Section 4

Environmental Features, Management Measures and Impacts

This section describes the specific environmental features of the Project Site and its surrounds that would or may be affected by Project.

This section is presented in two parts:

Part A: presents background information on a range of environmental features that, while not directly affected by the Project, may have some influence on a number of the subsequent issues; and

Part B: presents information on existing conditions, proposed safeguards and controls and potential impacts the Project may have after implementation of these measures on those environmental issues identified through the issue identification process of Section 3. Where appropriate, proposed monitoring programs are also described.

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Part 4A
Background Information

The descriptions of various assessments of potential environmental impacts throughout Part B of this section are reliant upon a range of background information common to many of the key environmental issues. Background information is provided on the topography, meteorology, land ownership, land uses and surrounding residences.

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4A.1 TOPOGRAPHY

4A.1.1 Regional Topography

The regional topography is shown on **Figure 4A.1**.

The Project Site lies within the Namoi River Basin in an area representative of the transition from the higher broken country to the northeast and south associated with the Nandewar, Great Dividing and Liverpool Ranges and the open plains to the west in the Wee Waa and Coonamble areas.

Natural slopes within the region range from less than 1° along the flood plain of the Namoi River to in excess of 25° within areas of Vickery State Forest and in excess of 45° within the adjacent Community Conservation Area (CCA) Zone 2 – Kelvin and the Nandewar Range.

Elevations in the region vary from 1094m AHD (approximately 35km east of the Project Site), to 250m AHD within the Namoi River Valley (approximately 12km southwest of the Project Site), with isolated peaks elsewhere such as Mt Binalong (18km southwest) and Goonbri Mountain (17km north-northeast) rising to in excess of 500m AHD.

4A.1.2 Local Topography

The local topography within the vicinity of the Project Site is shown on **Figure 4A.2**.

The Project Site lies within, and partially straddles, the 3km wide north-south trending valley between the elevated areas comprising Vickery State Forest and CCA Zone 2 – Kelvin. To the north and south of the Project Site, the valley widens to ultimately form part of the Namoi River floodplain (**Figure 4A.2**).

Elevations within the local area range from approximately 490m AHD in Vickery State Forest (Bull Mountain) and 885m AHD within CCA Zone 2 – Kelvin (Tulcumba trig) to approximately 270m AHD to the south of Shannon Harbour Road.

4A.1.3 Topography of the Project Site and Transport Route

Slopes within the Project Site generally range from <1° to 5°, with isolated areas adjacent to Vickery State Forest exhibiting slopes of up to 8°. The topography within the Project Site is presented at 5m contour intervals on **Figure 4A.2** and **Figure 2.1** (see Section 2).

Along the section of the transport route between the Project Site and Hoad Lane, slopes are generally less than 1°. Elevations along the public section of the transport route (from the intersection of Shannon Harbour Road and Hoad Lane to the Whitehaven CHPP), are also generally less than 1°. The land slopes generally to the south towards the Namoi River where the elevation is approximately 250m AHD.

