

# Section 4

# Environmental Setting

## Preamble

This section describes the environmental setting within and surrounding the Site for the proposed Sutton Forest Sand Quarry.

Emphasis is placed in this section on providing information about the environmental features that would contribute to or influence the assessment of a wide range of other environmental parameters. Information is provided on the local and Site topography, geology, meteorology, land ownership and land use.

Other features of the surrounding environment that would or may be affected by the proposed Quarry are detailed in Section 5 in conjunction with the design and operational safeguards and impact assessment for those features.



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## 4.1 TOPOGRAPHY

### 4.1.1 Regional and Local Topography

The Site lies on the eastern side of the Great Dividing Range in an area consisting of narrow to broad valleys with undulating landforms with variable gradients reflecting its location near the edge of the Sydney Basin (see Section 4.2.1).

**Figure 4.1** displays the local topography around the Site with the key features being the presence of two creeks, namely Long Swamp Creek and Hanging Rock Swamp Creek with the catchment divide and hence the highest elevations between the two systems located between the southern extent of the Quarry Site Boundary and the Hume Highway. The presence of swamps within the creek system is also a feature of the local topography.

### 4.1.2 Site Topography

The Site is located in an area of elevated terrain within the Southern Highlands. Elevations range from approximately 625m AHD to 710m AHD at the highest point within the Site (see **Figure 4.2**).

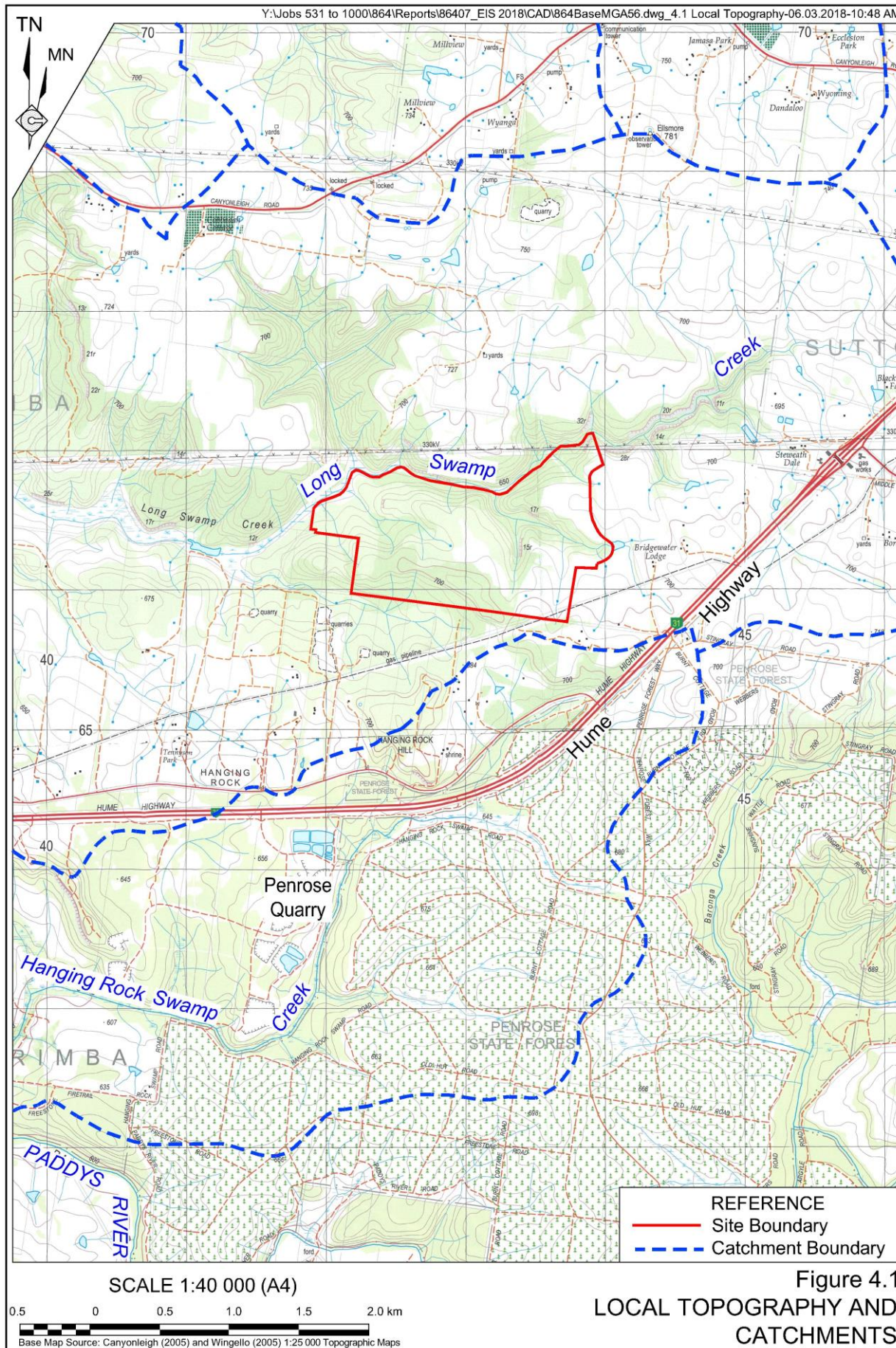
The Site covers a variety of landforms, from gently-inclined (<5% slope) crests and ridges to moderately inclined (up to 30%) short hill slopes. Small cliff lines with drops of up to 5m to 10m are present within the Site but beyond the proposed extraction area. The proposed extraction area occupies a series of gentle crests and ridges, lying mostly at or near the top of the local catchments. A substantial ridge is located on the southern side of the extraction area which would provide substantive topographic protection to the properties south of the Site.

