Development Application and Environmental Impact Statement

Expansion of Beef Cattle Feedlot from 999 head to 3,200 head

Level 1 odour impact assessment

"High Claire"
58 Broughans Road
Pine Lodge NSW 2714

AJ & NA Varley
"Arkoona"
RMB 3095 Lower Finley Road
FINLEY NSW 2713

[November 2024]

RDC ENGINEERS
AGRICULTURAL ENVIRONMENTAL PROJECT MANAGEMENT

PO Box 1223
TOOWOOMBA QLD 4350

rdcengineers.com.au

DOCUMENT INFORMATION RECORD

Project details

Client name:	AJ & NA Varley (ABN 88 390 323 468)
Project:	Proposed expansion of High Claire Feedlot
Project No:	F3-107

Document control

Document title:	Development Application and Environmental Impact Statement – Expansion of Beef Cattle Feedlot from 999 head to 3,200 head – Level 1 odour impact assessment		
File name:	F3-107 ANV HCFL SD V1R2.docx		
Revision:	V1R2		
Author:	Rod Davis	**Position:**	Director
Signature:		**Date:**	07/11/2024
Reviewed by:	Rod Davis	**Position:**	Director
Signature:		**Date:**	07/11/2024
Approved by:	Rod Davis	**Position:**	Director
Signature:		**Date:**	07/11/2024

Revision history

Version	Issue date	Reason for issue	Author	Reviewed by	Approved by
V1R1	31/08/2024	Draft for client review	Rod Davis	Rod Davis	Rod Davis
V1R2	07/11/2024	Final for lodgement to ERC	Rod Davis	Rod Davis	Rod Davis

Distribution

Version	Recipient	Lodgement	Copies
V1R1	AJ & NA Varley	Electronic	-
V1R2	AJ & NA Varley / Edward River Council (ERC)	Electronic	-

Disclaimer

This document has been prepared based on the Client's description of its requirements and RDC Engineers Pty Ltd's experience, having regard to assumptions that RDC Engineers Pty Ltd can reasonably be expected to make in accordance with sound professional principles. RDC Engineers Pty Ltd may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified.

RDC Engineers Pty Ltd has prepared this document for the sole use of the Client and for a specific purpose, each as expressly stated in the document. This document has been prepared solely for the benefit of Client. No other party should rely on this document without the prior written consent of RDC Engineers Pty Ltd. RDC Engineers Pty Ltd undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. No other warranty, expressed or implied, is made as to the professional advice given in this document.

RDC Engineers Pty Ltd maintains NO responsibility for the misrepresentation of results due to incorrect use of information contained within this document.

Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

Once printed, this is an uncontrolled document unless issued and stamped Controlled Copy.

Citation

RDC Engineers Pty Ltd, 2024, Development Application and Environmental Impact Statement – Expansion of Beef Cattle Feedlot from 999 head to 3,200 head – Level 1 odour impact assessment, F3-107B/V1R2 RDC Engineers Pty Ltd, Toowoomba, QLD, 4350.

Table of Contents

List of Tables

List of Figures

List of Photographs

Executive Summary

AJ & NA Varley own and operate a mixed farming operation across several properties at Pinelodge including "High Claire", "Arkoona", "Sunnyside", "Killara Rise", Langunyah" and "Glen Cluan" some 17 km by road west of Finley and 49 km by road east-southeast of Deniliquin in Riverina region of NSW.

AJ & NA Varley primarily engage in dryland and irrigated cropping, beef, sheep and wool production. AJ & NA Varley produce wheat, barley in winter and sorghum and maize in summer under irrigation and dryland farming systems.

Central to the beef production enterprise is the breeding, growing and lot feeding of cattle for the domestic market. Currently the beef supply chain includes breeding and growing of beef cattle and lot feeding of cattle within a feedlot on the property "High Claire".

"High Claire" comprises some 195.19 ha (~482.12 acres) and currently, a dryland and irrigated cropping business is undertaken on a large proportion of the property with lot feeding of beef cattle and sheep.

There has been a beef cattle feedlot on "High Claire" for over twenty years after approval was granted for a 999 head feedlot by the former Conargo Shire (now Edward River Council) in 2004 (DA 293). Under Schedule 3, Item 21 of the Environmental Planning and Assessment Regulation 2000, as the capacity of the existing beef cattle development does not exceed 1000 head it is not a designated development and an environmental licence from NSW EPA is not required.

Co-located with the beef cattle feedlot is a 4,000 head sheep feedlot which was granted approval in 2006 by the former Conargo Shire (now Edward River Council) in 2004 (DA 352). Under Schedule 3, Item 21 of the Environmental Planning and Assessment Regulation 2000, as the capacity of the existing sheep development does not exceed 4000 head it is not a designated development and an environmental licence from NSW EPA is not required.

The beef cattle Feedlot is accredited under the National Feedlot Accreditation Scheme (NFAS) with audits conducted annually.

The beef cattle feedlot currently operates for 12 months of the year and employs approximately 2 full time staff. Casual staff and contractors are engaged as required during busy periods such as planting and harvesting of silage and fodder and to supply various associated services such as plant maintenance and veterinary requirements.

AJ & NA Varley wish to expand the existing beef cattle feedlot from the current approved capacity of 999 head by gaining development approval for intensive livestock agriculture to operate as a 3,200 head beef cattle feedlot on the site. The proposal also involves the ceasation of the sheep feedlot with the existing infrastructure repurposed for the lot feeding of cattle. The proposed development is not proposed to be staged.

The proposed development shall utilise the existing approved and constructed development complex infrastructure on the subject land. The proposed development does not propose to reconfigure existing built infrastructure.

The increase in the number of head in the development shall be gained by reducing the stocking density from 22 m^2/head to 10.1 m^2/head and utilising the pens currently used for the sheep feedlot as cattle pens.

Existing infrastructure such as the grain storage and processing and cattle handling facilities have sufficient capacity to cater for the demands of the proposed development.

The proposed development shall utilise the existing approved manure and effluent utilisation areas on the property. The proposed development does not propose to reconfigure the existing waste utilisation areas.

The property "High Claire" is within the Edward River Council local government area and relevant environmental planning instrument is the Conargo Local Environmental Plan 2013 (CLEP).

The existing development has been designed and constructed according to recommended methods outlined in the relevant state guidelines at the time of construction in the early 2004. These included the NSW Feedlot Manual (NSW Agriculture, 1997) and the Reference Manual for the Establishment and Operation of Cattle Feedlots in Queensland (Skerman, 2000) and National Guidelines for Beef Cattle Feedlots in Australia 2nd Edition (SCARM, 1997).

