Intended for
UPC Renewables Australia Pty Ltd

Date
April 2022

VALLEY OF THE WINDS
ENVIRONMENTAL IMPACT STATEMENT

Bright ideas. Sustainable change.

VALLEY OF THE WINDS
ENVIRONMENTAL IMPACT STATEMENT

Project name	**Valley of the Winds**
Project no.	**318001172**
Recipient	**UPC Renewables Australia Pty Ltd**
Document type	**Environmental Impact Statement**
Version	**V4.0**
Date	**28/04/2022**
Prepared by	**T Hancock and C Butterfield**
Checked by	**Belinda Sinclair**
Approved by	**Jon Williamson**

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Revision	Date	Prepared by	Checked by	Approved by	Description
1	25/02/2022	T Hancock, C Butterfield	B Sinclair	J Williamson	Issued to UPC\AC
2	28/02/2022	T Hancock, C Butterfield	B Sinclair	J Williamson	Issued to UPC\AC
3	31/03/2022	T Hancock, C Butterfield	B Sinclair	J Williamson	Issued to Department of Planning and Environment
4	28/4/2021	T Hancock, C Butterfield	B Sinclair	J Williamson	Issued to Department of Planning and Environment

Ramboll Australia Pty Ltd.
ACN 095 437 442
ABN 49 095 437 442

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ACKNOWLEDGEMENT

Aboriginal people have had a long and continuous association with the region for thousands of years. UPC/AC would like to acknowledge and pay respects to the traditional owners of the country which is encompassed by the project.

The name Coolah is derived from traditional language – meaning Valley of the Winds.

CERTIFICATION

For submission of an environmental impact statement (EIS) under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979*.

EIS prepared by

Ramboll Australia Pty Ltd

Applicant

UPC Renewables Australia Pty Ltd

Proposed Development

The Valley of the Winds project includes the construction, operation and decommissioning of a wind farm comprising approximately up to 148 wind turbines and supporting infrastructure including a high voltage transmission line. The proposed development would be located close to the township of Coolah, in the Warrumbungle Local Government Area.

Land to be developed

The Valley of the Winds project site would be located on:

Lot	Deposited Plan
1	DP1091571
1	DP1120886
1	DP1187452
1	DP120973
1	DP121325
1	DP1214801
1	DP1214808
1	DP1227122
1	DP1238648
1	DP1252803
1	DP1253559
1	DP132142
1	DP132931

Lot	Deposited Plan
1	DP217788
1	DP378972
1	DP512844
1	DP596076
1	DP661801
1	DP720365
1	DP754975
1	DP812579
1	DP864298
1	DP876041
10	DP132925
10	DP256130
10	DP750772

Lot	Deposited Plan
10	DP754975
100	DP750745
101	DP750745
103	DP750740
104	DP750740
104	DP750745
105	DP750740
105	DP750745
106	DP750740
106	DP750745
107	DP750740
107	DP750745
108	DP750740

Lot	Deposited Plan
108	DP750745
108	DP750772
109	DP750745
109	DP750772
11	DP132925
11	DP256130
11	DP754975
11	DP820719
110	DP750772
111	DP750772
112	DP750740
112	DP750772
113	DP750740
113	DP750745
113	DP750768
114	DP750740
114	DP750772
115	DP750740
115	DP750768
115	DP750772
116	DP750740
116	DP750768
116	DP750772
117	DP750740
118	DP750740
119	DP750740
12	DP750768
12	DP750772
12	DP754975
12	DP820719
120	DP750745

Lot	Deposited Plan
122	DP750772
123	DP750768
123	DP750772
126	DP750740
126	DP750745
128	DP750745
129	DP750745
13	DP750772
13	DP754967
13	DP820719
131	DP750740
132	DP721774
132	DP750745
136	DP824118
137	DP824118
139	DP750740
14	DP750745
14	DP750759
14	DP750768
14	DP754967
140	DP750772
142	DP750740
142	DP750772
143	DP750772
149	DP750740
15	DP750772
150	DP750740
151	DP750772
152	DP750772
154	DP750772
155	DP750772

Lot	Deposited Plan
157	DP750772
177	DP750772
19	DP754966
195	DP750740
2	DP1091571
2	DP1105831
2	DP1120886
2	DP1187452
2	DP1227122
2	DP1253639
2	DP132931
2	DP244310
2	DP382987
2	DP512844
2	DP631136
2	DP746422
2	DP754975
2	DP876041
20	DP750740
207	DP750740
208	DP750740
21	DP750740
22	DP750740
22	DP750745
23	DP750768
24	DP750768
25	DP750745
26	DP750745
27	DP750745
28	DP750745
29	DP750745

Lot	Deposited Plan
3	DP1253547
3	DP1257054
3	DP132931
3	DP754975
30	DP750745
31	DP750745
32	DP750745
32	DP754977
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35	DP750740
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36	DP750745
36	DP750759
37	DP750745
38	DP750768
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4	DP1256557
4	DP132931
4	DP133873
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4	DP820719
41	DP750768
42	DP750745
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43	DP750740
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43	DP750772
44	DP750768
45	DP750772
46	DP750772

Lot	Deposited Plan
47	DP750768
47	DP754966
48	DP750745
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49	DP1115849
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57	DP750768
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59	DP750745
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6	DP750768
6	DP750772
61	DP750745

Lot	Deposited Plan
61	DP750768
62	DP750745
63	DP750745
63	DP754966
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69	DP750768
69	DP754966
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7	DP750745
7	DP750772
7001	DP1028400
7002	DP96946
7005	DP1026530
7005	DP1028425
7006	DP1028362
7006	DP1068801
7007	DP1068801
7013	DP1028426
7014	DP1028426
71	DP750768
73	DP750745
73	DP750768

Lot	Deposited Plan
74	DP750745
75	DP750745
76	DP750745
76	DP750772
76	DP754966
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78	DP754966
79	DP750740
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81	DP750740
81	DP750745
81	DP754966
82	DP750745
82	DP750768
82	DP754966

Lot	Deposited Plan
83	DP750740
83	DP750745
83	DP750768
84	DP750745
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88	DP750740
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88	DP754966
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90	DP750740
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91	DP750772
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92	DP754966
93	DP750745

Lot	Deposited Plan
94	DP750745
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95	DP750740
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96	DP750772
96	DP754966
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99	DP750740
99	DP750745
A	DP430321
176	750772
2	759014
7356	1179126
7308	1150970
1	759014
7306	1141903
7006	1068801

Certification

I certify that I have prepared the contents of this Environmental Impact Statement in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulations 2021.* To the best of my knowledge, this assessment contains all available information that is relevant to the environmental assessment of the development, activity or infrastructure, and that information in the EIS is neither false nor misleading.

Name:	Jon Williamson, *Project Director*
Address:	Level 3, 100 Pacific Highway, North Sydney NSW 2060
Professional qualifications:	Bachelor of Science (Marine) and Master of Environmental Science
Signature:	
Date:	28 April 2022

SUMMARY

Overview
UPC Renewables Australia Pty Ltd, operating as UPC\AC Renewables Australia, proposes to construct and operate the Valley of the Winds wind farm (the project) located close to the townships of Coolah and Leadville, and within the Warrumbungle Local Government Area. The wind farm site is located within the Central West Orana Renewable Energy Zone, recently legislated by the NSW Government to help meet its objective to achieve net zero emissions by 2050. The project would include a transmission line running generally south to its connection with the Central West Orana Renewable Energy Zone Transmission line, supplying over 800 megawatts of electricity into the National Electricity Market.

The project would involve the construction operation and decommissioning of up to 148 turbines across three clusters, that would be connected electrically (refer to **Project Layout Figure**). These are:

- Mount Hope cluster –76 turbines
- Girragulang Road cluster –51 turbines
- Leadville cluster –21 turbines.

Key infrastructure for the project would be:

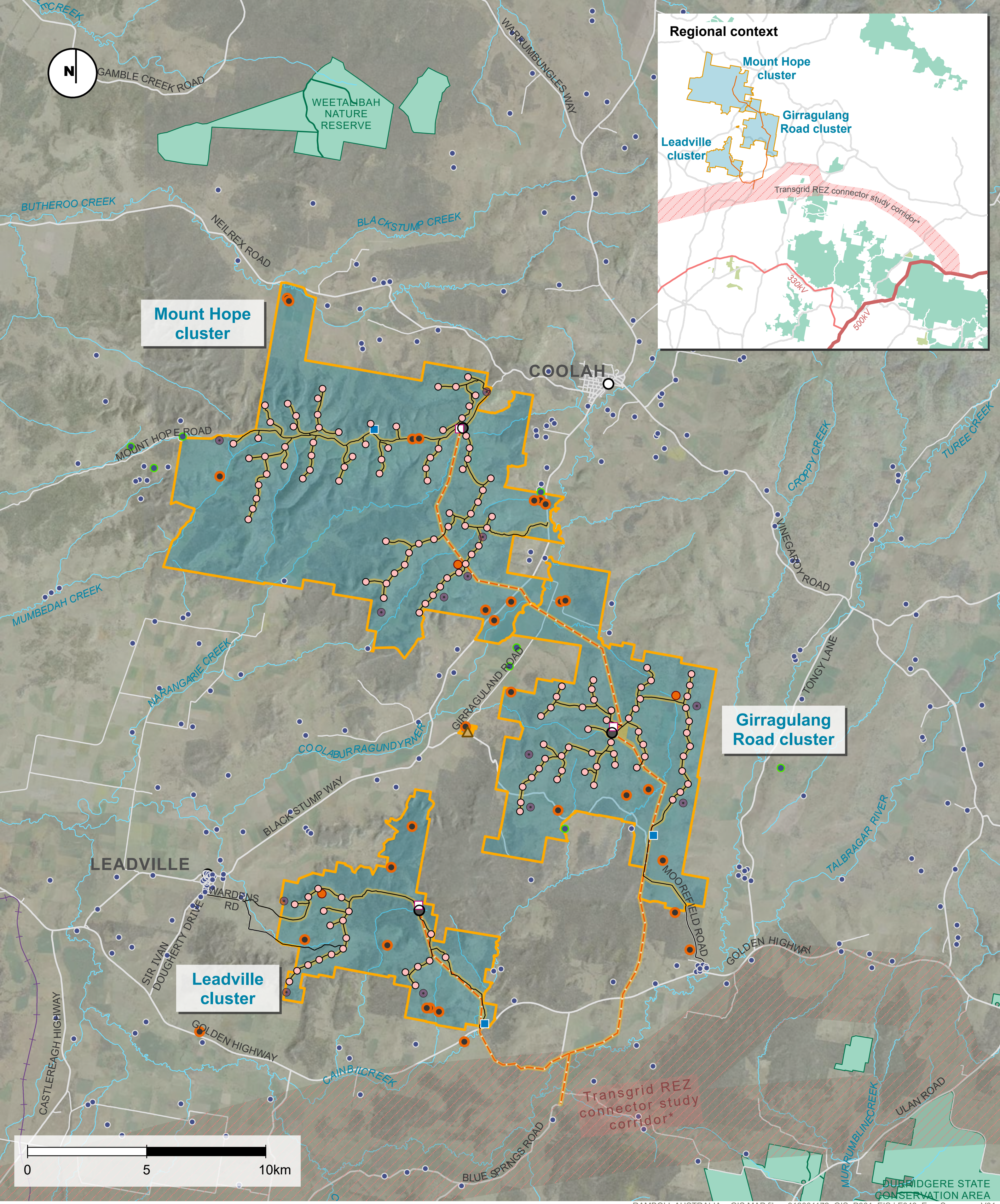
- up to 148 wind turbines with a maximum tip height of 250 metres and a hardstand area at the base of each turbine
- electrical infrastructure, including:
  - substations in each cluster and a step-up facility at the connection to the Central West Orana REZ Transmission line
  - where possible, underground 33 kilovolt electrical reticulation connecting the turbines to the substations in each cluster
  - overhead transmission lines (220 kilovolt or 330 kilovolt) dispatching electricity from each cluster
  - other electrical infrastructure as required including a potential battery energy storage system with a potential capacity of 320MW/640MWh
  - a high voltage transmission line (330 kilovolt or 500 kilovolt) connecting the wind farm to the Central West Orana Renewable Energy Zone Transmission line
- other permanent on-site ancillary infrastructure:
  - permanent operation and maintenance facilities
  - meteorological masts (up to thirteen)
- access track network:
  - access and egress points to each cluster from public roads
  - operational access tracks and associated infrastructure within each cluster on private property
- temporary construction ancillary facilities:
  - potential construction workforce accommodation on site
  - construction compounds
  - laydown areas
  - concrete batching plants
  - quarry sites for construction material (rock for access tracks and hardstands).

At the end of its practical life, the wind farm would be decommissioned, and the site returned to its pre-existing land use in consultation with the affected landholders.

The project is expected to require up to 400 full-time employees during peak construction and approximately 50 full-time employees during operation and ongoing maintenance of the wind farm.

The capital value of the project would be more than $30 million. Accordingly, the project is a State Significant Development under the *State Environmental Planning Policy (State and Regional Development) 2011*. This environmental impact statement has been prepared in accordance with Part 4 of the NSW *Environmental Planning and Assessment Act 1979* to support a development application to be lodged with the NSW Department of Planning, Infrastructure and Environment.

On 13 July 2020, a delegate of the Federal Minister for the Department of Agriculture, Water and the Environment determined that the project was a controlled action under section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* and therefore requires assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999*.



RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F040_ExecSummary_V01
Aerial photography from NSW Government Spatial Services

KEY

- Wind farm site
- Survey boundary
- Turbine location
- Access track
- Overhead transmission line
- Potential construction workforce accommodation
- Substation location
- Permanent operations and maintenance compound (also used during construction)
- Temporary construction compound
- Indicative quarry location
- Permanent meteorological mast location
- Host dwelling
- Associated dwelling
- Non-associated dwelling
- Railway
- National Parks and Reserves

*Approximate only

Project layout figure

Site selection and justification

On an international scale, the Valley of the Winds wind farm would help contribute towards meeting Australia's commitment under the 2015 UNFCCC "Paris Agreement", to reduce emissions by 26 to 28 per cent on 2005 levels by 2030. Aligning with Australian policy, the project would generate over 800 megawatts of electricity annually, which would contribute to achieving the aims set under Australia's Renewable Energy Target scheme through the generation of approximately one large-scale generation certificate for every megawatt hour of electricity generated by the project. As an 800-megawatt wind farm, the project could be expected to generate around two million large-scale generation certificates per annum.

In a more local context, several major energy generators in NSW will reach the end of their lifespan and are scheduled to be retired in the coming decades. Four out of the five operating coal-fired generators in the State are scheduled for retirement by 2035, approximately 5-gigawatt of baseload by 2030. By 2043, all five coal-fired generators operating are expected to retire
The project would contribute to security of the National Electricity Market through the generation of additional electricity to meet demand and helping to avoid a shortfall that is currently expected in NSW following the closure of the existing coal-fired generators.

The Australian Energy Market Operation released the second Integrated System Plan in July 2020 that provides a roadmap for the power system of eastern Australia to optimise consumer benefits and aims to reduce costs and uncertainty. The Draft Integrated System Plan 2022 was published on 10 December 2021 provides an update to the inputs, assumptions and scenarios that were considered in the 2020 plan. The Integrated System Plan prioritises Renewable Energy Zone developments in three overlapping phases. Renewable energy development in Central West Orana Renewable Energy Zone, where the project would be located, has been identified in as part of the first-priority phase.

TransGrid, in consultation with the NSW Government, have released a study corridor for the Central West Orana Renewable Energy Zone transmission line which runs approximately east-west, south of the wind farm site. The project is within the Central West Orana Renewable Energy Zone, and close to the proposed Central West Orana Renewable Energy Zone transmission infrastructure, highlighting the appropriate choice of location for the project and alignment with the market operator's thinking of where new generation capacity is likely to be located.

The project has been developed over a period of three years with site due diligence, preliminary investigations, detailed assessments and extensive consultation with key stakeholders having been conducted.

UPC\AC carried out assessments of a number of different sites through the identification of Valley of the Winds. The evaluation of site options and various layouts identified the site and proposed layout as being:

- a site with high quality wind energy potential
- gentle terrain that is well suited to the development of associated project infrastructure (such as electricity reticulation and substations) and allows for good access for both construction and operation
- a turbine layout that enables continuation of current farming practices with little disruption
- close to the proposed Central West Orana Renewable Energy Zone transmission line allowing a relatively short connection distance
- aligned with NSW and Federal strategic direction on emissions reduction
- allow for minimisation of environmental impacts where avoidance was not possible

- responsive to community and environmental considerations and constraints.

Project refinement

In response to ongoing consultation with the local community and the findings of ongoing environmental assessments throughout the environmental impact assessment preparation, there have been numerous refinements to the wind farm site, project layout and transmission infrastructure.

Since scoping phase, the number of turbines has been significantly reduced to avoid environmental and social impacts, as well as cumulative impacts relating to other major projects in the region. In addition to a number of project refinements, a location has been identified for a potential workforce accommodation area in response to concerns around accommodation availability for the peak construction workforce within surrounding townships.

Cumulatively, these refinements have enhanced the functionality of the project whilst addressing community concern.

Consultation

UPC\AC developed a community and stakeholder engagement plan that outlines the consultation objectives and implementation throughout all phases of the project from development to decommissioning. This plan will continue to be implemented following submission of the environmental impact statement and if approved, through the construction, operation and decommissioning of the project.

Key consultation and engagement with landowners, near neighbours, the wider community, government agencies; and other relevant stakeholders during the preparation of this environmental impact statement has included:

- establishment and operation of a dedicated project website, Facebook page, project email address and community information phone line
- numerous phone calls, emails and face-to-face meetings including meetings with Council and government departments, infrastructure hosts, neighbouring landholders and importantly the wider regional community
- community information drop-in sessions and group meetings including stands at a number of town shows in the region
- distribution of fact sheets, flyers and letters to community as well as publications in the local newspapers, paid advertisements and radio
- targeted community consultation to support the development of the social impact assessment
- consultation with registered Aboriginal parties during preparation of the Aboriginal Cultural Heritage Assessment Report
- Meetings with local and industry special interest groups throughout the region.

Environmental assessment

<u>Landscape character and visual</u>

The project layout has a substantially smaller footprint and refined layout to those previously considered and has gone through a range of iterations to limit environmental and amenity impacts, including visual impacts. Key features of the existing landscape including large areas of vegetation on ridgelines and grazing paddocks, undulating topography, roadside vegetation and riparian vegetation associated with rivers and creek lines would assist in reducing the visual impact of the project.

A visual impact assessment for the project found a total of 112 non-participating dwellings within the blue line of visual magnitude (4,950 metres of the nearest turbine). Of those, 42 are located within the black line of visual magnitude (3,350 m from the nearest wind turbine). It should be noted that approximately 70% of these are currently believed to be lived in.

Representative assessments were undertaken for 61 of the 112 non-associated dwellings within 4,950 metres of the nearest wind turbine. For various reasons access was unable to be obtained at some non-associated dwellings. The results were:

- For non-associated dwellings within 3,350 metres of the nearest turbine:
  - Six (6) rated as nil / negligible visual impact rating
  - 19 rated as having a low visual impact rating
  - 14 were assessed as having a moderate visual impact rating
  - Three (3) were assessed as having a high visual impact rating
- For non- associated dwellings within 3,350 - 4,950 metres of the nearest turbine:
  - 18 were assessed as having nil / negligible visual impact rating
  - 13 were assessed as having a low visual impact rating
  - 15 were assessed as having a moderate visual impact rating
  - Zero (0) were assessed as having a high visual impact rating.

Numbers above do not include 24 non-participating linked dwellings associated with Leadville. An assessment has been undertaken from representative non-participating Dwelling 154, which was rated as having a moderate visual impact. It is worth noting the representative dwelling selected was based on a worst-case scenario on the eastern side of the township. Existing built form and vegetation within the township is likely to screen views from most dwellings within the township, resulting in a generally low visual impact from dwellings associated with the Leadville township.

Specific consultation is well progressed with the landholders of non-associated dwellings identified as having a high or moderate visual impacts. It is expected that prior to public exhibition of the EIS, agreements will be in place with a number of these landholders.

A further five non-associated dwellings in excess of 4,950 metres were assessed due to being identified as having potential views of turbines associated with the project and Liverpool Range Wind Farm. The assessment found the impacts related to the project to be negligible.

Practical and feasible mitigation measures have been proposed for each of the non-participating dwellings with a moderate visual impact rating. The proposed mitigation measures would assist in significantly reducing negative impacts resulting from these dwellings.
A viewpoint analysis to determine the visual influence of the project was prepared across 41 public locations. Of the 41 viewpoints assessed, a total of 39 viewpoints were rated as low and two viewpoints were rated as Moderate. These viewpoints are located on Mount Hope Road, Coolah and Wardens Road, Leadville. Views from these viewpoints will be fleeting given the nature of the public road and the roadside vegetation. No public viewpoints were rated as high.

