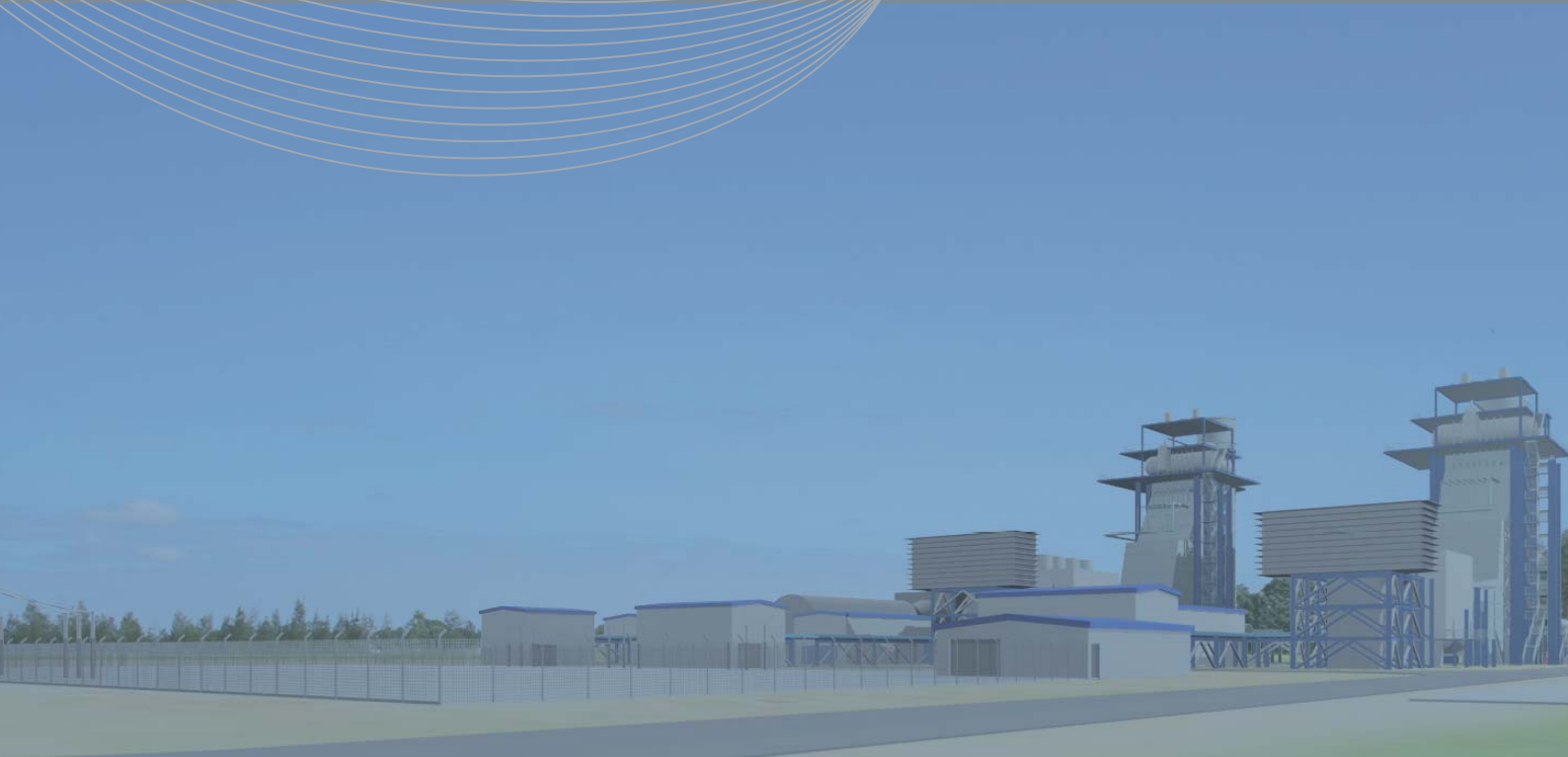
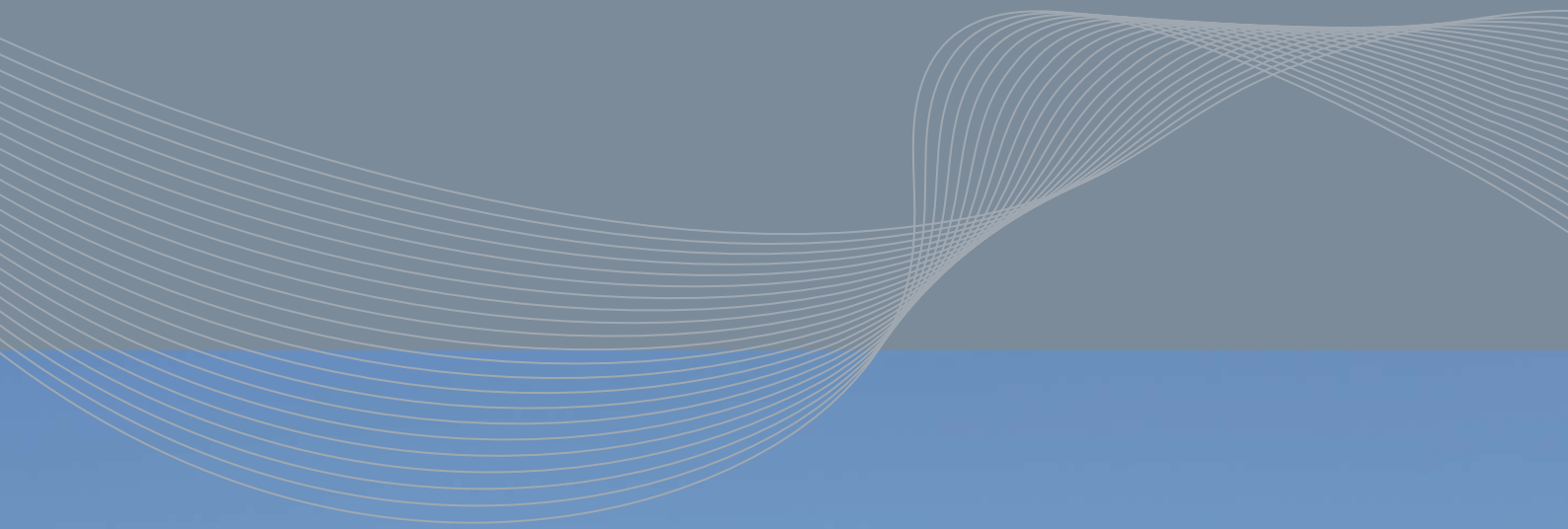