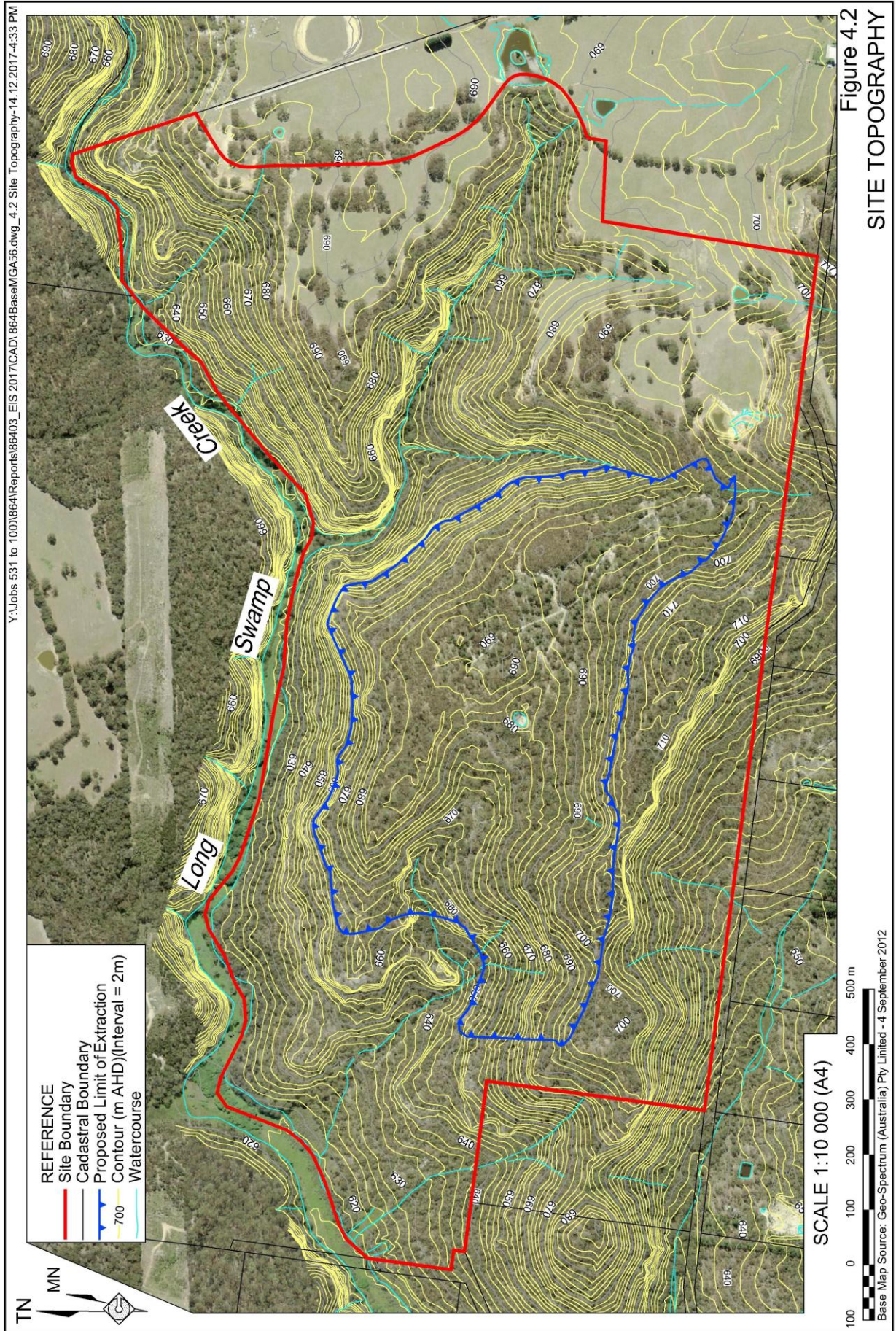
## 4.2 GEOLOGY

### 4.2.1 Regional Geology

The Site is located on the southwestern edge of the Sydney Basin where the near-surface bedrock generally consists of Triassic age sedimentary rocks. The Geological Survey of NSW 1:250 000 Geological Series Wollongong map-sheet indicates that the area is located at the edge of the outcrop extent of the Triassic Hawkesbury Sandstone Formation, which unconformably overlies the Permian age Shoalhaven Group. The Hawkesbury Sandstone outcrops on ridges and hill tops, with the Permian sedimentary rocks outcropping in eroded valleys. The Hawkesbury Sandstone in the locality is deeply weathered and considered, “friable” due to the weathering sand grain bonds and cement, which improves the ability for the sandstone to be easily processed into a construction sand product.

Isolated igneous rocks occur in the area, consisting mainly of weathered remnants of Tertiary basalts. The Hawkesbury Sandstone is a predominantly quartz sandstone with some shale lenses. The Permian sedimentary rocks of the Shoalhaven Group are typically siltstone, shale and sandstone.





## 4.2.2 Site Geology

The description of the geology of the Site is based largely on the interpretation of exploratory drilling by geologist Mr Graham Lee (Lee, 2016). A total of five diamond drill holes and four open holes were drilled across the Site during 2012 and 2015. These holes were drilled to a maximum depth of approximately 65m below ground surface, penetrating the Hawkesbury Sandstone.

The Hawkesbury Sandstone beneath the Quarry Operations Area comprises friable, variously pale-coloured sandstones and clayey sands, and thin pale greyish coloured clay, with darker shale lenses at approximately 650m AHD. The darker shale lenses encountered do not display significant lateral extent, reflecting a localised and lensoidal nature of the shale unit that is interpreted as being formed in a billabong of a meandering watercourse.