Figure 4A.1
REGIONAL TOPOGRAPHY

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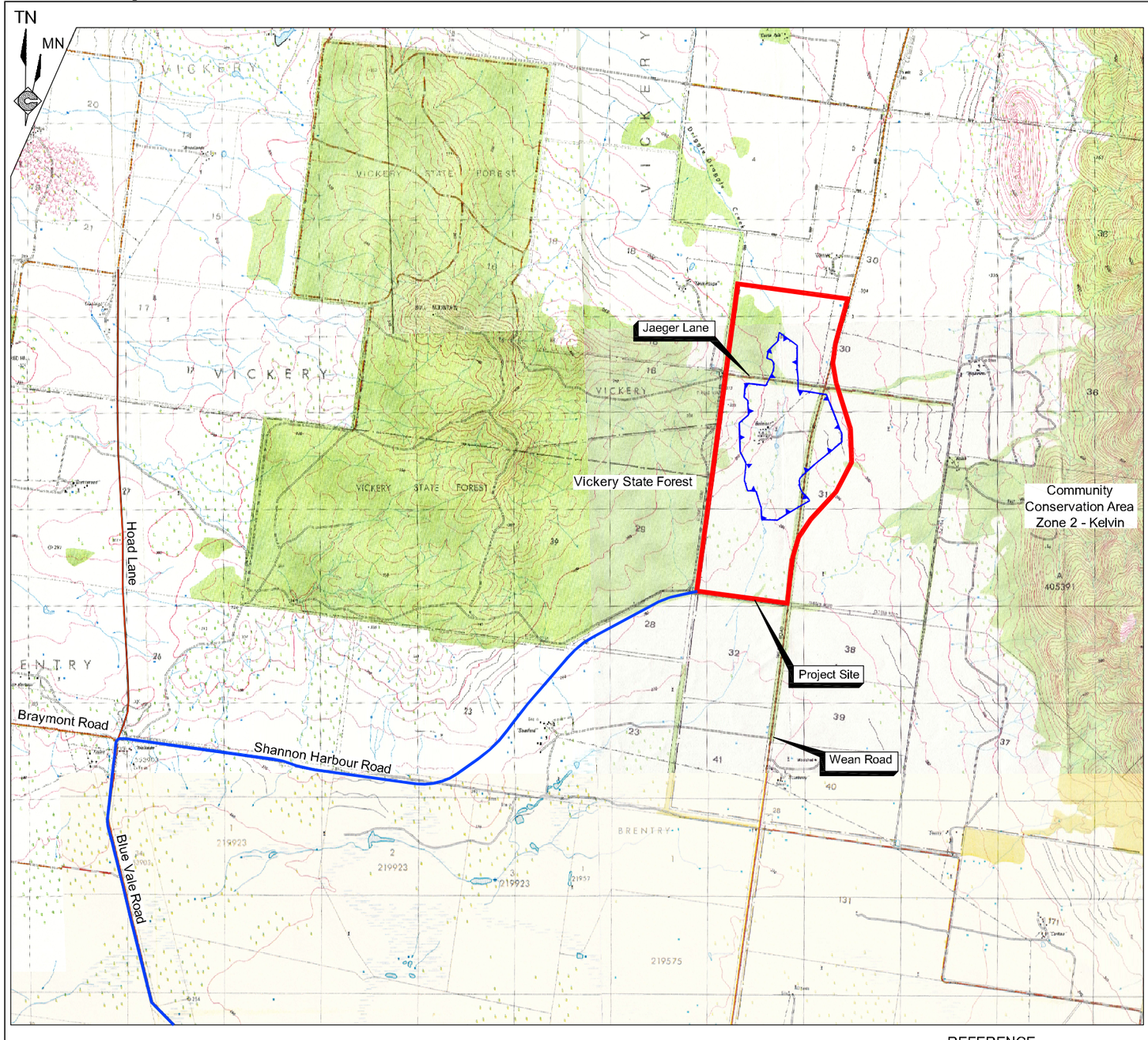
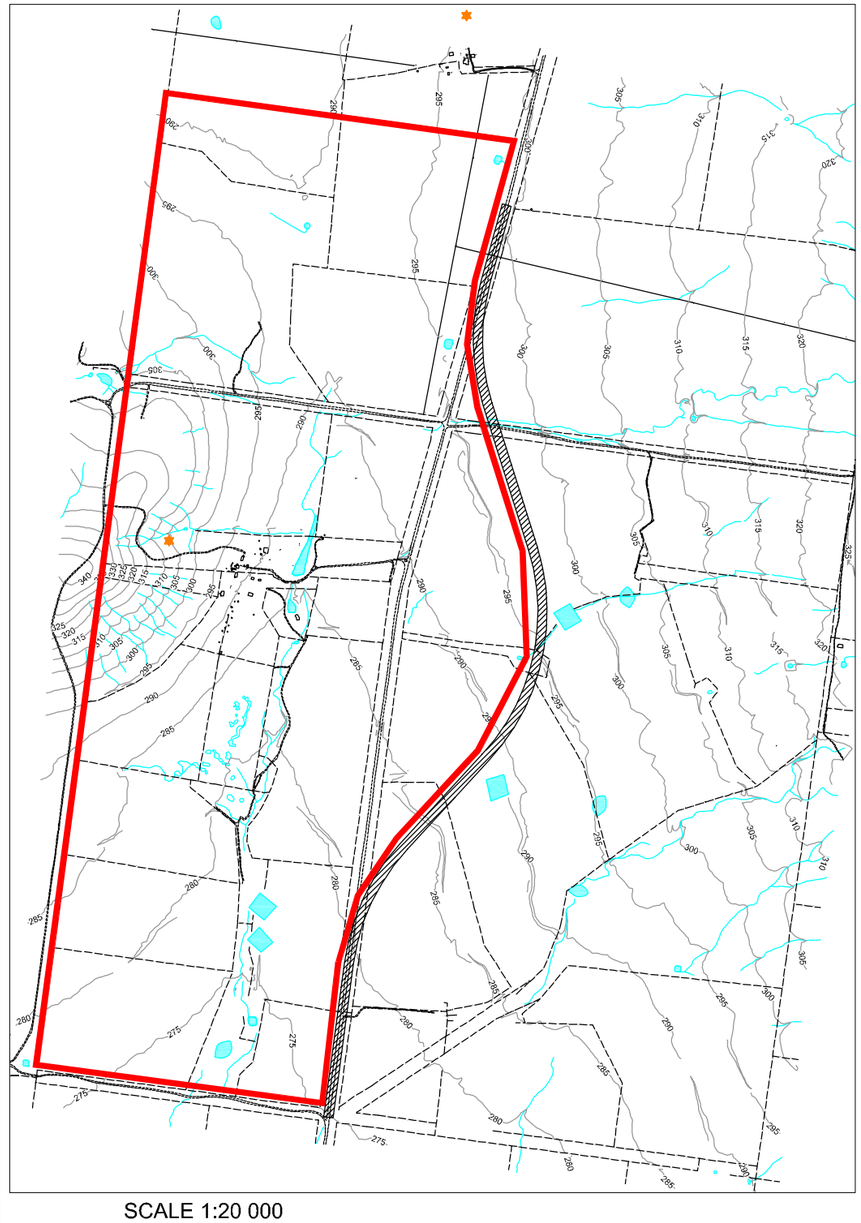