Beef cattle feedlots which exceed 1,000 head capacity are defined as designated development under Schedule 3 (Part 1 section 21a) of the Environmental Planning and Assessment Regulation 2000 and therefore require a full Environmental Impact Statement (EIS) to accompany the development application.

This report forms part of the EIS prepared to support the Development Application to the Edward River Council for the proposed development and provides a separation distance assessment from sensitive receivers in accordance with methodology outlined in The National Guidelines for Beef Cattle Feedlots in Australia (3rd Edition) (MLA, 2012).

The separation distance assessment using the s-factor methodology demonstrates that sufficient separation exists between the proposed development with a capacity of 3,200 head and sensitive receptors.

1 Background

1.1 Introduction

AJ & NA Varley own and operate a mixed farming operation across several properties at Pinelodge including "High Claire", "Arkoona", "Sunnyside", "Killara Rise", Langunyah" and "Glen Cluan" some 17 km by road west of Finley and 49 km by road east-southeast of Deniliquin in Riverina region of NSW.

AJ & NA Varley primarily engage in dryland and irrigated cropping, beef, sheep and wool production. AJ & NA Varley produce wheat, barley in winter and sorghum and maize in summer under irrigation and dryland farming systems.

Central to the beef production enterprise is the breeding, growing and lot feeding of cattle for the domestic market. Currently the beef supply chain includes breeding and growing of beef cattle and lot feeding of cattle within a feedlot on the property "High Claire".

"High Claire" comprises some 195.19 ha (~482.12 acres) and currently, a dryland and irrigated cropping business is undertaken on a large proportion of the property with lot feeding of beef cattle and sheep.

There has been a beef cattle feedlot on "High Claire" for over twenty years after approval was granted for a 999 head feedlot by the former Conargo Shire (now Edward River Council) in 2004 (DA 293). Under Schedule 3, Item 21 of the Environmental Planning and Assessment Regulation 2000, as the capacity of the existing beef cattle development does not exceed 1000 head it is not a designated development and an environmental licence from NSW EPA is not required.

Co-located with the beef cattle feedlot is a 4,000 head sheep feedlot which was granted approval in 2006 by the former Conargo Shire (now Edward River Council) in 2004 (DA 352). Under Schedule 3, Item 21 of the Environmental Planning and Assessment Regulation 2000, as the capacity of the existing sheep development does not exceed 4000 head it is not a designated development and an environmental licence from NSW EPA is not required.

The existing beef cattle feedlot is known as High Claire. High Claire Feedlot is used to finish AJ & NA Varley's own cattle for the domestic and export market along with custom feeding. The beef cattle feedlot is accredited under the National Feedlot Accreditation Scheme (NFAS) with audits conducted annually.

The beef cattle feedlot currently operates for 12 months of the year and employs approximately 2 full time staff. Casual staff and contractors are engaged as required during busy periods such as planting and harvesting of silage and fodder and to supply various associated services such as plant maintenance and veterinary requirements.

AJ & NA Varley wish to expand the existing beef cattle feedlot from the current approved capacity of 999 head by gaining development approval for intensive livestock agriculture to operate as a 3,200 head beef cattle feedlot on the site. The proposal also involves the ceasation

of the sheep feedlot with the existing infrastructure repurposed for the lot feeding of cattle. The proposed development is not proposed to be staged.

The proposed development shall utilise the existing approved and constructed development complex infrastructure on the subject land. The proposed development does not propose to reconfigure existing built infrastructure.

The increase in the number of head in the development shall be gained by reducing the stocking density from 22 m^2/head to 10.1 m^2/head and utilising the pens currently used for the sheep feedlot as cattle pens.

The proposed development shall comprise one controlled drainage area with associated production pens and drainage system which includes catch drains, sedimentation basin and holding pond. Existing infrastructure such as the grain storage and processing and cattle handling facilities have sufficient capacity to cater for the demands of the proposed development.

The proposed development shall utilise the existing approved manure and effluent utilisation areas on the property. The proposed development does not propose to reconfigure the existing waste utilisation areas.

The property "High Claire" is within the Edward River Shire Council local government area and relevant environmental planning instrument is the Conargo Local Environmental Plan 2013 (CLEP).

AJ & NA Varley have access to a secure and appropriately licensed supply of groundwater for 400 shares under the Lower Murray Shallow Groundwater Source for irrigation use on the subject land under water access licence 30535 (Works Approval 50CA511670).

The existing development has been designed and constructed according to recommended methods outlined in the relevant state guidelines at the time of construction in the early 2004. These included the NSW Feedlot Manual (NSW Agriculture, 1997) and the Reference Manual for the Establishment and Operation of Cattle Feedlots in Queensland (Skerman, 2000) and National Guidelines for Beef Cattle Feedlots in Australia 2nd Edition (SCARM, 1997).

Beef cattle feedlots which exceed 1,000 head capacity are defined as designated development under Schedule 3 (Part 1 section 21a) of the Environmental Planning and Assessment Regulation 2000 and therefore require a full Environmental Impact Statement (EIS) to accompany the development application.

This report forms part of the EIS prepared to support the Development Application to the Edward River Council for the proposed development and provides a separation distance assessment from sensitive receivers in accordance with methodology outlined in The National Guidelines for Beef Cattle Feedlots in Australia (3rd Edition) (MLA, 2012).

The separation distance assessment using the s-factor methodology demonstrates that sufficient separation exists between the proposed development with a capacity of 3,200 head and sensitive receptors.

2 Site and locality

2.1 Subject land

The proposed development is to be located on one land parcel which forms the property known as "High Claire". The subject land is approximately 500 km west-southwest of Canberra and about 300 km north of Melbourne in the southern Riverina region. The subject land is located on Broughans Road approximately some 17 km by road west of Finley, 49 km by road east-southeast of Deniliquin and 20 km west-northwest of Tocumwal.

The subject land has primary frontage to Broughans Road (unsealed) of approximately 1.2 km in length and secondary frontage to James Road on the western boundary. Broughans Road intersects with the Newell Highway some 11 km east of the subject land. The subject land is about 4.0 km south of the Riverina Highway via James Road.

The proposed development site is bounded on the north by Broughans Road; to the west by James Road; to the south by Bowlers Road and east by other predominantly irrigated and dryland cropping mixed farming landholdings. Road access to the proposed development is from Broughans Road, a council- controlled road.