<u>Noise and vibration</u>
Noise and vibration impacts of the project were assessed relating to the construction, operation and decommissioning phases. 57 noise sensitive locations (sensitive receivers) were identified within three kilometres of the project. Noise agreements have been formalised between the landowners and UPC\AC at 22 of these receivers (associated dwellings).

35 non-associated receivers have been assessed with the closest being 2,026m to nearest turbine. An assessment was undertaken using three turbine models. The predicted noise levels from the project have been assessed to be below the NSW Noise Assessment Bulletin base (minimum) criterion of 35 dB LAeq at all of the assessed non-associated receivers for two of the assessed turbine models. For the other turbine model, predicted noise levels would be 35.2 dB at one non-associated receiver.

With design consideration of these results the assessment indicates that the project could be designed and operated to comply with the operational noise requirements of the NSW Noise Assessment Bulletin.

The EIS includes extended working hours for the construction of the project, however a commitment has been made that with the hours of extension outside of the standard hours works stipulated by the Interim Construction Noise Guideline will be inaudible at sensitive receptors. Therefore, the assessment of the construction noise has been undertaken assuming standard construction hours. These are Monday to Friday 7am to 6pm; Saturday 8am to 1pm; and no work on Sunday or public holidays.

Proposed extended working hours of the project would maintain flexibility for large concrete pours and curing cycles and reduce the overall construction program. High noise level activities, such as those involving noisy machinery, would be deferred to standard working hours where possible.

The predicted noise levels during construction indicate some exceedances above management measures for the nearest non-associated receivers, generally located at the entrance of access roads to each wind farm cluster, during the construction of access roads. Exceedances above the management levels are not unique to this project and are characteristic of most construction noise impact assessments and typical for the construction of a wind farm.

Biodiversity

The project was referred to the Commonwealth Minister for the Environment in 2020, and was declared a controlled action due to potential impacts primarily to Box Gum Woodland CEEC (Referral 2020/8668).

An assessment of the potential impacts on biodiversity impacts from the project included an assessment of a 500m buffer around the construction and operation footprint. This buffer allows flexibility during the detailed design phase whilst allowing the assessment of a very worst case scenario.

Nine plant community types (PCTs) were recorded within the study area totalling 6,448 hectares. This includes:

- PCT 42 - River Red Gum / River Oak riparian woodland wetland in the Hunter Valley
- PCT 84 - River Oak-Rough-barked Apple-red gum-box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion
- PCT 272 - White Box -Black Cypress Pine -red gum +/-Mugga Ironbark shrubby woodland in hills of the NSW central western slopes
- PCT 281 - Rough-Barked Apple -red gum -Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion
- PCT 461 - Tumbledown Gum woodland on hills in the northern NSW South Western Slopes Bioregion and southern Brigalow Belt South Bioregion

- PCT 478 - Red Ironbark -Black Cypress Pine -stringybark +/-Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong -Mendooran region, southern Brigalow Belt South Bioregion
- PCT 479 - Narrow-leaved Ironbark-Black Cypress Pine -stringybark +/-Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion
- PCT - 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley
- PCT - 616 Grey Myrtle -Rusty Fig dry rainforest in sandstone gorges of the upper Hunter Valley, mainly Sydney Basin Bioregion

An assessment of significance was completed for all MNES known or likely to be impacted by the project. Assessments concluded that the only MNES likely to be significantly impacted is White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland due to the permanent removal of 64.23 hectares of this CEEC.

Although significant project refinements with the ultimate goal of minimising the projects biodiversity impact have been undertaken where possible, offset of those project impacts will be necessary. These offsets equate to a total of 8,966 ecosystem credits and 19,688 species credits.

The project has been designed to avoid and minimise impacts and is predominately located in areas of low or no biodiversity value. The residual impact of the proposed development requires 8,966 ecosystem credits and 19,688 species credits. The project commits to surveying land that was not accessible at the time of the assessment and provides a conservative assumption and assumed presence of species credit species that results in additional credit liability.

<u>Traffic and transport</u>
The goal of the traffic assessment was to minimise traffic associated with the wind farm on public roadways. Numerous iterations of access routes and locations have been preliminary assessed with the final design of a single point of access for the Over Size Over Mass (OSOM) deliveries into each cluster having gone through the detailed assessment.

Traffic surveys were undertaken on 9 June 2021 at six key intersections in June 2021. The assessment incorporated two scenarios for light vehicle access routes also included an assessment of the logistical requirements of transporting large components to the project site from the Port of Newcastle and consideration of oversize over mass (OSOM) vehicle turning movements and any potential upgrades to local roads and intersections to accommodate the required swept paths. The project would generate the greatest traffic and transport impacts during the construction peak period for the Mount Hope cluster, as it has the most turbines. The project anticipates construction traffic volumes in the way of 72 heavy vehicle trips per day and 506 light vehicles per day if the construction workforce is distributed regionally. In the scenario where a construction workforce accommodation is utilised as part of the project, it is forecast that only 128 light vehicle trips per day would be generated to transport construction staff.

The worst case scenario has been assessed showing traffic increases during the construction period compared the current form indicate that eight upgrades (widening and strengthening of the pavement) would be required for:

- Short Street, Turee Street, Main Street, Wyaldra Street, Moorefield Road, Wardens Road, The Leadville Stock Route and Mount Hope Road.

Intersection upgrades would be required to cater for OSOM vehicles at the following intersections:

- Black Stump Way / Mount Hope Access Road
- Turee Street / Main Street
- Wyaldra Street / Moorefield Road
- Golden Highway / Black Stump Way
- Golden Highway / Leadville Access Road
- Golden Highway / Short Street

Traffic generation during the operational phase of the project is forecast to be much less than the construction phase, with approximately 50 operational staff forecast to generate about 100 daily light vehicle trips, consisting of 50 cars entering the site during AM peak hour and 50 cars exiting the site during the PM peak hour, with no ride sharing amongst the staff.

Hazards and risks

The Hazards and Risks chapter considers health and safety related impacts potentially arising from the following subsections:

Aviation

The project is located close to the certified Coolah Airport (YCAH), which is approximately 3.24 nautical miles (six kilometres) north from the nearest Wind Turbine (MH39). Coolah Airport is a certified Code 2 non-instrument airport, operated by Warrumbungle Shire Council. The wind farm site is beyond 30 nautical miles (55.56 kilometres) of any other certified airports. There are three aircraft landing areas (ALAs) located within three nautical miles of the proposed wind turbines. These are:

- Coolah ALA, Ozton
- Tongy ALA
- Unknown ALA 1.

The project is also located within Danger Area D538B and a Restricted Area R559B associated with Military Flying Training operated by No 453 Squadron at RAAF Base Williamtown. Military flying in this area is restricted from the ground surface up to 10,000 feet (3048 metres) above mean sea level.

The impact assessment found that Coolah Airport would not be impacted by the project. It is also unlikely that the project will impact on circuit operations and approach and take-off surfaces at the three nearby ALAs. Mitigation measures are proposed that would limit the impacts of wake turbulence effects on aircraft in the circuit area of Coolah ALA and Ozton Tongy ALA. The risks associated with military flying training within Danger Area D538B can be managed with the measures described and ongoing consultation with Department of Defence.

Telecommunications

The assessment of impacts identifies the existing radio, telecommunications and communications systems already operating within the region. It also provides an assessment of the potential impacts and interference effects that may be caused by the Project. There is the potential for large structures, including wind turbines, to introduce interference when they occur close to or within the signal path. The assessment found that dwellings in the vicinity of the project may experience interference to digital television broadcast signals from two of the nearby towers, although coverage maps suggest that dwellings within these interference zones may not be receiving signal from these towers in the existing conditions. Existing weak mobile phone services may be susceptible to interference, but the overall likelihood of interference is considered low and there are a range of options available to rectify difficulties. Potential impacts to other services considered in the assessment including wireless internet, broadcast radio and trigonometrical stations are considered minor.

Human health

An electromagnetic field is a physical field produced by a moving electric charge that consists of both and electric field component and a magnetic field component. Electromagnetic field associated with the generation, distribution and use of electricity is classified as extremely low frequency electromagnetic field. Short term exposure to very high levels of EMF can be detrimental to human health. The risks to human health from electromagnetic field associated with the project are considered low. Simulations of the electromagnetic field produced from the proposed medium voltage underground cabling has shown that the electromagnetic field at ground level would be within exposure limits recommended for the protection of the general public. The electromagnetic field levels produced by the project are within the recommended exposure limits at all publicly accessible locations in and around the wind farm site

Bushfire

The wind farm site is located within the Castlereagh Bushfire Management Committee region. Historically, the Castlereagh Castlereagh Bushfire Management Committee region has experienced an average of 80 bushfires per year with an average of three major fires a year. The most recent and significant fire in the region (Sir Ivan fire) was triggered by a lightning strike on 11 February 2017. This fire burnt approximately 55,0000 hectares of remnant vegetation and agricultural land including land surrounding the Leadville and Girragulang Road clusters.

The key bushfire hazards and the associated risk levels for an unmitigated scenario have been determined for the project finding that risk to life and safety and project infrastructure are at the highest overall. Due to the inherent fire safety construction for industrial use facilities, the design and materials of the project would be somewhat resilient to the impacts of bushfire. Bushfire risk can be managed with the measures inherent to the project and those that are specific to the protection of life and safety from bushfire in accordance with the NSW Rural Fire Service policy Planning for Bushfire Protection 2019 including maintenance of asset protection zones and the provision of a dedicated water supply within each of the clusters and at the potential construction workers accommodation.

Blade throw

Blade throw refers to an incident in which a structural failure in the blade of a wind turbine occurs during operation and results in parts of the blade detaching and being thrown into the surrounding area. The detachment of the entire blade or a portion of the blade has been assessed to simulate a catastrophic failure or worst case scenario.

For the project, the maximum throw distance for an entire blade at a maximum rotor speed is 250 metres. There are no dwellings or other sensitive locations within 250 metres of the proposed turbine locations. All dwellings are more than 860 metres from the nearest proposed turbine location, which is 610 metres beyond the expected maximum throw distance for an entire blade.

Battery storage

A preliminary hazard analysis was prepared to consider and assess the potential hazards and risks posed by the project and the management measures proposed to address these potential hazards and risks in accordance with the requirements of *State Environmental Planning Policy (Resilience and Hazards) 2021* (Resilience and Hazards SEPP).

The preliminary hazard analysis identifies the hazardous materials to be stored on and transported to the study area and consideration of the applicable Resilience and Hazards SEPP threshold. The analysis shows that none of the Resilience and Hazards SEPP threshold levels are predicted to be exceeded during any phase of the project and therefore the BESS infrastructure would not be a potentially hazardous development. The management measures to be implemented as part of the project would further minimise the potential impacts from these materials.

Aboriginal heritage

An aboriginal cultural heritage assessment report was prepared for the project. A field assessment of the survey area was undertaken by a team of OzArk Senior Archaeologists and heritage specialists over a program which equated to three weeks on site due to having two independent teams in week 1. The dates of the surveys are:

- Week 1: Monday 17 May to 21 May 2021
- Week 2: Monday 24 May to 28 May 2021.

A one-day site inspection was also completed on 31 August 2021 to ground-truth areas added to the project through the project refinement stages, following the initial survey that was completed in May, or where access was not granted at the time of the initial survey. The location of one previously recorded AHIMS site known site at Cainbil Creek. (36-3-0111) was ground-truthed during an additional survey undertaken in December 2021. An additional day of survey was completed on 19 April 2022 to assess areas within the Mount Hope and Leadville clusters that were not previously accessible as well as land surrounding proposed intersection upgrades.

Five new Aboriginal sites were identified and two previously recorded sites were identified within the survey area. These include:

- Orana OS-1
- Old Farm OS-1
- Kensington OS-1
- Cainbil Creek OS-1
- The Rock IF-1
- Argyll No.1
- Argyll No.3.

Of the six Aboriginal sites, one has been avoided by the project through the exclusion of a turbine. The remaining sites can be avoided through the implementation of the environmental exclusion zones and a formal survey of unassessed areas within the survey boundary by archaeologists and representatives from Aboriginal parties post approval.

Refinement to the road design has allowed Cainbil Creek OS-1 PAD to be avoided completely, however, the site extent cannot be avoided entirely. This site has low to moderate archaeological value, low aesthetic value, high cultural value and social significance. The project commits to artefact collection and fencing to protect unimpacted portions of the site during construction.

<u>Historic heritage</u>
A field assessment of the study area was undertaken concurrently with the survey for the ACHAR. During the survey, four historic heritage items were recorded within the survey boundary. These include:

- Mt Hope-HS01
- The Rock-HS01
- The Rock-HS02
- Collier Creek-HS01.

No areas that are likely to contain significant archaeological deposits of conservation value were identified within the survey boundary. The four identified historic items have been assessed as having no significant historic values under the current Heritage NSW guidelines and the Burra Charter. While none of the recorded historic heritage items have significant heritage values, all items will be avoided by the project.

<u>Water and soils</u>
Coolaburragundy River is the major watercourse in the area and traverses between the Mount Hope cluster and the Girragulang Road cluster (excluded from the wind farm site). It is a perennial stream that is part of the Murray–Darling basin, rising from the south-western slopes of the Liverpool Range, flowing south-west before reaching its mouth at the confluence with the Talbragar River near Leadville.

Given there is no significant increase to impervious areas within the wind farm site, changes to hydrological flows are expected to be negligible. The project will not involve any controlled discharges to the surrounding watercourses. All wastewater will be removed from the site via truck.

Given the depth to groundwater (expected to be 10 metres below ground level or greater) impact on groundwater levels, quantity or quality from the project is expected to be negligible. The significant differences between existing groundwater levels and proposed infrastructure implies that construction of deep foundations could occur with minimal impact on groundwater.

Some soils across the wind farm site have high erosion potential. Specific management measures would address areas of high erosion potential during both construction and operational phases of the project and will be documented in an Erosion and Sediment Control Plan and implemented in accordance with Managing Urban Stormwater: Soils and Construction.

<u>Waste and resources</u>
The project would produce various waste streams during the construction and decommissioning phases. Minor quantities of waste would also continue to be generated by the operation of the project. Most waste generated by the project would be classified as non-putrescible general solid

waste. Ancillary facilities in the site compound would also produce sanitary wastes classified as putrescible general solid waste. The majority of the project components are able to be reused or recycled in accordance with resource management hierarchy principles.

Although the large majority of the componentry within the wind turbine can be easily recycled (steel towers etc.) there are currently no economically feasible methods to recycle retired wind turbine blades in Australia due to the complex dismantling process that is required to separate the materials. This is a global issue in a range of industries, not just the wind energy sector. UPC\AC will consider reasonable and feasible alternative disposal methods based on the industry standards at the time of decommissioning. New technologies have recently been announced overseas that would work towards making a whole wind turbines fully recyclable by 2040. This would be well in advance of the decommissioning phase of the project.

Strategies for waste management would be considered by the contractor as part of its construction environment management plan in consultation with regional waste management facilities.

Social

The project is located within the Warrumbungle Shire Local Government Area, south of the township of Coolah and adjacent to the localities of Leadville and Uarbry. The social impact assessment included establishment of a social baseline through the collection of information from desktop analysis of demographic data as well through an impartial and participatory engagement process, undertaken independently of the project EIS engagement activities.

Perceived positive and negative impacts of the project identified through the social impact assessment consultation cover a range of social impact categories and reflect the fears and aspirations of the stakeholders consulted. In summary, the fears and aspirations identified through the research related to the following categories:

- visual Landscape
- social amenity
- sense of community and culture
- land use change and conflict
- access to and use of infrastructure and services
- economic contributions and sustainability
- intergenerational equity
- cumulative impacts
- health and wellbeing

This project provides a real opportunity for Coolah and surrounds to achieve increased community resilience and improved access to services, employment and economic stimulus. For this benefit to be realised, it is important that the economic stimulus is distributed in an equitable way, and directly to the towns and villages that will experience the greatest change as a result of this project, including Coolah, Leadville, Uarbry and Dunedoo.

The results of the SIA have allowed a number of mitigation measures to be either incorporated into the projects design or committed to during the operational phase of the project. The intention of these strategies is to maximise the benefits to the local communities and minimise negative impacts.

To successfully achieve this goal, it’s imperative that ongoing and open communication is facilitated between all parties and stakeholders involved.

Economic

The average annual construction effects of the project on the regional economy are estimated at between:

- $274M and $284M in annual direct and indirect output
- $109M and $115M in annual direct and indirect value-added
- $41M and $43M in annual direct and indirect household income
- 518 and 569 direct and indirect jobs.

Foregone agriculture as a result of the project is expected to be <0.26% of total agricultural economic activity in the region. While there is a loss of potential agricultural activity to the region, this is a private economic decision by the landholders for which they are compensated. The regional economic activity impacts of potential foregone agricultural activity are minor and significantly less than those of the construction and operation of the project. Therefore, as well as increased benefit to the private landholders, in terms of economic activity, the regional economy would also be better-off.

Impacts on agricultural activity are for the term of the project and would not impact the capability of the land for future agricultural production. UPC\AC will work in partnership with Warrumbungle Shire Council and the local community to help maximise the projected regional economic benefits whist minimising any impacts. Some schemes to achieve this have already been initiated and include:

- employment of regional residents preferentially where they have the required skills and experience and can demonstrate a cultural fit with the organisation
- participating, as appropriate, in business group meetings, events or programs in the regional community
- locally sourcing non-labour inputs to production where local producers can be cost and quality competitive, to support local industries.
- Voluntary Planning Agreement with Warrumbungle Shire Council
- Neighbouring property benefits scheme.

Other issues

Other issues included impacts on land use, air quality and climate change and greenhouse gasses. The impacts were found to be negligible and were considered non key issues as prescribed by the SEARs.

Cumulative

Other developments in the vicinity of the project were considered to assess potential cumulative impacts. The projects identified for assessment were considered relevant to the project based on proximity, type of development, size of the construction and or operational workforce and project timing. The projects include other renewable energy projects, large scale mines and other infrastructure projects. The potential combined cumulative impacts include visual, traffic, noise, biodiversity, social, air quality and land use impacts. Identifying these impacts at an early stage has informed significant design refinements throughout the project development.

The project specific mitigation measures have been developed in consideration of cumulative impacts and are considered appropriate to satisfactorily address the potential combined effects of other surrounding developments.

Justification and conclusion

The environmental assessment undertaken for the project has determined that it would not result in significant impacts to environmental, cultural, social and economic values. The residual impacts, albeit minimised throughout the design refinements, will be managed with the implementation of the thorough and appropriate mitigation measures proposed. Furthermore, the project is consistent with the principles of Ecologically Sustainable Development, and the objectives of the NSW Environmental Planning and Assessment Act 1979.

The project forms an important part of Australia's transition to renewable energy generation and would positively contribute towards meeting Commonwealth and NSW government targets. The project would enhance the reliability and security of electricity supply by contributing towards bridging the anticipated supply gaps that would result following the closure of over 7000 megawatts of major coal-fired power generators within NSW in the coming ten to fifteen years. Noting that with recent announcements, the expected timeline could be shortened.

There are numerous State, Federal and international agreements and strategic documents that provide the context and justification for why the development of the project is justified, including:

- The 2015 UNFCCC "Paris Agreement"
- The Federal Government's Renewable Energy Target scheme
- The AEMO 2020 Integrated System Plan
- NSW Net Zero Plan Stage 1: 2020-2030
- NSW Renewable Energy Action Plan 2013 and NSW Renewable Energy Action Plan Completion Report 2018
- NSW Electricity Strategy 2019
- NSW Electricity Infrastructure Roadmap 2020 and associated NSW legislation.

The proposed development is also supported by and consistent with strategic planning policies and agreements at a local level. Furthermore, given the location of the project within the Central West Orana Renewable Energy Zone it is clear that the proposed development is highly consistent with the NSW Government's plans for development in the wider region and with the emerging land use for renewable energy generation.

The project commitments relating to coordinated management plans for construction, operation and decommissioning of the project and ongoing engagement with the proponents of nearby projects within the Central West Orana Renewable Energy Zone, are expected to reduce the cumulative impacts of the project.

Should the project not proceed it would be more difficult for the Commonwealth and NSW Governments to achieve their respective renewable energy and greenhouse gas emission reduction targets, while the future security of electricity supply in NSW would be weakened. Furthermore, the significant project benefits to the region described within the EIS would not be realised.