SCALE 1:50 000

0.5 0 0.5 1.0 1.5 2.0 2.5 km

Base Map Source: Boggabri, Willuri, Gulligal & Kelvin 1:25 000 Topographic Maps



SCALE 1:20 000

200 0 200 400 600 800 1000 m

REFERENCE
- Project Site Boundary
- Limit of Open Cut Mining
- Transport Route
- Unsealed Road / Track
- Fence
- Contour (m AHD)(Interval= 5m)
- Storage Dam
- Creek / Drainage Line

Figure 4A.2
LOCAL AND PROJECT SITE TOPOGRAPHY

4A.2 METEOROLOGY

4A.2.1 Introduction

The Project Site is situated within the Namoi River Valley between the tropical and temperate climatic zones, and between the belts of the sub-tropical highs and the zone of mid-latitude westerlies. In summer, synoptic highs dominate the climate. Low pressure systems pass at regular intervals bringing milder temperatures and winds from the southerly quadrant. The climate is also influenced by substantial mountain ranges located to the east and south, and to a lesser extent to the west.

4A.2.2 Source of Data

The following summaries of meteorological information for the Project Site have been derived from both long term data collected by the Bureau of Meteorology at Stations No. 055023 and No. 055024 in Gunnedah (Gunnedah Pool Station and Gunnedah Soil Conservation Research Station respectively) and a meteorological station installed on the Project Site in 2002.

Data collected from each of the above sources is as follows.

Station 055023	:	temperature, rainfall, relative humidity, fog and frost frequency and wind (9:00am and 3:00pm).
Station 055024	:	pan evaporation.
Belmont Meteorological Station	:	temperature, rainfall, pan evaporation and continuous wind speed and direction.

Garradd (1997) has also been sourced with respect to temperature inversions.

With the exception of continuous wind data, all meteorological data is summarised in **Table 4A.1**.

4A.2.3 Temperature

The data summarised in **Table 4A.1** indicates that the area is characterised by mild to hot summers and cool winters. December, January and February are the warmest months with mean daily maximum temperatures approximating 34°C. July is the coldest month with a mean daily minimum of 2.9°C. Autumn and Spring are generally mild with occasional erratic temperature fluctuations. Mean diurnal temperature variation is relatively constant throughout the year at about 15°C.

Table 4A.1
Mean Monthly Meteorological Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
TEMPERATURE (°C)													
Gunnedah Pool (Station No. 055023) – 116 Years of Records													
Mean Maximum	34.0	32.9	30.8	26.4	21.2	17.5	16.7	18.9	22.7	26.6	30.2	33.0	
Mean Minimum	18.3	18.1	15.8	11.4	7.1	4.2	2.9	4.1	6.9	10.6	14.0	16.8	
RAINFALL (mm)													
Belmont Meteorological Station – 12 Months of Data													
Rainfall	41.4	87.4	13.6	53.4	No data	49.8	58.0	4.0	23.6	No data	73.4	8.6	
Rain Days	6	12	4	5	No data	9	9	2	9	No data	9	5	
Gunnedah Pool (Station No. 055023) – 126 Years of Records													
Mean	72.4	65.9	48.5	38.2	43.3	42.5	42.3	41.9	39.5	55.6	59.9	66.3	616.4
Median	53.9	50.2	34.4	32.5	33.1	36.3	33.3	35.7	32.6	52.4	52.8	50.2	619.9
Mean Rain Days	6.5	6.0	4.7	4.3	5.3	6.2	6.2	6.2	5.8	6.9	6.7	6.9	71.7
Highest	301.0	253.5	367.6	151.4	171.2	172.5	177.8	138.5	128.0	161.2	259.3	185.4	
Lowest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.3	0.0	
EVAPORATION (mm)													
Gunnedah Soil Conservation Research (Station No. 055024) – 20 Years of Records													
Mean Monthly Pan Evaporation *	238.7	187.6	186.0	129.0	83.7	57.0	58.9	83.7	117.0	164.3	198.0	244.9	1 752
RELATIVE HUMIDITY (%)													
Gunnedah Pool (Station No. 055023) – 33 Years of Records													
Mean 9:00am	61	65	64	67	73	78	77	71	65	61	58	57	67
Mean 3:00pm	43	43	44	46	52	55	53	48	43	43	39	38	46
WINDS km/hr													
Gunnedah Pool (Station No. 055023) – 42 Years of Records													
Mean 9:00am Wind Speed	7.7	8.4	8.2	6.7	5.8	5.8	5.4	5.8	6.8	8.0	7.9	7.3	7.0
Mean 3:00pm Wind Speed	9.8	9.1	9.7	8.7	7.7	9.2	10.2	11.0	11.0	10.5	11.2	10.5	9.9
FROST FREQUENCY (DAYS/MONTH)													
Gunnedah Pool (Station No. 055023) – 33 Years of Records													
Mean Monthly	0.0	0.0	0.0	0.0	1.0	3.8	3.8	5.0	1.2	0.0	0.0	0.0	
FOG FREQUENCY (DAYS/MONTH)													
Gunnedah Pool (Station No. 055023) – 33 Years of Records													
Mean Monthly	0.1	0.0	0.0	0.1	0.3	0.4	0.4	0.1	0.3	0.1	0.0	0.1	
Source: Bureau of Meteorology *Based on daily data													

4A.2.4 Relative Humidity

The relative humidity of Gunnedah region can be described as moderate based on the observed conditions at the Gunnedah Pool Meteorological Station. The mean 9:00am and 3:00pm relative humidity is 67% and 46% respectively, with an increase occurring through the winter months.