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Appendix F

Bushfire Risk Assessment (GHD)





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Delta Electricity
Bamarang Gas Fired Power
Facility
Bushfire Risk Assessment
December 2005



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1. Introduction

1.1 Purpose

GHD Pty Ltd (GHD) was commissioned by Delta Electricity to undertake a bushfire risk assessment for the proposed gas fired power facility and associated structures at Bamarang on the NSW South Coast. The proposal comprises:

- ▶ establishment of a transmission line easement along the southern side of Yalwal Road and an existing powerline easement;
- ▶ construction of a gas fire power facility within a site south of Yalwal Road currently supporting a disused abattoir; and
- ▶ installation of a gas pipeline connecting the gas fired power facility with the Eastern Gas Pipeline.

1.2 Background

The study area is located at Bamarang on the NSW South Coast within the Shoalhaven Local Government Area (LGA) (Figure 1). The proposed gas fired power facility is to be located south of Yalwal Road on a site currently supporting a disused abattoir and areas of native vegetation (Figure 2). Yalwal Road and part of Bamarang Nature Reserve abuts this area to the north and Crown Land supporting native vegetation occurs to the east, south and west.

The transmission lines will run along the southern side of Yalwal Road from Fitler Road and connecting to the current transmission line easement north of Yalwal Road near the junction of Bamarang and Yalwal Roads.

Installation of a gas pipeline to fuel the gas fired power facility is also required and is proposed to run perpendicular to the gas fired power facility site and join the current Eastern Gas Pipeline. This area is currently vegetated and supports vegetation similar to that within the disused abattoir site.

The majority of the study area supports native vegetation and the proposal will pass through part of the Triplarina Nature Reserve. A number of drainage lines also occur throughout the study area.

In this report the gas fired power facility site is referred to as 'the site,' the areas required for the transmission lines are referred to as 'the easement,' the area proposed for the gas pipeline are referred to as the 'pipeline route' and all areas proposed for development combined are referred to as the 'study area'.



Geology, Soils and Topography

The study area is located in the Sydney Basin Bioregion. Soils within the study area comprise predominantly sandy loam and are well drained in most places except along drainage lines and creeks.

The study area has a slightly undulating topography with a number of drainage lines crossing throughout. No steep escarpment areas occur in the area with the nearest escarpments occurring to the north and east of the study area near the Shoalhaven River.

Hydrology

A number of creeks and tributaries occur throughout the study area with the following occurring along the proposed easement:

- ▶ Flat Rock Creek;
- ▶ Sandy Creek;
- ▶ Cabbage Tree Creek; and
- ▶ Two other unnamed drainage lines.

Two tributaries of Sandy Creek also run east to west adjacent to each other across the proposed gas fired power facility site.

1.3 Bushfire Prone Land

Designated Bushfire Prone Land maps have been prepared for the Shoalhaven LGA. The entire study area has been mapped as supporting Bushfire Prone Land. Therefore it is recommended that the development complies with the bushfire provisions within *Planning for Bushfire Protection* (hereafter referred to as 'PBP') (PlanningNSW 2001).

Fire Management Strategies for the site that comply with PBP are described in Section 5.