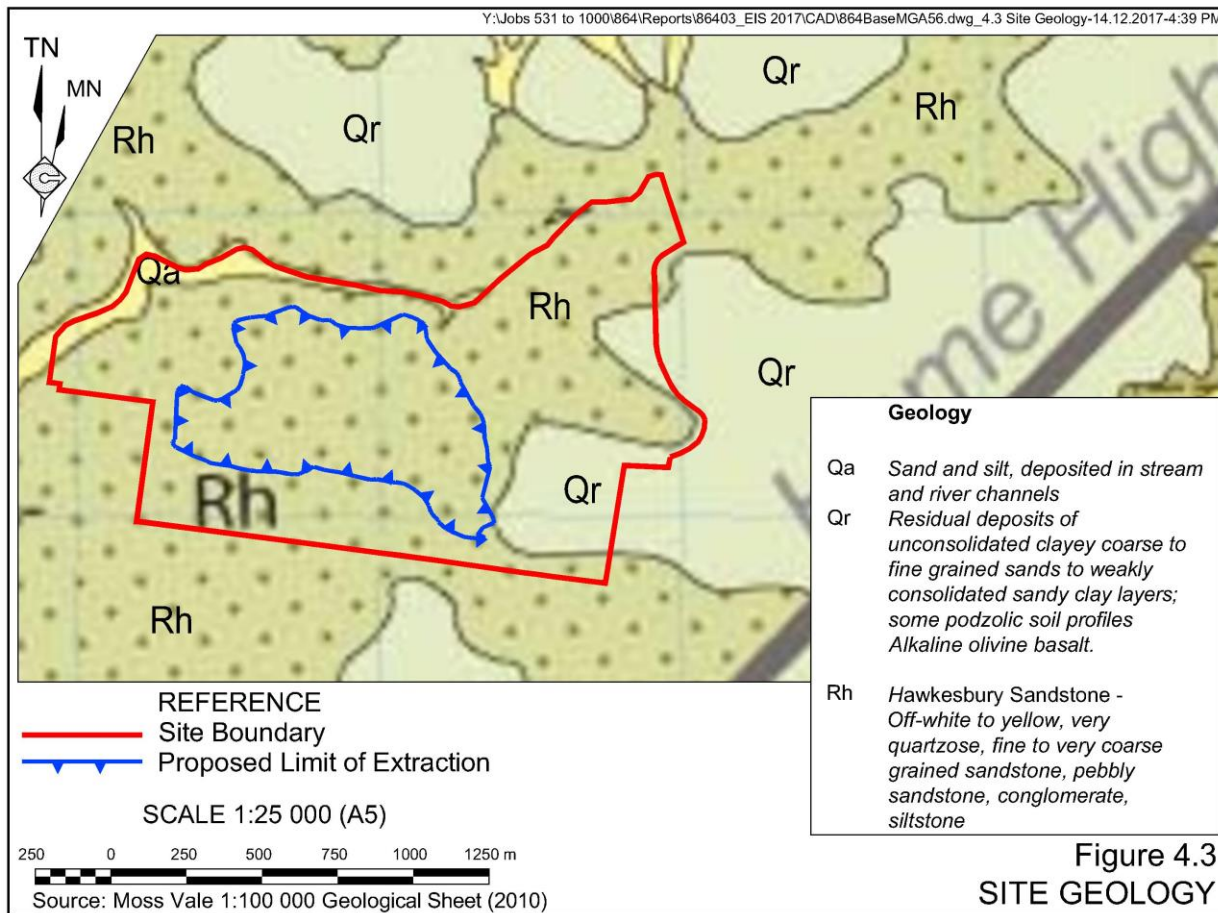
Apart from the shale lenses, the Hawkesbury Sandstone resource within the proposed extraction area generally displays a vertically continuous sandstone sequence, showing typical Hawkesbury Sandstone sedimentary depositional characteristics with overlying sand beds, grading from coarse to fine. A coarse-grained sandstone and pebble conglomerate is present at the base of the Hawkesbury Sandstone which in turn is underlain by the Permian Berry Formation.

The defined resource is located within the proposed extraction area (covering approximately 47.7ha (**Figure 4.3**)) as well as the 12ha processing and stockpiling area. Within these areas, the resources have been classified as Indicated Resources as defined by the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (the JORC Code (2012)). The total sandstone resource estimates presented in **Table 4.1** are based on results from all five cored drill holes and the four open drill holes.

**Table 4.1**  
**Total Raw Sandstone Resource Estimates**

Bench (m)	Sandstone (Inc Fe Stone+ Clay/Shale) (m <sup>3</sup> )	Density (t/m <sup>3</sup> )	Sandstone (Inc Fe Stone+ Clay/Shale) (t)	Sandstone Less Fe Stone & Clay/Shale (%)	Sandstone Less Fe Stone & Clay/Shale (t)
700-710	78 825	2.2	173 415	96.0	1 664 784
690-700	564 325	2.2	1 241 515	96.0	1 191 854
680-690	2 097 500	2.2	4 614 500	96.0	4 429 920
670-680	2 639 900	2.2	5 807 780	96.0	5 575 469
660-670	2 901 050	2.2	6 382 310	96.0	6 127 018
650-660	2 965 125	2.2	6 523 275	96.0	6 262 344
640-650	2 816 050	2.2	6 195 310	96.0	5 947 498
630-640	2 582 125	2.2	5 680 675	96.0	5 453 448
<b>Sub-Total</b>	<b>16 644 900</b>				
<b>Less Soil</b>	<b>590000</b>				
<b>Total</b>	<b>16 054 900</b>	<b>2.2</b>	<b>35 320 780</b>	<b>96.0</b>	<b>33 907 949</b>
<b>Sandstone (Rounded)</b>			<b>35 Million</b>		<b>34 Million</b>

Source: Lee (2016) - Table 1



Based on the core drill hole logs and tested samples, after making allowances for rejection of lump ironstone plus pebbles (+6.7mm = 2.3%) and the fine silt + clay fraction (-0.075mm = 11.5%), the product sand Indicated Resource is estimated to be 29.5 million tonnes.

The resource within the proposed extraction area is well suited to the production of fine-grained concrete aggregates as defined by AS2758.1. From this investigation, it is concluded that a raw sandstone resource comprising approximately 37 million tonnes (including grey shale at 650m AHD) occurs within the proposed extraction area. After rejecting ironstone and other clay/shale materials, the raw sandstone available for wash plant feed would be approximately 34 million tonnes. With a wash plant yield of 86%, the resources would produce in the order of 29 million tonnes of sand. Extraction waste and wash plant rejects would comprise a total of approximately 7.7 million tonnes to be placed into the extraction area void or Fines Storage Area 1 as backfill.