4A.2.5 Rainfall

Rainfall in the local area results from the passage of one of three major synoptic systems, or from localised convective thunderstorms, namely:

- the regular passage of cold fronts across NSW, whenever these fronts extend north into the area; or
- the passage of moist upper atmosphere low cells into the area from Queensland; or
- the passage of inland tropical cyclones or low pressure systems which have been located over the Pacific Ocean.

Of these, the latter two principally occur in the warmer months when convectional storms are also most frequent and result in the majority of the area's total rainfall. Falls during this period are often of high intensity.

Monthly rainfall for Gunnedah and the Project Site is presented in **Table 4A.1** and shows that highest rainfalls recorded at Gunnedah (and the Project Site) occur during Spring and Summer with January having the highest median rainfall of 89.8mm. April and May are the driest months with median rainfalls of 30.2mm and 34.4mm respectively. On average, Gunnedah experiences 72 rain days per year.

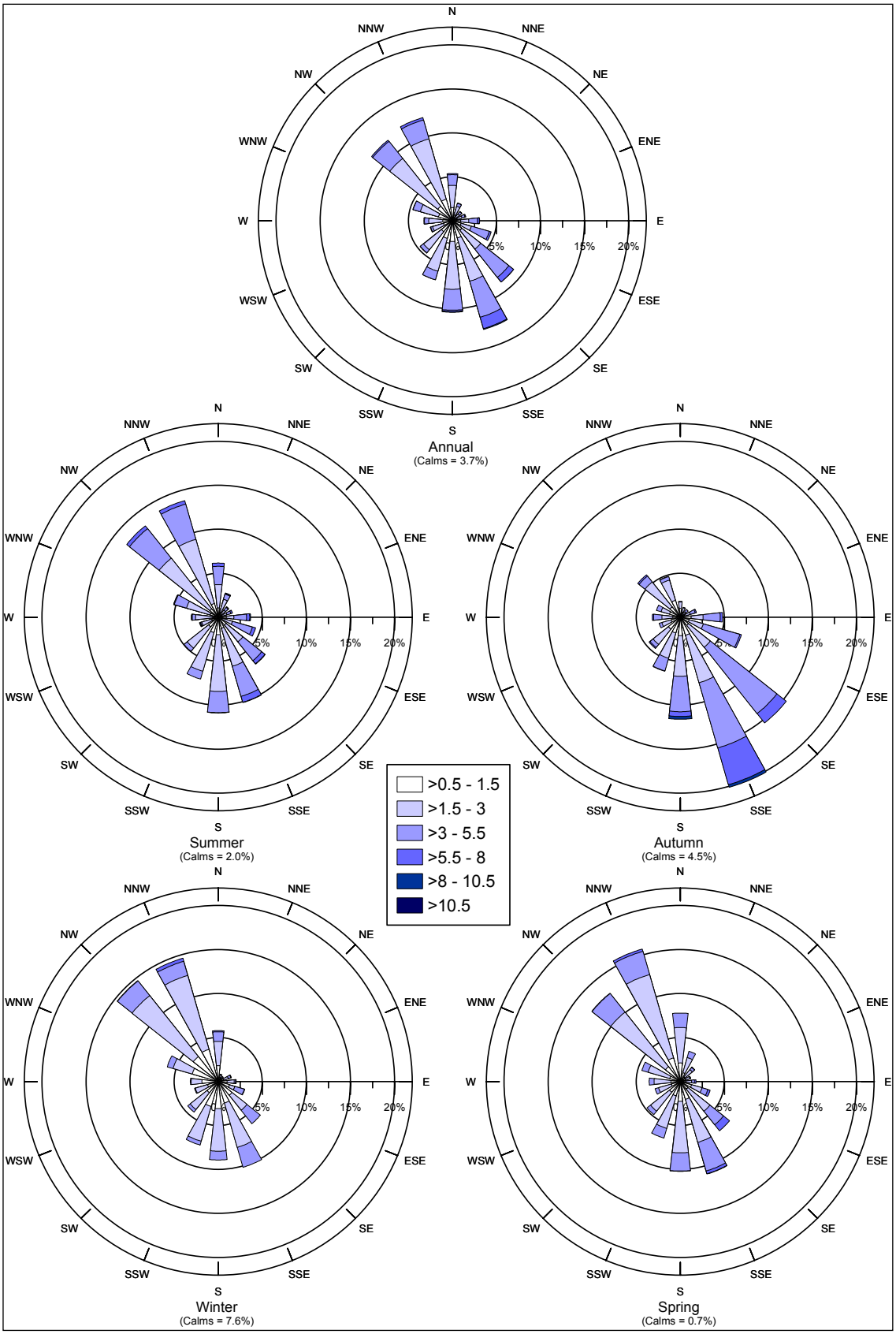
A statistical review of rainfall records has identified that for a dry year (10^{th} percentile rainfall event) the annual rainfall is 373.6mm. For a wet year (90^{th} percentile rainfall event) the annual rainfall is 843.4mm.