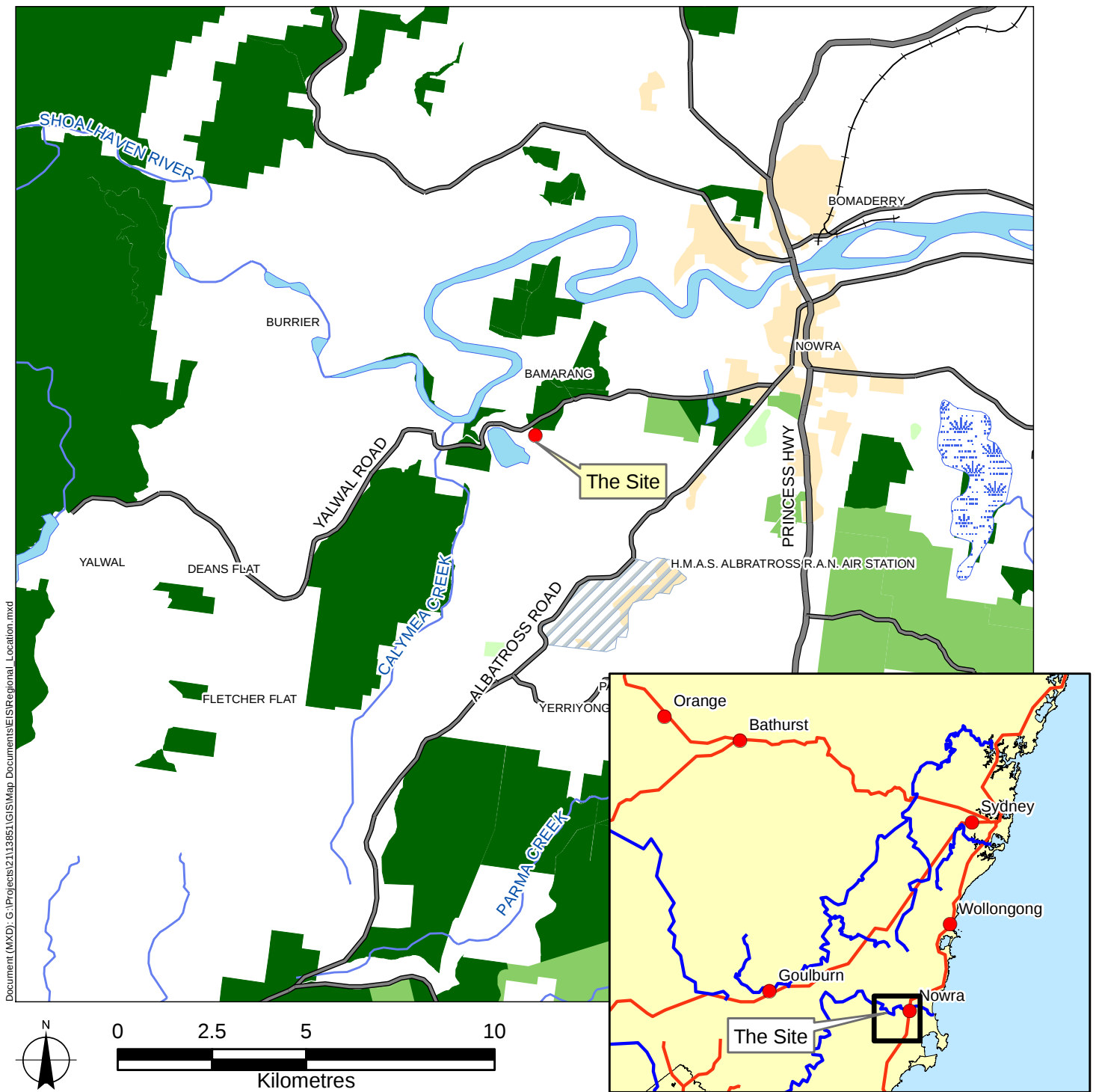


Figure 1 Site Location

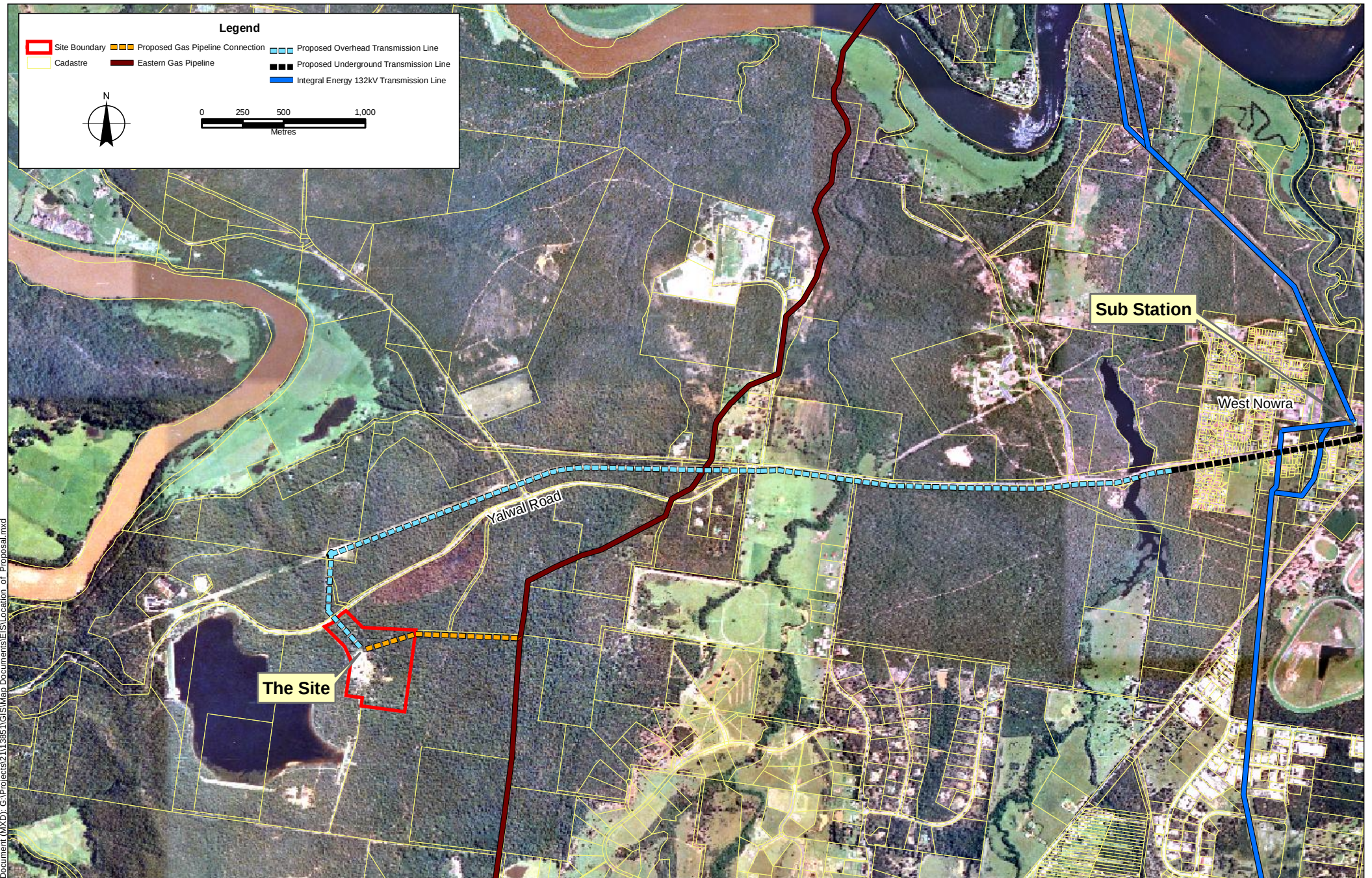


Figure 2 Transmission Line and Gas Pipeline Routes



2. Legislation

2.1 NSW Environmental Planning and Assessment Act 1979 and Rural Fire Services Act 1997

The proposal does not require referral to the NSW Rural Fire Service under section 79BA of the *Environmental Planning and Assessment Act 1979* (EP&A Act) nor section 100B of the *Rural Fires Act 1997* (RF Act) as neither residential nor rural residential development are proposed for the study area.

Under section 100B of the *Rural Fire Act 1997* authorisation is required for the subdivision of bushfire prone land that could lawfully be used for residential or rural residential purposes or development of land for special fire protection purposes.

However in accordance with section 79C of the EP&A Act, the Department of Planning may choose to refer the application to the Rural Fire Service.

2.2 Planning For Bushfire Protection 2001

Whilst the proposed development is not required to comply with the PBP, it is recommended that the principles of this document be applied to the proposal in order to reduce the threat of fires to both the proposed gas fired power facility and adjacent lands and property. Principles considered within the document include:

- ▶ setbacks and asset protection zones;
- ▶ siting and access;
- ▶ water supply;
- ▶ vegetation management; and
- ▶ building construction requirements.

2.3 Special Protection Developments

There are several classes of development that are constrained by the presence of “high bushfire hazard,” including developments such as aged care facilities, disabled people care facilities, schools and institutions for the mentally disabled. Specific fire-safety requirements are associated with such developments and these need to be considered by a consent authority when assessing development applications. State Environmental Planning Policies (eg. SEPP 5 Seniors Living, SEPP 9 Group Homes) have been introduced to allow councils to disallow such developments on land that has a “high bushfire hazard.” Given that the site it proposed for industrial development these provisions would not apply.