In summary, based on the data presented above:

Estimated total volume of extracted material	= 16 650 000m <sup>3</sup>
Estimated total quantity extracted Sandstone	= 33 910 000 tonnes
Estimated total sand produced	= 29 230 000 tonnes
Estimated total +6.7mm materials	= 780 000 tonnes
Estimated total -0.075mm materials	= 3 900 000 tonnes

## 4.3 METEOROLOGY

### 4.3.1 Introduction

This section provides a summary of the meteorological data relevant to the Site and the environmental issues considered in the various Specialist Consultant Studies and Section 5 of this document. In some cases, additional Bureau of Meteorology (BoM) weather monitoring stations have been relied upon by the specialist consultants to suit their particular assessments. For example, SEEC (2018a) compiled composite daily and monthly rainfall records using a range of weather monitoring stations, particularly from Eling, a Bureau of Meteorology (BoM ID 068093) station which monitored rainfall from 1945 until it ceased recording in 2004 but is closer to the Site and was considered more appropriate for the derivation of rainfall and runoff data.

### 4.3.2 Climate Data

**Table 4.2** provides a brief statistical summary of temperature, humidity and rainfall data sourced from the automated weather monitoring station (AWS) at Moss Vale (BoM ID 068239), identified as the closest station to the Site with ongoing and recent reporting of the relevant climate statistics. Evaporation data was sourced from the Goulburn TAFE weather monitoring station (BoM ID 070263) as this is the nearest location to the Site where this information is collected, i.e. approximately 40km southwest of the Site. The maximum and minimum values presented in **Table 4.2** are coloured red and blue respectively.

**Table 4.2**  
**Monthly Meteorological Data**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Temperature (°C) Moss Vale AWS (Station # 068239) 2001 to 2018</b>												
Mean maximum temperature	26.3	24.4	22.0	18.9	15.5	12.6	11.8	13.4	16.7	19.6	22.1	24.1
Mean minimum temperature	14.0	14.1	12.0	8.4	4.7	3.5	2.4	2.9	5.4	7.8	10.5	12.2
<b>Relative Humidity (%) Moss Vale AWS (Station # 068239) 2001 to 2010</b>												
9:00am	70	80	83	79	83	83	81	73	67	63	70	67
3:00pm	51	60	59	58	60	63	61	53	51	51	56	52
<b>Rainfall (mm) Moss Vale AWS (Station # 068239) 2001 to 2018</b>												
Mean monthly rainfall	69.8	98.6	83.2	54.9	41.2	87.4	45.9	49.4	38.2	44.2	65.7	52.9
Highest monthly rainfall	136.8	254.4	237.0	210.4	110.4	318.0	104.6	217.8	107.0	98.6	176.2	106.6
Lowest monthly rainfall	12.4	4.0	24.8	5.4	4.8	10.4	1.4	4.4	1.4	1.6	11.0	11.6
Highest daily rainfall	66.0	78.4	71.2	63.0	50.6	135.8	61.6	109.4	40.2	56.0	41.8	51.8
<b>Evaporation (mm) Goulburn TAFE (Station # 070263) 1978 to 2018</b>												
Mean monthly evaporation	195.3	145.6	124.0	75.0	49.6	33.0	37.2	58.9	84.0	120.9	150.0	189.1
Source: Bureau of Meteorology – Accessed 28 February 2018												

### 4.3.3 Temperature and Humidity

The highest mean temperatures are recorded from December through to February with January having the highest mean monthly temperature of 26.3°C. The lowest temperatures are recorded through June to August with the lowest mean monthly temperature in July of 2.4°C.

The months with the highest humidity (measured at 9am) on average are March, May and June with a 9:00am average of 83%, and the lowest is October with an average of 63%.

#### 4.3.4 Rainfall

Mean annual rainfall derived from composited data (SEEC, 2018a) is 902mm, with mean rainfall highest from November to March with the highest monthly mean rainfall occurring in February.

#### 4.3.5 Evaporation

The nearest meteorological station with long term (40 years) continuous evaporation data is Goulburn TAFE (BoM ID. 070263). The station has recorded evaporation data from 1978 to the present day. **Table 4.2** shows the average monthly evaporation levels. Annual evaporation averages 1 263mm and exceeds rainfall during all months except June and July.

#### 4.3.6 Wind

The wind distribution patterns at the Site automated weather station (location displayed in **Figure 4.4**) across the period March 2014 to February 2015. The wind roses shows that, with the exception of winter, wind directions are quite variable in all seasons and that very few winds are from the south on an annual basis. Westerlies dominate in all seasons other than summer, which experiences more winds from the northern and eastern quadrants. Whilst strong winds are a feature of the area, average wind speeds of up to 2.7 m/s from the southeast and up to 2.1 m/s from the west typically occur more than 30% of the time during some seasons and time periods. Winds from the northern and eastern quadrants are also a feature of spring and autumn, however they are very infrequent in winter. The annual average wind speed is 2.4 m/s with calms (winds less than 0.5 m/s) occurring approximately 3.6% of the time.

