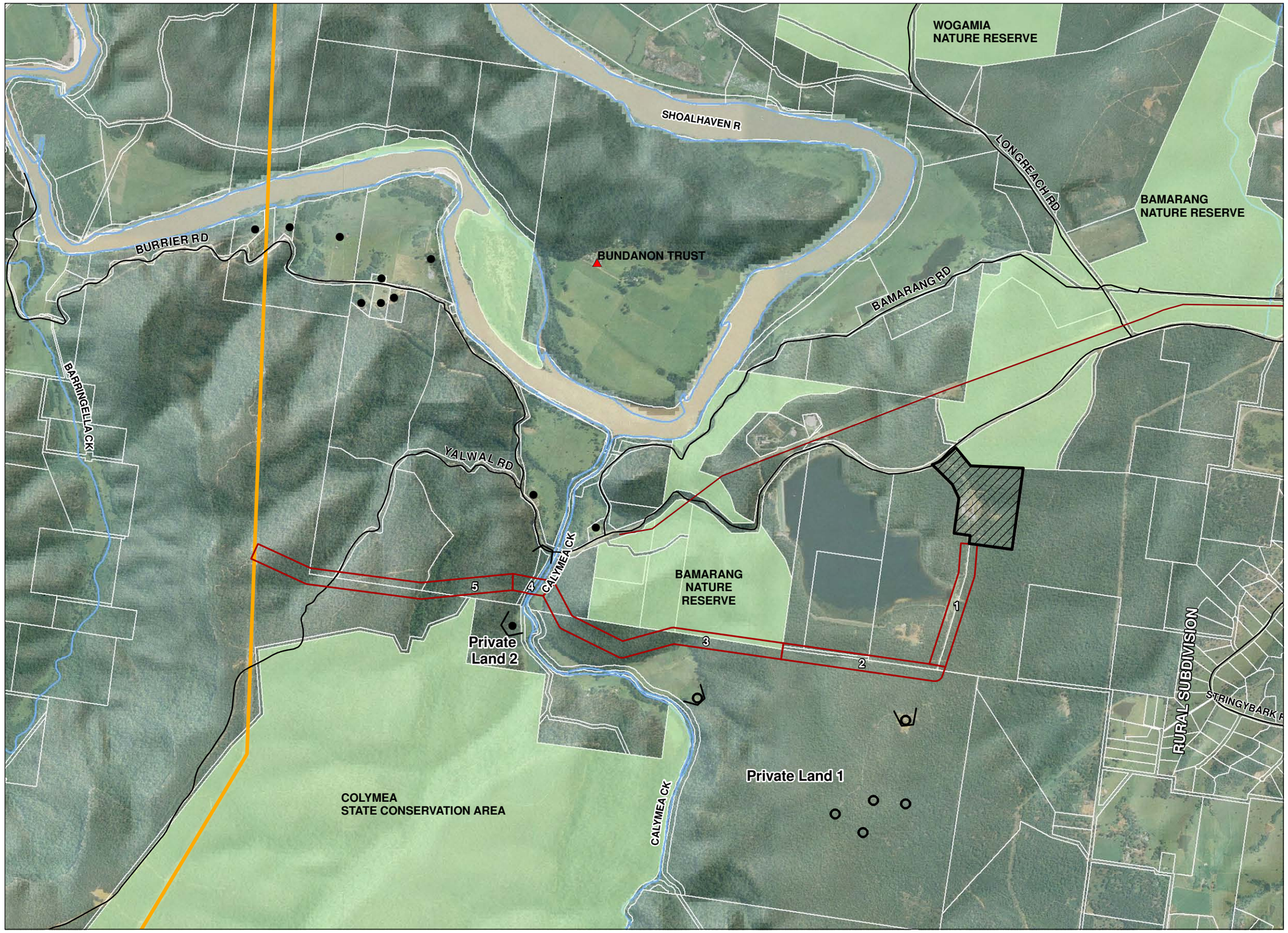
A visual impact assessment is undertaken in the following sections.

4.5.2 Methodology

The visual impact assessment included a desktop analysis of existing photographs, maps and drawings, a field survey of sensitive locations, assessment of the visual impact and development of mitigation measures which would minimise the visual impact of the proposed new transmission line. The purpose of the visual assessment was to establish the visual impact of the proposed new transmission line by considering the degree of visual modification and the visual sensitivity of the surrounding areas.

Visual Modification

The degree of visual modification of the transmission line development is the expression of the visual interaction between the development and the existing visual environment along the transmission line. It can also be expressed as a level of visual contrast of the development to the visual setting within which it is placed. The different levels of visual modification are described in **Table 4-4**. The degree of visual modification generally decreases as the distance between the proposed development and the viewer increases.



Legend

- Proposed Residences
- Existing Residences
- 330 kV
- 33 kV
- Roads
- Waterways
- Proposed PS Site
- National Parks
- Visual Management Units
- Viewpoints
- Private Land 1 / Private Land 2 — Refer to Table 4.2 for description

Data Sources:

Aerial Photograph - LPI, NSW (2001)
Topodata - Streetworks
Cadastre - LPI, 2007

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Kilometres
1:25,000 @ A3

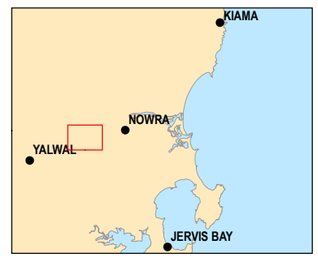

FIGURE 4-6: VIEW LOCATIONS AND VISUAL MANAGEMENT UNITS

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Table 4-4: Levels of Visual Modification

Level of Visual Modification	Description
High	Proposed development is a major element that contrasts strongly with the existing environment. Little or no natural screening or integration with existing environment.
Medium	Proposed development is visible and contrasts with the surrounding environment but is integrated to some degree. Surrounding vegetation / topography provides some visual screening.
Low	Proposed development may be noticeable but does not markedly contrast with the existing environment. High level of integration in terms of form, shape, colour or texture.

Visual Sensitivity

Visual sensitivity is a measure of how critically a change to the existing landscape would be viewed from various areas. The visual sensitivity depends on a range of characteristics such as land use, the number of viewers, the viewing time and the distance between the proposed development and the viewer. These characteristics were all considered in developing the different levels of visual sensitivity from land uses surrounding the proposed transmission line (refer to **Table 4-5**).

- **Table 4-5 Levels of Visual Sensitivity**

Land Use	Foreground		Middleground		Background
	0 – 0.5 km	0.5 – 1 km	1-2 km	2-3 km	>3 km
Rural residential	H	H	H	M	L
Local roads	M	L	L	L	L
Agricultural areas	L	L	L	L	L

Typically, residential areas are more sensitive to changes in the visual environment than roads or productive land. This is primarily due to the different lifestyle contexts associated with these land uses. Hence, rural residential areas have been rated quite highly in terms of their visual sensitivity. Similarly, individuals on holiday and using local roads and are using the surrounding landscape as part of the holiday experience would generally regard change to the landscape more critically than agricultural workers in the same setting.

Visual Impact

The visual impact of the proposed development is determined by considering both the degree of visual modification and the visual sensitivity. A matrix has been developed to identify the level of impact for each combination of visual modification and visual sensitivity (refer to **Table 4-6**).