3. Methods

3.1 Site Inspection

A site inspection was conducted to determine potential bushfire risks associated with the site. The guidelines for bushfire risk assessment as set out in PBP were used to determine these potential bushfire risks.

3.2 Vegetation Communities

Vegetation typically provides the principle source of fuel for bushfires. As vegetation types vary in their ability to provide fuel, PBP provides a number of vegetation type descriptions, each of which is linked to particular hazard ratings. The vegetation of the site and surrounding areas was classed on the basis of an assessment of the vegetation structure based on PBP.

3.3 Slope

Slopes affect the speed and intensity of bushfires, with steep upslopes carrying a greater hazard than flatter slopes or downslopes. Land on the site was classified into slope classes (as per PBP) on the basis of angle over a distance of 140 m. The gradient considered to be the most likely to influence fire behaviour was used to calculate the bushfire risks.



4. Results

4.1 Existing Vegetation

4.1.1 General Vegetation Communities

The site of the proposed gas fired power facility is on a disused abattoir. Much of the vegetation on the western side of the site appears to have been cleared during the construction phase. However, scattered native trees remain and the groundcover comprises mainly native grasses. A fire trail approximately 4 m wide has been maintained around the perimeter and informal tracks are also evident through some of the site.

The current transmission line easements are regularly slashed and vegetation is maintained as a grassy cover. Road reserves along Yalwal Road are also regularly slashed.

Weed invasion was limited throughout the study area with the only major occurrences recorded along Cabbage Tree Creek on the southern side of Yalwal Road and within pasture areas.