4A.2.6 Wind

The wind data from the Belmont Meteorological Station, along with wind data obtained from the Belmont meteorological station was used by Heggies (2007) to generate annual and seasonal wind roses for the Project Site using The Air Pollution Model (TAPM) software developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Annual and seasonal wind roses compiled from this data and software are presented in **Figure 4A.3**. TAPM is a prognostic model used to predict three-dimensional meteorological data. Records from the Belmont meteorological station were included along with general information on local terrain, vegetation and soil type, and synoptic scale meteorological analyses to generate the 2005 wind roses. For further information on TAPM, see Part 8 of the *Specialist Consultant Studies Compendium*.

The annual wind rose for the Project Site indicates that winds are experienced predominantly from the southeast and northwest quadrants and are mild to moderate in nature, having an average wind speed of between 1.5m/s and 8m/s. Calm conditions occur approximately 3.7% of the time. Seasonal variations include the following.

- In summer, the prevailing wind directions are from the north-northwest and northwest.



Source: Heggies (2007) – Appendix 3

Figure 4A.3
Annual and Seasonal Wind Roses for Project Site - 2005

- In autumn, the prevailing wind directions are from the south-southeast.
- In winter, the prevailing wind directions are from the north-northwest and northwest.
- In spring, the prevailing wind directions are from the north-northwest and northwest.
- The strongest winds occur in the autumn months and prevail from the south and southeast.

Differences between the wind conditions at the Project Site and those of the two nearby coal mines is probably best explained by local topographic features on and surrounding the Project Site. Of particular influence are the elevated areas to the east and west of the Project Site, CCA Zone 2 – Kelvin and Vickery State Forest respectively, which provide a funneling effect for local winds and thereby increase the occurrence of local winds from a generally northerly and southerly direction.

The prevailing meteorological conditions are indicative of moderately stable Class "D" conditions (see Part 8 *Specialist Consultant Studies Compendium*). Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion of air particles. The Pasquill-Gifford-Turner assignment scheme identifies six Stability Classes, "A" to "F", to categorise the degree of atmospheric stability. Stability Class "A" represents highly unstable conditions that are typically found during summer and categorised by strong winds and convective conditions. Conversely, Stability Class "F" relates to highly stable conditions, typically associated with clear skies, light winds and the presence of a temperature inversion. Classes "B" through to "E" represent conditions intermediate to these extremes.

4A.2.7 Evaporation

Mean monthly evaporation data for Gunnedah is presented in **Table 4A.1**. Mean monthly evaporation is greatest from November to March and corresponds to the months of highest temperatures and lowest relative humidities. During each of these months, evaporation exceeds 180mm. Mean monthly evaporation is least during June and July at 57mm and 59mm respectively. Average evaporation exceeds rainfall in all months and exceeds median annual rainfall by a factor of nearly four.

4A.2.8 Temperature Inversions

Temperature inversions are often expressed as fogs and/or frosts and invariably occur during calm, clear, cool nights. After sunrise, the inversions normally increase in height before being broken down by solar heating of the land surface.

Table 4A.1 shows that frosts generally occur in the Gunnedah area between May and September. Fogs may occur at any time of year but are a rare phenomenon. Based on these records alone, it may be concluded that temperature inversions could occur on up to 20% of

days each year. However, in a detailed review of the meteorology of the Gunnedah area, Garradd (1997) noted that "*surface inversions might be expected on 50% or more nights throughout the year*".

An assessment of inversion occurrence at the Whitehaven Coal Mine during 2001 showed a similar result to that identified in Garradd, with weak to strong inversions occurring on 42%, 46%, 54% and 47% of nights in summer, autumn, winter and spring. Night-time inversions generally prevail from about 8:00 pm.

During the day-time, ie. 7:00am to 6:00pm, weak to strong inversions occurred on less than 1% of summer, autumn and spring days and on approximately 3% of winter days, but only prevailed to approximately 8:00 am before dissipating.

Given the proximity of the Whitehaven and Belmont sites, similar inversion occurrence patterns would be expected for the Belmont Project Site.

4A.3 LAND OWNERSHIP, SURROUNDING RESIDENCES AND LAND USE

4A.3.1 Introduction

In order to assess the impact the establishment and operation of the Belmont Coal Project would have on the surrounding environment, an understanding of the number and location of surrounding landholdings and residences along with the land use is required. This sub-section identifies the landholdings and residences in the vicinity of the Project Site and transport route. The sub-section also presents the proximity of surrounding residences to the proposed areas of activity and provides an overview of the land uses both in the local area and surrounding the Project Site.