- **Table 4-6: Visual Impact Matrix**

		Visual Sensitivity		
		High	Medium	Low
Visual Modification	High	H	H	M
	Medium	H	M	L
	Low	M	L	L

4.5.3 Visual Characteristics of new line and environment

The proposed transmission line is predominantly surrounded by natural vegetation, conservation areas and rural residential lots (developed and undeveloped). The terrain over which the transmission line would be carried is undulating and, in some cases, quite steep. Elevation runs from approximately 100m AHD at its eastern end to about 10m AHD adjacent to Calymea Creek to approximately 170m AHD at the western end, with particular topographical features near the alignment including the Trig station adjacent to Bamarang Nature Reserve at 144m AHD and the escarpment to the west at more than 180m AHD.

The nearest township is Nowra to the east, with its western outskirts comprising rural lots along Stringybark Road, about 1-2 km to the east of the proposal. Existing or proposed residences are shown in **Figure 4-6**.

Visual Management Units

The site for the new transmission line plant can be divided into five visual management units (VMUs), which reflect areas where the landform, vegetation and land use are relatively consistent throughout the unit. These are shown in **Table 4-7** and **Figure 4-6**.

- **Table 4-7 Visual Management Units (VMU)**

VMU	Land form	View Areas
1 Line from Bamarang PS through Government land to corner of private property	Elevation about 100m AHD. Flat land, adjacent to access track along eastern boundary of reservoir. Vegetated with Scribbly Gum Heathy Forest, canopy up to 12-15m high.	Possible views from Stringybark Rd and rural subdivision
2 Line along northern boundary of private property	Elevation about 100m AHD. Flat land, adjacent to cleared boundary line along northern boundary of Lot 5 and Lot 4. Along Lot 5 vegetated with Scribbly Gum Heathy Forest, canopy up to 12-15m high. Along Lot 4 Spotted Gum Red Bloodwood Forest with canopy to 5-18m.	Possible view from new residential subdivision area, Lots 4 and 5 Possible view from Yalwal Road across reservoir
3 Line along northern boundary of private property and southern boundary of Bamarang Nature Reserve	Elevation drops from 100m to about 40m AHD. Passes along steep sloped land at 40m on southern slope of Calymea Trig Station. Vegetation Spotted Gum Red Bloodwood Forest canopy up to 18m.	View from proposed house site at Lot 6 in new subdivision View from existing house site in Lot 1 DP 1120147 (off Yalwal Rd)
4 Crossing Calymea Creek	Crosses creek which is at 10m AHD. Vegetation is Blue Gum / Bangalay Riparian Forest up to 22m high. Pole locations at about 40m AHD on either side of creek, with Spotted Gum Red Bloodwood Forest in these areas.	Possible View from existing house site in Lot 1 DP 1120147 and from Yalwal Rd.
5 Ascent to existing transmission line	Ascent from 40m to 170m AHD. Mixture of Eucalypt forest types, rainforest and heathy woodland (in high areas).	View from Yalwal Rd

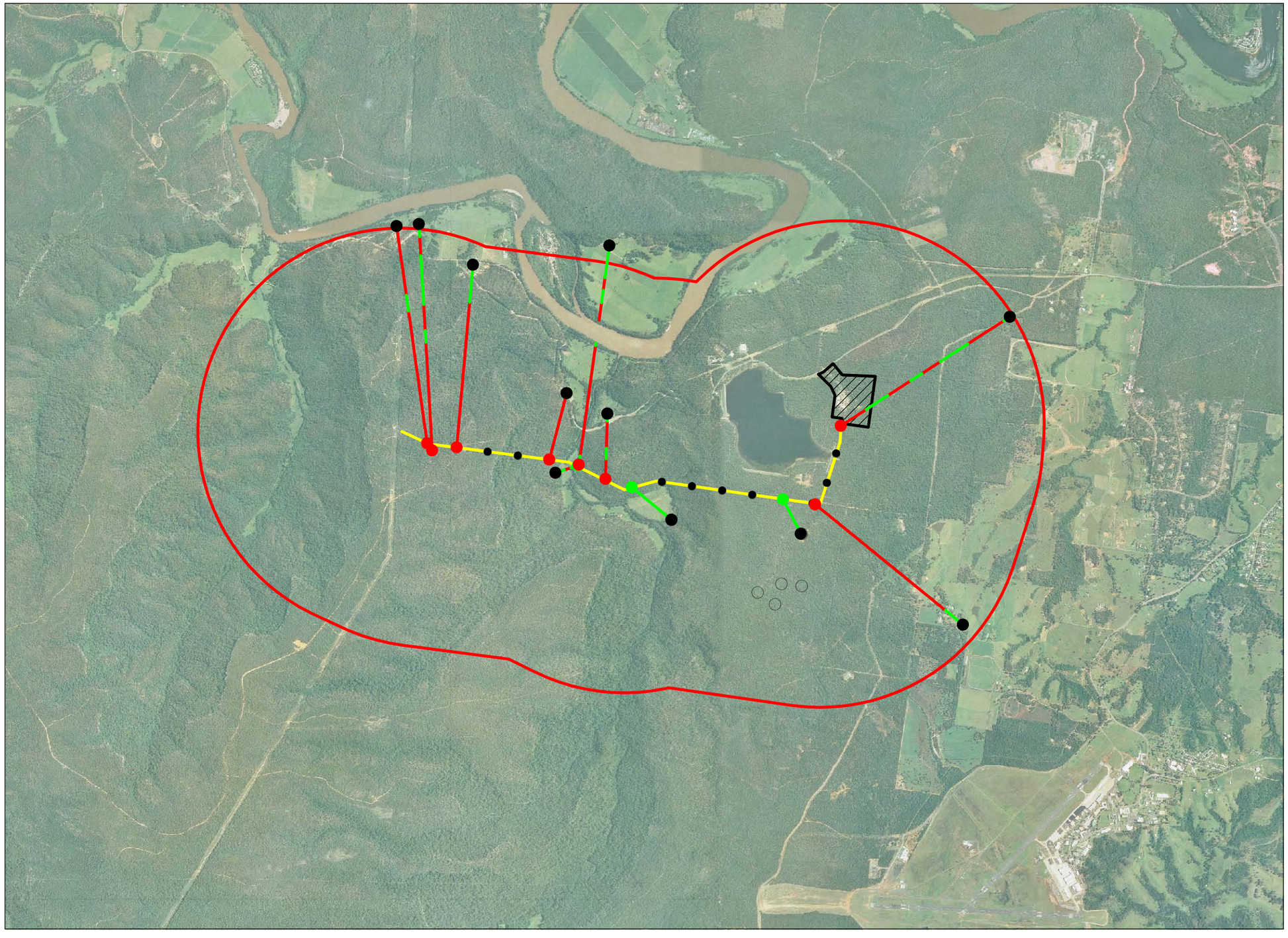
4.5.4 Visual Impact Assessment

Visual impacts are assessed by comparing visual modification and visual sensitivity (using the matrix outlined in **Table 4-6**) and generally relate to the ability of the landscape to absorb visual modification. The degree to which the environment can absorb any visual impacts is influenced by topography (whether it can be screened) and vegetation (whether it can be concealed). In general, there are more opportunities to minimise the visual impact of a development from distant views and in varied and undulating landscapes than areas of flat terrain. The visual assessment is provided in **Table 4-8**. **Figure 4-7** shows views from key locations (mainly existing or proposed residential lots) to the transmission line. For the purpose of this report, the views were developed by assuming a viewer at height 10m above ground (worst case in terms of view) and using a terrain model which included the height of existing vegetation, and so represent the likelihood of a person being able to see the transmission line system from these viewpoints.