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GLOSSARY

Term / Abbreviation	Definition
AHIMS	Aboriginal Heritage Information Management System
AERSCREEN	US EPA recommended screening-level air quality model based on the AERMOD model.
Associated dwellings / associated properties	Dwellings or properties on which the wind turbines, or the transmission line, are located.
ACMA RRL	Australian Communications and Media Authority Register of Radiocommunications Licences
AMSL	Above mean sea level
ATSIHP Act	Aboriginal and Torres Strait Islander Heritage Protection Act 1984
BAM	Biodiversity Assessment Methodology
BC Act	*Biodiversity Conservation Act 2016*
Battery energy storage system	A technology developed for storing electric charge by using specially developed batteries
Construction access tracks	Vehicle access tracks for construction and delivery of plant and equipment on private property.
Girragulang Road	Cluster east of Black Stump Way and Girragulang Road, south of Coolah
Heritage Act	*Heritage Act 1977*
LALC	Local Aboriginal Land Council
Leadville	Cluster north of Golden Highway and east of Leadville township
Micrositing	Refers to the process of determining the type of wind turbine and its exact position.
Non-associated dwellings / non-associated properties	Dwellings or properties that are potentially impacted by the proposed wind farm and on which wind turbines or transmission line are not located i.e. indirectly affected by the proposed development.
NPW Act	*National Parks and Wildlife Act 1974*
NRM	National Resource Management
NSW EPA	New South Wales Environmental Protection Authority
Operational access tracks	Vehicle access tracks for operations and maintenance on associated properties.
OSOM	Over size and over mass
PCTs	Plant community types
POEO Act	Protection of Environment Operations Act 1997
Project	Refers to the total area of the proposed Valley of the Winds wind farm, including the wind farm and the transmission line.
Proponent	UPC-AC Renewables (abbreviated to 'UPC\AC')
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
TECs	Threatened ecological communities
The Bulletin	NSW Wind Energy: Visual Assessment Bulletin

Term / Abbreviation	Definition
The preliminary noise report	Preliminary noise modelling was prepared by Marshall Day as part of a preliminary noise assessment for the project
the Noise Assessment Bulletin	NSW Wind Energy: Noise Assessment Bulletin
Transport routes	Public roads that are to be used for delivery of plant and equipment (eg rotor blades)
TxL	Transmission Line
Wind farm site	The wind farm site boundary corresponds with the outer boundary of properties upon which the proposed Valley of the Winds wind farm is located. The wind farm site is made up of three separate wind turbine clusters.

ACRONYMS

Abbreviation	Definition
ACHAR	Aboriginal Cultural and Heritage Assessment Report
ACHRs	*Aboriginal Cultural Heritage Consultation Requirements for Proponents.*
ACMA	Australian Communications and Media Authority
ADGC	Australian Dangerous Goods Code
AGL	Above ground level
AHD	Australian Height Datum
AHMP	Aboriginal heritage Management plan
ALA	Aircraft landing area
APZ	Asset Protection Zone
ASS	acid sulfate soils
BAM	Biodiversity Assessment Method
BDAR	Biodiversity development assessment report
BEMOP	Bush Fire Emergency Management and Operations Plan
BESS	Battery energy storage system
BFMC	Bushfire Management Committee
BSAL	Biophysical strategic agricultural land
CAAP	Civil Aviation Advisory Authority Publications
CASA	Civil Aviation Safety Authority
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CLM Act	Contaminated Land Management Act 1997

Abbreviation	Definition
CFIT	Controlled flight into terrain
CWO-REZ	Central West Orana Renewable Energy Zone
DAWE	Department of Agriculture, Water and the Environment
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment
DPE	Department of Planning and Environment
DECCW	Department of Environment, Climate Change and Water
DG	Dangerous goods
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
ELF	Extremely low frequency
EMI	Electromagnetic interference
EMI	Electromagnetic Interference
ENA	Energy Networks Associations
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environmental Protection Licence
EP&A Act	*Environmental Planning and Assessment Act 1979*
FM Act	*Fisheries Management Act 1994*
GHG	Greenhouse gas
GDE	Groundwater-dependent ecosystem
HHMP	Historical heritage management plan
HIS	Heritage impact statement
HVAC	Heating ventilation air conditioning
ICNIRP	International Commission on Non-Ionizing Radiation Projection
IPA	Inner Protection Area
KFH	KFH key fish habitat
LEP	Local Environmental Plan
LGA	Local Government Area
LCU	Landscape character units
LSALT	Lowest safe altitude
LVIA	Landscape character and visual impact assessment
MOC	Minimum obstacle clearance
MNES	Matter of National Environmental Significance

Abbreviation	Definition
NEM	National Energy Market
NES	NSW Electricity Strategy
NHMRC	National Health and Medical Research Council
NBN	NBN Co Limited
NVR Map	Native Vegetation Regulatory map
OEH	Office of Environment and Heritage
OLS	Obstacle Limitation Surface
OSOM	Over size over mass
PBP	Planning for Bushfire
PHA	Preliminary hazard assessment
RFS	Rural Fire Service
RRL	Register of Radiocommunications Licences
SEPPs	State Environmental Planning Policies
SEPP 33	*State Environmental Planning Policy No. 33: Hazardous and Offensive Development*
WARR Act	*Waste Avoidance and Resource Recovery Act 2001*
WMT	Wind monitoring towers
WRP	Macquarie–Castlereagh Water Resource Plan (2019)
YCAH	Coolah Airport
YCBB	Coonabarabran Airport
YSDU	Dubbo Airport
YSCO	Scone Airport
YMDG	Mudgee Airport
YQDI	Quirindi Airport

1. INTRODUCTION

1.1 Project overview

UPC Renewables Australia Pty Ltd, operating as UPC\AC Renewables Australia (UPC\AC) (the Proponent), proposes to construct and operate the Valley of the Winds wind farm (the project).

The project would consist of up to 148 wind turbines and supporting infrastructure, including a high voltage transmission line which would run approximately 13 kilometres from the Girragulang Road cluster to a connection point with the Central West Orana REZ Transmission line proposed by the NSW Government. The project would supply over 800 megawatts (MW) of electricity into the National Electricity Market (NEM).

The wind farm would be located close to the townships of Coolah and Leadville, with the transmission line running generally south to its connection with the Central West Orana REZ Transmission line. The project would be entirely within the Warrumbungle Local Government Area (LGA).

The project would involve the construction, operation and decommissioning of three clusters of wind turbines, that would be connected electrically. These are:

- Mount Hope cluster – 76 turbines
- Girragulang Road cluster – 51 turbines
- Leadville cluster – 21 turbines.

The project includes the following key components:

- 148 wind turbines with a maximum tip height of 250 metres and a hardstand area at the base of each turbine
- Electrical infrastructure, including:
    - substations in each cluster and a step-up facility at the connection to the Central West Orana REZ Transmission line
    - where possible, underground 33 kilovolt electrical reticulation connecting the turbines to the substations in each cluster
    - overhead transmission lines (up to 330 kilovolt) dispatching electricity from each cluster
    - other electrical infrastructure as required including a potential battery energy storage system (BESS) with a capacity of 320MW/640MWh
    - a high voltage transmission line (up to 500 kilovolt) connecting the wind farm to the Central West Orana REZ Transmission line
- Other permanent on-site ancillary infrastructure:
    - permanent operation and maintenance facilities
    - meteorological masts (up to thirteen)
- Access track network:
    - access and egress points to each cluster from public roads
    - operational access tracks and associated infrastructure within each cluster on private property
- Temporary construction ancillary facilities:
    - potential construction workforce accommodation on site
    - construction compounds
    - laydown areas
    - concrete batching plants
    - quarry sites for construction material (rock for access tracks and hardstands).

At the end of its practical life, the wind farm would be decommissioned, and the site returned to its pre-existing land use in consultation with the affected landholders.

The project is expected to require up to 400 full-time employees during peak construction and approximately 50 full-time employees would be required during operation and ongoing maintenance of the wind farm.

The capital value of the project would be more than $30 million. Accordingly, the project is a State Significant Development (SSD) under the *State Environmental Planning Policy (State and Regional Development) 2011* (SEPP SR&D) and is being assessed under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The project was also referred to the Commonwealth Department of Agriculture, Water and the Environment for potential impacts to matters of national environmental significance protected by the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

On 13 July 2020, a delegate of the Federal Minister for the Department of Agriculture, Water and the Environment determined that the project was a controlled action under section 75 of the EPBC Act and therefore requires assessment and approval under the EPBC Act. This assessment has been undertaken under the *Amended Bilateral Agreement* between the Australian Department of Agriculture, Water and the Environment and the New South Wales Department of Planning, Industry and Environment.

1.2 Project location and context

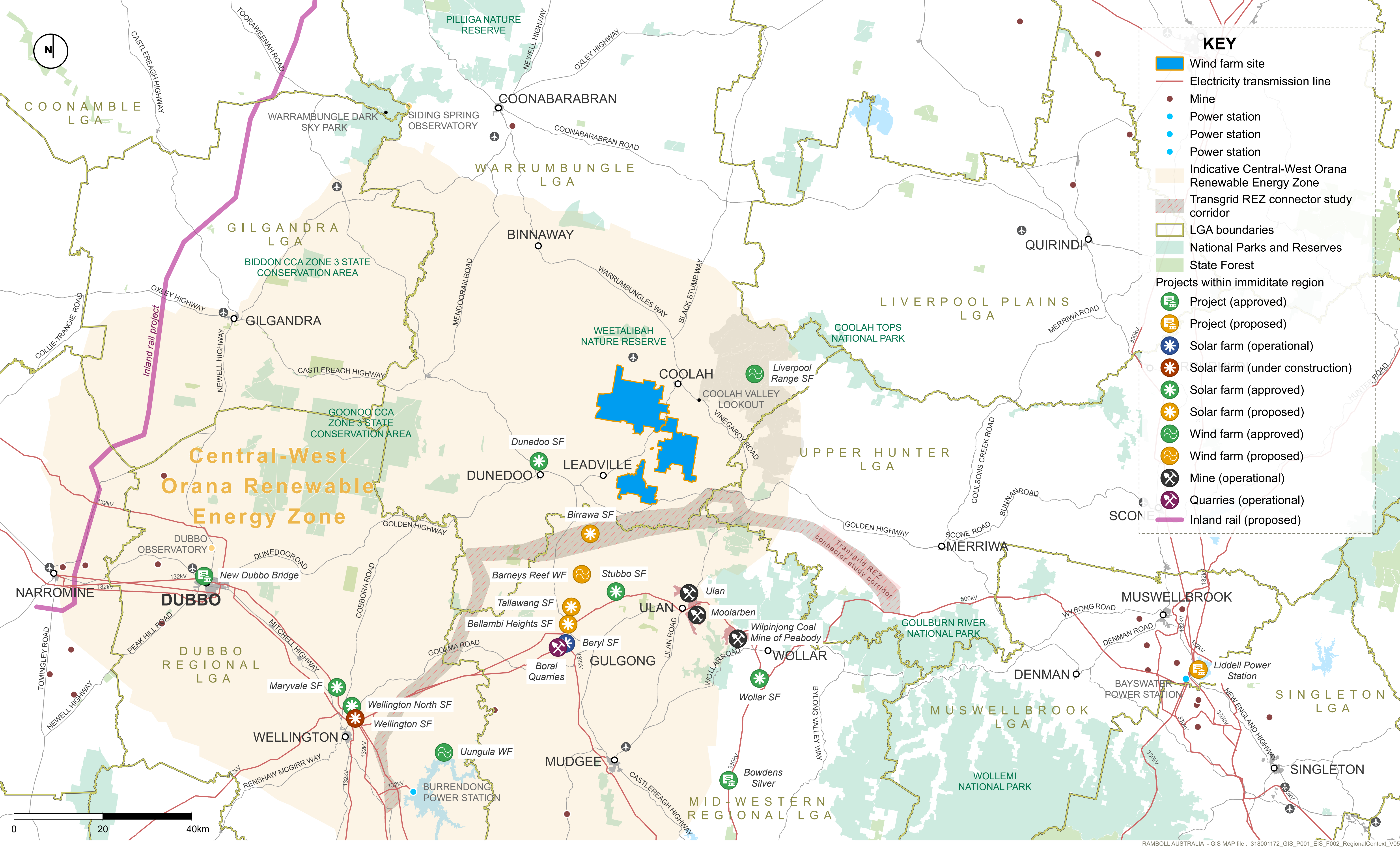
1.2.1 Regional context

The proposed wind farm site is located within the Central West Orana Renewable Energy Zone (CWO-REZ) south of the township of Coolah, in the Warrumbungle Shire Council Local Government Area (LGA), in Central West NSW (**Figure 1-1**). The site is approximately 280 kilometres inland from Newcastle and approximately 400 kilometres northwest of Sydney.

Major sources of employment in the broader region reflect the predominately rural nature of the area and include agriculture, education, mining, equine, viticulture, and retail.

Natural and built features that characterise the regional context of the wind farm site include:

- Coolah Tops National Park – approximately 30 kilometres to the northeast
- Warrumbungle National Park – approximately 70 kilometres to the north / northwest
- Goulburn River National Park – approximately 20 kilometres southeast
- other state conservation areas to the south of the site
- coal mining within the Mid-Western LGA – Ulan Coal, Moolarben Coal Complex, and Wilpinjong Mine located south of the project
- equine and viticulture industries in the Upper Hunter LGA with viticulture also being a predominant industry within the Mid-Western LGA.



Information presented in this figure is approximate only and should not be relied upon as accurate

Figure 1-1 | Regional context

1.2.2 Local context

The location of the proposed wind farm is shown in **Figure 1-2**. Land surrounding the wind farm site is characterised by rolling pastoral hills, open flat valleys, and ridgelines with scattered vegetation. The hill slopes are generally gentle in gradient and predominantly cleared of vegetation, except for patches of denser remnant vegetation on steeper terrain, near rocky outcrops and between saddles.

The townships of Coolah and Leadville are the closest population centres to the proposed site. These townships are located on gently sloping to level land within valleys near creeks. Most built structures are of low to moderate scale. The main street of Coolah is the focus for local retail and community services in the local area.

Local land uses include:

- **farming** – predominantly grazing cattle and sheep, with small patches of cropping (cereal and fodder)
- **rural living** – scattered rural dwellings and sheds present throughout the landscape, with a higher density of dwellings in the townships.

The predominant source of employment for both Coolah and Leadville is commercial agriculture (sheep and cattle grazing). The impacts of bushfires and long periods of drought can severely impact agricultural productivity and generate significant economic stress for the local community.

The Warrumbungle LGA has a higher unemployment rate compared to the NSW average (Australian Bureau of Statistics, 2016), which is a key indicator of economic stress in the local area. Anecdotally, younger people are moving from the local area to seek education and employment, which is reflected in a higher median age for Warrumbungle LGA compared to the NSW average.

1.2.3 The wind farm site

The proposed wind farm is split into three wind turbine clusters responding to local topography and wind resource, with overhead electrical transmission lines connecting the clusters (refer to **Figure 1-2**). The three clusters are south of Coolah, and north and east of Leadville, on private land which is currently used for cattle grazing. No cropping currently takes place within the wind farm site due its undulating topography and rocky subsurface.

The transmission line may cross cropped land, subject to confirmation of the final location of the proposed CWO-REZ transmission line. The final route of the transmission lines and connection point will be determined upon release of the technical details relating to the CWO-REZ transmission line infrastructure.

The topography of the wind farm site is variable with the ridgelines ranging between 626 metres Australian Height Datum (AHD) and 757 metres AHD. The highest point is located at Mount Hope, south west of Coolah, near Mount Hope Road.

Plates 1 to 5 illustrate the typical landscape and land use characteristics of the wind farm site.

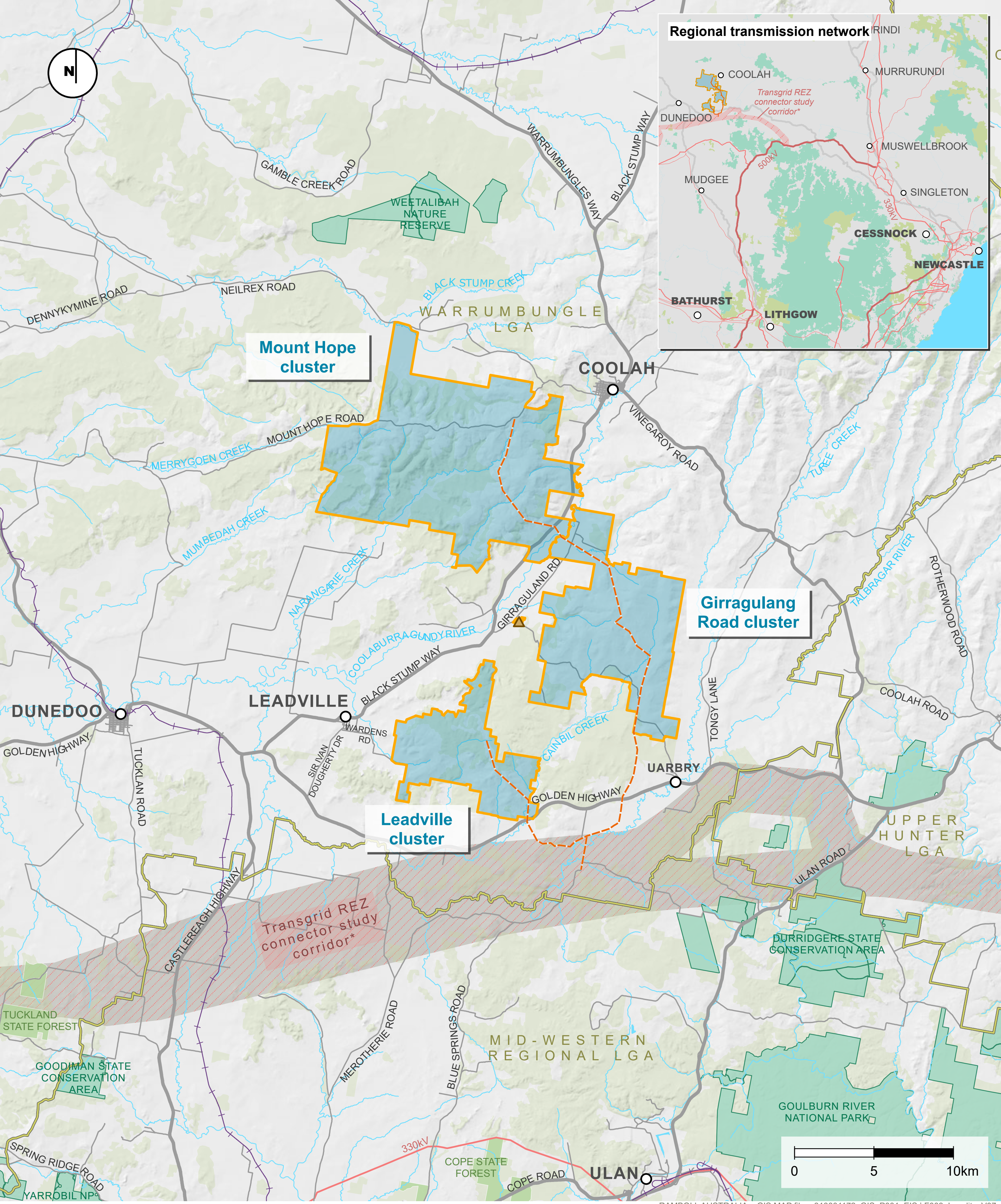
Plate 1 View of Coolah township from Girragulang Road cluster ridgeline

Plate 2 View of Girragulang Road cluster ridgeline (foreground)

Plate 3 View from valley towards Mount Hope

Plate 4 View of Mount Hope cluster ridgeline (foreground)

Plate 5 View of Leadville cluster ridgeline (foreground)



RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F003_Locality_V07

KEY

- Wind farm site
- Overhead transmission line
- Potential construction workforce accommodation
- Electricity transmission line
- Transgrid REZ connector study corridor*
- Railway
- LGA boundary
- National Parks and Reserves
- State forest
- Indicative vegetated area

**Approximate only*

Figure 1-2 | Locality plan

1.3 The proponent

The proponent for the Project is UPC Renewables Australia Pty Ltd, operating as UPC\AC Renewables Australia (UPC\AC). UPC\AC is a 50-50 joint venture between UPC Renewables Ltd and AC Energy Pte Ltd.

UPC\AC is a leading renewable energy developer in the Asia Pacific region with offices in Australia, China, Hong Kong SAR, India, Indonesia, Philippines, South Korea, Taiwan, and Vietnam. UPC\AC Renewables was established in 1995 and has been active in Asia since 2006. To date, UPC\AC companies have developed more than 4,500 megawatts of operating wind and solar projects with an estimated investment value of over $6 billion.