4.1.2 General Vegetation Communities

Ten ecological communities were recorded within the study area. These are listed below and their locations are shown on Figure 3. A flora species list has also been included in Appendix A.

1. Red Bloodwood/Scribbly Gum/White Stringybark Forest ($\pm$ Blackbutt, $\pm$ Grey Gum)

This community occurred along the current transmission line easement and was characterised by the presence of Red Bloodwood (*Corymbia gummifera*), Scribbly Gum (*Eucalyptus sclerophylla*) and White Stringybark (*Eucalyptus globoidea*) with occasional occurrences of Blackbutt (*Eucalyptus pilularis*) and Grey Gum (*Eucalyptus punctata*). The midstorey was dominated by patches of Black She-oak (*Allocasuarina littoralis*) and the shrub layer comprised regenerating *Eucalyptus* spp., Spiny Bossiaea (*Bossiaea obcordata*), Mountain Devil (*Lambertia formosa*), *Platylobium formosum*, Round Leaf Tea-tree (*Leptospermum rotundifolium*), Hairpin Banksia (*Banksia spinulosa*), Tick Bush (*Kunzea ambigua*), Needlebush (*Hakea sericea*) Broad-leaved Geebung (*Persoonia leavis*), Slender Rice Flower (*Pimelea linifolia*) and Flax-leaved Paperbark (*Melaleuca linariifolia*). The groundcover was grassy in parts, with moister sections dominated by Bracken Fern (*Pteridium esculentum*) and *Gahnia* sp.. Other groundcover and climber species included species such as False Sarsparilla (*Hardenbergia violacea*), *Cassyntha pubescens*, Wiry Panic (*Entolasia stricta*), Coral Heath (*Epacris microphylla*) and Grass Tree (*Xanthorrhoea* sp.). Areas of this community with a recent intense fire history had a large amount of *Eucalyptus* sp. regeneration. A small section of this community was also present between Filter Road and Flat Rock Creek (see Figure 3).



Nowra Heath-myrtle was recorded along the drainage lines within this community and is listed as Endangered under the TSC Act.

2. Spotted Gum/Grey Gum Forest

This community occurred in small sections east and west of Flat Rock Creek (Figure 3). Characteristic species included Spotted Gum (*Corymbia maculata*) and Grey Gum in the canopy, with a midstorey dominated by Black She-oak. The shrub layer was scattered, with occurrences of Spiny Bossiaea, Tick Bush, Sydney Golden Wattle (*Acacia longifolia*), Cherry Ballart (*Exocarpus cupressiformis*), Needlebush, Large-leaf Hopbush (*Dodonaea triquetra*), Bracelet Honey-myrtle (*Melaleuca armarillis*), Wallum Heath (*Epacris pulchella*), Sweet Pittosporum (*Pittosporum undulatum*) and Scented Paperbark (*Melaleuca squarrosa*).

Nowra Heath-myrtle was also recorded in this community on the eastern side of Flat Rock Creek.

3. Red Bloodwood/Thin-leaved Stringybark Forest (±Grey Gum, ±Scribbly Gum)

This community occurred west of Flat Rock creek and had a canopy layer dominated by Red Bloodwood and Thin-leaved Stringybark (*Eucalyptus euginoides*, with occasional occurrences of Grey Gum and Scribbly Gum (Figure 3). The midstorey was dominated by Black She-oak with occasional *Allocasuarina distyla*. The shrub layer was dominated by Tick Bush, Hairpin Banksia, Needlebush, Conesticks (*Petrophile pulchella*), *Pultenaea daphnoides*, and *Acacia terminalis*.

4. Cabbage Gum/Forest Red Gum Forest (River-flat Eucalypt Forest)

This community occurred adjacent to Cabbage Tree Creek and was characteristic of a modified remnant of River-flat Eucalypt Forest, an Endangered Ecological community under the TSC Act (Figure 3). The canopy was dominated by Cabbage Gum (*Eucalyptus amplifolia*) and Forest Red Gum (*Eucalyptus tereticornis*), with patchy Prickly-leaved Paperbark (*Melaleuca stypheloides*) and Snow-in-summer (*Melaleuca lineariifolia*) in the midstorey. The shrub layer was sparse and dominated by Flax-leaved Paperbark (*Melaleuca hypericifolia*) and Blackthorn (*Bursaria spinosa*). Dominant species in the understorey included *Cheilanthes sieberi*, Weeping Grass (*Microlaena stipoides*), Kangaroo Grass (*Themeda australis*) Spiny Mat Rush (*Lomandra longifolia*) and Kidney Weed (*Dichondra repens*). Many of these species are characteristic of the TSC Act listed River-flat Eucalypt Forest.

5. Spotted Gum/White Stringybark (±Grey Gum Forest)

This community was characterised by Spotted Gum and White Stringybark in the canopy, with a midstorey of Black She-oak. The shrub layer is sparse, with main species including Needlebush, Gorse Bitter Pea (*Davesia ulicifolia*), Broad-leaved Geebung (*Persoonia levis*), Conesticks and Cherry Ballart. Groundcover species include *Aristida* sp., *Dianella longifolia* and Many-flowered Mat-rush (*Lomandra multiflora*).