The extent of modification and sensitivity for key locations can be seen in **Plates 1-4**.

- **Table 4-8 Visual Assessment**

VMU	Distance to sensitive viewpoint	Level of visual modification	Viewer Sensitivity	Visual Impact	Comment
1	Stringybark Rd and rural residential areas to east >1 km	L	M / H	L / M	May be apparent to some residences more than 2km away (refer to Figure 4-7) as towers (45m) would be above existing vegetation (15m). It is surrounded by existing vegetation and views would be mitigated by existing vegetation closer to the viewpoints
2	Lot 5 in new subdivision development – 500m Private Land 1 in Figure 4-6.	L	H	M	Would probably be apparent to residence about 500 m in the distance (refer to Figure 4-7) as towers (45m) would be above existing vegetation (15m). It is surrounded by existing vegetation and views would be mitigated by existing / new planting closer to the viewpoints. Refer Plate 3.
3	Lot 6 in new subdivision development. Private Land 1 in Figure 4-6. Lot 1 DP 1120147 existing house. Private Land 2 in Figure 4-6.	M M	H H	H H	The alignment passes in elevated view with limited opportunity for screening, given tower height of 45m and vegetation height in front of and below structures of about 18 m. Figure 4-7 shows view to structures. Plate 4 shows view from Lot 6. Plate 1 shows view from Lot 1.
4	View from Lot 1 DP 1120147 existing house Private Land 2 in Figure 4-6. View from Yalwal Rd	L L	M M	L L	Plate 1 shows view from Lot 1. Transmission lines are screened by existing vegetation. Figure 4-7 and Plate 4 show the view to the alignment from the Calymea Creek bridge. The alignment is screened by existing vegetation, but it would be visible to users of the existing access road.
5	View from Yalwal Road	M	M	M	The alignment crosses Yalwal Rd near the existing 330 kV alignment. Although highly visible from the road, the road usage is low and the existing transmission lines puts in the new line and structures in context.



Legend

- Propoesed Observer locations
- Poles along 330 kV Option C
- 330 kV Option C
- 330kV Option C 2 km Buffer
- Proposed PS Site

Visual Assessment

- Not Visible
- Visible

Green Path - Visible Area
Red Path - Obstructed Area

- Target Location
- Observer Location

Assumptions:

330 kV Tower Height - 50m
Spacing - 300m

0 1
Kilometres
1:40,000 @ A3

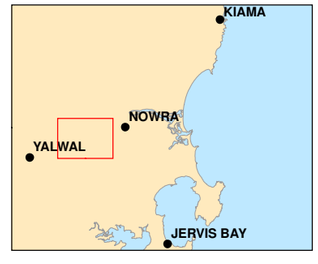


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Figure 4-7: VISUAL ASSESSMENT

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Plate 1 - View from Lot 1

Plate 2 - View from Yalwal Road

Plates 1-4: Site Views	
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Plate 3 - View from Lot 5

Plate 4 - View from Lot 6

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PLATES 1-4: Site Views

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It is clear that high visual impact would result on existing residence in Lot 1 DP 1120147 and proposed residence in Lot 6 in the new subdivision in VMU 3, whereas other visual impacts, given distance or land use, would be low to moderate.

4.5.5 Mitigation of Visual Impacts

In areas where the topography does not conceal the development from surrounding areas, vegetation can be used to screen the development from sensitive viewpoints. In general, smaller trees with low canopies can be used effectively on gentle slopes or flat areas to screen developments, and taller trees with high canopies are more effective on steeper slopes.

The visual impacts of the new transmission alignment have been mitigated, as far as practicable, through its location and design.

Location

The selection of the alignment corridor considered the means by which as many residences as practicable could avoid having a view of the structures. This was particularly so on the western side of Calymea Creek where there were few opportunities for residences to view the structures. On the eastern side of Calymea Creek, opportunities for alignment changes were very difficult due to the need to avoid Bamarang Nature Reserve and Bamarang Reservoir lands. Nevertheless, the alignment was located below ridge lines so that the lines would be seen with vegetation as background.

Design

In areas where transmission towers would be visible in the foreground (VMU 3), the design of the structures will be modified to minimise impacts. The use of poles instead of pylons and the ability to use dull surface and dark green structures as they are seen against the vegetation retained higher up the slope will mean that the visual impacts will be reduced significantly.

In all cases, and especially in VMU 3, the degree of clearance within the easement would be minimised, with vegetation lopped rather than cleared as far as practicable to reduce the extent of any clearance impacts.

4.6 Hazards and Risk

4.6.1 Bushfire

Due to oil-bearing eucalyptus trees, dry grass, low humidity and hot, gusty winds, the countryside of south-eastern Australia is a very flammable environment. In such an environment, bush fires can result from both the construction and operation of transmission lines. The transmission line easement and surrounding landscape comprises a mix of native pasture grasses and woodland. This area would be prone to bushfires during the summer months.

Construction

Bushfire risks and corresponding risk control measures for construction activities that may take place during the construction of the proposal and present a bushfire hazard include:

- smoking;
- grinding, mowing, slashing and using a petrol powered chainsaw;
- welding and soldering;
- using a petrol, LPG or diesel powered motor vehicle over land containing combustible material;
- using a mobile plant fitted with power hydraulics on land containing combustible material;
- using a gas torch to apply heat shrink cable products; and
- manual re-closing of overhead lines.

The bushfire hazard associated with the above-listed activities would be minimised as far as practical during the construction of the proposal through the implementation of appropriate management measures. With the implementation of these measures, construction of the proposal would not present a significant bushfire risk.

The management measures to be implemented during construction would include:

- All construction work would be carried out in accordance with standard procedures, practices and guidelines for bushfires set out in relevant transmission agency manuals and as advised by the Rural Fire Service;
- The risk of fire and its prevention would be part of the Hazard Identification, Risk Assessment and Control process to be carried out prior to work commencing;
- Contractors/work staff would be trained in how to prevent, control and survive bush fires;
- Work vehicles would be equipped with appropriate bushfire control equipment.

Operation

Any overhead electricity reticulation system is a potential source of ignition. Bushfires can be caused by faults in the system and by vegetation coming into contact with conductors. The bushfire hazard associated with the operation of the proposal would be minimised as far as practical through the implementation of appropriate management measures. With the implementation of these measures, operation of the proposal would not present a significant bushfire risk.

To reduce the risk of bush fires being caused by the operation of the transmission line, the operator would adhere to the procedures, principles and guidelines laid out in its Environmental

Operations Manual and its Bush Fire Prevention, Control and Survival requirements. The management measures typically contained in these documents would include the following:

- bush fire prone areas are identified and classified in consultation with local councils and the NSW Rural Fire Service;
- to minimise the chance of vegetation coming into contact with transmission lines and starting bushfires, the required clearances and the requirements of ISSC3 (Industry Safety Clearing Committee Guideline No. 3) of additional clearances of bush fire prone areas would be met;
- the Operator would liaise and consult with the NSW Rural Fire Service, NSW Fire Brigades, local government and other relevant government departments regarding bush fire-related matters;
- the Operator would inform the general public about the fire hazards associated with overhead transmission lines and vegetation, particularly during storms and conditions of high fire danger; and
- to identify any factors associated with overhead lines that could lead to the initiation of a bush fire, the Operator would carry out a number of mitigation patrols, including annual aerial or ground inspections in bush fire prone areas, vegetation maintenance (every 2-3 years), and pole and line inspections (every 4-5 years).