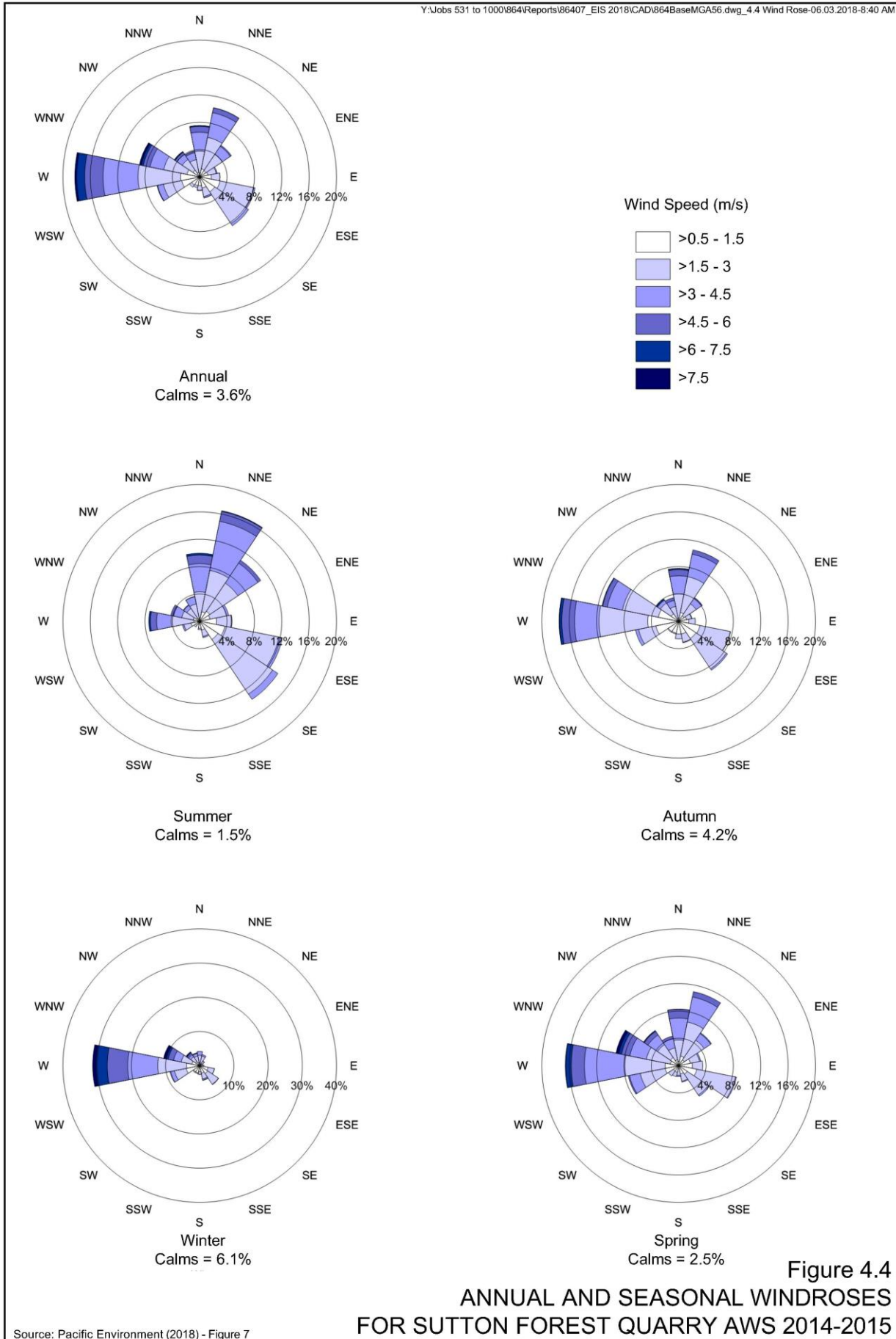
### 4.4 LAND OWNERSHIP AND SURROUNDING RESIDENCES

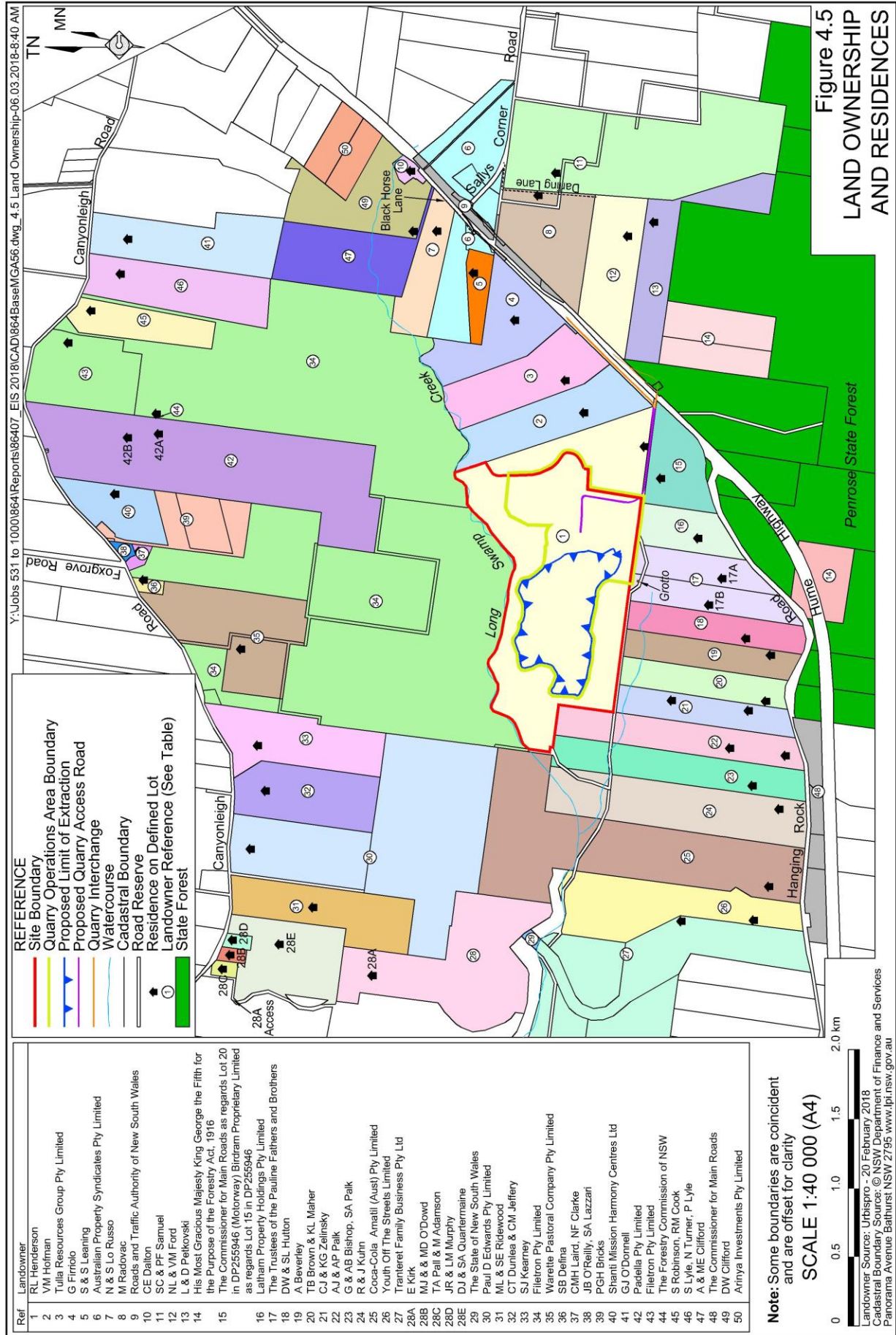
The existing land ownership within and surrounding the Site is shown on **Figure 4.5**. Residences on properties surrounding the Site are also shown in **Figure 4.5**. A total of six residences are located within 1km of the proposed extraction area whilst a further eleven residences are located between 1km and 2km from the proposed extraction area.