4A.3.2 Land Ownership and Surrounding Residences

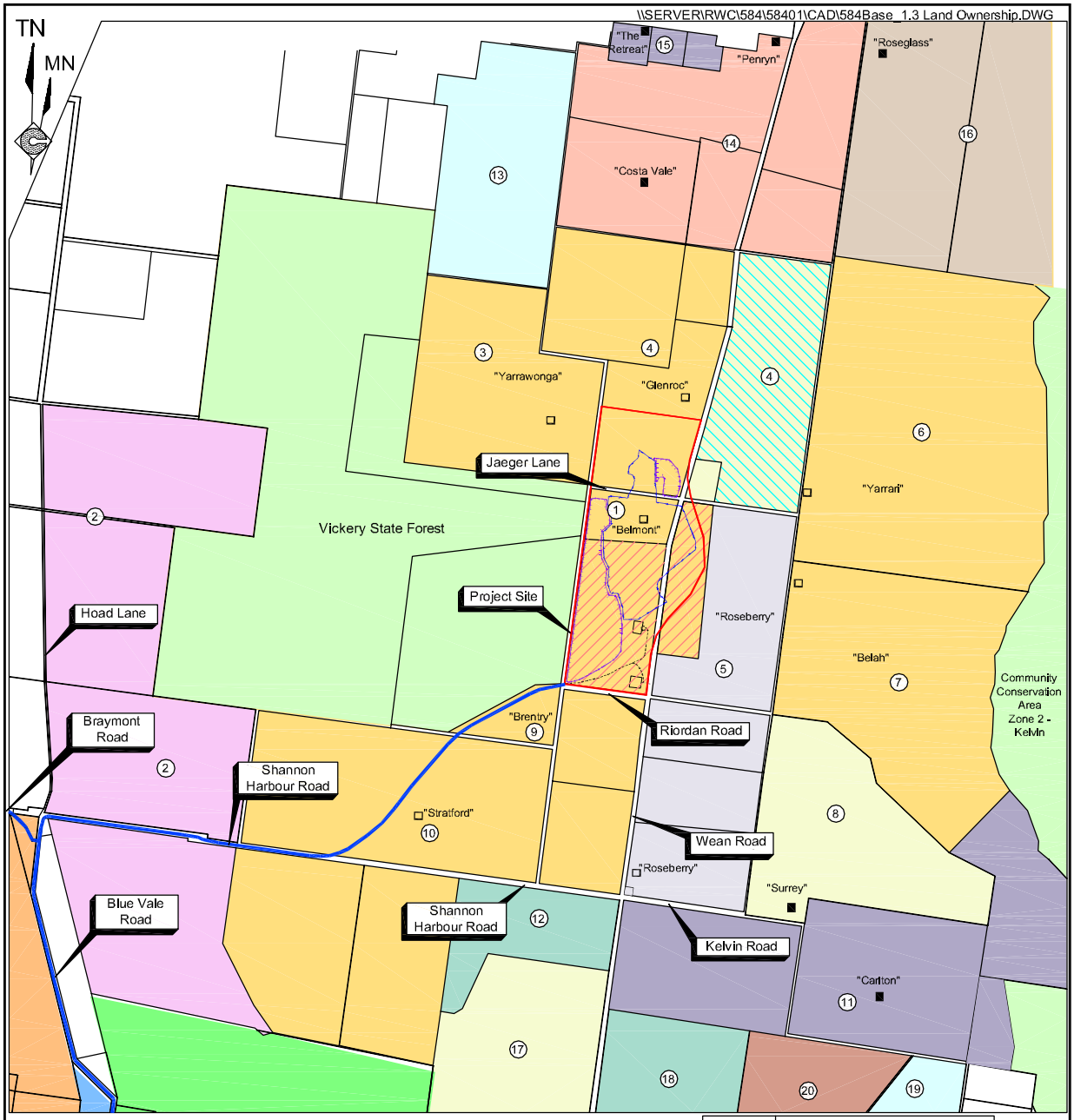
4A.3.2.1 The Project Site and Surrounds

Figure 4A.4 presents the ownership details within and immediately surrounding the Project Site. The Proponent owns the properties of "Belmont", "Glenroc", "Yarrrawonga", "Yarrari", "Belah", "Brentry" and "Stratford". The Proponent also owns that part of the "Roseberry" property coinciding with the Project. The remaining area within the Project Site occurs as road easements for Wean Road and Jaeger Lane.

Vickery State Forest, owned by the Crown, is located to the immediate west of the Project Site.

Further from the Project Site Boundary, are the following properties.

- "Costa Vale", "Penryn" and "The Retreat" to the north.
- "Surrey" and "Carlton" to the southeast.



REFERENCE
- Project Site Boundary
- Cadastral Boundary
- Road Reserve
- Whitehaven Coal Mining Pty Ltd has purchased an Area of the "Roseberry" Property which is located within the Belmont Project Site*
- Land Swap Area to be Exchanged to "Roseberry" Property*
- Non-project Related Residence
- Project Related Residence

Reference	Land Ownership
1	Whitehaven Coal Mining Pty Ltd
2	Namoi Valley Coal Pty Ltd
3	Whitehaven Coal Mining Pty Ltd
4	Whitehaven Coal Mining Pty Ltd
5	R. Rennick
6	Whitehaven Coal Mining Pty Ltd
7	Whitehaven Coal Mining Pty Ltd
8	R. & A. Barnes
9	Whitehaven Coal Mining Pty Ltd
10	Whitehaven Coal Mining Pty Ltd
11	W. Sales
12	W. Laurie
13	I. Hall
14	G. & M. Geddes
15	R. & K. Penrose
16	C. & M. Harmsel
17	W. Nichols
18	J. Myers
19	D. Torrens
20	K. Perrett
21	J. Dixon

* Note: Subject to Approval from Gunnedah Shire Council

SCALE 1:75 000

1 0 1 2 3 4km

Land Ownership Source: Whitehaven Coal Pty Ltd / Dept. of Lands (2007)

Figure 4A.4
LAND OWNERSHIP AND RESIDENCES SURROUNDING THE PROJECT SITE

Figure 4A.4 also shows the locations of 13 residences within and immediately surrounding the Project Site. Seven of the residences, namely those on "Belmont", "Glenroc", "Yarrrawonga", "Yarrari", "Belah", and "Stratford" are owned by the Proponent and hence classified as project-related. The residence on the "Roseberry" property is also deemed project related by virtue of the contract of sale for the section of the property purchased by the Proponent. The distances from each of the residences to the proposed areas of activity within the Project Site are listed in **Table 4A.2.** Of the non-project related residences, "Costa Vale" would be the closest to mining activities during Year 1 (3 060m) and "Surrey" and would be the closest to mining activities during Year 7 (3 480m).