4.6.2 Electromagnetic Fields (EMF)

Potential Impacts of Transmission Lines

Power frequency electric and magnetic fields (EMFs) are produced by virtually all electrical equipment and occur wherever electricity is being used. The electric field is proportional to the voltage, whereas the magnetic field is proportional to the current. These fields emanate from wires delivering electricity and all devices which use electricity. Most concern has been raised about the possible link between exposure to magnetic fields, in particular, and an increased risk of cancer. Electric fields are shielded by building materials and the earth, but the shielding of magnetic fields is more difficult and the easiest way to reduce exposure to magnetic fields is to increase the distance from the source.

Exposure levels to EMFs around the home are in the range of 0.01 to 0.25 microTesla (μT) [0.1 to 2.5 milliGaus (mG)]. For homes near (say within 30m) powerlines, these levels may be as high as 0.5-1 μT [5-10 mG] and immediately under a power line magnetic field levels of 6-10 μT [60-100 mG] may be found. In rural environments, away from dwellings, workshops, power lines and other electrical equipment, the power frequency electric and magnetic fields would be negligible.

Like other types of electrical equipment, transmission lines produce both electric and magnetic fields. The strength of the electric field varies generally with the operating voltage of the line

whilst the magnetic field strength is related to the current (amps) flowing in the line. The field strengths are also dependent on the height of the wires above ground, their geometric arrangement and the arrangement of the phases.

Scientific basis for assessing human health impacts

There have been many decades of research on the possible health risks associated with exposure to EMFs. The most recent scientific research confirms that, while links between EMFs and adverse health effects have not been proven, the possibility of such links cannot be ruled out (ARPANSA, 2006).

Whilst the authors of the guidelines had regard to the epidemiological and laboratory studies regarding EMF and cancer, they considered that the available data did not provide any basis for health risk assessment useful for the development of exposure limits. Accordingly, the exposure limits contained in the guidelines are based primarily on established or predicted effects related to the flow of electric current within the body. They are not intended to "define safe limits for" possible health effects, should they exist, from fields at strengths normally encountered in the vicinity of electrical equipment.

Due to continuing scientific debate regarding the possibility of health effects at exposure levels people normally experience, major public inquiries conducted on EMFs in Australia, such as the Gibbs Inquiry, have recommended the adoption of a policy of prudent avoidance in respect of the electric and magnetic fields of transmission lines. Prudent avoidance means looking systematically for strategies which can restrict field exposure and adopting those strategies which seem to be prudent investments, given their costs and the level of scientific understanding about possible risks. In recent years, health concerns have focussed on magnetic fields rather than electric fields. For this reason, prudent avoidance is normally viewed from the standpoint of magnetic fields.

The scientific literature on this subject is extensive, complex and inconclusive. In addressing the question of adverse health effects, this assessment has relied on the findings of independent scientific review panels and public inquiries. There is broad consensus that adverse health effects have not been established. Although, the possibility of such effects has not been ruled out, the research data shows that the risk to human health (if any) is likely to be a small one. However, recent review reports suggest the range of any possible effects is narrowing. In response to the scientific uncertainty, this assessment has taken the view that it should continue to take a cautious approach and apply a policy of "prudent avoidance" in the siting of new transmission facilities. This policy has been applied in respect of the proposed transmission line.

The general rationale for selecting the preferred line route has been dictated by a number of factors including visual impacts, impacts on the natural environment, proximity to houses and

community concerns about electric and magnetic fields. To this end the route chosen would ensure the closest existing or potential dwelling would be at a distance where magnetic fields in the residence would be dominated by the effects of low voltage electricity use by the consumer and the proposed transmission line would not add to magnetic field exposure by residents.

Based on the foregoing, it has not been scientifically established that power frequency electric and magnetic fields in general have any adverse health effects. Although the possibility of there being some adverse effect cannot be ruled out, there is a recent trend for the range of possible health effects to be narrowed.

Several review panels and public inquiries have recommended prudent avoidance as an appropriate response to the present state of scientific uncertainty. In designing and locating the new transmission line, this assessment has implemented measures consistent with the concept of prudent avoidance.

The transmission line would not result in any significant increase in electric or magnetic field exposure in any existing or identified future residence. Based on the findings of the scientific and medical reviews, it may be concluded that the new transmission line can proceed without any significant impact due to power frequency fields.

Guidelines for Human Health Protection

In November 1989, the (Australian) National Health and Medical Research Council (NHMRC) adopted and published interim guidelines for public and occupational exposure to 50/60 Hz EMFs (NHMRC, 1989). These Interim Guidelines were identical to the guidelines adopted earlier that year by the International Radiation Protection Association (IRPA) and are relevant to electricity transmission lines in Australia. The maximum acceptable public exposure levels identified by the NHMRC Interim Guidelines were as follows:

- continuous exposure: 100 µT [1,000 mG] for magnetic fields and 5 kV/m for electric fields;
- casual exposure: 1,000 µT [10,000 mG] for magnetic fields and 10 kV/m for electric fields; and
- occupational exposure: 5,000 µT [50,000 mG] for magnetic fields and 30 kV/m for electric fields.

The NHMRC recommended exposure limits are shown in **Table 4-9**.

Table 4-9: NHMRC Limits of Exposure

Exposure characteristics	Electric field strength (kV/m) (rms)	Magnetic flux density (field strength) (µT) (rms)
Occupational		
Whole working day	10	500 µT
Short term	30 (a)	5,000 µT (b)
General Public		
Up to 24 hours/day	5	100 µT
Few hours/day	10	1,000 µT

Notes:
(a) The duration of exposure to fields between 10 and 30 kV/m may be calculated from the formula tδ80/E, where t is the duration in hours per work day and E is the electric field strength in kV/m.
(b) Maximum exposure duration is two hours per work day.

Up until 2006, the NHMRC Interim Guidelines were the only management guidelines for safe EMF exposure levels available in Australia. In 2006, the NHMRC Interim Guidelines were updated with the release by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) of a draft Standard for EMF exposure (ARPANSA, 2006a). The EMF frequency range covered by the ARPANSA draft Standard is 0 to 3 kHz, including the 50 Hz frequency used for electricity supply in Australia. The draft Standard updates requirements for the management of exposure to extremely low frequency (ELF) EMFs in Australia for the general public and occupational locations. For EMF frequencies in the order of 50/60 Hz (being the frequency of relevance to transmission lines) the guidelines for safe exposure levels provided in the new ARPANSA draft Standard are almost identical to the NHMRC Interim Guidelines (ARPANSA, 2006b).

Methodology of Calculating EMF Levels

The electric and magnetic field of a transmission line is depending on a number of factors. Among the more tangible factors determining both the electric and magnetic field associated with a transmission line are:

- Line design and geometry;
- Distance to point of interest (i.e. height of conductors above ground). Both the electric and the magnetic fields are inversely proportional to distance, i.e. the field decreases with increasing distance.

Other key variables determining the electric field are the line voltage, the line current (loading) and direction of current flow for determining the magnetic field.