6. Red Bloodwood/Thin-leaved Stringybark/Grey Gum Forest (±Blackbutt, ±Scribbly Gum)

This community was present across the proposed gas fired power facility site and gas pipeline route (Figure 3). It was characterised by Red Bloodwood, Thin-leaved Stringybark and Grey Gum, with Blackbutt and Scribbly Gum scattered throughout but rarely together in the canopy layer. The midstorey was dominated by patches of Black She-oak, with a shrub layer comprised of Box-leaf Wattle (*Acacia buxifolia*), Slender Rice-flower (*Pimelia linifolia*), *Dillwynia retorta*, Spiny Bossiaea, Gorse Bitter Pea, Tick Bush, Brown's Wattle (*Acacia brownii*), Silky Purple Flag (*Patersonia sericea*), Large Wedge Pea (*Gompholobium grandiflorum*), and Erect Guinea Flower (*Hibbertia riparia*). Groundcover species included Kangaroo Grass (*Themeda australis*), Barbed-wire Grass (*Cymbopogon refractus*), Dusky Coral Pea (*Kennedia rubicunda*), False Sarsparilla (*Hardgenbergia violacea*), *Austrodanthonia* sp. and Purple Wiregrass (*Aristida ramosa*).

This community also occurred north of the site along the north-south section of the proposed transmission line easement. James (2005) identified an intergrade between this community and the regionally significant Northern Foothills Spotted Gum – Blackbutt Moist Shrub Forest in this area. Spotted Gum was not present within the proposed clearance area and immediate vicinity and therefore the potential impact area does not represent a stand of this community. However, it is likely that Northern Foothills Spotted Gum – Blackbutt Moist Shrub Forest occurs further to the north outside the study area (James 2005).

7. Red Bloodwood/Scribbly Gum/Thin-leaved Stringybark Open Woodland

A small patch of this community occurred in the south eastern portion of the proposed gas fired power facility site (Figure 3). It was characterised by species similar to that of the remainder of the site but had a more open woodland structure. Dominant canopy species included Red Bloodwood, Scribbly Gum and Thin-leaved Stringybark with occasional occurrences of White Stringybark and a grassy understorey. This community recorded the highest diversity of orchids in the study area. Kangaroo Grass dominated the groundcover, with patches of shrubs such as Tick Bush.

8. Heath

Only small areas of this community occurred within the study area adjacent to Flat Rock Creek. As the name suggests the canopy layer in this community was absent and vegetation cover was dominated by tall shrubs including Tick Bush, Hillock Bush (*Melaleuca hypericifolia*), *Leucopogon lanceolatus* and *Calytrix tetragona*.

9. Disturbed Riparian Vegetation

South of Yalwal Road along Cabbage Tree Creek was comprised mainly of exotic riparian species indicative of a high level of disturbance including *Cotoneaster pannosus* and Privett (*Ligustrum sinense*).

10. Pasture

Pasture areas occurred to the west and east of Cabbage Tree Creek on the northern side of Yalwal Road and to the west on the south side (Figure 3). This community has



been historically cleared and dominated by exotic pasture species such as *Paspalum (Paspalum dilatatum)*, Kikuyu (*Pennisetum clandestinum*) and Little Quaking Grass (*Briza minor*).

4.2 Vegetation Classes

A variety of vegetation communities have been identified within the study area. Table 1 lists the corresponding PBP vegetation group for each of these communities. Vegetation groups are classified in accordance with the likely flammability of each vegetation type and are based on factors such as likely fuel loads, vegetation composition and presence of sclerophyllous species. Vegetation communities are assigned to three categories with Group 1 presenting the greatest fire hazard and Group 3 the least

Table 1 PBP Vegetation Groups

Vegetation Community	PBP Vegetation Group	PBP Group Number
Red Bloodwood/Scribbly Gum/White Stringybark Forest (±Blackbutt, ±Grey Gum)	Dry Sclerophyll Forest	1
Spotted Gum/Grey Gum Forest	Dry Sclerophyll Forest	1
Red Bloodwood/Thin-leaved Stringybark Forest (±Grey Gum, ±Scribbly Gum)	Dry Sclerophyll Forest	1
Cabbage Gum/Forest Red Gum Forest (River-flat Eucalypt Forest)	Woodland	2
Spotted Gum/White Stringybark (±Grey Gum Forest)	Dry Sclerophyll Forest	1
Red Bloodwood/Thin-leaved Stringybark/Grey Gum Forest (±Blackbutt, ±Scribbly Gum)	Dry Sclerophyll Forest	1
Red Bloodwood/Scribbly Gum/Thin-leaved Stringybark Open Woodland	Woodland	2
Heath	Tall Heath	2
Disturbed Riparian Vegetation	Tall Heath	2
Pasture	Grassland (pasture)	3

Note: PBP = *Planning for Bushfire Protection* (PlanningNSW 2001)



4.3 Slope

The slope of the site was generally flat and can be classified as '<0-5° upslope' (Planning NSW 2001).