AC Energy is the energy platform of the Ayala Corporation, one of the largest business groups in the Philippines with nearly 190 years of history and several projects in South East Asia developed in partnership with UPC Renewables Group. AC Energy is one of the fastest growing energy companies with over $1 billion of invested and committed equity in renewable and thermal energy in the Philippines and around the region.

UPC\AC is focused on supplying renewable energy at the lowest possible price in a socially responsible way and independently develops, builds, owns, and operates its renewable energy generating assets as an independent power producer. UPC\AC typically has an 'owner-operator' business model, which means it will continue to be directly involved in projects as they are constructed and operated for their full lifecycle, including decommissioning.

1.4 Project objectives

Broadly, the objectives of the project are to:

- develop an economically viable grid-connected wind farm that contributes to the delivery of affordable, sustainable and reliable electricity within NSW
- enhance energy security by contributing to diversification of the State's energy mix in preparation for the retirement of large coal-fired power stations
- produce clean and renewable energy that contributes to meeting State and National climate change mitigation targets and reduces greenhouse gas emissions
- provide local and regional employment opportunities and provide economic benefits to the local community
- avoid and/or minimise environmental impacts wherever practicable, through careful design and implementation of best practice environmental management and mitigation.

Further discussion on the project objectives and how it would strategically contribute to the NSW Government's Electricity Infrastructure Roadmap is provided in **Chapter 2**.

1.5 Purpose of this environmental impact statement

This environmental impact statement (EIS) has been prepared in accordance with Part 4 of the EP&A Act by Ramboll Australia Pty Ltd on behalf of UPC\AC.

The EIS supports the development application (DA) for the project to be lodged with the NSW Department of Planning, Industry and Environment for Development Consent; and fulfils the requirements of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) and Section 4.15 of the EP&A Act.

Under Section 4.12(8) of the EP&A Act, a DA for SSD must be accompanied by an EIS. This EIS identifies and assesses the potential environmental, economic, and social impacts associated with the construction, operation and decommissioning of the proposed wind farm. The EIS is intended to help the community, government agencies and the consent authority to make informed submissions or decisions on the merits of the project.

This report has been prepared giving consideration of the 'NSW Wind Energy Framework' which comprises:

- *Wind Energy Guideline* (NSW DPIE, 2016) (Wind Guideline)
- *Wind Energy: Visual Assessment Bulletin* (NSW Department of Planning and Environment, 2016) (Visual Bulletin)
- *Wind Energy: Noise Assessment Bulletin* (NSW Department of Planning and Environment, 2016) (Noise Bulletin)
- *Standard Secretary's Environmental Assessment Requirements* (NSW Department of Planning and Environment, 2016)
- *Wind Energy Framework Q&As* (NSW Department of Planning and Environment, 2016).

The structure and content of the EIS addresses the Secretary's Environmental Assessment Requirements (SEARs) provided by the NSW Department of Planning, Industry and Environment on 9 June 2020 and the supplementary SEARs issued in July 2020, to address the requirements of the Australian Department of Agriculture, Water and the Environment.

A list of the SEARs and where they have been addressed in this EIS is provided in **Table 1-1** (initial SEARs) and **Table 1-2** (supplementary SEARs).

Table 1-1: SEARs and where each requirement has been addressed in this EIS

Requirement	Where addressed
General Requirements	
The Environmental Impact Statement (EIS) for the development must comply with the requirements in Schedule 2 of the Environmental Planning and Assessment Regulation 2000. In particular, the EIS must include:	
• a stand-alone executive summary	**Executive Summary**
• a full description of the development, including:	**Chapter 4**
– details of construction, operation and decommissioning, including any proposed staging of the development or refurbishing of turbines over time	**Chapter 4.8 to Section 4.10**
– all infrastructure and facilities, such as substations, transmission lines, construction compounds, concrete batching plants, internal access roads, and road upgrades (including any infrastructure that would be required for the development, but the subject of a separate approvals process)	**Chapter 4**
– plans for any buildings	N/A
– site plans and maps at an adequate scale with dimensions showing:	Figures in **Chapter 4**
○ the location and dimensions of all project components including coordinates in latitude / longitude and maximum AHD heights of the turbines	Figures in **Chapter 4**
○ existing infrastructure, land use, and environmental features in the vicinity of the development, including nearby residences and approved residential developments or subdivisions within 5 km of a proposed turbine, and any other existing, approved or projects in the region	Figures in **Chapter 4**
○ the development corridor that has been assessed, including any allowance for micro-siting of turbines and identification of the key environmental constraints that have been considered in the design of the development	Figures in **Chapter 4**
– details of the progressive rehabilitation of the site	N/A
• a list of any approvals that must be obtained before the development may commence	**Section 3.4**
• the terms of any proposed voluntary planning agreement with the relevant local council	**Section 15.4**

Requirement	**Where addressed**
• an assessment of the likely impacts of the development on the environment, focusing on the specific issues identified below, including:	**Chapter 6** to **Chapter 18**
– a description of the existing environment likely to be affected by the development using sufficient baseline data	**Chapter 6** to **Chapter 18**
– an assessment of the likely impacts of all stages of the development, taking into consideration any relevant legislation, environmental planning instruments, guidelines, policies, plans and industry codes of practice and including the NSW *Wind Energy Guideline for State Significant Wind Energy Development* (2016)	**Chapter 6** to **Chapter 18**
– a description of the measures that would be implemented to avoid, mitigate and/or offset residual impacts of the development and the likely effectiveness of these measures, including details of consultation with any affected non-associated landowners in relation to the development of mitigation measures, and any negotiated agreements with these landowners	**Chapter 6** to **Chapter 18**
– a description of the measures that would be implemented to monitor and report on the environmental performance of the development, including adaptive management strategies and contingency measures to address residual impacts	**Chapter 6** to **Chapter 18**
• a consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS	**Chapter 19**
• the reasons why the development should be approved having regard to:	**Chapter 20**
– relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act, and how the principles of ecologically sustainable development have been incorporated in the design, construction, and ongoing operations of the development	**Chapter 20**
– an evaluation of the merits of the project as a whole, having regard to the requirements in Section 4.15 of the *Environmental Planning and Assessment Act 1979*	**Chapter 20**
– the requirements of the Environment Protection and *Biodiversity Conservation Act 1999* (EPBC Act) and Schedule 4 of the *Environment Protection and Biodiversity Conservation Regulations 2000* (EPBC Regulations)	**Chapter 20**
– the environmental, economic and social costs and benefits of the development, having regard to the predicted electricity demand in NSW and the National Electricity Market, the Commonwealth's Renewable Energy Target Scheme, and the greenhouse gas savings of the development	**Chapter 20**

Requirement	Where addressed
– a detailed consideration of the capability of the project to the security and reliability of the electricity system in the National Electricity Market, having regard to local system conditions and the Department's guidance on the matter	**Chapter 2**
– the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses, including rural villages, rural dwellings, subdivisions, land of high scenic value, conservation areas (including National Parks / Reserves), strategic agricultural land, state forests, mineral and coal resources, triangulation stations, tourism facilities, existing or projects, and the capacity of the existing electricity transmission network to accommodate the development	**Section 2.3**
– feasible alternatives to the development (and its key components), including the consequences of not carrying out the development.	**Section 2.2**
In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified person that includes an accurate estimate of the capital investment value of the development (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*).	Submitted separately
Key Issues	
The EIS must address the following specific issues for the wind farm and associated infrastructure:	
Landscape and Visual – the EIS must include a detailed assessment of the visual impacts of all components of the project (including turbines, transmission lines, substations, and any other ancillary infrastructure) in accordance with the NSW Wind Energy: Visual Assessment Bulletin (DPE, 2016).	**Chapter 6** and **Appendix D**
Noise and Vibration – the EIS must: • assess wind turbine noise in accordance with the NSW Wind Energy: Noise Assessment Bulletin (EPA/DPE, 2016) • assess noise generated by ancillary infrastructure in accordance with the NSW Noise Policy for Industry (EPA, 2017) • assess construction noise under the Interim Construction Noise Guideline (DECC, 2009) • assess traffic noise under the NSW Road Noise Policy (DECCW, 2011) • assess vibration under the Assessing Vibration: A Technical Guideline (DECC, 2006).	**Chapter 7, Appendix E** and **Appendix F**

Requirement	Where addressed
Biodiversity – the EIS must: • assess biodiversity values and the likely biodiversity impacts of the development including impacts associated with transport route road upgrades in accordance with the Biodiversity Conservation Act 2016 (NSW), including a detailed description of the proposed regime for minimising, managing and reporting on the biodiversity impacts of the development over time, and a strategy to offset any residual impacts of the development in accordance with the Biodiversity Conservation Act 2016 (NSW) • assess the likely impacts on koalas and their habitat in accordance with the requirements of State Environmental Planning Policy No. 44 – Koala Habitat Protection • assess the impact of the project on birds and bats from blade strikes, low air pressure zones at the blade tips (barotrauma), and alteration to movement patterns resulting from the turbines and considering cumulative effects of other wind farms in the vicinity.	**Chapter 8** and **Appendix G**
Traffic and Transport – the EIS must: • assess the construction, operational and decommissioning traffic impacts of the development on the local and State road network • provide details of traffic volumes (both light and heavy vehicles) and transport and haulage routes during construction, operation and decommissioning, including traffic associated with sourcing raw materials (water, sand and gravel) • assess the potential traffic impacts of the project on road network function including intersection performance, site access arrangements, site access and haulage routes, and road safety, including school bus routes and school zones • assess the capacity of the existing road network to accommodate the type and volume of traffic generated by the project (including over-mass / over-dimensional traffic haulage routes from port) during construction, operation and decommissioning • an assessment of the likely transport impacts to the site access and haulage routes, site access point, any rail safety issues, any Crown Land, particularly in relation to the capacity and conditions of the roads • provide details of measures to mitigate and / or manage potential impacts including a schedule of all required road upgrades (including resulting from over mass / over dimensional traffic haulage routes), road maintenance contributions, and any other traffic control measures, developed in consultation with the relevant road authority.	**Chapter 9** and **Appendix H**
Hazard / Risks – the EIS must include an assessment of the following: • *Aviation Safety*:	**Chapter 10 and Appendix I,**

Requirement	Where addressed
– assess the impact of the development under the National Airports Safeguarding Framework Guideline D: Managing Wind Turbine Risk to Aircraft – provide associated height and co-ordinates for each turbine assessed – assess potential impacts on aviation safety, including cumulative effects of wind farms in the vicinity, potential wake / turbulence issues, the need for aviation hazard lighting, considering, defined air traffic routes, aircraft operating heights, approach / departure procedures, radar interference, communication systems, navigation aids – identify aerodromes within 30 km of the turbines and consider the impact to nearby aerodromes and aircraft landing areas – address impacts on obstacle limitation surfaces – assess the impact of the turbines on the safe and efficient aerial application of agricultural fertilisers and pesticides in the vicinity of the turbines and transmission line • *Telecommunications* – identify possible effects on telecommunications systems, assess impacts and mitigation measures including undertaking a detailed assessment to examine the potential impacts as well as analysis and agreement on the implementation of suitable options to avoid potential disruptions to radio communication services, which may include the installation and maintenance of alternative sites • *Health* – consider and document any health issues having regard to the latest advice of the National Health and Medical Research Council, and identify potential hazards and risks associated with electric and magnetic fields (EMF) and demonstrate the application of the principles of prudent avoidance • *Bushfire* – identify potential hazards and risks associated with bushfires / use of bushfire prone land, including the risks that a wind farm would cause bush fire and any potential impacts on the aerial fighting of bush fires and demonstrate compliance with Planning for Bush Fire Protection 2019 • *Blade Throw* – assess blade throw risks.	**Appendix J, Appendix K** and **Appendix L**
Heritage – the EIS must: • assess the impact to Aboriginal cultural heritage items (archaeological and cultural) in accordance with the Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (OEH, 2011) and the Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW (DECCW, 2010) • provide evidence of consultation with Aboriginal communities in determining and assessing impacts, developing options and selecting options and mitigation measures (including the final proposed measures), having regard to the Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010) • assess the impact to historic heritage having regard to the NSW Heritage Manual.	**Chapter 11, Chapter 12, Appendix N** and **Appendix O**

Requirement	Where addressed
Water and Soils – the EIS must: • quantify water demand, identify water sources (surface and groundwater), including any licensing requirements, and determine whether an adequate and secure water supply is available for the development • assess potential impacts on the quantity and quality of surface and groundwater resources, including impacts on other water users and watercourses • where the project involves works within 40 metres of the high bank of any river, lake or wetlands (collectively waterfront land), identify likely impacts to the waterfront land, and how the activities are to be designed and implemented in accordance with the DPI Guidelines for Controlled Activities on Waterfront Land (2018) and (if necessary) Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (DPI 2003); and Policy & Guidelines for Fish Habitat Conservation & Management (DPI, 2013) • describe the measures to minimise surface and groundwater impacts, including how works on steep gradient land or erodible soil types would be managed and any contingency requirements to address residual impacts.	**Chapter 13**
Waste – the EIS must: identify, quantify and classify the likely waste streams to be generated during construction and operation, and describe the measures to be implemented to manage, reuse, recycle and safely dispose of this waste.	**Chapter 14**
Social & Economic – the EIS must include an assessment of the social and economic impacts and benefits of the project for the region and the State as a whole, including consideration of any increase in demand for community infrastructure services.	**Chapter 15, Chapter 16, Appendix P** and **Appendix Q**

Table 1-2: Supplementary SEARs and where each requirement has been addressed in this EIS

Requirement	Where addressed
Introduction	
1. On 13 July 2020, a delegate of the Federal Minister for the Department of Agriculture, Water and the Environment (formerly Department of Environment and Energy) determined that the Valley of the Winds Wind Farm Project was a controlled action under section 75 of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The EPBC Act controlling provisions for the proposed actions are: i. listed threatened species and communities (sections 18 and 18A); and ii. listed migratory species (sections 20 and 20A).	**Chapter 8** and **Appendix G**
2. The proposed action will be assessed in accordance with the bilateral assessment agreement Amending Agreement No. 1, and as such, is required to be assessed in the manner specified in Schedule 1 to that Agreement, including,	**Chapter 8** and **Appendix G**

Requirement	Where addressed
addressing the matters outlined in Schedule 4 of the Environment Protection and Biodiversity Conservation Regulations 2000 (EPBC Regulations).	
3. The proponent must undertake an assessment of all protected matters that may be impacted by the development under the controlling provision identified in paragraph 1. The Commonwealth Department of Agriculture, Water and the Environment considers that the proposed action is likely to have a significant impact on threatened species and communities and migratory species listed in Appendix A.	**Chapter 8** and **Appendix G**
4. The proponent must consider each of the protected matters under the triggered controlling provisions that may be impacted by the action. Note that this may not be a complete list and it is the responsibility of the proponent to undertake an analysis of the significance of the relevant impacts and ensure that all protected matters that are likely to be significantly impacted are assessed for the Commonwealth Minister's consideration.	**Chapter 8** and **Appendix G**
General Requirements	
Relevant Regulations	
5. The Environmental Impact Statement (EIS) must address all matters outlined in Schedule 4 of the EPBC Regulations and all the matters outlined below in relation to the controlling provisions.	**Chapter 8** and **Appendix G**
Project Description	**Chapter 8** and **Appendix G**
6. The title of the action, background to the action and the current status.	**Chapter 8** and **Appendix G**
7. The precise location and description of all works to be undertaken (including associated offsite works and infrastructure), structures to be built or elements of the action that may have impacts on Matters of National Environmental Significance (MNES).	**Chapter 8** and **Appendix G**
8. How the action relates to any other actions that have been or are being taken in the region affected by the action.	**Chapter 8** and **Appendix G**
9. How the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts on MNES.	**Chapter 8** and **Appendix G**
Impacts	
10. The EIS must include an assessment of the relevant impacts of the action on the matters protected by the controlling provisions, including:	**Chapter 8** and **Appendix G**

Requirement	Where addressed
i. a description and detailed assessment of the nature and extent of the likely direct, indirect and consequential impacts, including short term and long-term relevant impacts ii. a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible iii. analysis of the significance of the relevant impacts iv. any technical data and other information used or needed to make a detailed assessment of the relevant impacts.	
Avoidance, mitigation and offsetting	
11. For each of the relevant matters protected that are likely to be significantly impacted by the action, the EIS must provide information on proposed avoidance and mitigation measures to manage the relevant impacts of the action, including: i. a description and an assessment of the expected or predicted effectiveness of the mitigation measures ii. any statutory policy basis for the mitigation measures iii. the cost of the mitigation measures iv. an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing v. the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program.	**Chapter 8** and **Appendix G**
12. Where a significant residual adverse impact to a relevant protected matter is considered likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy.	**Chapter 8** and **Appendix G**
13. For each of the relevant matters likely to be impacted by the action the EIS must provide reference to, and consideration of, relevant Commonwealth guidelines and policy statements including any: i. conservation advice or recovery plan for the species of community ii. relevant threat abatement plan for the species iii. wildlife conservation plan for the species iv. any strategic assessment.	**Chapter 8** and **Appendix G**

Requirement	Where addressed
Key issues	
Biodiversity (threatened species and communities and migratory species)	
Assessment Requirements	
14. The EIS must identify each EPBC Act listed threatened species and community and migratory species likely to be impacted by the action. For any species and communities that are likely to be impacted, the proponent must provide a description of the nature, quantum and consequences of the impacts. For species and communities potentially located in the project area or in the vicinity that are not likely to be impacted, provide evidence why they are not likely to be impacted.	**Chapter 8** and **Appendix G**
15. For each of the EPBC Act listed threatened species and communities and migratory species likely to be impacted by the action the EIS must provide a separate: a. description of the habitat (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advice, conservation advice and recovery plans b. details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements c. description of the relevant impacts of the action having regard to the full national extent of the species or community's range d. description of the specific proposed avoidance and mitigation measures to deal with relevant impacts of the action e. identification of significant residual adverse impacts likely to occur after the proposed activities to avoid and mitigate all impacts are taken into account f. description of any offsets proposed to address residual adverse significant impacts and how these offsets will be established. g. details of how the current published NSW Biodiversity Assessment Methodology has been applied in accordance with the objects of the EPBC Act to offset significant residual adverse impacts; and h. details of the offset package to compensate for significant residual impacts including details of the credit profiles required to offset the action in accordance with the NSW Biodiversity Assessment Methodology and/or mapping and descriptions of the extent and condition of the relevant habitat and/or threatened communities occurring on proposed offset sites **Note**: For the purposes of approval under the EPBC Act, it is a requirement that offsets directly contribute to the ongoing viability of the specific protected matter impacted by a proposed action and deliver an overall conservation	**Chapter 8** and **Appendix G**

Requirement	Where addressed
outcome that improves or maintains the viability of the MNES i.e. 'like for like'. Like-for-like includes protection of native vegetation that is the same ecological community or habitat being impacted (preferably in the same region where the impact occurs), or funding to provide a direct benefit to the matter being impacted e.g. threat abatement, breeding and propagation programs or other relevant conservation measures.	
16. Any significant residual impacts not addressed by the NSW Biodiversity Assessment Methodology may need to be addressed in accordance with the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offset Policy. http://www.environment.gov.au/epbc/publications/epbc-act-environmental-offsets-policy.	
Other approvals and conditions	
17. Information in relation to any other approvals of conditions required must include the information prescribed in Schedule 4 Clause 5 (a) (b) (c) and (d) of the EPBC Regulations 2000.	**Chapter 3**
Environmental Record of person proposing to take the action	
18. Information in relation to the environmental record of a person proposing to take action must include details as prescribed in Schedule 4 Clause 6 of the EPBC Regulations 2000.	There have been no proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against UPC\AC.
Information Sources	
19. For information given in the EIS, the EIS must state the source of the information, how recent the information is, how the reliability of the information was tested, and what uncertainties (if any) are in the information.	**All Chapters** and **Appendices**

1.6 Structure of this environmental impact statement

This EIS is structured as follows:

- **Chapter 1. Introduction** – introduces the project, including an overview of the project location and regional context, the proponent, the project objectives, and the purpose and structure of this EIS
- **Chapter 2. Strategic context and alternatives** – outlines the strategic context for the project and provides a summary of the alternatives and options considered during the design phase
- **Chapter 3. Statutory planning and approvals summary** – summarises the approvals process and relevant statutory planning documents that relate to the project
- **Chapter 4. Project description** – provides a description of the project including key project definitions, key elements and indicative layout, and activities required for construction, operation, and decommissioning
- **Chapter 5. Consultation** – provides a summary of the consultation undertaken to date and an overview of proposed future consultation
- **Chapter 6 to Chapter 16. Key issues** – provides an assessment of the key environmental, economic and social issues for the project, their potential impacts and proposed management measures. The key issues identified in the SEARs are:
    - Landscape character and visual
    - Noise and vibration
    - Biodiversity
    - Traffic and transport
    - Hazards and risks
    - Heritage
    - Water and soils
    - Waste and resources
    - Social
    - Economic.
- **Section 17. Other issues** – an assessment of other non-key environmental issues including land use, air quality and climate change and greenhouse gas
- **Section 18. Cumulative** – an assessment of the cumulative impacts of the project for both existing and proposed developments within the locality
- **Section 19. Environmental management and mitigation measures** – provides a summary of the environmental management and mitigation measures to be implemented for the project
- **Section 20. Project justification and conclusion** – presents the overall impacts and benefits of the project, considering the principals of ecologically sustainable development (ESD)
- **Section 21. References**
- **Appendices** – the appendices to the EIS which support the main document, including copies of all technical assessments. Appendices include:
    - **Appendix A**: Secretary's Environmental Assessment Requirements
    - **Appendix B**: Agency response to scoping report
    - **Appendix C**: Statutory planning and approvals – detailed discussion
    - **Appendix D**: Landscape and visual impact assessment
    - **Appendix E**: Background noise assessment
    - **Appendix F**: Noise assessment
    - **Appendix G**: Biodiversity Assessment Report
    - **Appendix H**: Traffic assessment – Traffic and transport report
    - **Appendix I**: Aviation impact assessment

- **Appendix J**: EMI and EMF health impact assessment
- **Appendix K**: Bushfire risk assessment
- **Appendix L**: Blade throw assessment
- **Appendix M**: Preliminary hazard analysis
- **Appendix N**: Aboriginal cultural heritage assessment report
- **Appendix O**: Heritage impact statement
- **Appendix P**: Social impact assessment
- **Appendix Q**: Economic assessment
- **Appendix R**: Air quality impact assessment.