Figure 1 is a locality plan highlighting the subject land to roads and the nearby townships of Deniliquin and Finley and the main watercourses and drainage lines in the region. The subject land falls within the catchment of the Murray-Darling Basin, more specifically the central Murray River catchment which comprises the Murray River and a number of anabranch systems including the Edward, Wakool and Little Murray Rivers, as well as Ulupna and Gunbower Creeks.

The subject land has been historically used for irrigated agriculture (cereals (maize, barley) and dryland agriculture (cereals (wheat, barley) and extensive beef cattle grazing and intensive beef cattle feedlot. The subject land is located in a rural area which encourages agricultural uses.

2.1.1 Real property description

The real property description for the subject land is provided in Table 1. The subject land comprises of one (1) cadastral portion. The total area of the subject land is about 195.2 ha (~482.23 acres). The subject land is in the Edward River Council.

Figure 2 is a cadastral plan highlighting the cadastral parcel that comprises the subject land. Figure 3 is an aerial plan of the subject land.

Table 1 – Subject land – Real property description

Property name	Lot no.	Plan no.	Easements	Area Ha	Local government area
"High Claire"	130	DP756353	-	~195.19	Edward River Shire

2.1.1.1 Limitations/Interests/Encumbrances

The subject land does not contain any easements as shown in Table 1 and Figure 2.

The subject land is not subject to reservations and interests in favour of the crown other than minerals under Crown Grant (S).

The subject land is subject to a mortgage.

2.1.1.2 Road reserve

The subject land does not contain a road reserve under the *Roads Act 1993* as shown in Figure 2.

Figure 1 – Subject land – Locality plan

Figure 2 – Subject land – Cadastral plan

Figure 3 – Subject land – Aerial plan

2.2 Proposed development

AJ & NA Varley wish to expand the existing beef cattle feedlot on the subject land from the currently approved capacity of 999 head to 3,200 head when fully developed by reducing the stocking density from 22 m^2/head to 10.1 m^2/head and utilising the pens currently used for the sheep feedlot as cattle pens.

The proposed development shall utilise the existing approved and constructed development complex infrastructure on the subject land. The proposed development does not propose to reconfigure existing built infrastructure.

The proposed development comprises a permanent pen area with adjoining feed alley in which the beef cattle are housed in the open air and provided with their daily feed and water requirements. The pen area shall incorporate water, feeding and shade infrastructure.

There are two components of the proposed development being the infrastructure and waste utilisation area.

The infrastructure of the proposed development includes:

- Production pens for beef cattle;
- Drainage system incorporating catch drains, sedimentation basin and holding pond;
- A cattle handling facility with receival/dispatch infrastructure;
- Internal roadways connecting the subject land access to the cattle handling and commodity storage facilities;

The waste utilisation area includes:

- Effluent and solid waste (manure) utilisation areas. When available, effluent shall be applied to crops land via irrigation and solid waste applied to cropping land within the dedicated utilisation areas.

The layout of the proposed development is shown in Figure 4.

Figure 4 – Proposed development – Development complex layout

2.3 Existing environment

2.3.1 Climate

The closest meteorological station with climatic data to the subject land is the Bureau of Meteorology (BoM) station at Finley Post Office located about 11 km east of the subject land. The Finley Post Office (Site number: 074042) (BoM, 2024a) has been recording rainfall since 1897.

A summary of the rainfall data from the Finley Post Office (Site number: 074042) (BoM, 2024a) is provided in Table 2.

The closest meteorological station to the subject land with climatic data is the Deniliquin Airport (Site number: 074258) located some 46 km to the west north-west. However, this station has only been collecting climate data since 1997 (BoM, 2024b). These data may not be representative of the long term climate of the subject land.

Long-term daily interpolated climate data for the area (Latitude -35.65S, Longitude 145.45E) were derived from the Department of Science, Information Technology and Innovation (DSITIA) Silo Data Drill database (DSITIA, 2024). The Data Drill accesses data on a 5 km grid derived by interpolation from point observations by the Bureau of Meteorology station records. The data in the Data Drill are all synthetic; there are no original meteorological station data left in the calculated grid fields (Jeffrey et al. 2001). The data are supplied as an individual file of interpolated daily rainfall, maximum and minimum temperature, potential evapotranspiration and radiation at the nominated point location for the period 01/01/1924 to 31/12/2023 (DSITIA, 2024). A summary of the data used is included in Table 3.

The climate of the region is between the tropical and temperate climatic zones. Under the Köppen-Geiger climate classification system this climate is classified as steppe (BSk), and experiences dry hot summers and wet cool winters.

Rainfall varies with time of year due to the latitude of the region (-35.7^0) and tends to be winter dominant. Rainfall patterns are linked to cold fronts and associated low pressure systems. These systems peak between the months of April and October (the 'cool season') when the lows in the Southern Ocean tend to move closest to Australia. Table 2 shows that the long-term average rainfall recorded at Finley Post Office for the period 1897 to 2024 was 432 mm with approximately 55% falling in the five months between May and October. Monthly rainfall over the autumn and winter months averages around 40 mm per month. The lowest rainfall totals are between December and March (Table 2).

Table 3 shows that the average annual rainfall interpolated by SILO for the period 1924 to 2023 is approximately 424 mm/year slightly less than that measured by BoM at the Finley Post Office site. The annual evaporation is approximately 1,650 mm/year. The region has nett deficit rainfall with rainfall less than the evaporation and transpiration rates.

There is a large degree of variability in rainfall between years and there has been a drying climate with lower average annual rainfall over the last 30 years.

The climatic influence on temperatures results in warm to hot summers and cool winters, regularly reaching single digit temperature. Table 3 shows that the mean maximum temperature interpolated by SILO for the period 1924 to 2023 is 31.7^0C in January and a mean minimum temperature of about 3.3^0C for July.

Relative humidity in the area is higher during the winter months when temperatures are lower. Average relative humidity 9 am readings range from 39% in July to 40% in November.