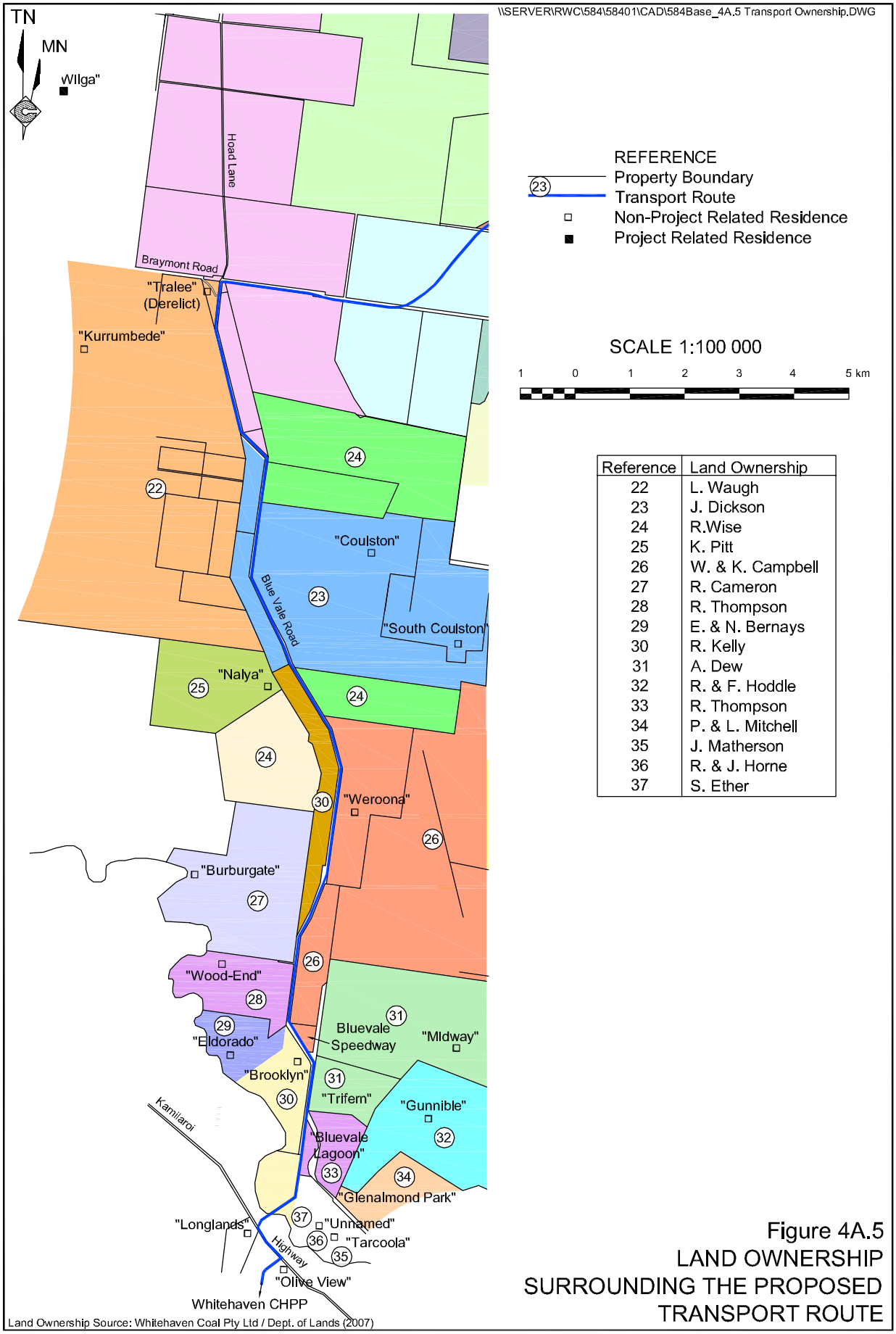
Table 4A.2
Proximity of Residences Surrounding the Project Site

Residence Identifier [Name]*	Closest Distance from (m) and orientation of Residence to:		
	Limit of Open Cut Mining	Coal Handling and Processing Area	Out-of-pit Overburden Emplacement
A ["Belmont"] #	Residence within the Project Site		
B ["Glenroc"] #	780(S)	2 600(SSW)	740 (S)
C ["Yarrari"] #	1 370 (SW)	2 3710 (SW)	1 450 (W)
D ["Belah"] #	1 250 (WNW)	1 800 (WNW)	1 690 (NW)
E ["Stratford"] #	3 240 (NE)	3 250 (NE)	2 280 (NE)
F ["Yarrawonga"] #	1 050 (SW)	2 470(SE)	1 020 (SE)
G ["Roseberry"] #	2 880 (SSE)	2 740 (SSE)	2 290 (SE)
H ["Costa Vale"]	3 060 (N)	4 970 (N)	3 160 (N)
I ["Penryn"]	4 900 (N)	6 800 (N)	5 870 (N)
J ["The Retreat"]	4 780 (NNW)	6 720 (NNW)	4 800 (NNW)
K ["Surrey"]	3 730 (SE)	3 550 (SE)	3480 (SE)
L ["Carlton"]	5 100 (SE)	4950 (SE)	4 900 (SE)
M ["Roseglass"]	5 230 (NNE)	6 970 (NNE)	5 150 (NNE)
* See **Figure 4A.4**	# Project-related		