2. STRATEGIC CONTEXT AND ALTERNATIVES

2.1 Strategic context

2.1.1 Overview of key strategic documents

Several key policies support the development of the proposed wind farm, including:

- **The 2015 UNFCCC "Paris Agreement"**: the Australian Government is a signatory to the Paris Agreement (ratified November 2016) establishing a National commitment to combat climate change and to move towards a sustainable low carbon future
- **The Federal Government's Renewable Energy Target scheme**: an Australian Government policy aiming to ensure that at least 33,000 gigawatt hours of Australia's electricity comes from renewable sources by 2020
- ***2020 Integrated System Plan 2020* (2020 ISP) and *Draft 2022 Integrated System Plan* (Draft ISP 2022)**: the Draft ISP 2022 was published on 10 December 2021 provides an update to the inputs, assumptions and scenarios that were considered in the 2020 ISP which is intended to be updated every two years. The 2020 ISP and Draft ISP 2022 identifies:
  "investment choices and recommends essential actions to optimise consumer benefits as Australia experiences what is acknowledged to be the world's fastest energy transition".
- ***NSW Net Zero Plan Stage 1: 2020-2030***: outlines the proposed actions of the NSW Government to achieve its objective of net zero emissions by 2050
- ***NSW Renewable Energy Action Plan 2013* and *NSW Renewable Energy Action Plan Completion Report 2018***: includes 24 actions under three goals that detail the Government's intention to work closely with NSW communities and the renewable energy industry, to increase renewable energy generation in the state at the least cost to the consumer
- ***NSW Electricity Strategy 2019* (adopted November 2019)**: provides detailed strategy for electricity supply to NSW
- ***NSW Electricity Infrastructure Roadmap 2020***: outlines new policy measures to drive the transition of the state's electricity sector.

The proposed development is also supported by and consistent with strategic planning policies and agreements at a local level, which are discussed in the following sections.

2.1.2 National and international context

Paris Agreement

The Paris Agreement of 2015 came into force on 4 November 2016 and was established under the United Nations Framework Convention on Climate Change, to combat climate change and move towards a sustainable low carbon future. The key aim of the agreement is to ensure global temperature rise this century remains well below two degrees Celsius and to attempt to limit temperature increase to 1.5 degrees Celsius.

As a signatory to the Agreement, the Australian Government committed to reduce emissions to 26–28 per cent on 2005 levels by 2030. In 2020 the Australian Government reviewed its emissions reduction commitments and affirmed Australia's 2030 target. Australia will submit its next emissions reduction commitments, with a post–2030 target, to the United Nations Framework Convention on Climate Change in 2025 (Department of Industry, Science, Energy and Resources, 2021).

To contribute to achieving its revised commitments under the Paris Agreement, the Commonwealth Government proposed to double Australia's renewable energy capacity by the end of 2020, equating to over 23 per cent (33,000 gigawatt hours) of Australia's electricity supply, through the Renewable Energy Target (RET).

Given the Paris Agreement's aim is to limit global mean temperature rise to 2 degrees Celsius above 1990 levels, more action will be required from Australia's power sector to reduce emissions. Considering several sectors of the economy (e.g. agriculture) have limited alternative technology options to reduce emissions, it is widely viewed by energy and climate change academics, and independent research institutions, that the electricity sector will have to completely transition to renewable energy to meet the required emissions reductions. The current Renewable Energy Target (RET) scheme only requires 23.5 per cent of Australia's electricity to be generated by renewable sources from 2020 to 2030 (Climate Change Council, 2016).

As a generator of renewable sourced electricity, the Valley of the Winds wind farm would help contribute towards meeting Australia's commitment under the Paris Agreement, to reduce emissions by 26 to 28 per cent on 2005 levels by 2030.

Renewable Energy Target scheme

The RET is an Australian Government policy aiming to ensure that at least 33,000 gigawatt hours of Australia's electricity comes from renewable sources by 2020 (Clean Energy Council, 2018).

The RET operates in two parts:

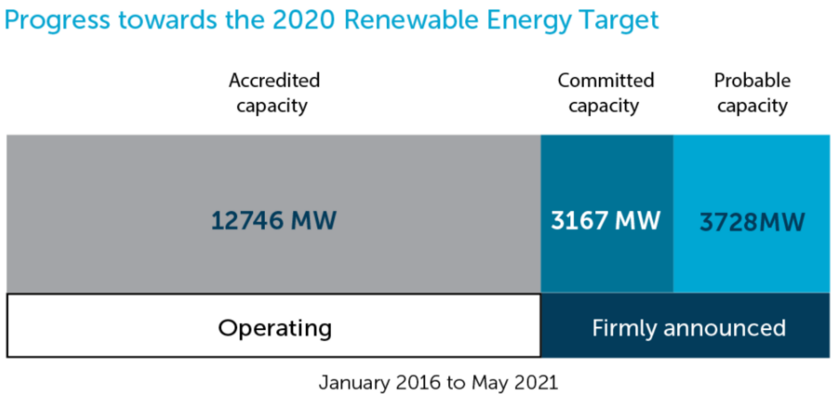
1. the Large-scale Renewable Energy Target (LRET)
2. the Small-scale Renewable Energy Scheme (SRES).

The LRET is most relevant to the project as it encourages the uptake of renewables through creation of a financial incentives for the establishment or expansion of renewable energy power stations, such as wind farms. This is done by legislating demand for large-scale generation certificates (LGCs), whereby one LGC is created for each megawatt per hour of eligible renewable electricity produced by an accredited power station.

Electricity retailers and some high energy users are required under the LRET to acquire a fixed proportion of their electricity from renewable sources. Liable parties can purchase the LGCs from eligible power stations and surrender them to the Clean Energy Regulator to demonstrate compliance with the annual targets of the RET scheme (Australian Government Department of Industry, 2020); (Clean Energy Council, 2018). Revenue earned by the power station generated by the sale of LGCs to these high energy users is in addition to revenue generated by the sale of the electricity (Australian Government Department of Industry, 2020).

There have been several reviews and updates of the RET and associated legislation, including a reduction from the previously legislated 41,000-gigawatt hours to the current 33,000-gigawatt hours. As of September 2019, the Clean Energy Regulator announced that Australia had met the LRET more than a year ahead of schedule, however, the scheme will continue to require electricity retailers and high energy users to meet obligations under the policy until 2030 (Clean Energy Council, 2018).

It was estimated in 2016 that for the 2020 target to be reached, the total new capacity of renewable energy power projects required to be committed through to the end of 2018, was 6000 megawatts. However, due to a higher proportion of renewable energy projects in the pipeline than expected, this estimate was updated to 6400 megawatts. This required capacity of 6400 megawatts has been met and exceeded (refer to **Figure 2-1**) (Clean Energy Regulator, 2021).



Source: (Clean Energy Regulator, 2021)

Figure 2-1: Progress towards the 2020 Renewable Energy Target

Corporations such as Woolworths, Coles, Aldi, Telstra, Amazon, Mars, Carlton United and others are also choosing to voluntarily procure renewable energy and LGCs to cover their entire electricity needs, irrespective of the RET obligation. Hence, there is a growing demand for green energy and the associated LGCs for these corporate "offtakes" or power purchasing agreements ("PPAs").

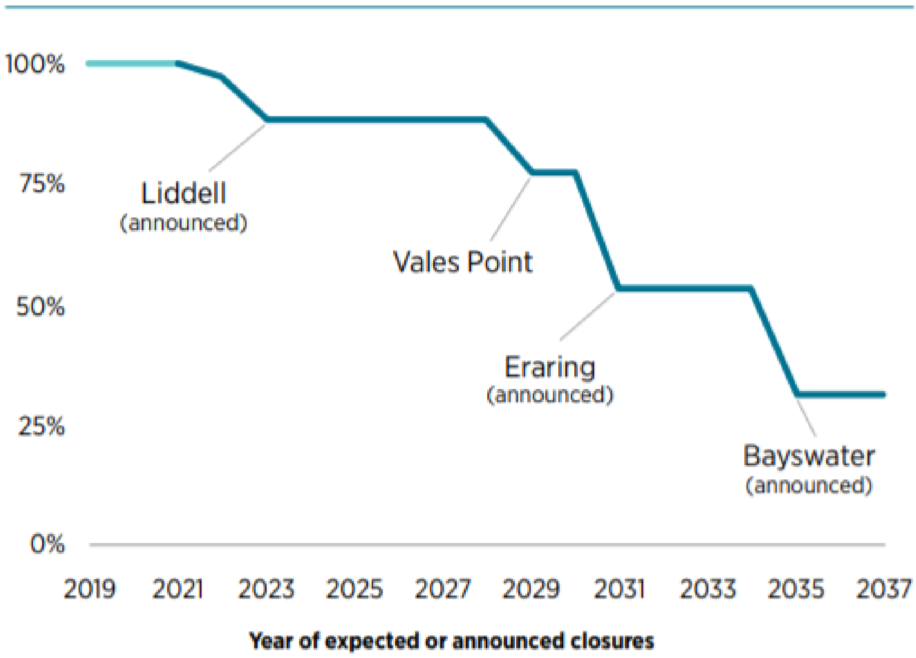
The project would generate approximately 800 megawatts of electricity annually, which would contribute to assisting the RET through the generation of approximately 1 LGC for every megawatt hour of electricity generated by the project via the LRET scheme. As an 800-megawatt wind farm, Valley of the Winds could be expected to generate around two million LGCs per annum.

2.1.3 Energy market considerations

Closure of coal-fired generators

Several major energy generators in NSW will reach the end of their lifespan and are scheduled to be retired in the coming decades. As shown in **Figure 2-2**, four out of the five operating coal-fired generators in the State are scheduled for retirement by 2035. By 2043, all five coal-fired generators operating are expected to retire (NSW Department of Planning, Industry and Environment, 2019). This includes:

- Liddell Power Station (currently generating 1680 megawatts through its four generators that are currently operating at a reduced capacity of 420 megawatts each) in 2023
- Vales Point Power Station (generating 1,320 megawatts) in 2029
- Eraring Power Station (generating 2,880 megawatts) in 2025
- Bayswater Power Station (2,640 megawatts) in 2035
- Mount Piper Power Station (1,400 megawatts) in 2043.



Source*:* (NSW Department of Planning, Industry and Environment, 2019)

**Note: Recent announcement by the NSW Government that Eraring Power Station (generating 2,880 megawatts) is now expected to close in 2025*

Figure 2-2: Schedule of coal-fired power generator closure

The Australian Energy Market Operation (AEMO) reported in its *2020 Electricity Statement of Opportunities* report, that the electricity reliability outlook for NSW after the Liddell Power Station retires, has improved since the *2019 Electricity Statement of Opportunities* report. This improvement is a result of the committed augmentation of the Queensland to NSW Interconnector and the development of local new renewable energy generation (900 megawatts) (Australian Energy Market Operation, 2020).

AEMO found that without additional investment in electricity generation projects, the NSW region is forecast to exceed the Interim Reliability Measure from 2023 to 2024 onwards, and to be vulnerable to the coincidence of high demands, generator outages, and low renewable generation. The Snowy 2.0 project is expected to improve the reliability outlook once commissioned (expected 2025) and only when combined with the HumeLink transmission augmentations (Australian Energy Market Operation, 2020).

The project would contribute to security of the NEM through the generation of additional electricity to meet demand, thereby helping to avoid a shortfall that is currently expected in NSW following the closure of the existing coal-fired generators. Due to the long lead times in the development of a project, investment in energy is needed several years before retirement of existing energy generators.

2020 Integrated System Plan and Draft 2022 Integrated System Plan

Since the first *Integrated System* Plan (ISP) was prepared by AEMO and endorsed by the COAG Energy Council in 2018, it has since guided governments, industry and consumers on the investments that are needed to achieve an affordable, secure and reliable energy future, while still meeting required emissions trajectories.

With the ISP to be updated every two years, AEMO has published the 2020 ISP (30 July 2020), and commenced work on the 2022 ISP which is scheduled to be published in June 2022. A draft version of the 2022 ISP was published in December 2021.

The process for actionable ISP projects were triggered by the first ISP, while the 2020 ISP responds to the latest technology and policy developments, and economy (Australian Energy Market Operator, 2019). The 2020 ISP provides a roadmap for the power system of eastern Australia to optimise consumer benefits while it transitions through a period of uncertainty, and aims to:

> ***"minimise costs and the risk of events that can adversely impact future power costs and consumer prices, while also maintaining the reliability and security of the power system"*** (Australian Energy Market Operator, 2019)***.***

The modelling undertaken for the 2020 ISP confirms that the least cost and least regret transition through to 2040,from a system dominated by coal-fired generation, to a diverse mix of behind the meter and grid-scale renewable energy, supported by firming resources and enhanced grid and service capabilities to ensure security of the power system (Australian Energy Market Operator, 2019).

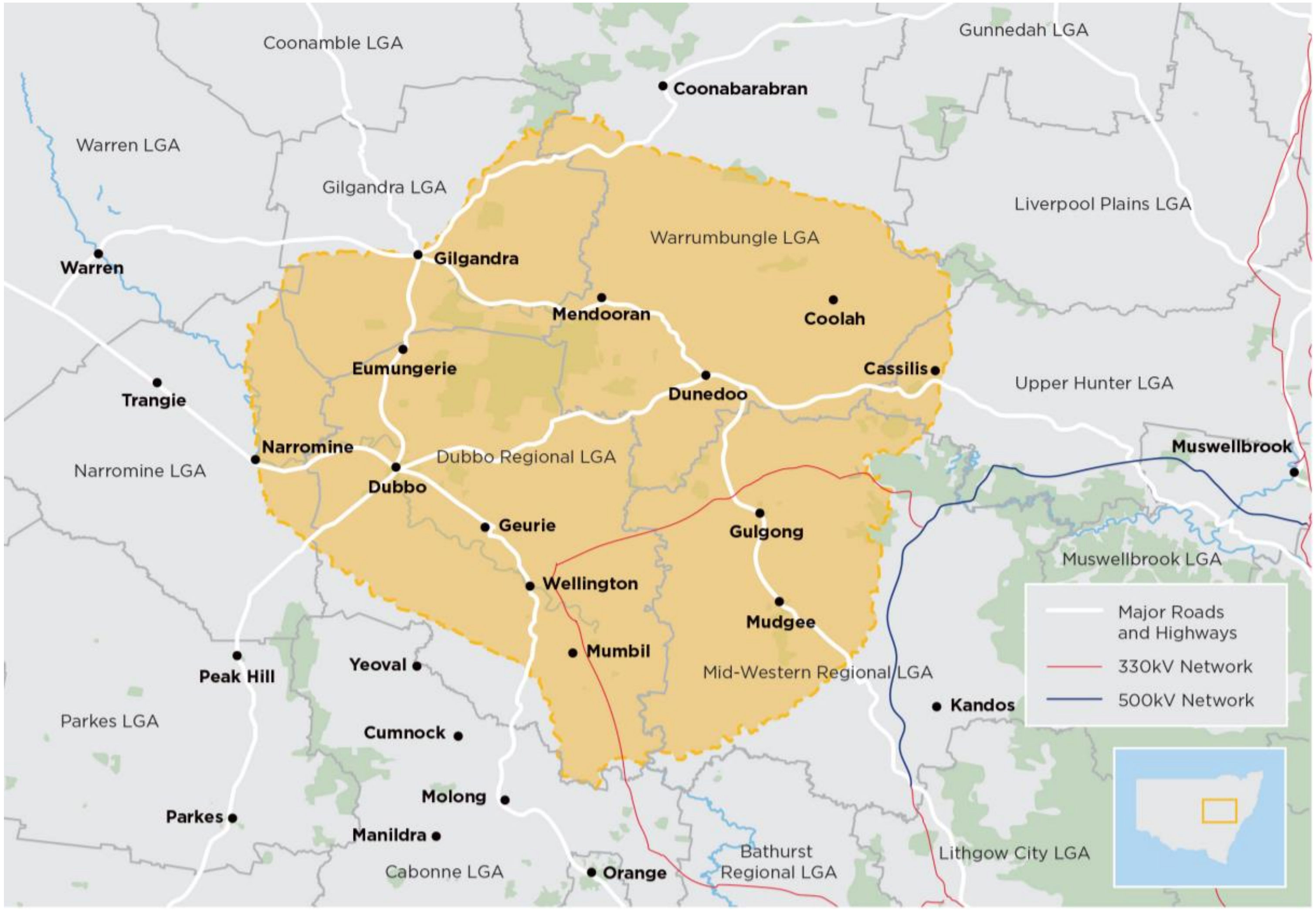
AEMO has extended the ISP's planning horizon through to 2050, to reflect Australia's 2050 net zero emissions target. The Draft 2022 ISP identifies that through to 2050, the NEM will need to cater for significant investment in generation capacity, storage, firming generation and transmission augmentations as coal generation withdraws. Importantly, all major projects will need careful design to meet environmental, economic and social licence expectations. The 2022 ISP will have a 30-year planning horizon and aims to guide the NEM through the energy transition. As the market operator, AEMO is the key government entity responsible for ensuring the efficient, affordable and reliable supply of electricity for households and businesses into the future.

To achieve the transition, the Draft 2022 ISP has modelled several scenarios to transition to renewable energy by 2050. The ISP highlights that the NEM's operational consumption needs to double by 2050. Currently, the NEM relies on 23 gigawatts from coal, and another 20 gigawatts of capacity from storage and gas generation Without coal, the NEM will require 45 gigawatts / 620 GWh (gigawatt hours) of storage and over 120 gigawatts of new capacity from renewables to provide electricity to consumers with the lowest-cost generation supply and meet rrenewable energy policies.

The *Integrated System Plan Consultation 2017* defines Renewable Energy Zones (REZ) as areas where clusters of large-scale renewable energy can be developed to promote economies of scale in higher-resource available areas and capture a diversity of technological and geographical renewable resources (Australian Energy Market Operator, 2017). It is expected that much of the 26 gigawatts of new renewables required for the transition will be built in REZs.

The 2020 ISP states that by 2040 the transmission grid will need to be augmented to balance resources and unlock new REZs, and that strategically placed interconnectors and REZs (combined with energy storage) will be the most cost-effective way to supply capacity and balance resources across the NEM.

The 2020 ISP prioritises REZ developments in three overlapping phases. The first phase is development to help meet regional renewable energy targets and other policies, or areas where there is already good access to existing network capacity with good system strength. Renewable energy development in CWO-REZ, where the project would be located, has been identified as part of this first-priority phase (refer to **Figure 2-3**).



Source: (NSW Energy, 2020)

Figure 2-3: Central West Orana Renewable Energy Zone

The 2020 ISP also identifies several actionable ISP projects, with one being the Central West Orana REZ Transmission Line, which provides network augmentation to support the development of the CWO-REZ. This transmission line would distribute electricity between the CWO-REZ and major load centres in NSW and is due to be completed in 2024-2025 (Australian Energy Market Operator, 2019). The Draft 2022 ISP sets out a draft optimal development path (ODP) with committed and anticipated projects underway, actionable projects to commence at the earliest planned time and future ISP projects to augment the NEM.