Table 2 – Rainfall data from Finley Post Office (1897-2024) (BoM, 2024a)

	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall														
Mean rainfall	mm	33.9	26.6	33.2	28.7	39.2	42.1	39.0	39.7	38.2	40.4	34.9	33.4	432.0
Median rainfall	mm	22.9	16.6	22.1	23.2	28.4	36.0	31.9	37.4	33.1	33.2	26.9	22.8	421.4
Lowest rainfall	mm	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.6	2.8	0.0	0.0	0.0	161.3
90% years at least rainfall	mm	0.8	0.0	1.2	1.4	6.2	11.2	11.7	9.7	9.2	4.9	3.4	1.5	270.3
10% years at least rainfall	mm	75.7	72.1	79.3	62.5	85.0	77.8	74.9	70.6	69.5	81.4	73.2	78.0	596.3
Highest rainfall	mm	257.8	144.3	202.0	111.4	148.9	116.0	94.8	113.0	139.1	200.9	158.5	206.1	898.3

Table 3 – Climatic data derived for SILO (1924-2023) (DSITIA, 2024)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall													
Mean rainfall (mm)	33.1	28.7	32.8	30.6	37.5	37.2	38.6	38.1	35.9	42.8	34.9	33.8	423.9
Median rainfall (mm)	21.7	16.6	22.8	25.6	28.8	34.0	32.9	35.5	32.1	33.4	30.2	23.4	421.5
Lowest rainfall (mm)	0	0	0	0	0	0.2	1.7	1.1	3.9	0	0.4	0	180.4
90% years at least rainfall (mm)	1.0	0.4	1.1	3.0	7.7	11.2	13.1	9.5	7.5	8.4	6.5	2.4	249.5
10% years at least rainfall (mm)	66.4	74.6	75.6	66.5	78.3	69.1	71.6	64.5	63.5	84.9	71.2	80.9	584.2
Highest rainfall (mm)	247.2	144.3	189.4	112.2	127.3	106.8	97.7	108.1	130	202.5	138.2	180.1	836.8
Temperature, Humidity and Pan evaporation													
Mean pan evaporation (mm)	273.9	219.0	176.5	99.0	54.1	35.2	38.1	58.0	91.9	146.4	201.1	254.9	1650.2
Mean maximum temperature (deg C)	31.7	31.4	28.0	22.7	18.0	14.5	14.1	15.6	18.8	22.6	26.5	29.7	22.8
Mean minimum temperature (deg C)	15.9	16.0	13.4	9.4	6.5	4.1	3.3	4.2	5.9	8.6	11.4	14.0	9.4
Relative Humidity (%)	43.5	46.3	46.2	46.0	48.0	48.7	45.5	42.1	40.1	40.0	39.8	41.4	44.0

2.3.2 Wind direction

The wind direction, frequency and intensity at the site are influenced by several factors including the local terrain and land use. On a relatively small scale, winds would be largely affected by the local topography. At larger scales, winds are affected by synoptic scale winds, which are modified by sea breezes near the coast in the daytime in summer (also to a certain extent in the winter) and by a complex pattern of regional drainage flows that develop overnight.

As no meteorological data exists for the proposed development site, data was obtained from the closest meteorological record station that holds wind direction statistics to the subject land. However, the closest station is the Deniliquin Airport (1997-2024) (BoM, 2024a) which is located approximately 46 km west north-west of the subject land. Given the distance and terrain, these data can be used to provide a general indication of wind speed and direction at the proposed development site.

However, a more representative local wind speed and direction data was obtained using the meteorological model – The Air Pollution Model (TAPM) (Version 4).

TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which is used to predict three-dimensional meteorological data and air pollution concentrations. A detailed description of the TAPM model can be found in Hurley (2008).

TAPM software allows users to generate synthetic observations by referencing in-built databases (e.g. terrain information, synoptic scale meteorological observations, vegetation and soil type etc.) which are subsequently used in generating site-specific hourly meteorological observations.

The modelling was centred on the closest grid point to the proposed development site being 35°39.0'S; 145° 27.0'E and was configured with a 30 x 30 grid. In total, five domains were set up with grid spacings of 30km, 10 km, 3 km, 1 km and 0.3 km. Five (5) years data were modelled from 2018 to 2022. This setup is consistent with good practice and the guidance detailed in the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (NSW EPA, 2022).

Wind speed and direction information obtained from TAPM modelling is presented in the form of wind roses. Wind roses are a way of presenting a summary of wind speed and directional data for a particular time and location and show the frequency of occurrence of winds by direction and strength.

The annual wind roses developed for the proposed development site from TAPM in years 2018 to 2022 inclusive are shown in Figure 5. All years modelled result in similar wind directions. Each bar shown on the wind rose represents winds blowing from that direction. The length of the bar represents the frequency of occurrence of winds from that direction, and the colour and width of the bar sections correspond to wind speed categories as outlined in the legend.

The composite wind rose developed for the proposed development site from TAPM in all five years (2017 to 2021) is shown in Figure 6. Figure 6 shows that wind direction is predominantly from the south through to the west sector with light to moderate wind speeds (2.1 – 5.7 m/s) observed for most of the year.

Analyses of the TAPM data shows that about 50% of the winds blow from ±40° from the general direction of south through to the west.