4A.3.2.2 Transport Route

Figure 4A.5 presents the land ownership on and surrounding the transport route between the Project Site and the Kamilaroi Highway. Only the project related residence on the "Stratford" property is located within 0.5km of the section of the transport route to be constructed or upgraded between the Project Site and Hoad Lane.

A total of eight occupied residences are located within 2km of the section of the transport route which is already used for the transportation of coal between the Whitehaven and Tarrawonga Coal Mines and Whitehaven CHPP and Rail Siding, ie. Hoad Lane, Blue Vale Road and the



Reference	Land Ownership
22	L. Waugh
23	J. Dickson
24	R.Wise
25	K. Pitt
26	W. & K. Campbell
27	R. Cameron
28	R. Thompson
29	E. & N. Bernays
30	R. Kelly
31	A. Dew
32	R. & F. Hoddle
33	R. Thompson
34	P. & L. Mitchell
35	J. Matherson
36	R. & J. Horne
37	S. Ether

Figure 4A.5
LAND OWNERSHIP SURROUNDING THE PROPOSED TRANSPORT ROUTE

Kamilaroi Highway (see **Figure 4A.5**). A further six residences are set back between 2km and 3km from this section of the transport route. The distances of each residence from Blue Vale Road are listed in **Table 4A.3**. Residences closer to the Kamilaroi Highway than the transport route have been excluded from **Table 4A.3** given noise levels at those residences would be more influenced by highway traffic noise.

Table 4A.3
Non-Project Related Residences within 2km of the Transport Route

Ref*	Property Name	Distance to Transport Route (m)
N	"Will-gai"	5 450
O	"Tralee" (Derelict)	220
P	"Nalya"	550
Q	"Weroona"	360
R	"Wood-End"	1 320
S	"Eldorado"	1 230
T	"Brooklyn"	70
U	"Tarcoola"	1 020
V	Unnamed	700
* See **Figure 4A.5**		

It is noted from **Table 4A.3** that the closest inhabited residences to the southern section of the transport route are "Brooklyn" (70m) and "Weroona" (360m).

Residences closer to the Kamilaroi Highway than the transport route have been excluded from **Table 4A.3** given noise levels at those residences would be more influenced by highway traffic noise.

One house is located adjacent to the Kamilaroi Highway component of the transport route to the Whitehaven Siding at a distance of 120m from the pavement centre line (see **Figure 4A.5**). This residence, "Longlands", is positioned 520m from the Siding Access Road. A second residence, "Olive View", is positioned approximately 320m to the east of the Siding Access Road and 90m from the Kamilaroi Highway pavement centre-line.

4A.3.2.3 Road Reserves

Project Site and transport route incorporate approximately 3.4km of Council road reserve.

Project Site

- Wean Road (1.8km).
- Jaeger Lane (1.1km).

Transport Route

- Riordan Road between the Project Site and "Stratford" property (crossing only).
- Shannon Harbour Road between "Stratford" property and Hoad Lane (2.5km).

4A.3.3 Land Use

4A.3.3.1 Project Site and Immediate Surrounds

Immediately to the west of the Project Site is Vickery State Forest. In a decision by the State government (5 May 2005) identifying new community conservation areas in the Brigalow Belt South and Nandewar Bioregions, Vickery State Forest was declared as within a Zone 4 community conservation area. Although the Project Site does not include any area within Vickery State Forest, it is worthy of note that the permissible land uses within the forest include forestry, recreation and mineral extraction.

Land uses within and surrounding the properties comprising the Project Site are as follows.

- "Belmont" – cattle grazing.
- "Glenroc" – sheep and cattle grazing with fodder / cereal crop production also undertaken on the area immediately north of Jaeger Lane.
- "Roseberry" – cattle grazing. Low intensity piggery adjacent to the southern "Belmont" property boundary.
- "Stratford" – cereal / fodder cropping and sheep grazing.
- "Brentry" – cattle grazing in rotation with cereal / fodder crop production.
- "Belah" – cattle grazing in rotation with cereal / fodder crop production.
- "Yarrari" - cattle grazing in rotation with cereal / fodder crop production.

4A.3.3.2 Surrounding Properties

With the exception of Vickery State Forest, all other land within the vicinity of the Project Site and along the transport route to the Whitehaven CHPP and rail loading facility is primarily used for a combination of cereal / fodder cropping and / or grazing. No agricultural land in the vicinity of the Project Site is used for purposes which may be considered sensitive to mining or mining-related impacts.

The Blue Vale speedway is located adjacent to Hoad Lane approximately 3.5km from the intersection with the Kamilaroi Highway.

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