TransGrid, in consultation with the NSW Government, have released a study corridor for the CWO-REZ transmission line which runs approximately east-west, south of the wind farm site. This is discussed further below and in **Section 2.4.4.**

Given that the project is in the CWO-REZ, and close to the proposed CWO-REZ transmission line, this highlights the appropriate choice of location for the project and alignment with the market operator's thinking of where new generation capacity is likely to be located.

REZs proposed in NSW, including the CWO-REZ are discussed further in **Section 2.1.4.**

National Electricity Market system security and reliability

Security of supply

Modelling undertaken by AEMO predicts that there will be an electricity supply reliability risk in NSW following the gradual closure of existing coal-fired generators if no actions are taken to develop alternative generation. If approved, the project would contribute to security of the NEM through the generation of additional electricity and help avoid the shortfall that is currently predicted.

The project would connect directly to the proposed CWO-REZ transmission line via an up to 500kV transmission line constructed as part of the project. The transmission line runs north-west from the existing 500kV network near Merriwa, passing south of Dunedoo before connecting to the existing network east of Wellington. This line allows for the project's output to be transported to meet loads across the NEM. The project would therefore contribute to the security and reliability of the electricity system in the NEM.

System security and reliability through storage

The project would incorporate either a centralised 'AC Coupled' battery energy storage system (BESS) near the connection to the CWO-REZ transmission line, or a decentralised 'DC Coupled' BESS with small BESS units connected to the substations in each cluster.

While the final design of the BESS for the project would be dependent on a range of commercial and functional considerations, it is noted that even a relatively small-scale BESS can contribute to system security and reliability, for example through the provision of frequency control ancillary services (FCAS), reactive power support or by firming the active power output of the project.

The introduction of grid connected battery systems in South Australia has shown that utility-scale BESS projects can lower the cost of provision of these services to consumers. In the longer term, there is the potential for a BESS to provide fast frequency response and/or synthetic inertia services if a market for these services emerges in the NEM.

UPC\AC is considering the use of grid-forming inverters as part of the BESS for the project which enables the BESS to operate as a virtual synchronous generator, supporting system strength, unlike standard wind and solar farm generators which use grid-following inverters.

In October 2020, AEMO requested submissions for non-network options to support the augmentation of the existing 330 kilovolt network across the CWO-REZ. UPC\AC provided a submission indicating that the Valley of the Winds Wind Farm would be ideally placed within the REZ and its development timing was well aligned with delivery of the CWO-REZ transmission line.

UPC\AC noted that while the proposed BESS would help alleviate congestion and system strength issues on the existing network in the CWO region, it is not seen as a substitute for the significant transmission upgrades envisaged by the NSW Government and the ISP. Rather, UPC\AC sees the role of the proposed BESS as being complementary to the new transmission investment needed to unlock several gigawatts of new renewable energy generation in the region.

Generator performance standards

Any major generator proposing to connect to the NEM must submit a connection application with the relevant network service provider under Chapter 5 of the National Electricity Rules (NER), which is assessed by AEMO and, in the case of this project, TransGrid.

Part of the requirements of the NER are that the generator must satisfy a range of safety, reliability, and security standards, including the following:

- the reactive power capability of a generating system at its connection point, which assists in the maintenance of a suitable power system voltage profile
- the quality of the electricity generated by a generating system at its connection point that can have a detrimental effect on other network users
- the response of the generator to frequency disturbances at the connection point and the conditions for which the generator will/will not remain connected
- the response of the generator to voltage disturbances at the connection point and the conditions for which the generator will/will not remain connected
- the response of the generating system to all disturbances, including network faults, and credible contingency events
- the quality of supply with respect to voltage fluctuations, harmonic voltage distortion and voltage unbalance at the connection point for which a generating system is required to remain connected
- the performance of protection systems and frequency control systems
- the impact of the generating system on inter-regional, and intra-regional transfer capability
- the performance of the voltage control system, and the ability of the generating system to increase or decrease its reactive power output in response to a power system incident
- the ability of a generating system to increase or decrease its active power transfer in response to a dispatch instruction from AEMO.

The project would only obtain an offer to connect if it can be demonstrated that it can satisfy the requirements of the NEL with respect to the generator performance standards.

In addition, there is a need to demonstrate that the project would not adversely impact on system strength, which involves the completion of an impact assessment. The final sign off against the generator performance standards and system strength assessment will be undertaken by TransGrid and AEMO as the relevant authorities responsible for matters of system reliability, safety and security.

Compliance with the NER and TransGrid and AEMO's requirements would ensure the project would meet the relevant requirements for safe, reliable, and secure connection to the electricity system.

2.1.4 NSW context

NSW Net Zero Plan Stage 1:2020-2030
The NSW Government has an objective to achieve net zero emissions by 2050. The NSW *Net Zero Plan Stage 1: 2020-2030* outlines the actions the NSW Government will take over the next decade to contribute to meeting this objective. The plan focuses on the period of 2020 to 2030 due to rapid changes in technology causing difficulties in identifying the lowest cost path to net zero beyond 2030 (NSW DPIE, 2020).

The plan identifies that there is an increasing and maturing global demand for low emissions products, and that as this demand grows, the cost of low emissions technologies continue to reduce.

The plan sets out four priority areas for development over the next decade. One of these priority areas involves driving the uptake of proven emissions reduction technologies that grow the economy, create new jobs, or reduce the cost of living.

The NSW Government's priority for this area is to provide a pathway to deploy these technologies at a large scale over the next decade. The plan notes that the national electricity system is undergoing a period of change with the retirement of existing power stations and introduction of new forms of generation, and that the NSW Government is committed to ensuring the provision of reliable and affordable electricity during this time, while also protecting the environment.

To achieve this, the NSW and Australian Government are fast-tracking the delivery of the NSW REZs (the New England REZ, the South-West REZ and the CWO-REZ) with the CWO-REZ being the priority as the "pilot REZ". The three REZs will play a critical role in replacing retiring generators in NSW and generating up to 17,700 megawatts of cheaper and renewable power to the NEM. The REZs are also expected to drive up to $23 billion of private sector investment and create approximately 2000 construction jobs per year in regional NSW (NSW DPIE, 2020).

NSW Renewable Energy Action Plan 2013 and Completion Report 2018
The *NSW Renewable Energy Action Plan 2013* outlines a vision of increasing generation, storage and use of renewable energy in NSW. The plan includes 24 actions under three core goals to encourage private sector investment in new technologies and secure a reliable, affordable, and clean energy future in NSW (NSW Government, 2018). These core goals comprise:

3. attract renewable energy investment
4. build community support for renewable energy
5. attract and grow expertise in renewable energy.

The *NSW Renewable Energy Action Plan Completion Report* identified that all 24 actions have now been completed. However, the report states that the NSW Government continues to promote the renewables boom. A total of 14 new wind and solar farms have been built in NSW with a capacity of more than 1,100 megawatts, supporting about $2.8 billion of investment in NSW and jobs in regional communities.

NSW Electricity Strategy 2019
In November 2019, the NSW Government released the NSW Electricity Strategy (NES), which aims to address key challenges in providing

"a reliable, affordable and sustainable electricity future that supports a growing economy".

The strategy will support approximately $8 billion of private investment in the NSW electricity system over a 10-year period (including $5.6 billion in regional NSW), and is expected to generate 1,200 jobs, mostly in regional NSW. To achieve this, the NES proposes several measures to improve the efficiency and competitiveness of the NSW electricity market, including the delivery of three REZs in NSW, as discussed previously. The NES aligns closely with the *NSW Net Zero Plan Stage 1:2020-2030*.

The NES discusses the *NSW Transmission Infrastructure Strategy*, which is the NSW Government's plan to unlock private sector investment in priority energy projects. The strategy has three aims, with one of those being to increase NSW's energy capacity through prioritising REZs in the Central West, South West and New England areas of NSW, which will bring diversity to the State's energy mix and expand its transmission capabilities (NSW Department of Planning, Industry and Environment, 2019).

The NES sets out ten actions to secure the State's electricity future, with a preference for the market to deliver investment required to ensure reliable and affordable energy. The action most relevant to the project is 'Action 4: Rolling out NSW Renewable Energy Zones'.

As part of this action, the NSW Government has committed to supporting transmission upgrades for a 3,000 megawatts pilot REZ in the Central West (i.e. the CWO-REZ), with a view to use the delivery model to inform the development of other REZs (NSW Department of Planning, Industry and Environment, 2019).

Together, the NSW Government and the Australian Government entered into a Memorandum of understanding in November 2019 and agreed on joint funding for the delivery of the CWO-REZ as NSW's first renewable energy zone, with this expected to commence in 2022. The NSW Government alone has committed over $40m to the development of the CWO-REZ.

The project would be located within the CWO-REZ, supplying approximately 800 megawatts (0.8 gigawatts) to the NEM and contributing towards the targeted 3,000 megawatts for the CWO-REZ as identified in the NES.

NSW Electricity Infrastructure Roadmap 2020

On 9 November 2020 the NSW Government announced its Electricity Infrastructure Roadmap, which outlined new policy measures to drive the transition of the state's electricity sector to a system underpinned by wind and solar power, backed up by pumped hydro, batteries and gas peaking.

The *Electricity Infrastructure Investment Bill 2020* was passed through the NSW Parliament in November 2020. The Bill will implement in several legislation changes in NSW which further encourage investment in renewable energy generation projects in NSW, in particular renewables combined with storage and specifically located in REZs. These include:

1. a wholesale power price underwriting mechanism called the Infrastructure Safeguard Scheme. This would ensure that projects located in designated REZs would be able to sell power into the wholesale market at a minimum price guaranteed by the NSW Government.

2. an availability payment for long duration (8 hours) storage projects located in designated REZs (it is noted that this is specifically suited to pumped hydro projects)
3. a contract for “firming” of renewable energy output provided by batteries, under Long Term Energy Services Agreements. These contracts would be entered into by the State, if modelling suggests reliability standards under the Energy Security Target will be breached (e.g. as a result of coal plant retirements). The contracts are to be tendered for via a competitive process by the Consumer Trustee, an entity to be established by the State.
4. measures to deliver the REZ transmission infrastructure, including making declarations under the Act that a proposed line is a “declared REZ transmission line” and triggering the Independent Regulator to assess the level of cost recovery from consumers to fund the line. Access arrangements will also be developed for secure rights to connect to and evacuate power through the REZ transmission infrastructure.

2.1.5 Local and regional context

Central West and Orana Regional Plan 2036

The Central West and Orana region’s population is expected to increase to more than 300,000 people by 2036. Most of that population growth will be centred in the regional cities such as such as Dubbo, Mudgee and Orange, with these cities providing new opportunities for surrounding networks of communities (NSW Government, 2017).

The Central West and Orana Regional Plan will guide NSW Government’s land use planning priorities and decisions for the region until 2036. The plan also provides an overarching framework to guide more detailed land uses plans, development proposals and infrastructure funding decisions. An accompanying implementation plan outlines priority actions and medium-term and longer-term actions, to align with population and economic change in the region (NSW Government, 2017).

The plan notes that the two areas of Central West and Orana function in different ways however create a resilient and dynamic region when brought together. The Orana region, where the project is located, includes some of the most productive agricultural areas in NSW. The plan identifies that infrastructure improvements will strengthen the supply chain with markets both across Australia and internationally.

The plan’s vision is for the Central West and Orana region to be *“the most diverse regional economy in NSW with a vibrant network of centres leveraging the opportunities of being at the heart of NSW”* (NSW Government, 2017).

The plan outlines four goals to contribute to this vision, each with several directions:
1. be the most diverse regional economy in NSW
2. be a stronger, healthier environment and diverse heritage
3. provide quality freight, transport and infrastructure works
4. build dynamic, vibrant, and healthy communities.

The first goal, to be the most diverse regional economy in NSW is most relevant, with the project aligning with Direction 9: Increase renewable generation.

The plan notes that growth in renewable energy in the region (particularly wind, solar and bioenergy) will promote local jobs in smaller communities and development opportunities for associated industries.

Warrumbungle Shire Council Development Control Plan 2015

The *Warrumbungle Shire Council – Development Control Plan 2015* (Warrumbungle Shire Council, 2015) (the Warrumbungle DCP) was adopted by Warrumbungle Shire Council on 17 September 2015 and subsequently amended on 16 February 2017 by Council Resolution 190/1617 then commenced operation 23 February 2017.

The Warrumbungle DCP compliments the *Warrumbungle Local Environmental Plan 2013* (Warrumbungle Shire Council, 2013) and provides detailed requirements to guide development in the Warrumbungle Shire Council LGA.

Section 5 of the Warrumbungle DCP applies to RU1 Primary Production Zones and R5 Large Lot Residential Zones. It is a requirement under Section 5 that

> ***"Any new residence or residential accommodation should be located a minimum distance of 2km from any active or proposed wind turbine, unless suitable measures are taken in the design and construction of the dwelling to ameliorate any noise or other impacts.".***

Any future residential development applications near the wind farm would need to consider Section 5 of the Warrumbungle DCP.

2.2 Project options and alternatives considered

2.2.1 'Do nothing'

The 'do nothing' option represents the option of not developing a wind farm project, and not investing in other renewable projects. This option would avoid all the impacts of the project as described in this EIS, however, would also not deliver the potential benefits of the project. The benefits that would not be delivered include:

- a renewable energy development that would align with NSW and Federal strategic direction on emissions reduction including emissions reduction targets
- development within the first REZ in NSW, supplying approximately 800 megawatts to the NEM, and contributing to the targeted 3,000 megawatts for the CWO-REZ as identified in the NES
- contributing to the security and reliability of the NEM following the expected closure of all five coal-fired electricity generators operating in NSW by 2043
- direct and indirect economic benefits to local communities in regional NSW, through employment opportunities, increased spending in local communities because of the project workers during construction and operation,
- direct and indirect economic benefits to the local community through community benefit programs, neighbouring property benefits scheme and lease payments to landholders
- broader community benefits as a result of the project making funding available during its operational life, such as supporting local education and training programs and public infrastructure upgrades.

2.2.2 Investing in other renewable projects

UPC\AC are investing in a significant pipeline of wind, solar, pumped hydro and other energy projects both within NSW and nationally. Most notably New England Solar Farm is currently under construction, as well as multiple developments being pursues that have been granted planning approval.

The decision was made to progress the development of a number of renewable energy projects around the Central West due to several factors, including abundant wind and solar resource, topography favourable for both wind solar, and existing rural land uses and subsequent low density of surrounding dwellings, and the area having a planned focus on renewable energy as part of the CWO-REZ.

2.2.3 Alternative renewable energy projects

Once the decision was made to proceed with a renewable energy project in the area surrounding Coolah, further consideration was given to the type of development that would best suit the environmental conditions, whilst having regard to the local community and other environmental constraints.

The topography local to Coolah lends itself to wind energy due the moderately complex terrain and elevation, facilitating high average wind speeds when compared to the surrounding lower elevation locations within NSW. Wind farms or hybrid developments were considered, which would typically comprise wind and solar, or wind and another renewable technology.

UPC\AC has carried out preliminary wind resource modelling, which shows the areas around Coolah as having a resource appropriate for wind generation with the optimal locations for turbines being along ridgelines (refer to discussion in **Section 2.3**).

According to the Clean Energy Council, wind power is currently the cheapest source of large-scale renewable energy in Australia. In 2018, Australia's wind farms produced 33.5 per cent of the country's clean energy and 7.1 per cent of the country's total electricity generation.

Wind energy investment is now more than $8 billion in Australia, helping to create about 5000 jobs. Wind power is an important energy source that will help Australia meet its national and international commitments to reduce its greenhouse gas emissions.

2.3 Site selection and justification

2.3.1 Overview of site selection and justification

The project has been developed over a period of two years to date and site due diligence, preliminary investigations and discussions with landholders and key stakeholders (including the Department of Planning, Industry and Environment) have been conducted.

UPC\AC carried out preliminary assessments of potential sites and turbine layouts as part of project development. The evaluation of site options and layouts considered various factors including technical feasibility, as well as potential or perceived impacts on the local community and the environment.

The following justifications support the decision to proceed with the project in its current location:

- quality of the wind resource in the area
- suitability of the land for project infrastructure
- strong connection point into the NEM, via the proposed CWO-REZ transmission line
- alignment with strategic plans for the wider region (refer to discussion in **Section 2.1**)
- economic benefit to the area which could potentially increase employment opportunities in the area.

2.3.2 Technical feasibility

Quality of wind resource

The effectiveness of any wind generating project is limited by wind generating potential of the site. According to Geoscience Australia (Geoscience Australia, 2019), regions with high wind energy potential are characterised by:

- high average wind speeds (greater than 7.5 metres per second)
- winds that are either constant or coinciding with peak energy consumption periods (during the day or evening)
- proximity to a major energy consumption region (i.e. urban/industrial areas)
- smooth landscape, which increases wind speeds, and reduces the mechanical stress on wind turbine components (resulting from variable and turbulent wind conditions associated with rough landscapes).

The project has been split into three wind turbine clusters (characterised by the above points) to align with areas that experience higher average wind speeds.

Suitability of the land

Topography

The local topography and other variability in the local terrain such as surface roughness, exert a major influence on wind speed and wind variability. Wind speed decreases with an increasingly rough surface cover, but can be accelerated over steep hills, reaching a maximum at the crest, and then separating into zones of turbulent air flow (Geoscience Australia, 2019). For these reasons, the optimal location for turbines is along ridgelines.

The topography of the site is variable with the ridgelines ranging between 626 metres AHD and 757 metres AHD. The local terrain lends itself to site optimising, with the major ridgelines orientated perpendicular to the predominant wind direction. The gentle ridgelines of the site provide for flexibility in design for micro siting of turbines in response to environmental, heritage and visual constraints.

The gentle terrain is well suited to the development of associated project infrastructure (such as electricity reticulation and substations) and allows for good access for both construction and operation.

Land use

All turbines are proposed to be located on freehold land under agreements with the landowners (refer to discussion in **Section 17.1**).

The current predominant land use of the site is cattle grazing. The land will continue to be used for grazing for the operational life of the wind farm to maintain current use without significant impediment following the decommission of the wind farm at the end of its practical life.

The indicative turbine layout enables continuation of current farming practices with little disruption. During operation, the total ground footprint of the project will be 549 hectares or 2% of the wind farm site, with land between the turbines remaining available for rural land use activities such as grazing.

The access tracks would promote dual purpose for existing landowners who would be able to continue using these for access through their property. Parts of the project that continue to serve a functional purpose for the predominant land use such as these access tracks, may be left in place after decommissioning, depending on individual landowner agreements with UPC\AC.

Connection to the NEM

The high voltage transmission line of up to 330 kilovolts required to connect the wind farm to the CWO-REZ, would run generally south from the substation in the Girragulang Road cluster, and southeast from the substation in the Leadville cluster. The proposed transmission lines provide a relatively short connection distance (about 15 kilometres), which would help to reduce community, social and environmental issues associated with high voltage transmission lines.

The electricity available to the NEM per annum from the project would be approximately 800 megawatts, contributing to reduced emissions and a greater mix of renewable energy in the NEM, in turn supporting Australia's transition to a lower carbon future.

2.3.3 Community and environmental considerations

UPC\AC has undertaken extensive community and stakeholder consultation during the development of the project, which along with preliminary environmental assessments, has provided substantial input in the evaluation of site options and layouts. In designing the project, the following hierarchy was adopted:

- **avoid** – in the first instance, all efforts were made to avoid potential environmental impacts
- **minimise** – where potential impacts could not be avoided, design principles sought to minimise environmental impacts, as far as feasibly possible
- **mitigate** – mitigation strategies will be implemented to manage the extent and severity of remaining environmental impacts
- **offset** – environmental offsets shall be used only as applicable, following all efforts to first avoid, minimise and mitigate environmental impacts.

Key community and environmental factors considered in the site selection and refinements to the layout for the project are discussed in **Section 2.4**.

2.4 Project refinements

2.4.1 Overview of project refinements

There have been numerous refinements to the wind farm site, turbine layout and high voltage transmission line throughout project development. Refinements have largely been driven by ongoing consultation with landowners, in response to the findings of ongoing environmental assessments for the EIS, and in response to community feedback since the project scoping phase.

A summary of refinements to the main project elements is presented in **Table 2-1** and shown in **Figure 2-4**.