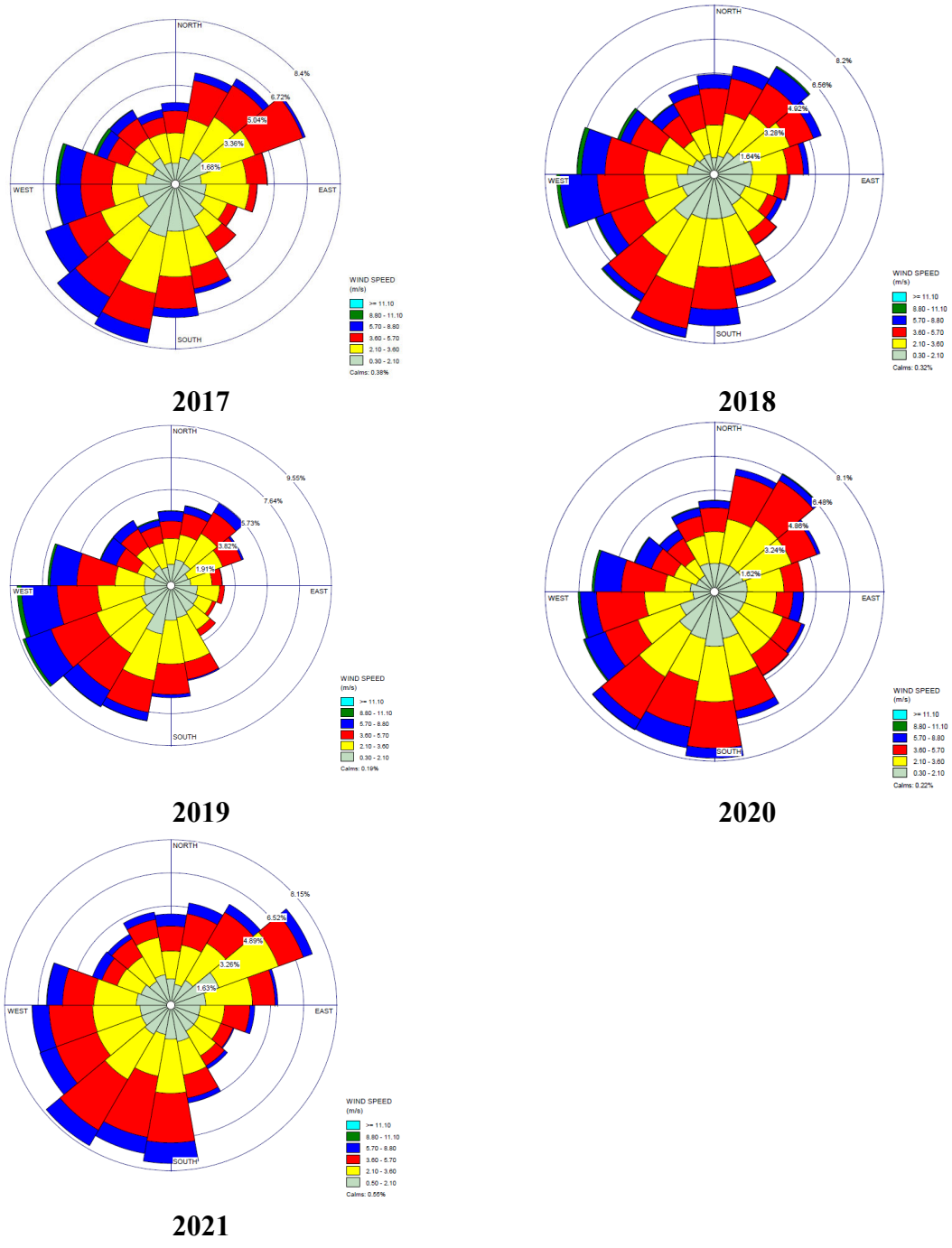

Figure 5 – Proposed development site – Annual windroses (TAPM)

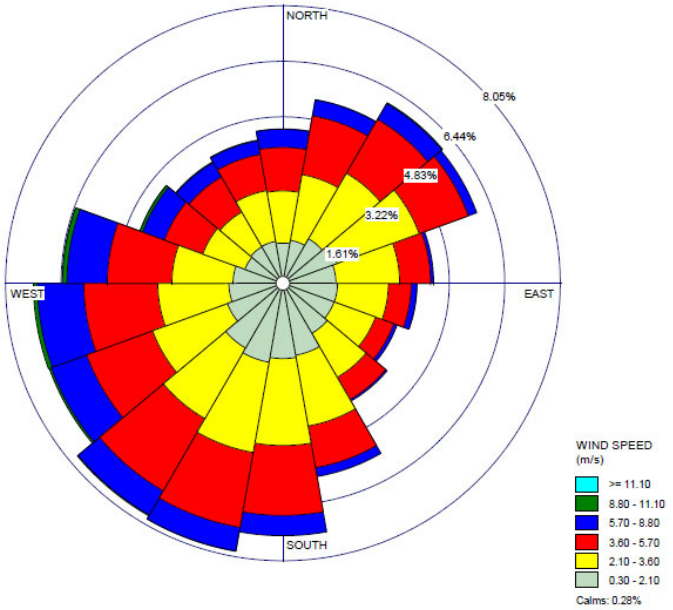

Figure 6 – Proposed development site – Composite annual windrose (TAPM 2017-2021)

2.4 Landform and topography

2.4.1 Landform

The geologic history and its climate contrasts are reflected in the landforms of the region. The subject land is located in the Riverina region of the Murray Basin which extends over an area 300,000 km^2 of inland southeastern Australia. The Murray Basin is flanked by subdued mountain ranges and forms a low-lying saucer-shaped basin with thin flat-lying Cainozoic sediments. This basin was formed by massive land subsidence during the Tertiary period and began to fill with sediments. The Cainozoic succession of the Murray Basin forms an extensive blanket of sediment. Poorly consolidated, non-marine sand, silt, clay, and carbonaceous sedimentary rocks predominate in the east and north, but each of the depositional sequences includes weakly lithified marine sedimentary rocks in central and southwestern areas. Where the basin and adjacent highlands are drained by the Murray, Murrumbidgee and Lachlan Rivers, the Tertiary sequence underlies flat-lying fluvio-lacustrine and minor aeolian sediments of the semi-arid landscape of the Riverine Plain.

These components have determined the landforms of the Riverina region and the overall pattern of drainage and relief. The Riverina region is part of an extensive alluvial plain dominated by river channels, floodplains, backplains, swamps, lakes and lunettes that are all of Quaternary age. The region comprises three overlapping alluvial fans centred on the eastern half of the Murray Basin. Features of each fan differ slightly because of differences in the discharge of the streams. The Murray fan is more confined than the Lachlan and Murrumbidgee fans and has more active anabranch channels where it is forced to flow around the obstacle of the Cadell fault near Echuca.

At times of extreme flood flow, water from the different streams can cross the fan surfaces and enter channels of another system. The landform of the region is typically near level to gently sloping.

2.4.2 Topography

The Riverina covers the alluvial fans of the Lachlan, Murrumbidgee and Murray Rivers west of the Great Dividing Range and extends down the Murray River. Much of the geology and geomorphology of the region is similar to that of the Darling Riverine Plains. The upper catchment landscape is a series of overlapping, low gradient alluvial fans. The lower tract of the river is a floodplain with overflow lakes. Discharge from past and present streams control patterns of sediment deposition, soils, landscapes and vegetation.

The subject land is located within the Blighty (7926) 1:50,000 topographic map sheets within the southern Riverina region of NSW. The topography at a regional scale is generally flat, with elevations from 100 m to 125 m AHD. The subject land is on the centre south of the plains with slopes in the order of 0.1-0.2%.

A topographic plan of the subject land was prepared from topographic data at a scale of 1:10,000 with a 0.5 m contour interval and is shown in Figure 7. This shows that the subject land is generally flat with an elevation of about 105 m AHD. There are no topographic highs.

Drainage has been altered by development for irrigation such as distribution channels, diversion banks and irrigation bays). There are no natural drainage lines remaining on the subject land.

The proposed development infrastructure shall be located geographically to the centre-north of the subject land where the land is gently sloping.

The proposed effluent utilisation area is located in the northwest of the subject land on relatively flat land as shown on Figure 7. The solid waste utilisation areas are located across the subject land where the land is relatively flat land as shown on Figure 7.