The proposed transmission line has two circuits, each circuit comprising three double (bundled) phase conductors, and two overhead earth wires. The direction of current flowing through each circuit will nominate how the resulting magnetic field of each circuit will interact and generate the total magnetic field of the line. This interaction may result in a strengthening of the total magnetic field where the field of each circuit coincides, and similarly weakening the total magnetic field where the field of each circuit oppose each other.

The electric and magnetic fields associated with the proposed line were calculated using the CDEGS proprietary software (the CDEGS software package is a set of integrated engineering software tools designed to analyse electromagnetic fields and other features).

The calculation approach was based on the guidelines “Standard Basis for Quoting Transmission Line Magnetic Fields” published by Energy Networks Association (ENA) of Australia.

The future loading level (i.e. current magnitude and flow directions) is not possible to define accurately at present, and will also be subjected to daily and seasonal variations and varying magnitude of power fed in by the proposed Bamarang Power Station. It is therefore necessary to assume a value for the loading current. The assumption was made that each circuit carried a load current equal to its thermal rating of 1540A. This current loading will, with certainty, be greater than the load value corresponding to ‘Typical Daily Maximum’ proposed by the ENA’s guideline to be applied. This conservative assumption generates predicted magnetic field levels higher than what would be expected if based on a ‘Typical Daily Maximum’ loading current.

The ‘Infrequent High Load’ situation, which may be encountered during yearly peak loading of the normally operating system, is likely to be less or equal to the applied loading current.

In a similar way as for the loading current, the direction of flow of current on each of the circuits may vary over time. The calculations were therefore made for the extreme alternatives where:

- Currents flowing in the same direction in both circuits; and
- Circuits carrying opposing current flows.

The height of the conductors of ground level varies along the line due the sag of the conductors and natural variations in the topography of the land. The sag of the conductors will vary depending on a number of factors including ambient temperature, wind speed and direction, and line loading. To counter for the range of variances of these factors the electric and magnetic fields were calculated based on a lowest hanging conductor average height of 13m corresponding to:

- the minimum ground clearance height of 9m (it should be noted that the line may actually not sag to this extent more than at a limited number of points along the line and under severe loading and ambient conditions)\; plus
- one third (1/3) of the sag of the conductors.

The overhead earth wires of the transmission line were not considered in the calculations as the effect of the overhead earth wires is negligible.

The double circuit line (where both circuits carry a loading current flowing in common direction) was configured to yield higher magnetic field strengths compared with alternative arrangements.

The calculations were carried out for a straight length of the transmission line running over level land. The variations in electric and magnetic field due to the deflections in the line route are expected to be minor and are considered to be comprised by the average height approach utilised with regard to conductor heights as these deflections take place at the poles and tower (i.e. at a significantly greater height).

EMF Levels Calculation Results

The field strengths were calculated at two discrete points; i) directly under the centre of the transmission line, and ii) at the boundary of the prospective easement, i.e. 30m away perpendicular to the centre of the line, and in both cases at a height of 1m above ground level.

The maximum electric field strength would be experienced directly under the transmission line, and moving away from the line the electric field strength decreases with the inverse of the distance. **Table 4-10** presents the discrete point values of the calculated electrical field.

Table 4-10: Calculated Electrical Field

	@ Centre of Line [kV/m, rms]	@ Easement Boundary [kV/m, rms]
Common Current Flow Direction	3.7	0.3
Opposing Current Flow Directions	1.9	0.2

The calculated electrical field strengths are well below the maximum acceptable levels for both continuous and casual public exposure, as defined by NHMRC guidelines (i.e. 5 kV/m and 10 kV/m, respectively).

Considering that no dwellings or other facilities are intended to be built and occupied within the transmission line easement and the fact that the nearest potentially occupied building is approximately 350 m from the centreline, the electric field that would be generated by the proposed transmission line is not expected to have an adverse impact on human health.

Similarly to the electric field, maximum magnetic field strength would be experienced under the transmission line, and moving away from the line the magnetic field strength decreases with the inverse of the distance. **Table 4-11** presents the discrete point values of the calculated magnetic field.

Table 4-11: Calculated Magnetic Field

	@ Centre of Line [µT, rms]	@ Easement Boundary [µT, rms]
Common Current Flow Direction	19.0	7.5
Opposing Current Flow Directions	15.0	2.5

The calculated magnetic field strengths are well below the maximum acceptable levels for both continuous and casual public exposure, as defined by NHMRC guidelines (i.e. 100 µT and 1,000µT, respectively).

Considering that no dwellings or other facilities are intended to be built and occupied within the transmission line easement and the fact that the nearest potentially occupied building is approximately 350 m from the centreline, the magnetic field that would be generated by the proposed transmission line is not expected to have an adverse impact on human health.

4.6.3 Aviation safety

The proposed power station site is approximately 4 km from the Naval Air Station Nowra – HMAS Albatross. The power station and the area proposed for the 330 kV transmission line are located within the area affected by the Defence (Area Control) Regulations (DACR) for NAS Nowra. The DACR controls the height of the objects (structures and vegetation) and the purpose for which they may be used within approximately 15 km radius of the airfield. The DACR height restrictions are based on the Obstruction Clearance Surface (OCS) for NAS Nowra (HMAS Albatross). The OCS for NAS Nowra comprises 3-dimensional reference surfaces in air space around the airfield and their purpose is to limit the height of objects that may endanger aircraft operations. Under DACR, the approval of the Minister for Defence would be required for the development.

A preliminary review of the OCS ranges in the eastern part of the study area indicates that transmission towers greater than 50m above ground may infringe the OCS levels. At the western end of the study area (adjacent to the existing 330 kV line) tower heights should be around 70-80 m to infringe the OCS. As the proposed tower/pole heights are 42-47 m, it is unlikely that the proposal would infringe the OCS.

The design developed for the purpose of this study has been referred to the Department of Defence. The design is currently being assessed as to whether this preliminary design may affect the Obstruction Clearance Surface for NAS Nowra. Detailed design would be undertaken only after approval for the modification is received and a decision to construct the line is made.

As per clause 2.24 of the Stage 1 Project Approval, Delta Electricity will consult with the Department of Defence during final design and decision on the final locations of towers and seek any necessary approvals with respect to the management of aviation hazards associated with operations at HMAS Albatross.

4.7 Topography, Soil, Water and Drainage

4.7.1 Topography and Soil

The topography of the study area ranges from the low-lying alluvial flats of the Shoalhaven River to steep rocky escarpments. Land unit types within the study area have been classified by the DECC and comprise a combination of rocky plateau and floodplain areas. These land unit types are summarised in **Table 4-12**.

Table 4-12: Land unit types within the study area

DECC Land Unit	Surface Rock Type	Topography
Shoalhaven Plateau	Nowra sandstone, some Berry siltstone residuals; Ordovician and Devonian shales and phyllites; Limestone pocket	Broad plateau surfaces deeply dissected by north/south streams and Shoalhaven River
Shoalhaven Floodplain	Sands and silts of marine and fluvial origin	Low lying floodplain, coastal and sandridge complexes; Delta complexes, large depressions

Source: SCC

Soil landscapes within the study area have been classified and described in Hazelton (1992;1993). The land within the study area extending westwards from the Bamarang power station site to the existing 330kV transmission line consists predominantly of three soil landscape types as follows:

- the Pulpit Rock Soil Landscape, which coincides with the steep escarpment areas to the west of the Power Station site;
- the Shoalhaven Soil Landscape, which coincides generally with areas of flat, cleared agricultural land adjacent to the Shoalhaven River and Calymea Creek; and
- the Nowra Soil Landscape, which coincides with the majority of remaining land within and surrounding the Bamarang Power Station site.