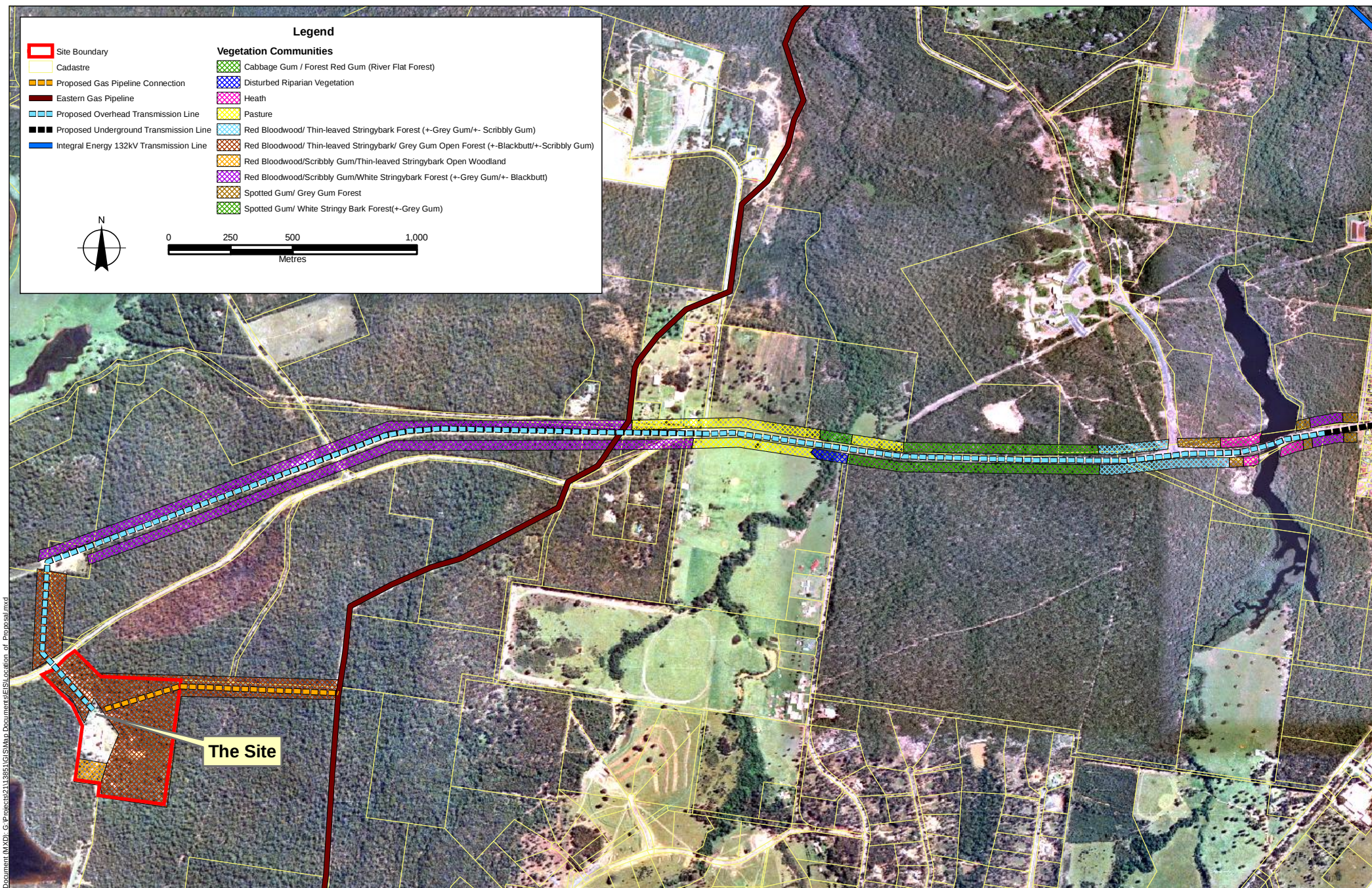


Figure 3 Vegetation Communities



5. Recommended Fire Management Measures

Recommended and required fire management measures have been outlined below and include the provision of adequate Asset Protection Zones (APZs), site access and water sources.

5.1 Asset Protection Zones

Asset Protection Zones acts as a buffer between the development and the hazard and are the principal protection mechanism. APZs reduce the vulnerability to fires through construction and maintenance of an Outer Protection Area (OPA) and an Inner Protection Area (IPA) (PlanningNSW 2001).

Vegetation types (eg. woodland or forest) present different levels of fire hazard. The level of fire hazard also varies with slope and aspect. Slope and aspect are unlikely to significantly affect fire behaviour at the site as the slope is less than 5°.

Rural Fire Service have advised that the required vegetation clearance for the transmission line easements and the standard vegetation management measures implemented below transmission lines are suitable for managing fire risks in these areas and no additional management measures need to be implemented. Furthermore, given that the proposed gas pipeline is to operate underground, no APZs are required in this area.

However, APZs would be required at the proposed gas fired power facility site. The required APZs across the site are listed in Table 2 and shown in Figure 4 and have been determined in consultation with RFS.

Table 2 Required APZs for gas fired power facility site.

Location	Required APZ
North of gas fired power facility	40 m from edge of structure.
South of gas fired power facility	40 m from edge of structure.
West of gas fired power facility	40 m from edge of structure.
Any additional structure protruding from main structure	20 m from edge of structure.
Adjacent to cooling tower	20 m from edge of structure.