### 4.5 LAND USES

#### 4.5.1 On-site Land Uses

The southeastern part of the Site is currently used by the landowner for the grazing of up to 50 dry stock cattle, with the remainder of the Site retained in native vegetation. The majority of the native vegetation within the extraction area is regrowth.





## 4.5.2 Surrounding Land Uses

**Figure 4.6** displays the land uses surrounding the Site.

Land uses directly to the east of the Quarry Operations Area comprise grazing land, greyhound training facilities and the Sutton Forest Interchange service centres. The western service centre comprises a Shell fuel outlet and a McDonalds restaurant. The eastern service centre also comprises a Shell fuel outlet, a McDonalds restaurant, Heatherbrae Pies and the Coolabah Tree Café. Development consent has been granted for further development on the eastern side of the Hume Highway which includes a market, hotel, caravan park and museum. Several small rural enterprises are located along Black Horse Lane to the north of the western service centre. These include a small established viticulture venture (Sutton Forest Estate Wines), grazing, an establishing truffle farm and a horse farm.

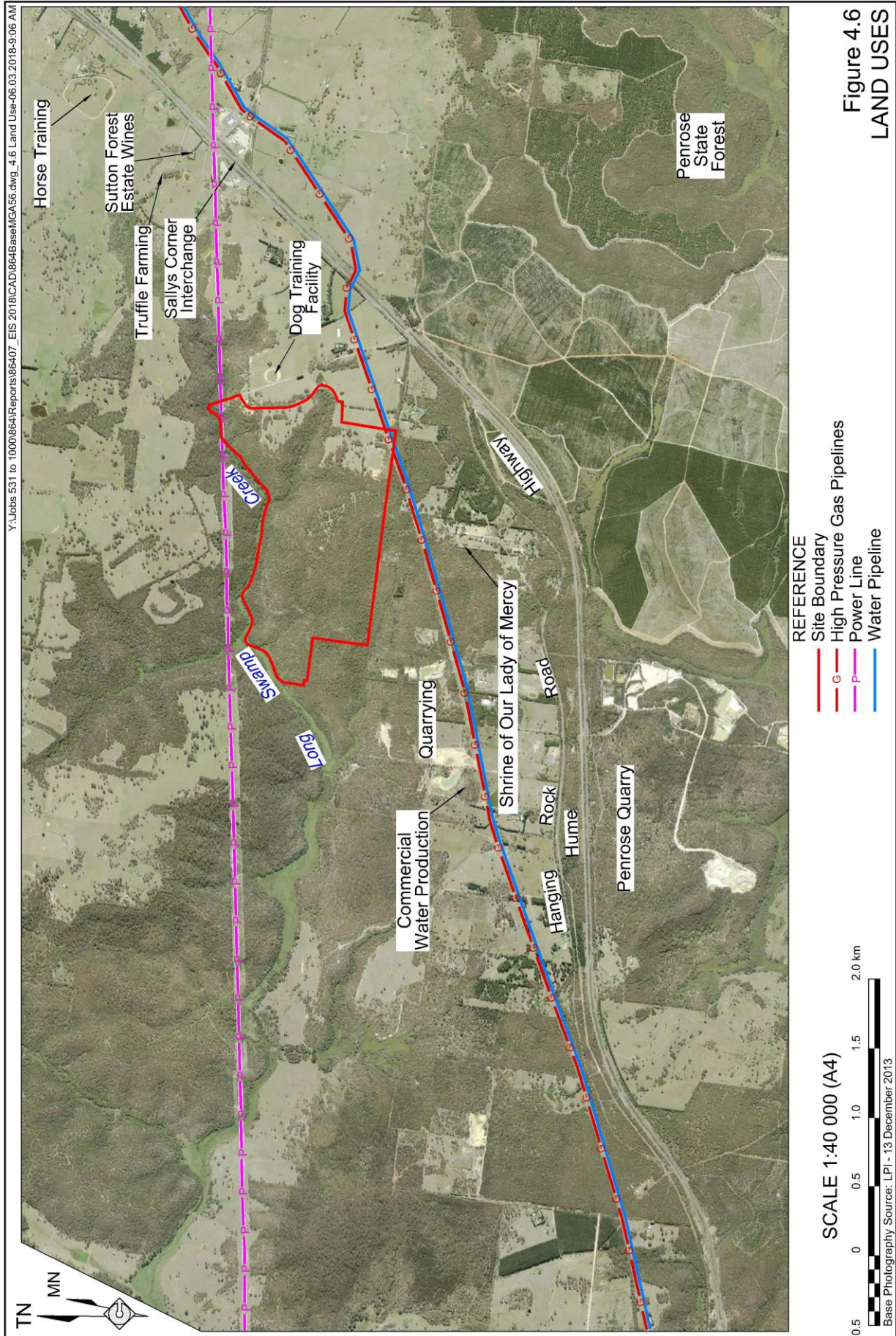
Land to the north and west of the Site generally comprises large to medium landholdings, substantial areas of which are vegetated although some grazing is undertaken on these landholdings.

Land to the south and southwest comprises medium sized lifestyle blocks (typically 15ha to 60ha) with some owners only present of a weekend, with a mixture of native vegetation, comparatively small extractive industry operations (sand and shale), agricultural land uses and water production (by Coca-Cola Amatil (Aust) Pty Limited and other private operators that supply Schweppes and other beverage companies).

The Penrose Quarry (owned by Hy-Tec Industries Pty Limited) is located to the south of the Site on the southern side of the Hume Highway. A new Quarry was approved on the “Green Valley” property 5km southwest of the Site in 2012. This Quarry has not yet commenced operations, however, physical commencement has been achieved.