The topography of the subject land has been modified slightly for irrigation development (channels, banks, irrigation bays) and landforming to establish the design grades and drainage for the existing development. There has been no modification to the natural landform from mining, quarrying or other groundworks which may have altered its topography through the removal of soil or other materials other than vegetation clearing.

Photograph 1 – Subject land – Existing development site

Photograph 2 – Subject land – Waste utilisation areas

Figure 7 – Subject land – Topographic plan

3 Air quality assessment

3.1 Separation distance assessment

The use of appropriate separation distances is a well-established and widely recognised means of mitigating the impacts on community amenity that arise from odour from beef cattle feedlots (MLA, 2012).

The National Guidelines for Beef Cattle Feedlots in Australia (3rd Edition) (MLA, 2012) provide two methods for determining appropriate separation distances between cattle feedlots and sensitive receptors. These include the S-factor method and odour dispersion modelling.

The S-factor method uses a standard empirical formula that provides a conservative estimate of the separation distance required and therefore offers higher levels of protection for community amenity. Typically, the separation distance estimated using the S-factor method more than complies with the quantitative performance criteria set out in relevant environmental legislation, regulation and policy.

Typically, odour dispersion modelling is used for large feedlot developments or developments on complex sites. The modelling process utilises odour emission data (from similar developments) and site-specific climatic data to determine the probability of a particular odour level being exceeded at nearby receptors.

Given, the rural locality of the proposed development site, the size and scale of the proposed development and proximity to sensitive receptors the S-factor method has been adopted to assess the separation distance required to mitigate potential odour nuisance issues for nearby sensitive receptors.

The S-factor method relies on factors such as the number of cattle in the development, receptor type, topography, vegetation (surface roughness), wind frequency and feedlot design and operation. The required separation distance is measured from the closest odour source of the proposed development in the direction of the sensitive receptor, not the centre of the development.

The National Guidelines for Beef Cattle Feedlots in Australia (3rd Edition) (MLA, 2012) calculation of separation distances for each receptor type follows the form:

Separation distance (D) (m) = $N^{0.5}$ x S_1 x S_2 x S_3 x S_4 x S_5

Where:

- N = feedlot capacity in SCU;
- 0.5 = feedlot size exponent determined using the results of modelling;
- S_1 = feedlot design and management factor;
- S_2 = receptor type factor;

- S_3 = topography or terrain weighting factor;
- S_4 = vegetative cover factor; and
- S_5 = wind direction factor.

3.1.1 N – Feedlot capacity

The layout of the proposed development is shown in Figure 4.

The proposed development will include an expansion of the existing capacity from 999 head (~758 SCUs) to 3,200 head (~2,427 SCUs).

A standard cattle unit is equivalent to an animal of 600 kg liveweight (MLA, 2012).

The proposed development shall have an average stocking density of ~10.1 m^2/head for the proposed beef cattle production pens for the total capacity of 3,200 head.

Each animal can be converted to a SCU equivalent based on their metabolic liveweight and the following formula:

$$\text{SCU scaling factor} = (\text{Animal liveweight}/600)^{0.75} \quad \text{----------Equation 1}$$

The SCU scaling factor for various average liveweight for beef cattle is provided in Table 4.

Table 4 – Standard Cattle Unit conversion factor

Average liveweight (kg)	SCU Scaling factor
350	0.68
400	0.74
450	0.81
500	0.87
550	0.94
600	1.00
650	1.06
700	1.12

The average liveweight of the cattle on-feed in the existing development is about 415kg. The SCU scaling factor applied to lot fed cattle with an average liveweight of about 415 kg (Table 4) can be determined from Equation 1 as follows.

$$\text{SCU scaling factor} = (415/600)^{0.75}$$
$$= 0.758$$

Consequently, the proposed development shall have a total capacity equivalent to 2,427 standard cattle units (SCUs) once fully developed. This equates to a stocking density in the order of about 13.25 m^2/SCU when the SCU scaling factor is applied.

3.1.2 Siting, design and management factor (S_1)

Siting, design and management factors will influence odour emissions from the proposed development. These factors include the climatic conditions at the site, pen cleaning frequency, and stocking density which influence the depth of manure on the pen surface and its moisture content.

The proposed development will operate at the equivalent of a Class 1 standard (i.e. adopt best management practice).

The average stocking density of the proposed development is proposed to be ~13.25 m^2/SCU.

For comparable odour emission rates, pens must be stocked at a lower density (i.e. greater m^2/SCU) in a wetter climate than in a drier one (with all other factors equal). Thus, S_1 values for specific stocking densities are provided for an average annual rainfall of either <750 mm or >750 mm. As outlined in section 2.3.1, the average annual rainfall for the area is about 423 mm per year.

Consequently, based on a stocking density of ~13.25 m^2/SCU and a rainfall category of <750mm/year, a S_1 factor of **56.75** was interpolated from Table B-1 of the National Guidelines for Beef Cattle Feedlots in Australia (3rd Edition) (MLA, 2012).

3.1.3 Receptor factor (S_2)

S_2 is a receptor type factor which accounts for the variation in population density, odour sensitivity and risk of exposure for receptors located in the vicinity of a development. The greater the exposed population, the more likely it is that 'sensitive' individuals might be exposed to nuisance odour. Thus, the S_2 value for a large population centre (and the minimum separation distance) is greater than that for a single rural dwelling (Table B.2, MLA, 2012).

There are two types of receptors to be considered surrounding the proposed development. These include single rural dwellings on surrounding rural properties, and the townships of Finley and Tocumwal which are population centres located some 11 km and 20 km to the east and south southeast respectively.

The S_2 factors were selected for the closest receptors at each compass point. The location of each receptor is shown in Figure 8 and are summarised in Table 5.