Inner Protection Area (IPA)

The IPAs should be 30 m wide and extend from the edge of the OPA to the development. The purpose of the IPA is to minimise the impact of direct flame contact and radiant heat on the development.

The performance of the IPA should be such that:

- ▶ there is minimal fine fuel that could be set alight by a bushfire; and
- ▶ fuels are discontinuous (i.e. separated by approximately 2 m).

Trees and shrubs are permitted within the IPA provided they do not form a continuous canopy, are not species that retain dead material or deposit excessive quantities of ground fuel in a short period or in the fire danger period and are located so that they will not ignite the asset through direct flame contact or radiant emission.

A fire trail should be incorporated into the IPA. This will provide:

- ▶ easier access for firefighters allowing more efficient use of fire fighting resources;
- ▶ a safe retreat for fire fighters; and
- ▶ a clear control line from which to conduct back-burning operations if necessary.

The fire trail will need to have the following attributes.

- ▶ located within a minimum 6 m wide reserve (4 m wide trail and 1 m wide cleared area each side of trail);
- ▶ constructed in accordance with design criteria outlined in Section 5.2;
- ▶ be trafficable by firefighting vehicles under all weather conditions;
- ▶ appropriate drainage and erosion controls;
- ▶ not traverse any wetlands or other land potentially subject to periodic inundation;
- ▶ should link to Yalwal Road;
- ▶ be maintained in a serviceable and accessible condition at all times; and
- ▶ have passing bays at regular intervals of 200 m.

The IPA should be kept free of fuel through regular mowing with less than three tonnes per hectare of fine fuel present at any time.

Outer Protection Area (OPA)

The purpose of the OPA is to decrease the fuel level to reduce the intensity of a fire and restrict fire to canopy fuels. This reduces the level of direct flame, radiant heat and ember attack on the IPA. In the absence of any other policy, the recommended fuel level is 8 tonnes/hectare (PlanningNSW 2001).

The OPAs at the site should be 10 m wide and be located adjacent to the hazard which begins at the vegetated areas. Any trees and shrubs in the OPA should be maintained in a manner that ensures that the vegetation/fuel load is not continuous.

Fuel should be manually removed from the OPA to be piled and burned in a cleared area during low fire danger conditions.



5.2 Site Access

Access to the site should be established and maintained and include a perimeter fire trail around the entire site boundary. This would need to be located entirely within the site and include the following attributes:

- ▶ a minimum trafficable width of 4 m with an additional 1m wide strip on each side of the road kept clear of bushes and long grass;
- ▶ the road should have a passing bay about every 200 m where possible, which should be 20 m long by 3 m wide, making a minimum trafficable width of 7 m at the passing bay;
- ▶ the capacity of road should be sufficient to carry fully loaded firefighting vehicles (approximately 28 tonnes or 9 tonnes per axle);
- ▶ a minimum vertical clearance of 6 m to any overhanging obstructions, including tree branches;
- ▶ curves should have a minimum inner radius of 6 m and be minimal in number to allow for rapid access and escape;
- ▶ the minimum distance between inner and outer curves should be 6 m;
- ▶ maximum grades should not exceed 15° and preferably not more than 10°;
- ▶ roads should provide sufficient width to allow firefighting vehicle crews to work with firefighting equipment around the vehicle.

If possible two access roads to the site are recommended along paths that are unlikely to be cut by a fire simultaneously and therefore ensure there is at least one safe evacuation point. However, given that the location of the site and surrounding land uses, this may not be possible.

5.3 Water Supply

Appropriate watering points should be provided along the perimeter trail from a series of fire hydrants. These hydrants should meet the requirements of Australian Standard 2419–*Fire Hydrant Installation* and be delivered by a ring main system.

5.4 Building Design, Materials and Construction Standards

PBP provides guidelines for construction standards for bushfire protection (Australian Standard 3959-1999). These guidelines are designed to reduce the risk of property damage from burning debris and radiant heat. Based on the vegetation type present at the proposed gas fired power facility site, the Category of Bushfire Attack would be **High** and therefore Level 2 (AS 3959 – 1999) Construction Standards would apply.

Given that the proposed development does not involve construction of a dwelling or building some of these provisions are not applicable. However, most importantly combustible materials likely to be impacted by radiant heat should not be used in construction of the gas fired power facility.



5.5 Additional Recommendations

A number of additional recommendations have been made by RFS for fire protection during construction and operation of the gas fired power facility and include:

- ▶ Preparation of an operation management plan that details fire prevention measures to be implemented during construction including but not limited to:
 - Work involving risk of ignition should not be carried out during total fire bans;
 - Fire suppression equipment should be available on site;
 - Storage and maintenance of fuels and other flammable materials.
- ▶ Evacuation procedures should also be detailed for any persons located at the gas fired power facility during a bushfire; and
- ▶ Local RFS Control Centre would be notified of the dates during which construction is to be undertaken and any dates during which 'hot works' are to be conducted would be highlighted. This would enable RFS to advise when weather conditions are not appropriate to carry out the works proposed.



Figure 4 - Fire Protection Requirements (Stage1)



Figure 5 - Fire Protection Requirements (Stage 2)



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