In addition to the more significant refinements outlined in **Table 2-1** and **Figure 2-4**, there have also been various minor refinements to the project layout not captured here, to reduce potential environmental and social impacts of turbines and ancillary infrastructure and to enhance the functionality of the wind farm layout.

Table 2-1: Summary of key project refinements

Project element	Change	Key reasons for refinement
Wind farm site	Removal of turbine clusters	Reduction of potential cumulative environmental and social impacts
	Additional properties added	Include additional land parcels which provides increased flexibility within the development footprint to avoid/exclude areas of environmental significance, whilst maximising the electricity generation potential of the infrastructure of the available development footprint
Turbine layout	Reduced number of turbines and refinement of turbine locations	• Avoid sensitive environmental areas • address social equity concerns associated with landholder agreements and available compensation • optimise wind resource access • address engineering constraints and opportunities
High voltage transmission line	Connect to the CWO-REZ	Minimise environmental and social impacts, reduce the number of landholders affected by the required high voltage transmission line, and provide connection to the CWO-REZ transmission line
Potential workforce accommodation area	Location for potential workforce accommodation area identified	Location identified in response to feedback from social impact assessment survey and community concern about regional availability of accommodation for the peak workforce. The potential accommodation area is subject to further consideration and consultation with Warrumbungle Shire Council.

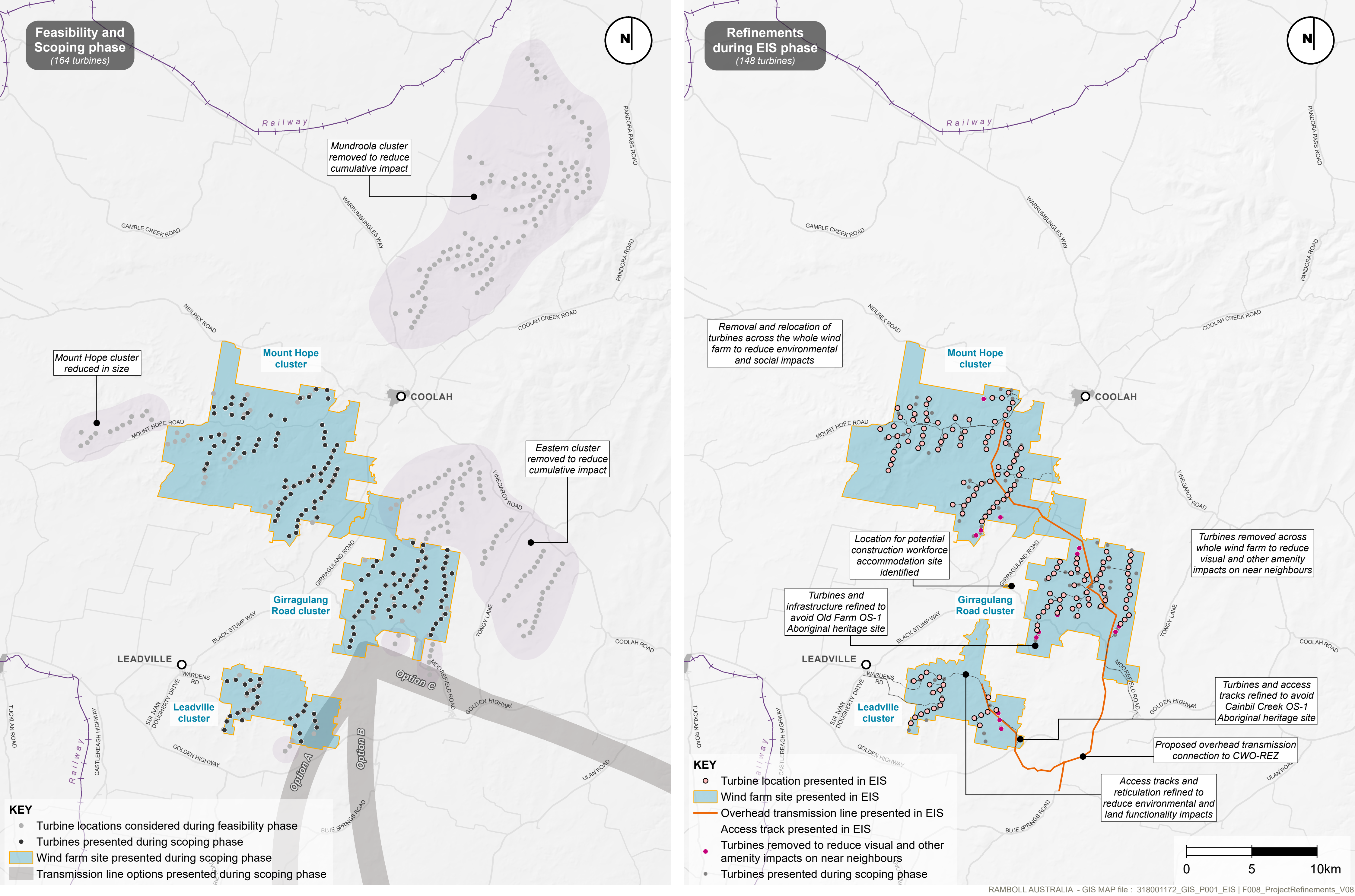


Figure 2-4 | Project refinements

2.4.2 Wind farm site

A preliminary desktop analysis of potential wind farm layouts undertaken during the early project feasibility assessment phase, considered the potential planning, environmental and social constraints arising from the proposed wind farm.

Through this process, UPC\AC concluded that two areas initially considered for the project had the potential to generate unwarranted cumulative impacts when considered alongside the proposed Liverpool Range Wind Farm. These two areas were:

- a turbine cluster to the north of Coolah, referred to as the 'Mundroola Cluster'
- another turbine cluster to the east of the Girragulang Road cluster, referred to as the 'Eastern Cluster'.

Although the wind resources in these northern areas would warrant consideration of micro siting of turbines, these clusters have been removed from the current project to avoid these unwarranted cumulative environmental and social impacts. A number of turbines in other areas were also removed or relocated during this process to minimise engineering, environmental and community constraints.

2.4.3 Turbine layout

In addition to the removal of the 'Mundroola' and 'Eastern' clusters, the turbine layout in the remaining three clusters has undergone numerous refinements to avoid or minimise potential and perceived environmental and social impacts. A summary of refinements to turbine numbers and turbine locations, along with the reasons for any changes, is presented in **Table 2-2**.

Table 2-2: Summary of refinements to turbine and clusters

Cluster	Initial number of turbines	Number of wind turbines in current layout	Change	Reason for change
Mt Hope	91	76	-12	Turbines extending further west have been excluded to avoid areas of environmental significance and higher dwelling density
Girragulang Road	122	51	-69	Turbines extending further north west have been excluded due to the perceived cumulative impact in conjunction with the approved Liverpool Ranges Wind Farm
Leadville	27	21	-6	Turbines reduced in response to environmental, social and technical issues
Mundroola	92	-	-92	Cluster has been removed due to the perceived cumulative impact on the town of Coolah

Cluster	Initial number of turbines	Number of wind turbines in current layout	Change	Reason for change
Eastern	76	-	-76	Cluster has been removed due to the potential cumulative impact on the town of Coolah

The turbine layout has undergone further refinement during the preparation of the EIS in response to the findings of the technical assessments and the outcomes of the social impact assessment, including concerns and comments raised by the community. Refinements have included:

- removal and relocation of turbines, access tracks and associated infrastructure in the Girragulang Road cluster to avoid impacts on known Aboriginal heritage item 'Old Farm'
- relocation of turbines and reduction of footprint of proposed access tracks in the Leadville cluster, to avoid areas of potential archaeological deposits associated with a known Aboriginal heritage item at Cainbil Creek
- removal and relocation of turbines and access tracks across all three clusters in response to the findings of the biodiversity investigations and to reduce the impact on existing vegetation. Refinements responding to biodiversity impacts are summarised in **Table 2-3**.
- Reduction of visual and other amenity impacts. This refinement has seen several turbines removed from the project, and turbines relocated to reduce the visual impact of the project on nearby dwellings whilst still maintaining the feasibility of the project.

Table 2-3: Summary of refinements to reduce biodiversity impacts

Development feature	Initial proposal (Scoping Study 2019)	Final proposal	Result
Wind turbine locations	175 wind turbines proposed across three wind farm clusters.	Reduced to 148 turbines.	15% reduction in wind turbines. Turbines in high-risk locations have been removed from the development. Final turbine layout maximises category 1 land and low condition native grassland.
Internal access tracks and electrical reticulation	Not included in original design	Internal access follows existing cleared farm tracks where possible.	Majority of all other tracks to be located in category 1 land and low condition native grassland. Electrical reticulation to be trenched along access tracks to consolidate area of ground disturbance.
Internal transmission lines (between wind farm clusters)	Connector transmission line between Girragulang Road and Mount Hope not included in original design. Connector transmission lines proposed directly between Leadville and Girragulang Road clusters through approximately 7.2km of forested vegetation.	Connector transmission line between Girragulang Road and Mount Hope crosses valley floor that is predominately cleared for cropping. Connector transmission lines proposed directly between Leadville and Girragulang Road abandoned, in preference for direct connection to REZ Transmission line from Leadville.	Areas of better-quality vegetation have generally been avoided by following cleared areas.

Development feature	Initial proposal (Scoping Study 2019)	Final proposal	Result
External transmission lines (wind farm to REZ Transmission line)	Approximately 75km of 500kv transmission line proposed from Girragulang Road cluster to Mount Piper to Bayswater Transmission line south of Merriwa, impacting CEEC and Regent Honeyeater important areas.	Approximately 15km of up to 500kV transmission line between Girragulang Road/Leadville clusters, to connect to the Central West Renewable Energy Zone Transmission line	Avoidance of significant areas of native vegetation. Significant reduction in area of CEEC impacted. Avoidance of Regent Honeyeater important areas.
Substations	Not included in original design	Located within category 1 land with little to no biodiversity value	Low impact and preservation of better-quality areas
Component haulage and construction access	Access to Mount Hope cluster via Neilrex Road and Mount Hope Road, resulting in potential major road upgrades through moderate condition native vegetation	Access to Mount Hope now follows existing farm tracks off Black Stump Way, no upgrades to public roadways required.	Low impact and preservation of better-quality areas
Ancillary infrastructure (site offices, laydown areas, etc)	Not included in original design	Located within category 1 land with little to no biodiversity value	Low impact and preservation of better-quality areas

2.4.4 High voltage transmission line

The scoping report issued to the Department of Planning, Industry and Environment in June 2020, included three route options for the project high voltage transmission line to connect to the NEM:

- **Option A**: a total length of approximately 70 kilometres to the existing Wollar substation and the 500 kV Wollar extension, through the Peabody mining lease areas
- **Option B**: a total length of approximately 55 kilometres to the existing Wollar substation and the 500 kV Wollar extension, through the Peabody mining lease areas
- **Option C**: a total length of approximately 65 kilometres to the Mt Piper to Bayswater 500kV transmission line. This option required the construction of a new substation for the connection the Mount Piper to Bayswater 500 kilovolt transmission line.

These transmission line route options are shown on **Figure 2-4**.

Since submission of the scoping report, TransGrid, in consultation with the NSW Government, have released the study corridor for the proposed CWO-REZ Transmission line, which runs approximately east-west, south of the wind farm site.

In response to this new connection option, the high voltage transmission line from the wind farm is now proposed to connect directly into the NEM via a high voltage transmission line which would run approximately 13 kilometres to a connection point with the Central West Orana REZ (CWO-REZ) Transmission line proposed by TransGrid and the NSW Government, as shown on **Figure 2-4**.

UPC\AC are consulting with the NSW Government to establish the most feasible strategy to connect the wind farm directly to the CWO-REZ Transmission line, noting that the proposed connection would significantly reduce the potential environmental and social impacts of the project by:

- reducing the number of landholders affected by the required high voltage transmission line
- reduce the overall environmental impacts of the project through a significantly reduced impact footprint and reduced vegetation clearance associated with the required transmission line easements
- improving the efficiency of dispatching the electricity generated by the wind farm by providing a more direct connection to the NEM via the CWO-REZ Transmission line.

2.4.5 Potential workforce accommodation area

Throughout the project scoping phase, UPC\AC have considered two options for accommodating the construction workforce required for the project. The first option is a regional distribution of the peak workforce with accommodation sourced from surrounding towns. The second option is to accommodate the entire incoming workforce in purpose-built workforce accommodation.

Key findings from the social impact assessment survey undertaken as part of this EIS suggest that one of the major recurring issues raised by the community is the difficulty of accommodating a large workforce within the surrounding towns. Issues raised in the survey include shortages of appropriate accommodation in surrounding towns and potential impacts on tourism and local housing associated with an increased pressure on available accommodation.

In response to this emerging issue, UPC\AC have refined the project to identify a suitable location for a purpose-built workforce accommodation area, which has been discussed with the relevant landholder and is shown on **Figure 2-4**.

If required, the purpose-built workforce accommodation area would include rooms and amenities for the expected peak workforce, and supporting facilities such as car parking, a dining hall, gym, library, and other recreational facilities. UPC\AC would enter into a lease agreement with this landholder for the duration of the construction period.

The two options for accommodating the construction workforce required for the project are discussed in more detail in **Section 4.8.2** and **Section 4.8.6.**

2.5 Cumulative considerations

The project is located nearby to other renewable energy projects and proposed infrastructure associated with the CWO-REZ.

Cumulative impact concerns identified during consultation primarily related to the potential for multiple concurrent and nearby major projects leading to reduced levels of social cohesion, creation of a skills shortages or a shortfall in supplies, increased pressure on community services and the impact on the road network. These have been considered by UPC\AC and are assessed in detail in **Chapter 15** and **Chapter 18.**

The key issues that have been subject to specific cumulative impact assessment relate to visual, traffic, noise, air quality, social and land use. The impacts would be dependent on the final timing and duration of construction and operation of nearby existing and proposed developments within the region. This being the case, the methodologies used for these assessments are based on conservative assumptions. Early identification and assessment of these impacts have informed significant design refinements as discussed in **Section 2.4**. The contribution of the project does not result in a change of compliance outcome with respect to noise limits and is not expected to generate unacceptable cumulative impacts related to road capacity, visual impacts, social, land use and air quality.

Cumulative impacts would be managed by the project commitments outlined in **Chapter 19** relating to coordinated management plans for construction, operation and decommissioning of the project and ongoing engagement with the proponents of nearby activities, particularly the Liverpool Range Wind Farm.

3. SUMMARY OF STATUTORY PLANNING AND APPROVAL PROCESS

3.1 Environmental planning framework overview

The following provides a summary of the environmental planning framework relevant to the project. A detailed discussion is provided in **Appendix C**.

3.1.1 Environmental Planning and Assessment Act 1979

Permissibility

The *Environmental Planning and Assessment Act, 1979* (EP&A Act) and the *Environmental Planning and Assessment Regulation, 2021* (EP&A Regulation) provide the framework for environmental planning and assessment in NSW.

Environmental planning instruments (EPIs) are established under the EP&A Act to regulate land use and development. EPIs determine the relevant part of the EP&A Act under which a development project must be assessed and therefore determine the need, or otherwise for development consent. EPIs consist of State environmental planning policies (SEPPs), regional environmental plans (REPs), and local environmental plans (LEPs).

The project is declared to be State significant development (SSD) by the provisions of the *State Environmental Planning Policy (Planning Systems) 2021* (Planning Systems SEPP). This is discussed further in **Appendix C**.

Development consent is required under Part 4 of the EP&A Act for any project that is considered SSD by a SEPP. The project is therefore subject to assessment under Part 4, Division 4.1 of the EP&A Act.

Development application process

An overview of the planning approval process for SSD under Division 4.1 of Part 4 of the EP&A Act is provided in **Figure 3-1**.

Section 4.12(8) of the EP&A Act requires a development application (DA) for SSD to be accompanied by an EIS prepared in accordance with the EP&A Regulation. Prior to preparation of an EIS, an applicant must make a written request for the Secretary's Environmental Assessment Requirements (SEARs) which specify what must be addressed in an EIS for a project. UPC\AC submitted a request for SEARs in May 2020, accompanied by a scoping report as required by Section 173 of the EP&A Regulation.

A referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was also submitted to the Australian Department of Agriculture, Water and the Environment in June 2020. The referral was required because the project is considered likely to have a significant impact on Matters of National Environmental Significance (MNES) due to potential impacts to listed threatened species and ecological communities, and migratory species.

On 13 July 2020, a delegate of the Federal Minister for the Department of Agriculture, Water and the Environment determined that the project was a controlled action under section 75 of the EPBC Act.

The SEARs for the project were issued on 9 June 2020, and supplementary SEARs to address the requirements of the Australian Department of Agriculture, Water and the Environment were issued in July 2020. These are both provided in **Appendix A.**

The project is being assessed in accordance with the NSW Assessment Bilateral Agreement, Amending Agreement No. 1, because it requires both NSW and Australian Government environmental approvals. Under the Agreement, the NSW Government can assess development applications on behalf of the Australian Government. The Australian Government remains the decision-maker for the EPBC Act approval, considering the assessment report prepared by the Department of Planning, Industry and Environment.

The EIS will be placed on public exhibition for a minimum of 30 days by the Department of Planning, Industry and Environment and submissions will be sought from local and State government agencies and the community. Any submissions received by the Department will be reviewed and forwarded to UPC\AC to consider and respond to, via a response to submissions report.

Following receipt of the response to submissions report, the Department of Planning, Industry and Environment will prepare its assessment report considering this EIS, all submissions received during the exhibition process, and the responses provided by UPC\AC. The Department of Planning, Industry and Environment's assessment report is forwarded to the consent authority for consideration before determining the DA.

Evaluation

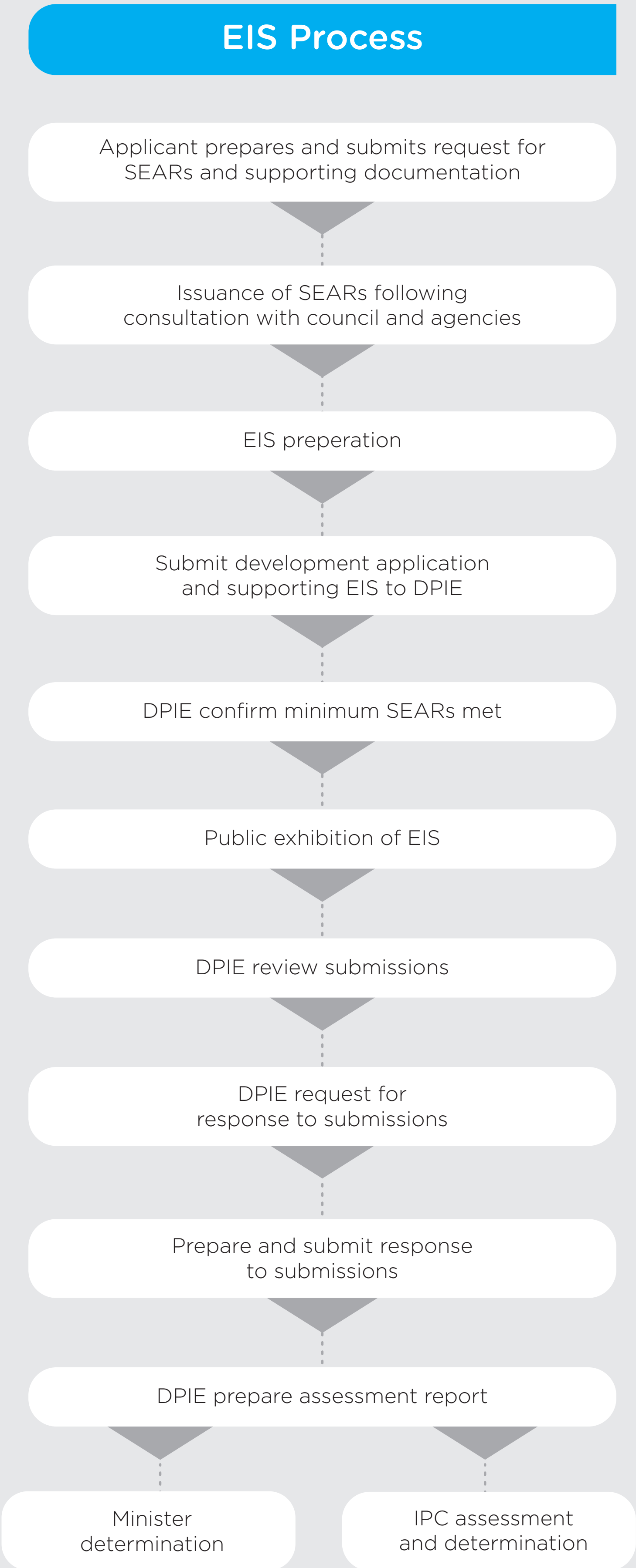
Under Section 4.38 of the EP&A Act, the NSW Minister for Planning is the consent authority for SSD. However, pursuant to Section 2.4 of the EP&A Act, the Minister may delegate the consent authority function to the Office of the Independent Planning Commission (OIPC), the Secretary or to any other public authority.