Table 5 – Proposed development – Receptor factors – Adopted values of S_2

Identifier	Location	Direction from Development	Receptor type	S_2 value
R1	299 James Road Pine Lodge	North by East	Single rural or farm dwelling	0.3
R2	299 James Road Pine Lodge	North by East	Single rural or farm dwelling	0.3
R3	203 Broughans Road Pine Lodge	East	Single rural or farm dwelling	0.3
R4	202 Broughans Road Pine Lodge	Southeast by East	Single rural or farm dwelling	0.3
R5	822 Pine Lodge Road Pine Lodge	South southeast	Single rural or farm dwelling	0.3
R6	108 Woodwards Road Pine Lodge	South	Single rural or farm dwelling	0.3
R7	306 Bowlers Road Pine Lodge	Southwest by South	Single rural or farm dwelling	0.3
R8	184 Bowlers Road Pine Lodge	Southwest by West	Single rural or farm dwelling	0.3
R9	179 Bowlers Road Pine Lodge	West by South	Single rural or farm dwelling	0.3
R10	442 James Road Pine Lodge	West by South	Single rural or farm dwelling	0.3
R11	1378 Lower Finley Road Pine Lodge	Northwest	Single rural or farm dwelling	0.3
R12	Finley (1,864 persons 2021)	East by North	Medium town > 500 -2000 persons	1.2
R13	Tocumwal (2,590 persons 2021)	Southeast by South	Large town > 2000 persons	1.6

3.1.4 Terrain factor (S_3)

The terrain weighting factor (S_3) relates to the potential for the odour plume to be exaggerated in particular directions, and relatively small in others. This method provides an estimation of the potential changes to odour dispersion in situations where meteorological conditions may be influenced by local terrain.

The S_3 terrain factor is selected based on the topography at the site. Generally speaking, the terrain is flat between the proposed development site and the receptors downhill or uphill as shown in the topographic data in Figure 7 and from photographs of the area as shown in Photograph 1 and Photograph 2. The terrain factor selected for each receptor is summarised in Table 6.

Table 6 – Proposed development – Terrain factor – Adopted values of S_3

Identifier	Location	Elevation[1] m (AHD)	Distance from Development m	Grade %	S_3 value
R1	299 James Road Pine Lodge	106	~1,130	0.09	1.0
R2	299 James Road Pine Lodge	106	~1,245	0.08	1.0
R3	203 Broughans Road Pine Lodge	108	~1,210	0.25	1.0
R4	202 Broughans Road Pine Lodge	109	~1,425	0.28	1.0
R5	822 Pine Lodge Road Pine Lodge	108	~3,600	0.08	1.0
R6	108 Woodwards Road Pine Lodge	108	~2,710	0.11	1.0
R7	306 Bowlers Road Pine Lodge	108	~1,930	0.16	1.0
R8	184 Bowlers Road Pine Lodge	106	~2,500	0.04	1.0
R9	179 Bowlers Road Pine Lodge	105	~2,240	0.00	1.0
R10	442 James Road Pine Lodge	106	~990	0.10	1.0
R11	1378 Lower Finley Road Pine Lodge	106	~1,715	0.06	1.0
R12	~Finley (1,864 persons 2021)	111	~11,000	0.06	1.0
R13	~Tocumwal (2,590 persons 2021)	110	~20,000	0.03	1.0

[1] Terrain heights were taken from the Google Earth™ at each receptor location. The elevation of the proposed development site ranges from about 104 to 106 m.

3.1.5 Vegetative cover factor (S_4)

The vegetative cover factor (S_4) relates to the vegetative density or 'roughness elements' between the proposed development and the receptor. Generally, the rougher the surface, the more turbulent the air flow, and the more mixing and dilution of the air and more odour dispersion. Maximum turbulence occurs when the surface is a mixture of various sized obstacles of various heights.

The local landscape is dominated by agricultural land uses such as extensive grazing of cattle and sheep and irrigated and dryland cropping with scattered paddock trees.

The vegetation factor for each sensitive receptor was selected based on both on-site observations and aerial imagery of the area and are shown in Figure 3. Receptors 1 through to 13 are separated by a combination of open grassland, cropping and remnant native vegetation woodland fringing drainage lines and roads. Consequently, for conservatism 'crops only (no effective tree cover)' was selected.

An indication of the vegetative cover can be seen on aerial imagery as shown in Figure 3.

Table 7 – Proposed development – Vegetative cover – Adopted values of S_4

Identifier	Location	Vegetation type	S_4 value
R1	299 James Road Pine Lodge	Crops only (no effective tree cover)	1.0
R2	299 James Road Pine Lodge	Crops only (no effective tree cover)	1.0
R3	203 Broughans Road Pine Lodge	Crops only (no effective tree cover)	1.0
R4	202 Broughans Road Pine Lodge	Crops only (no effective tree cover)	1.0
R5	822 Pine Lodge Road Pine Lodge	Crops only (no effective tree cover)	1.0
R6	108 Woodwards Road Pine Lodge	Crops only (no effective tree cover)	1.0
R7	306 Bowlers Road Pine Lodge	Crops only (no effective tree cover)	1.0
R8	184 Bowlers Road Pine Lodge	Crops only (no effective tree cover)	1.0
R9	179 Bowlers Road Pine Lodge	Crops only (no effective tree cover)	1.0
R10	442 James Road Pine Lodge	Crops only (no effective tree cover)	1.0
R11	1378 Lower Finley Road Pine Lodge	Crops only (no effective tree cover)	1.0
R12	Finley (~1,864 persons 2021)	Crops only (no effective tree cover)	1.0
R13	Tocumwal (~2,590 persons 2021)	Crops only (no effective tree cover)	1.0

Photograph 3 – Neighbouring land – Existing vegetation (north)

Photograph 4 – Neighbouring land – Existing vegetation (south)

Photograph 5 – Adjoining land – Existing vegetation (east)

Photograph 6 – Neighbouring land – Existing vegetation (west)

3.1.6 Wind direction factor (S_5)

Wind direction has the potential to increase the exposure of a receptor located in the downwind path. While most Australian feedlot sites will have some form of prevailing wind, it is unlikely that it will blow from that general direction (±40° of the direct line) for most of the time (>60%) (MLA, 2012).

Site-specific wind direction data was used in the S-factor assessment to determine wind direction. Wind roses derived from TAPM (2018-2022) were used which totalled 43,824 hours of data. Figure 6 (TAPM 2018-2022) shows that the predominant wind direction is from the south through to west. Consequently, the receptors that would be most affected is receptor R1, 23 and R3. However, the wind does not blow from that general direction (±40° of the direct line) towards these receptors for most of the time (>60%) in as outlined in Table 8. Consequently, a normal wind factor was applied to all receptors.