Details of the soil landscape types within the study area are summarised in **Table 4-13**.

Table 4-13: Soil landscapes within the study area

Soil Landscape*	Soil Landscape Description		
	Landscape Features	Soil Types	Erodibility and Limitations
Pulpit Rock	Convex weathered rugged sandstone cliffs on Nowra Sandstone with talus slopes. Relief <80m and slopes >30%. Extensive caves and concave weathered pinnacles. Partially uncleared with low open woodland.	Lithosols on crests, midslopes and lower slopes. Moderate to deep (100 - >150cm) Yellow Podzolic Soils occur on midslopes and lower slopes.	Soil erodibility – low. Erosion hazard – extreme. Limitations – steep slopes, mass movement hazard, rock fall hazard, shallow soil, rock outcrop, and water erosion hazard.
Shoalhaven	Level to gently undulating river bed and banks, active floodplain and backwater swamps on alluvium. Flat to gently undulating terrace surfaces of the Shoalhaven River. Relief <5m and slopes <3%. Completely cleared.	Moderately deep (50-100cm) Prairie Soils on levees. Red Earths and yellow and Red Podzolic Soils on terraces. Alluvial Soils and Gleyed Podzolic (potential Acid Sulphate) Soils occur on the floodplain.	Soil erodibility – low for topsoils and high for subsoils. Erosion hazard - slight. Limitations – flood hazard, permanent (localised) and seasonal waterlogging, permanently high water table, and acid sulphate potential subsoils.
Nowra	Moderately to gently undulating rises to low hills on Nowra Sandstone. Relief >40m and slopes >5%. Broad ridges and crests. Benched sandstone outcrops adjacent to drainage lines. Extensively to moderately cleared tall open-forest.	Moderately deep (50-100cm) Brown Podzolic Soils on crests and upper slopes. Soloths and/or Yellow Earths on midslopes. Yellow Podzolic Soils on lower slopes and drainage lines.	Soil erodibility – low for topsoils and high for subsoils. Erosion hazard – Moderate to high. Limitations – rock outcrop (localised), shallow soil (localised) and run-on.

* Hazelton (1992 and 1993)

Notable limitations to development include flood hazard and waterlogging on the Shoalhaven Soil Landscape and extreme erosion hazard on the Pulpit Rock Soil Landscape. These limitations do not constrain transmission line development but need to be considered in detailed transmission line design.

The sub-soils of low-lying areas around Calymea Creek may have potential acid sulphate properties. There is no known occurrence of land contamination in the area extending westwards from the Bamarang power station site to the existing TransGrid 330kV line.

4.7.2 Water and Drainage

The study area lies within the catchment of the Shoalhaven River. The area of land where the proposed transmission line would be located lies approximately 350 m south of the Shoalhaven

River at its closest point and drains to the Shoalhaven either directly (via bushland gullies and farmland) or via Calymea Creek. The Bamarang gas turbine site drains to the Shoalhaven River via Sandy Creek.

The Bamarang off-river water supply storage reservoir is located immediately to the west of the Bamarang gas turbine site. The designated water catchment zone surrounding this reservoir, as identified in the Shoalhaven LEP, has been avoided by the transmission line route. As such, the transmission line runs in a south-westerly direction from the gas turbine site before heading westwards to the TransGrid 330 kV line and spanning Calymea Creek.

The main constraints to the proposed transmission line route and sub-station area in relation to drainage issues are the need to avoid passage through the Bamarang off-river water supply storage reservoir catchment zone (as described above) and the need to avoid adverse impacts Calymea Creek. Adverse impacts on Calymea Creek can be avoided by spanning the creek, with pole placements located well away from riparian areas.

4.7.3 Potential Impacts and Mitigation Measures

Construction

The only construction issue relating to topography, geology and soils is the potential for construction of the Proposal to cause soil erosion. The specific construction activities that have the potential to cause soil erosion are limited to the following:

- Construction of the sub-station at the Bamarang gas turbine site;
- Excavation and boring at pole placement sites to facilitate pole installation; and
- Creation of the easement access track.

The risk of soil erosion resulting from the construction phase of the proposal is considered to be low given the following factors:

- The proposal incorporates erosion and sediment control measures, which would be implemented as an integral part of the construction works;
- The proposal would incorporate a Vegetation Clearing Protocol, which would be implemented as an integral part of construction to minimise the extent of clearing, particularly in areas of erosion risk;
- The excavation and earthwork requirements for the proposal are relatively minor, being limited to the pole placement sites and the sub-station site;
- in all other areas of the easement, exposure and disturbance of soils would be minimised to the greatest extent possible through the retention of existing ground cover vegetation;
- where soil disturbance is incurred during construction, for example at pole placement sites or in areas where existing ground cover vegetation is absent or minimal, ground cover would be

allowed to re-generate post construction hence limiting erosion risks to the construction period;

- pole placement within 40 m of the banks of any waterways (Calymea Creek) would be avoided;
- the proposed method for stringing of conductors would avoid the need for machinery to be operated at or near the banks of waterways; and
- the proposed new easement access tracks would not involve any waterway crossings and would follow the natural contour of the land as far as possible so that requirements for civil works are minimised.

In addition to the risks being minor, all risks can be effectively managed through standard construction site practices. With the effective implementation of these measures, the construction of the proposal would have no impacts on topography, geology or soils.

Operation

Operation of the proposal would not have any significant impacts on soils, geology or landforms. The new easement access track could, however, be a source of soil erosion if not properly maintained. The potential for soil erosion associated with the easement access track would be very minor and can be effectively managed. With the implementation of these measures in conjunction with the Proposal, there would be no impacts on topography, geology or soils.

4.7.4 Management Measures

The management measures listed below would be implemented in conjunction with the impact mitigation measures for the proposal to ensure that the risks of soil erosion are minimised as far as practical.

Construction

- A Sediment and Erosion Control Plan (in accordance with Landcom, 2004) would be prepared for the works, with particular attention paid to areas subject to vegetation clearing, work areas near gullies and water courses, and work areas on steep slopes;
- Erosion and sediment control measures would be maintained in effective working order until the subject work has been completed and the affected soils have been adequately stabilised;
- Stabilisation and restoration of disturbed areas would take place in a progressive manner during the construction phase;
- Rehabilitation of disturbed areas would be carried out in consultation with the relevant land owners and/or managers.

Operation

- Implementation of 'best practice' stormwater treatment measures to maximise onsite pollutant retention and removal at the sub-station site;
- All maintenance work would be carried out in accordance with the operators *Environmental Operations Manual;*
- Maintenance inspections of the easement access track would be carried out annually;
- The presence of erosion on the easement access track would be assessed at each maintenance inspection and corrective action taken as required.

4.8 Changes to Approval and Statement of Commitments

4.8.1 Statement of Commitments

The statements of commitment in the previous EAs prepared for the project are relevant to and generally consistent with the construction and operation of a new 330 kV line. The commitments in the four key issues areas assessed are:

- Flora and fauna – natural ecosystems to be protected from off-site impacts, habitat located on-site to be protected, habitat values of land to be maintained;
- Indigenous heritage – appropriate management of Aboriginal heritage;
- Visual amenity and landscape – minimise the visual impact of the proposal on the landscape;
- Hazard and risk – bushfire hazards and risks are reduced.