A substantial softwood plantation is maintained by Forests NSW on the southern side of the Hume Highway i.e. Penrose State Forest. The forest comprises in excess of 2 000ha of softwood plantation in various stages of growth. Timber harvested from the State Forest is milled by Penrose Pine Products, a commercial timber processing and preservation operation located in the village of Penrose. Consultation with the owner of Penrose Pine Products indicated that the operation uses Penrose Forest Way to despatch some timber products and to receive harvested timber with trucks exiting and entering Penrose State Forest at the Kingsbury VC Rest Area. It is also understood that staff at Penrose Pine Products and residents of the village of Penrose use Penrose Forest Way to access the Hume Highway. Potential traffic interactions on Penrose Forest Way are discussed in more detail in Section 5.1.7.

A 132kV power transmission line and easement runs in an east-west direction immediately north of the Site. An easement containing a natural gas pipeline (Moomba – Wilton), ethane pipeline (Moomba – Sydney) and water pipeline (Wingecarribee – Goulburn) runs in an east-northeast/west-southwest direction immediately south of and bisecting the southeastern corner of the Site.



The Shrine of Our Lady of Mercy – “Penrose Park” is owned and managed by the Order of Saint Paul The First Hermit, known as the Pauline Fathers, and is situated across two lots located southwest of the proposed processing and stockpiling area (Residence 17). The Shrine Church was built in 1997, however the Pauline Fathers have resided at the property since 1983. The Monastery has five permanent residents, however there are approved and proposed plans to extend the residential areas at the property. **Figure 4.7** displays the various built structures on the property as well as areas used for religious services. The key locations on the property include the following.

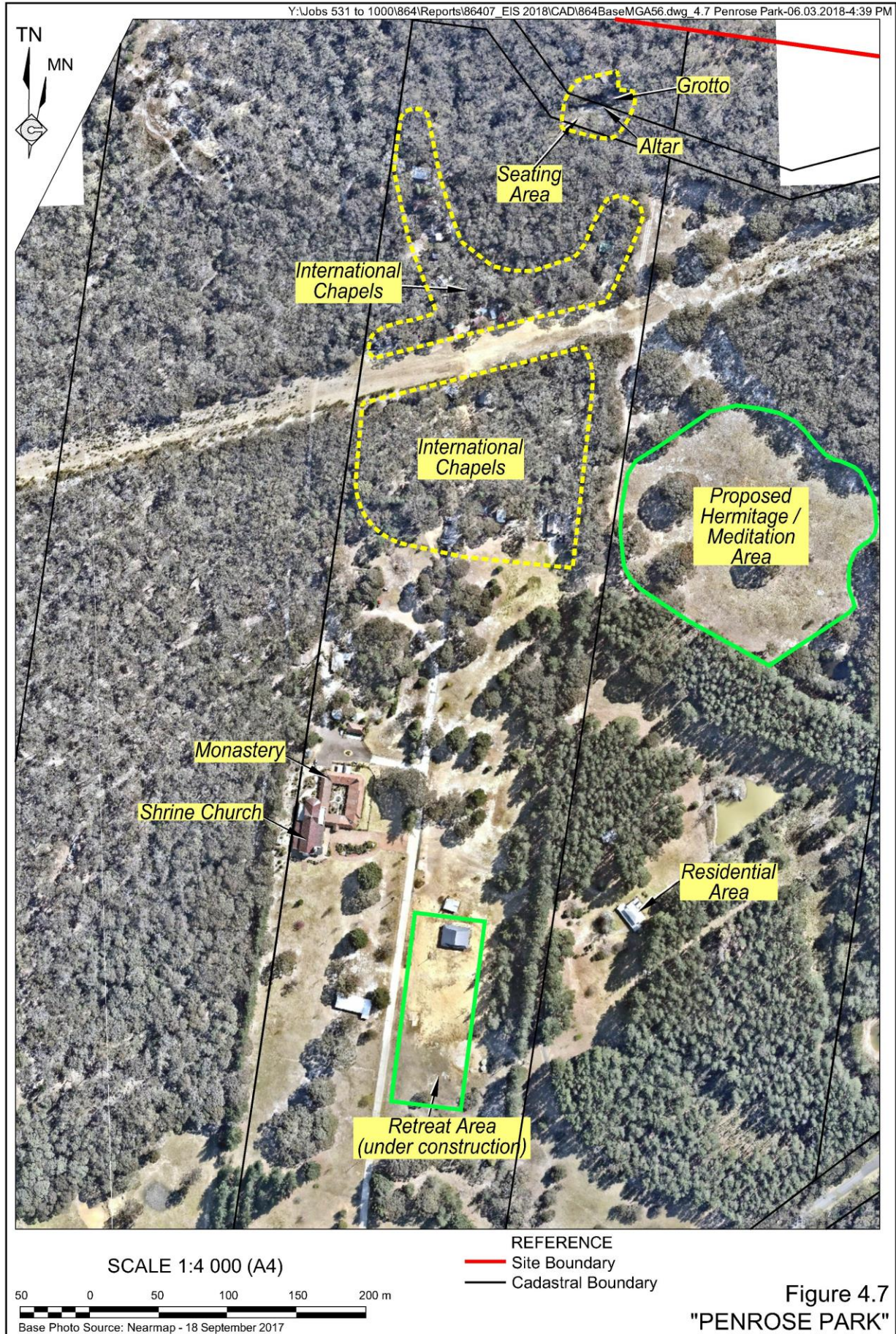
- A grotto, altar, tomb and seating area in the north of the property.
- 50 international chapels.
- Shrine Church and monastery.
- An additional residential area.
- A Retreat Centre that is currently under construction.
- A proposed Hermitage/Meditation Area.
- Religious shops and other facilities.

Monthly Fatima Day services are held on the 13<sup>th</sup> of each month with the most important services occurring on 13 May and 13 October each year to celebrate the anniversary of the original apparition of the Blessed Virgin Mary at Fatima, Portugal. When 13 May or 13 October fall on a weekend, the Pauline Fathers have reported that approximately 7 000 people have attended the services. Where other Fatima Days fall on a weekend they may attract 3 000 to 4 000 visitors. Where Fatima Day occurs mid-week, it is likely to attract approximately 1 000 visitors. Good Friday is also an important day with 3 000 to 4 000 visitors attending services. During the busiest periods, the police are required to direct traffic on the Hume Highway as visitors turn onto Hanging Rock Road. It is often the case that traffic in the right hand lane of the highway is congested between the access to Hanging Rock Road and the Sallys Corner Interchange.