Table 8 – Proposed development – Wind direction – Adopted values of S_5

Identifier	Location	Wind Direction (Bearing)	Hours wind blowing within ±40° of the bearing	Percentage wind blowing within ±40° of the bearing	S_5 value
R1	299 James Road Pine Lodge	187	12,019	27.4	1.0
R2	299 James Road Pine Lodge	191.25	12,115	27.6	1.0
R3	203 Broughans Road Pine Lodge	270	11,068	25.3	1.0
R4	202 Broughans Road Pine Lodge	306.6	8,416	19.2	1.0
R5	822 Pine Lodge Road Pine Lodge	343.1	7,472	17.1	1.0
R6	108 Woodwards Road Pine Lodge	357.2	8,080	18.4	1.0
R7	306 Bowlers Road Pine Lodge	33.75	9,644	22.0	1.0
R8	184 Bowlers Road Pine Lodge	59.1	9,861	22.5	1.0
R9	179 Bowlers Road Pine Lodge	75.9	9,386	21.4	1.0
R10	442 James Road Pine Lodge	81.6	9,030	20.6	1.0
R11	1378 Lower Finley Road Pine Lodge	140.6	8,495	19.4	1.0
R12	Finley (~1,864 persons 2021)	261.6	11,559	26.4	1.0
R13	Tocumwal (~2,590 persons 2021)	326.25	7,329	16.7	1.0

3.1.7 Cumulative effects

There are several intensive livestock facilities in the Finley region including beef cattle feedlots, piggeries and poultry farms and several large scale dairies. The closest intensive livestock facility is Haino Park Feedlot located some 6.5 km north-northwest of the existing and proposed development. Haino Park Feedlot is licensed for a capacity of 5,000 head and constructed to 2,000 head and owned by the Blackmore family.

The proposed development and Haino Park Feedlot are not separated by less than half the shortest separation distance (420 m). Consequently, the proposed development and Haino Feedlot do not need to be treated as a single entity (having a capacity equivalent to the combined capacities of the two facilities) as they are sufficiently separated.

There are no sensitive receptors unacceptably located within the 120% overlap zone of both the proposed development and Haino Park Feedlot as shown on Figure 8. Consequently, as there are no sensitive receptors unacceptably located within the 120% overlap zone a cumulative impact assessment is not warranted in accordance with the National Feedlot Guidelines (MLA, 2012) and normal separation distances apply.

3.1.8 Conclusion

As outlined in Table 9, the S-factor assessment demonstrates that sufficient separation exists between the proposed development with a capacity of 3,200 head (2,427 SCUs) at 13.25 m^2/SCU and sensitive receptors respectively.

The Level 1 odour impact assessment for the proposed development concludes that the existing separation distances exceed the minimum separation calculated by the NSW Level 1 requirements and the requirements of The National Guidelines for Beef Cattle Feedlots in Australia (3rd Edition) (MLA, 2012b).

As the proposed development can demonstrate a clear ‘pass’ at Level 1 odour impact assessment and there are no special risk factors such as katabatic drift or a populated area located just outside the calculated separation distance, there is no need to undertake Level 2 or 3 assessment.

Table 9 – Proposed development – Separation distances from National Feedlot Guidelines (MLA, 2012)

Identifier	Type	Direction	S_1	S_2	S_3	S_4	S_5	Distance Required Normal S_5	Available Distance	Compliance
							Normal	m	m	
R1	299 James Road Pine Lodge	North by East	56.75	0.3	1.0	1.0	1.0	839	~1,130	Yes
R2	299 James Road Pine Lodge	North by East	56.75	0.3	1.0	1.0	1.0	839	~1,245	Yes
R3	203 Broughans Road Pine Lodge	East	56.75	0.3	1.0	1.0	1.0	839	~1,210	Yes
R4	202 Broughans Road Pine Lodge	Southeast by East	56.75	0.3	1.0	1.0	1.0	839	~1,425	Yes
R5	822 Pine Lodge Road Pine Lodge	South southeast	56.75	0.3	1.0	1.0	1.0	839	~3,600	Yes
R6	108 Woodwards Road Pine Lodge	South	56.75	0.3	1.0	1.0	1.0	839	~2,710	Yes
R7	306 Bowlers Road Pine Lodge	Southwest by South	56.75	0.3	1.0	1.0	1.0	839	~1,930	Yes
R8	184 Bowlers Road Pine Lodge	Southwest by West	56.75	0.3	1.0	1.0	1.0	839	~2,500	Yes
R9	179 Bowlers Road Pine Lodge	West by South	56.75	0.3	1.0	1.0	1.0	839	~2,240	Yes
R10	442 James Road Pine Lodge	West by South	56.75	0.3	1.0	1.0	1.0	839	~990	Yes
R11	1378 Lower Finley Road Pine Lodge	Northwest	56.75	0.3	1.0	1.0	1.0	839	~1,715	Yes
R12	Finley (1,864 persons 2021)	East by North	56.75	1.2	1.0	1.0	1.0	3,354	~11,000	Yes
R13	Tocumwal (~2,590 persons 2021)	Southeast by South	56.75	1.6	1.0	1.0	1.0	4,473	~20,000	Yes

Figure 8 – Proposed development – Separation distance to sensitive receptors plan

4 References

Bureau of Meteorology, 2024a, Climate Statisitcs for Australian Locations – Finley Post Office 1897-2024, Site No 053095, Bureau of Meteorology, Commonwealth of Australia, viewed March 2024.

Bureau of Meteorology, 2024b, Climate Statistics for Australian Locations – Deniliquin Airport 1997-2024, Site No 074258, Bureau of Meteorology, Commonwealth of Australia, viewed March 2024.

Department of Science, Information Technology, Innovation and the Arts - Science Delivery (DSITISA), 2024, SILO Climate data (The Long Paddock), The State of Queensland (Department of Science, Information Technology and Innovation), Brisbane, Queensland.

Edward River Shire Council, 2013, Conargo Local Environmental Plan 2013, Edward River Shire Council, Deniliquin, NSW.

Hurley P, 2008, TAPM V4 User Manual- CSIRO Marine and Atmospheric Research Internal Report No.5 Aspendale, Victoria: CSIRO Marine and Atmospheric Research, s.l.: s.n.

Jeffrey, SJ, Carter, JO, Moodie, KB and Beswick, AR, 2001, Using spatial interpolation to construct a comprehensive archive of Australian climate data, Environmental Modelling & Software, 16, 309–330.

Meat and Livestock Australia, 2012, National Guidelines for Beef Cattle Feedlots in Australia 3rd Edition, Meat & Livestock Australia, North Sydney, NSW.

NSW Agriculture 1997, The New South Wales Feedlot manual, The Inter-Departmental Committee on Intensive Animal Industries (Feedlot Section), NSW Agriculture, Orange, NSW.

NSW Department of Primary Industries, 2006, Preparing a development application for intensive agriculture in NSW / NSW Government Department of Planning, NSW Department of Primary Industries, Orange NSW.