The relevant new management measures for each of these existing outcomes are described below.

4.8.2 Management and mitigation measures

Flora and Fauna

Objective: natural ecosystems to be protected from off-site impacts, habitat located on-site to be protected, habitat values of land to be maintained.

- Where possible vegetation clearance would be minimised;
- River-flat eucalypt Forest along Calymea Creek would be retained through spanning the proposed transmission lines from pole locations higher on adjacent slopes above the existing vegetation;
- The area of Lowland Rainforest west of Calymea Creek will be spanned;
- Individual habitat features of conservation significance within the study area would be avoided where possible by the proposed easement clearing. These will include trees with hollows, trees with a trunk diameter greater than 20 cm, standing dead trees greater than 3 metres in height, trees with bird nests and riparian vegetation zones;

- General habitat features of importance will be protected and appropriate management practices in the study area maintained. This will include fallen logs encountered within the works corridor being pushed aside and retained in their natural state, timber felled for clearing to be retained on the ground as cover for terrestrial fauna and minimising the loss of shrub cover and ameliorating any impact by the retention of felled vegetation to facilitate natural regeneration;
- The removal of hollow-bearing trees and hollow logs would be supervised by an experienced ecologist to minimise direct impacts to fauna potentially sheltering in these habitats;
- All construction machinery would be thoroughly washed down and sterilised as much as practicable to ensure weed propagules and pathogens such as Root Rot Fungus (*Phytophora cinnamomi*) are removed from equipment;
- Any exotic species cleared during construction will be disposed of appropriately;
- To offset the impacts of vegetation clearance of this proposal, Delta Electricity will investigate compensatory habitat offset options. The compensatory habitat package would consist of no fewer than two hectares of compensatory habitat for each hectare of vegetation removed as part of the project or as otherwise agreed by the DECC. Specifications for the compensatory habitat, including location, composition, quality and management of the habitat would be determined in consultation with the DECC;
- The potential for impact on Grey-headed Flying-fox to collide and be electrocuted on the newly established overhead transmission lines while seeking foraging habitat will be mitigated by the transmission lines being constructed so that the wires are not arranged in one plane or are greater than 1.6 metres apart, that is, greater than the wingspan of a flying-fox;
- All construction personnel would be inducted to the study corridor and be aware of their environmental responsibilities, including the preservation of endangered ecological communities, threatened species, tree cover and riparian habitats.

Indigenous Heritage

Objective: appropriate management of Aboriginal heritage.

- Of the three recorded Indigenous sites along the proposed alignment, all will be avoided by the project impacts, although they may require the implementation of appropriate site management measures to ensure no inadvertent impacts occur;
- All management of Indigenous sites in relation to the proposal will be embodied into an AHMP or CEMP. Development of these management documents would occur in consultation with the Indigenous community. Management measures may include that:
    - If identified sites can be avoided, they would be identified in the field prior to any construction impacts occurring. An appropriate curtilage would be delineated around

these sites using a highly visual physical barrier (ie 1 m high orange roadwork fencing). This would ensure all sites can be easily identified and protected from inadvertent machinery impacts. Should sites be in areas where tracks are required, mitigation may include protecting sites from the impacts of vehicles through the use of geofabrics, matting and materials imported to cover site areas for the construction period;

- If sites cannot be avoided, depending on the assessed level of significance, their management may include the test/salvage excavation of these sites, or simply the collection of artefacts prior to construction impacts occurring;

- In defining the remaining project impacts, the following guiding principles will help reduce impact to the Indigenous heritage resource:
  - Attempts to avoid direct impacts within 100 m of any waterway that the proposed line transects, as these are 'sensitive' in terms of Indigenous site location. Such areas should be spanned, where possible;
  - Avoid any sandstone overhangs, where possible. Although most of the line surveyed to date did not possess overhangs suitable for human habitation, the area east of the proposed structure 6 (unsurveyed) has potential;
  - Ensure that the inaccessible portions of the line are assessed once design detail has determined where impacts in these areas may be; and
  - Ensure survey is undertaken for all access tracks – existing, those to be upgraded and newly proposed;
- Members of the construction team, including sub-contractors, machine operators and truck drivers would be required to undergo site induction concerning cultural heritage issues, prior to working on the site. This would preferably be undertaken by an individual who has a good working knowledge of Indigenous sites and of the legislation protecting them. This induction should inform workers/contractors of the location of nearby sites, and of their legislative protection under Section 90 of the NSW National Parks and Wildlife Act 1974. These inductions should be recorded in a register, with all those present signing their complicity with these guidelines and the Conservation Environmental Management Plan (CEMP);
- Should any previously unidentified Indigenous 'objects' or other Aboriginal sites (such as burials) be uncovered during the course of construction, work in that area would cease and the DECC Regional Archaeologist (Queanbeyan Office), and the Nowra Local Aboriginal Land Council would be contacted to discuss how to proceed.

Visual and Landscape

Objective: minimise the visual impact of the proposal on the landscape.

- In areas, where the topography does not conceal the development from surrounding areas, vegetation will be used to screen the development from sensitive viewpoints. In general,

smaller trees with low canopies can be used effectively on gentle slopes or flat areas to screen developments, and taller trees with high canopies are more effective on steeper slopes;

- The selection of the alignment corridor considered the means by which as many residences as practicable could avoid having a view of the structures. This was particularly so on the western side of Calymea Creek where there were few opportunities for residences to view the structures. On the eastern side of Calymea Creek, opportunities for alignment changes were very difficult due to the need to avoid Bamarang Nature Reserve and Bamarang Reservoir lands. The alignment was located below ridge lines so that the lines would be seen with vegetation as background and this principle will be retained in any further alignment adjustments;
- In areas where transmission towers would be visible in the foreground (VMU 3), the design of the structures will be modified to minimise impacts. The use of poles instead of pylons in this area and the ability to use dull surface and dark green structures as they are seen against the vegetation retained higher up the slope will mean that the visual impacts in VMU 3 will be reduced significantly. In all locations along the alignment, and especially in VMU 3, the degree of clearance within the easement would be minimised, with vegetation lopped rather than cleared as far as practicable to reduce the extent of any clearance impacts.

Hazard and Risk

Objective: bushfire hazards and risks are reduced.

- All construction work would be carried out in accordance with standard procedures, practices and guidelines for bushfires set out in relevant transmission agency manuals and as advised by the Rural Fire Service;
- The risk of fire and its prevention would be part of the Hazard Identification, Risk Assessment and Control process to be carried out prior to work commencing;
- Contractors/work staff would be trained in how to prevent, control and survive bush fires;
- Work vehicles would be equipped with appropriate bushfire control equipment.
- Bush fire prone areas are identified and classified in consultation with local councils and the NSW Rural Fire Service;
- To minimise the chance of vegetation coming into contact with transmission lines and starting bushfires, the required clearances and the requirements of ISSC3 (Industry Safety Clearing Committee Guideline No. 3) of additional clearances of bush fire prone areas would be met;
- The Operator would liaise and consult with the NSW Rural Fire Service, NSW Fire Brigades, local government and other relevant government departments regarding bush fire-related matters;

- The Operator would inform the general public about the fire hazards associated with overhead transmission lines and vegetation, particularly during storms and conditions of high fire danger;
- To identify any factors associated with overhead lines that could lead to the initiation of a bush fire, the Operator would carry out a number of mitigation patrols, including annual aerial or ground inspections in bush fire prone areas, vegetation maintenance (every 2-3 years), and pole and line inspections (every 4-5 years);
- Delta Electricity will consult with the Department of Defence during final design and decision on the final locations of towers and seek any necessary approvals with respect to the management of aviation hazards associated with operations at HMAS Albatross;
- Several review panels and public inquiries have recommended prudent avoidance as an appropriate response to the present state of scientific uncertainty of EMF. In designing and locating the new transmission line, Delta Electricity will implement measures consistent with the concept of prudent avoidance.