The 50 international chapels at the property have been built through donations from patrons from various countries. Celebrations of the feast days of patron saints of these countries are celebrated at the property and may attract approximately 1 000 visitors.

The Pauline Fathers are in the process of constructing an approved Retreat Centre on the property that will provide accommodation for 70 visitors. The Retreat Centre is intended to be available to all visitors throughout the year. In addition, it is proposed that a Hermitage / Meditation Area is developed that would consist of isolated accommodation facilities available to visitors for quiet reflection. Plans for this area are still in development.

Consultation with the Pauline Fathers during preparation of the EIS and specialist assessments is described in Section 3.2.



## 4.6 BUSH FIRE HAZARD

Wingecarribee Shire Council has prepared the *Wingecarribee Shire Council Bush Fire Prone Map* (WSC, 2011) which identifies land prone to bush fires under three categories.

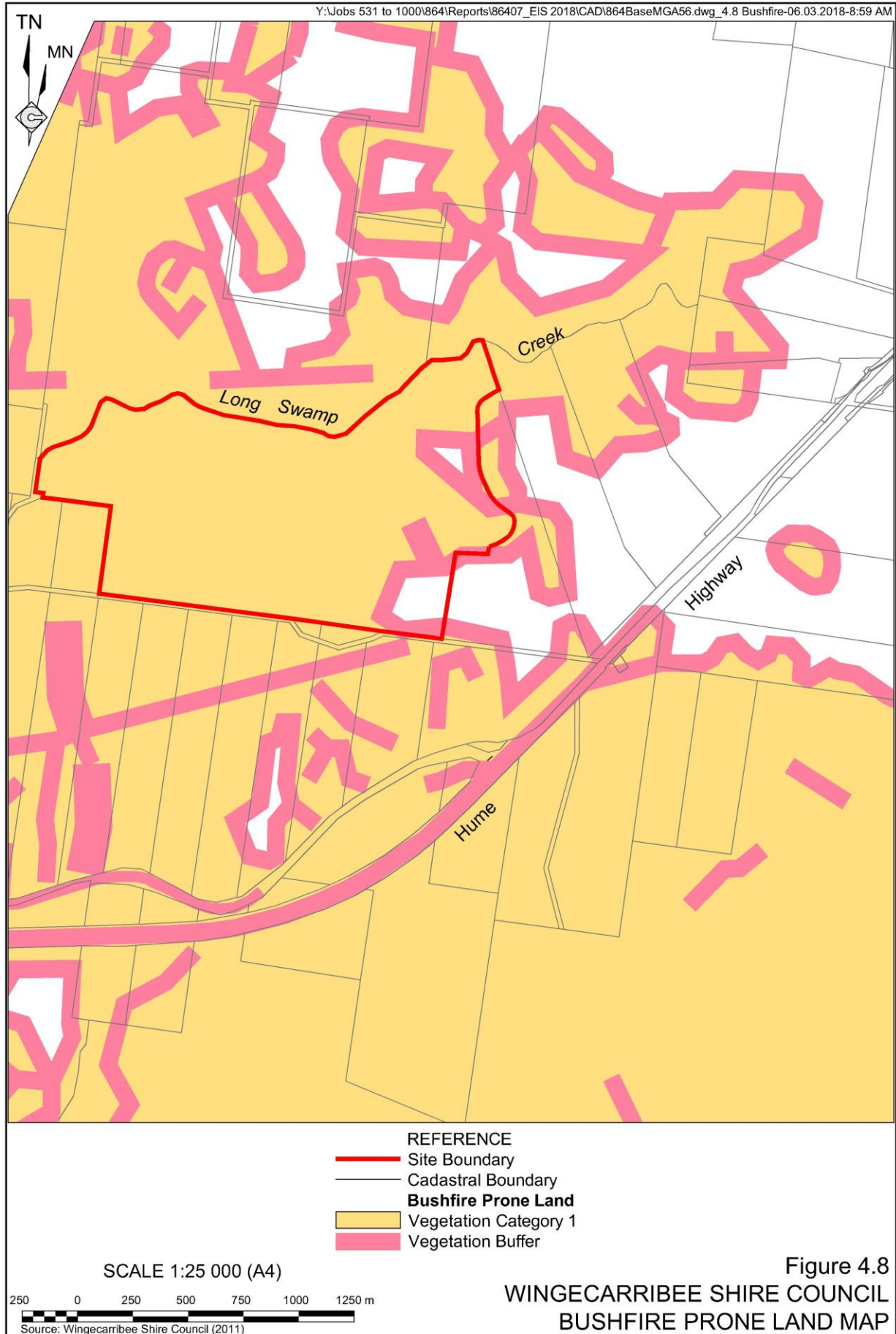
- Vegetation Category 1 Forest, woodlands, heaths and wetlands greater than 1ha.
- Vegetation Category 2 Moist rainforests, shrubland, open woodlands, mallee and grasslands greater than 1ha.
- Vegetation Buffer 100m external buffer to Vegetation Category 1 and 30m external buffer to Vegetation Category 2.

The Site is identified as Vegetation Category 1 with Vegetation Buffer (**Figure 4.8**). As the Site has been classed as bush fire prone land, an assessment of the bush fire hazard has been undertaken and appropriate precautions and controls proposed (see Section 5.1.3).

## 4.7 SERVICES

Two high pressure gas pipelines, (Moomba to Wilton natural gas and Sydney to Moomba ethane) and a water pipeline (Wingecarribee to Goulburn) traverse the southeastern corner of the Site, whilst 440kVA power lines traverse the northeastern corner of the Site. All of these items of infrastructure are located a sufficient distance from any quarrying operations and would not be impacted by the construction or operation of the Quarry. Notwithstanding this, appropriate measures would be taken to manage the pipeline easement during the site establishment and construction stage of the Quarry to provide sufficient protection during the passage of heavy vehicles.

No other services are located within the Site boundary.



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