4.8.3 Conditions of Approval

On 27 February 2007 the Stage 1 Project Approval was granted for the construction and operation of an OCGT plant and a 132 kV transmission line from the plant to a sub-station in west Nowra. On 29 October 2008, Project Approval was granted for a Stage 2 CCGT plant. This modification is now seeking approval for the inclusion of a 330 kV transmission connection alternative (to the 132 kV line) connecting the approved plant to the existing TransGrid Kangaroo Valley-Canberra 330 kV Transmission Line (Line 6).

The relevant conditions of Project Approval for Stage 1 include:

- 1.8 Transmission Infrastructure Alignment

This condition discussed the consultation required for positioning the alignment along Yalwal Road, and indicates the need to minimise vegetation clearance.

- 2.24 Aviation Hazards

This requires consultation with the Department of Defence over matters relating to aviation hazards at Nowra Air Base.

- 2.31 Compensatory Habitat

This requires a two for one compensation habitat package to be developed in consultation with DECC.

- 2.34 Visual Amenity Impacts

The provision of landscape details to minimise visual impacts.

- 5.4 (d) Operational Management Plan – Landscape and Ecology Management Protocol

Development of management techniques for the control of weeds and pests and also for the managing and monitoring threatened species habitat.

These conditions will need to include reference to and appropriate measures to deal with the proposal.

5. Justification and Conclusions

5.1 Justification of the Project Modification

This section justifies the project as it is outlined in this EA. This justification is presented in the context of Ecologically Sustainable Development (ESD).

ESD is defined in the National Strategy for ESD as *"…using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased"*. Achievement of ESD requires implementation of four principles, which are defined in Section 6(2) of the *Protection of the Environment Administration Act 1991* (POEA Act). The four principles of ESD are:

- the precautionary principle;
- inter-generational equity;
- conservation of biological diversity and ecological integrity; and
- improved valuation, pricing and incentive mechanisms.

This section seeks to demonstrate that the principals of ESD have been adequately considered in the determination of the proposal. The following sections detail the four principals of ESD and how they have been considered in the planning and assessment of the proposal.

5.2 The Precautionary Principle

The POEA Act defines the precautionary principle as "*if there are threats of serious or irreversible environmental damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*". That is, the implementation of the precautionary principle requires taking proactive measures to prevent harm to the environment in advance of scientific proof that such harm will occur.

The environmental consequences of the proposal are considered to have been assessed in accordance with the precautionary principle. The assessment process involved specialists in relevant disciplines where required and accepted assessment methodologies, and has enabled the potential impacts of the proposal to be predicted with an adequate degree of certainty. Where there was any uncertainty in the prediction of impacts, a conservative approach was adopted to ensure the worst case scenario was assessed. This is evident in, for example, the conservative assumption that total vegetated area lost would be 30ha, whereas it is likely to be significantly less.

The results of this EA indicate that the proposal does not pose a risk of serious or irreversible environmental damage. All potential threats to the environment have been identified and

measures to reduce impacts as far as practical have been developed. These impact mitigation measures have been identified would be implemented as an integral part of the proposal. No impact mitigation or management measures have been neglected due to lack of scientific certainty regarding potential threats to the environment.

5.3 Inter-generational Equity

Inter-generational equity, as defined under the POEA Act, requires 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 Proposal is considered to be consistent with the principle of inter-generational equity in that it facilitates a proposed gas fired energy development (the Bamarang Gas Fired Facility), which has already been approved under the EP&A Act. Without a new transmission line option, the Bamarang facility would be less viable and less able to provide a gas fired base load electricity and would not contribute to the development of lower level green house gas intensive electricity generating capability.

The potential adverse impacts of the transmission line on the local community have been considered and minimised during the transmission line route selection and refinement process. This process involved extensive land owner consultation. The potential adverse impacts of the final proposed transmission line development (the subject proposal) have been assessed and are considered to be minor. Consultation of affected land owners would be ongoing throughout the remainder of the planning process and during project implementation to ensure that impacts on the community are minimised in accordance with the impact mitigation measures identified in the EA. Overall, the proposal is considered unlikely to diminish the health, diversity or productivity of the environment.

5.4 Conservation of Biological Diversity and Ecological Integrity

This principle, as defined under the PoEA Act, requires that "*conservation of biological diversity and ecological integrity should be a fundamental consideration*". The principle extends to the conservation of the total variety of life forms and biotic systems, including the diversity of genes, species, populations and their communities, as well as the ecosystems and habitats to which they belong.

Conservation of biological diversity and ecological integrity has been a fundamental consideration throughout the planning and environmental assessment of the proposal. In particular, the potential impacts on biodiversity and ecosystems associated with the proposed transmission line development were considered during the initial route selection process and subsequent route refinement, resulting in a proposed route that minimises impacts on areas of threatened species and ecological communities. The potential impacts of the potential 330 kV proposal on flora, fauna and ecosystems have been thoroughly assessed and, although greater than

the approved 132 kV line, are not expected to be significant if the proposed mitigation measures are implemented.

The environmental assessment undertaken for the proposal involved a thorough assessment of the biological diversity and ecological integrity of the proposed work site. The Proposal incorporates impact mitigation measures, including a recommendation of habitat offsets. It also incorporates a range of management measures for terrestrial flora and fauna and water quality.

5.5 Improved Valuation, Pricing and Incentive Mechanisms

The principle of improved valuation, pricing and incentive mechanisms, as defined under the POEA Act, requires that "*environmental factors should be included in the valuation of assets and services*". Approaches to improved valuation that are based on this principle include the following:

- those who generate pollution and waste should bear the cost of containment, avoidance or abatement (polluter pays);
- 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
- 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 maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

Delta Electricity recognises the value of environmental resources and aims to minimise the impacts of its activities and operations by conducting thorough assessments of its activities and ensuring that appropriate impact mitigation measures are implemented. Consideration of potential environmental impacts and impact mitigation requirements commenced during the transmission line route selection process and resulted in the selection of a route that minimises environmental impacts as far as practical while maintaining an economically viable proposal for connection of the Bamarang facility to the 330kV grid.

A thorough assessment of the final proposed transmission line (the proposal) has been conducted, with the results documented in this EA. This EA also identifies the environmental impact mitigation measures that form part of the proposal and the additional environmental management measures that would be implemented in conjunction with the Proposal to minimise environmental impacts. The proposed impact mitigation measures include recommendations for a vegetation clearing protocol that minimises the amount of vegetation to be cleared, thus minimising impacts on this natural resource and minimising impacts on land values.

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