Additionally, in accordance with the Wind Guideline the OIPC is the consent authority for SSD in the following circumstances:

- 25 or more people have objected to the application
- the local council has objected to the application
- the applicant has disclosed a reportable political donation in connection with the application or a previous related application.

Part 4 Division 4.1 of the EP&A Act

State significant development planning process



Matters for consideration

When assessing a DA for SSD, the consent authority is required to take into consideration the matters outlined in Section 4.15 of the EP&A Act. A summary of the requirements under Section 4.15 and where each requirement has been addressed in this EIS is listed in **Table 3-1**.

Table 3-1: Matters for consideration under Section 4.15 of the EP&A Act

Provision	Where addressed
a) the provisions of:	
(i) any environmental planning instrument	**Section 3.1.2** and **3.1.3**
(ii) any proposed instrument that is or has been the subject of public consultation under this Act and that has been notified to the consent authority (unless the Planning Secretary has notified the consent authority that the making of the proposed instrument has been deferred indefinitely or has not been approved)	N/A
(iii) any development control plan	**Section 2.1.5**
(iii) (a) any planning agreement that has been entered into under section 7.4, or any draft planning agreement that a developer has offered to enter into under section 7.4	N/A
(iv) the regulations (to the extent that they prescribe matters for the purposes of this paragraph),	**Chapter 6 – Chapter 17**
(v) (Repealed) that apply to the land to which the development application relates,	N/A
b) the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,	**Chapter 6 – Chapter 17**
c) the suitability of the site for the development,	**Section 2.3**
d) any submissions made in accordance with this Act or the regulations,	To be confirmed following public exhibition
e) the public interest.	**Chapter 5** **Chapter 15**

Determination and appeals

Pursuant to Division 4.16 of the EP&A Act, a consent authority is to determine a DA by either:

a) granting consent to the application, either unconditionally or subject to conditions

b) refusing consent to the application.

As provided by Clause 113 of the EP&A Regulation, the consent authority has 90 days to determine a DA for SSD. If the DA is refused, an applicant may appeal to the Land and Environment Court against the determination, pursuant to Division 8.7 of the EP&A Act.

Exempt approvals for State significant development

Clause 4.41 of the EP&A Act clarifies that development consent for SSD includes authorisations under the following statutory provisions, meaning that the following separate planning approval processes do not apply:

- A permit under section 201, 205 or 219 of the Fisheries Management Act 1994
- An approval under Part 4, or an excavation permit under section 139, of the Heritage Act 1977
- An Aboriginal heritage impact permit (AHIP) under section 90 of the National Parks and Wildlife Act 1974
- A bushfire safety authority under section 100B of the Rural Fires Act 1997
- A water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the Water Management Act 2000.

3.1.2 State environmental planning policies

A summary of the SEPPs that are relevant to the project and how they are considered is provided in **Table 3-2**. This is discussed in more detail in **Appendix C**.

Table 3-2: Applicable SEPPs

SEPP	Comment
State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP)	Planning Systems SEPP identifies development and infrastructure that is regionally and State significant. Schedule 1 identifies general criteria to be met for a project to be considered SSD. Clause 20 of Schedule 1 outlines the criteria for electricity generating works and heat or co-generation. The project is a development for the purpose of electricity generation using a wind energy source and would have a capital investment value of more than $30 million and is therefore considered SSD for the purposes of the EP&A Act.
State Environmental Planning Policy (Transport and Infrastructure) 2021 (Transport and Infrastructure SEPP)	**Chapter 2 Infrastructure** Chapter 2 of the Transport and Infrastructure SEPP provides that development for the purpose of electricity generating works may be carried out by any person with consent on any land in a prescribed rural, industrial or special use zone. Under Clause 2.36(1) of the Transport and Infrastructure SEPP, the provisions of the SEPP prevail where there are inconsistencies with other environmental planning instruments, including local environmental plans. The project site is on land zoned RU1 – Primary Production under the Warrumbungle LEP and is permitted with consent through the provisions of Transport and Infrastructure SEPP. The provisions of Section 2.118 of the SEPP Infrastructure require access to be provided by a road other than a classified road, where practicable and safe. The impacts on traffic and logistics, including discussion on access requirements have been addressed in **Chapter 9**.

3.1.3 Local environmental plans

Warrumbungle Shire Council Local Environmental Plan 2013
The project is located within the Warrumbungle Local Government Area and is subject to the Warrumbungle LEP.

A summary of the relevant aspects of the Warrumbungle LEP applicable to the project is provided in **Table 3-3**.

Table 3-3: Summary of relevant Warrumbungle LEP provisions

Provision description	Relevance to the proposal
Clause 2.3 – Zone objectives and Land Use Table	Land zoning for the project is shown on **Figure 3-2**. The project is on land that is zoned RU1 – Primary Production. The project is complementary to continued productive agricultural use of RU1 zoned land and represents economic use of land. '*Electricity generating works*' is prohibited in the RU1 zone as it is not specified in item 2 or 3 of the land use table. The project is a prescribed rural zone under the Transport and Infrastructure SEPP as discussed in **Section 3.1.2** which prevails over the inconsistency and permits the land use for the project.
Clause 4.1 – Minimum subdivision lot size	Some project infrastructure is located within zone 'AG' on the minimum lot size map. AG is associated with a minimum subdivision lot size of 600 ha. The land on which the substations are constructed is likely to require subdivision. Following decommissioning of the project, the subdivided lots would be reconsolidated back into the original lot. Despite the provisions of Clause 4.1 of the LEP, the proposed subdivision would be permissible under Section 4.38 of the EP&A Act, subject to the approval of the Minister for Planning. Further discussion on the subdivision relating to land use is provided in **Section 17.1**.
Clause 5.10 – Heritage conservation	An Aboriginal cultural heritage assessment report (ACHAR) and a non-Aboriginal heritage impact assessment have been prepared and are provided in **Appendix N** and **Appendix O**. The potential impacts to Aboriginal and Historical heritage items by the project and responding management measures are discussed in **Chapter 11** and **Chapter 12**
Clause 6.2 – Flood planning	The project is not located within an identified flood planning area under the Warrumbungle LEP. Despite this, impacts on hydrology have been addressed in **Chapter 13.**

Provision description	Relevance to the proposal
Clause 6.3 – Terrestrial biodiversity	Areas of the study area have been identified as terrestrial biodiversity areas under the Warrumbungle LEP (refer to **Figure 3-3**. The requirements of Clause 6.3 have been considered in **Chapter 8.** The development has been designed to avoid, minimise and mitigate impacts to mapped areas of Biodiversity.
Clause 6.4 – Groundwater vulnerability	Areas of the study area have been identified as groundwater vulnerable under the Warrumbungle LEP (refer to Figure 3-3). The requirements under Clause 6.4 have been considered in **Chapter 13.**
Clause 6.5 – Riparian lands and watercourses	The Coolaburragundy River, Talbragar River, and other higher order watercourses have been identified as riparian lands and watercourses under the Warrumbungle LEP (refer to **Figure 3-3**). The requirements under Clause 6.5 have been considered in **Chapter 8** (biodiversity) and **Chapter 13** (water and soils).

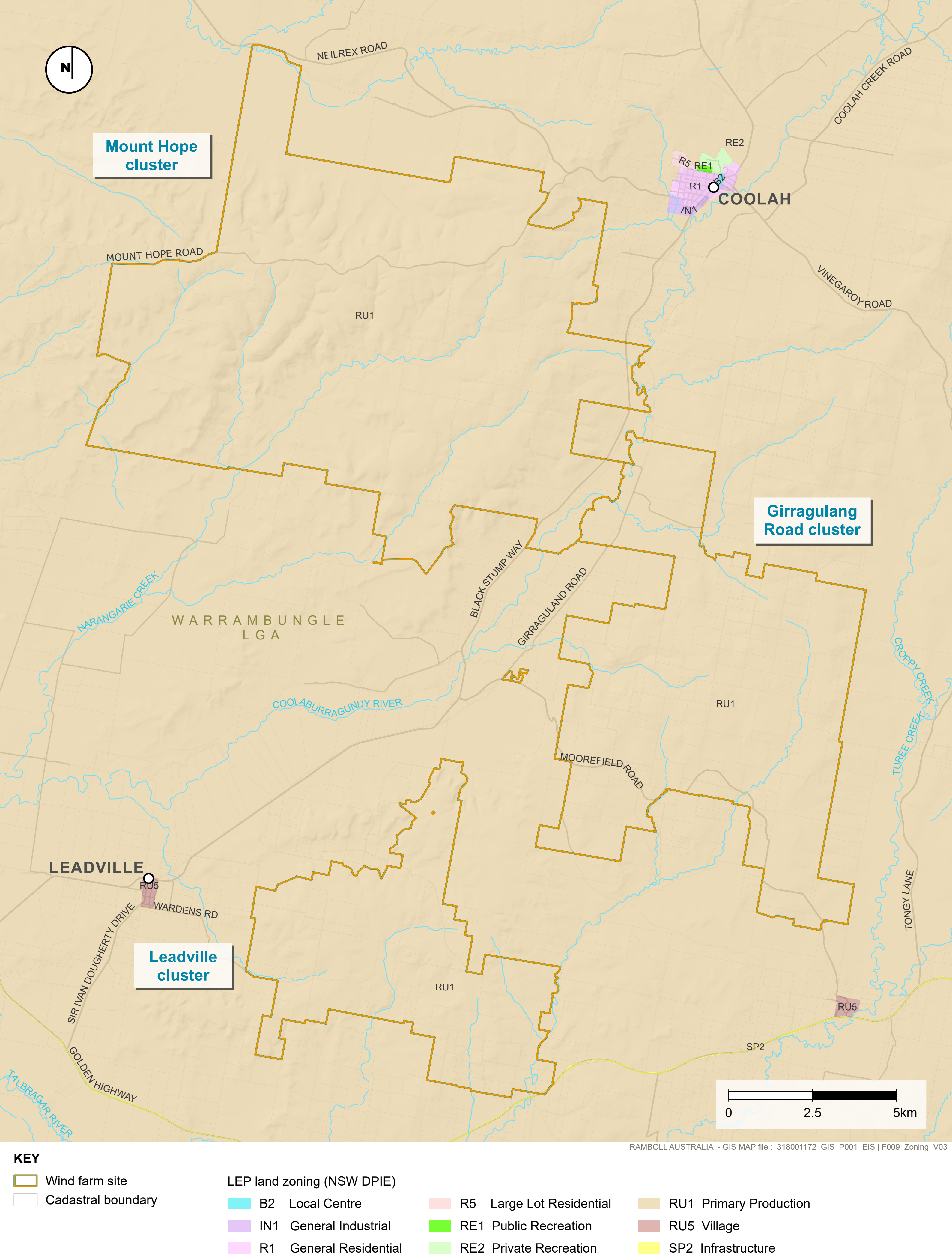
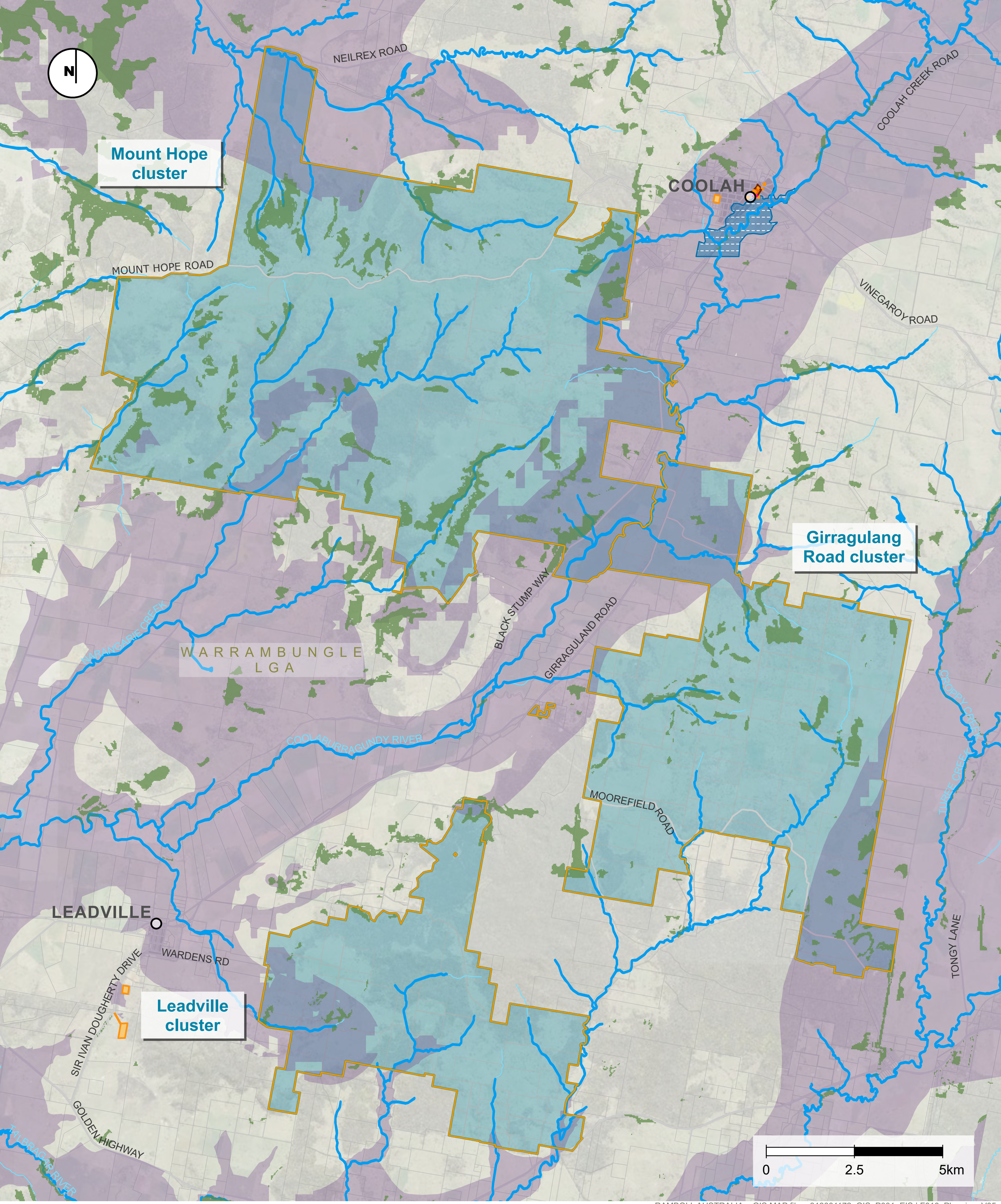


Figure 3-2 | Warrumbungle Shire Council Local Environmental Plan 2013 Land zoning



RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F010_Planning_V05
Aerial photography from NSW Government Spatial Services

KEY

- Wind farm site
- Cadastral boundary

Warrumbungle Shire Council Local Environmental Plan 2013 (NSW DPIE)

- Terrestrial biodiversity area
- Riparian land and watercourse
- Vulnerable groundwater
- Flood planning area
- State Heritage Register item

LEP heritage items

- General item
- General conservation area

Figure 3-3 | Relevant Warrumbungle Shire Council Local Environmental Plan 2013 considerations

3.2 Other NSW legislation

A summary of other relevant NSW legislation that is applicable to the project is provided in **Table 3-4** and a detailed assessment against each provision is provided in **Appendix C**.

Table 3-4: Other NSW legislation

Legislation	Comment
Protection of the Environment Operations Act 1997 (POEO Act)	The NSW Protection of the Environment Operations Act 1997 (POEO Act) is administered by the NSW Environment Protection Authority (EPA). Section 48 of the POEO Act requires an environment protection licence (EPL) to undertake scheduled activities at a premise. Scheduled activities are defined in Schedule 1 of the POEO Act and includes 'Electricity generation' as a premise-based activity. An EPL is required for wind energy projects which are SSD or a designated development. The project may also require an EPL during the construction phase for crushing, grinding or separating concrete if the activity has the capacity to process more than 150 tonnes of materials per day or 30,000 tonnes of materials per year. Part 5.7 of the POEO Act provides a duty to notify the relevant authority of pollution incidents, and under section 120 it is an offence to pollute waters. The project will be managed to ensure pollution risks are avoided or minimised. In the event of a pollution incident that causes or threatens material harm to the environment, the NSW EPA would be notified. It is an offence under section 143, to unlawfully transport and dispose of waste. Waste minimisation and management is discussed in **Chapter 14.**
Biodiversity Conservation Act 2016 (BC Act)	The NSW *Biodiversity Conservation Act 2016* (BC Act) establishes the regulatory framework for assessing and offsetting biodiversity impacts for proposed developments. Detailed ecological assessments of the study area have been undertaken in accordance with the Biodiversity Assessment Methodology and is at **Appendix G**. The project has been located to avoid and minimises impacts to biodiversity values. A total of 8,966 ecosystem credits and 19,688 species credits are required to offset the above impacts of the project.

Legislation	Comment
	Detailed assessment of the potential impacts of the project on native vegetation and threatened species listed under the BC Act is provided in **Chapter 8** and **Appendix G.**
Biosecurity Act 2015 (BSA Act)	The Warrumbungle Shire Council is the Local Control Authority responsible for administering the BSA Act in the region affected by the project. A weed assessment has been undertaken and is summarised in **Chapter 8**. With the appropriate mitigation measures in place for the project, the risk of spreading of these weeds is considered low. A detailed protocol would also be developed to confirm biosecurity is maintained for ongoing cattle grazing that is able to resume on by landowners as part of the project.
Noxious Weeds Act 1993	The *Noxious Weeds Act 1993* aims to prevent the establishment, reduce the risk of spread and minimise the extent of noxious weeds. Appropriate project management to minimise the risk of spreading noxious weeds would be considered and addressed in the construction environmental management plan (CEMP).
Local Land Services Act 2013 (LLS Act)	The NSW *Local Land Services Act 2013* (LLS Act) provides framework for the management of local land services and includes the requirement to obtain approval under Part 5A of the LLS Act to remove native vegetation in a regulated rural area. The project is, for the most part, sited on the ridgelines and therefore aims to avoid clearing or ground disturbance within the vulnerable regulated areas. Assessment of the impacts the project has on native vegetation is provided in **Chapter 8** and **Appendix G.** ELA have developed a mapping approach to provide a completed Native Vegetation Regulatory map (NVR) Map, to be applied to the assessment of the impact the project has on native vegetation. Further detail of the completion of the NSW Native Vegetation regulatory map and the impacts of the project on native vegetation is provided in **Chapter 8** and **Appendix G.**
National Parks and Wildlife Act 1974 (NPW Act)	Under Section 90 of the NPW Act, a person must not harm or desecrate an Aboriginal object or place without an Aboriginal heritage impact permit. Pursuant to section 4.41 of the EP&A Act, an Aboriginal Heritage Impact Permit (AHIP) under section 90 of the NP&W Act is not required for SSD. An ACHAR has been prepared and found that three Aboriginal cultural sites may be directly impacted by the project. Detailed discussion of the potential impacts to Aboriginal heritage sites and the required management measures are detailed in **Chapter 11** and **Appendix N**.

Legislation	Comment
Heritage Act 1977 (Heritage Act)	The site is not listed on the State Heritage Register (SHR), nor is it in the immediate vicinity of any SHR items. Approvals under Part 4 or an excavation permit under section 139 of the Heritage Act are not required for SSD by virtue of Section 4.41 of the EP&A Act.
Water Management Act 2000 (WM Act)	The NSW *Water Management Act 2000* (WM Act) regulates the use and interference of surface and groundwater in NSW where a water sharing plan has been implemented. A water use approval under Section 89 of the WM Act, a water management work approval under section 90, or a controlled activity approval (other than an aquifer interference approval) under section 91 of the WM Act, are not required for SSD by virtue of Section 4.41 of the EP&A Act.
Fisheries Management Act 1994 (FM Act)	A permit under sections 201, 205 or 219 of the FM Act is not required for SSD under the provisions of Section 4.41 of the EP&A Act. Direct impacts to aquatic habitats is associated primarily with the transmission line crossings of the Coolaburragundy Creek and Talbragar River which have been assessed as both of these waterways are identified as Key Fish Habitat (KFH). Given the degraded nature of the aquatic habitat present and mitigation measures proposed for the project, the direct impacts to aquatic habitat are unlikely to be significant. Further discussion of the potential impacts to KFH and aquatic species is in **Chapter 8** and **Appendix G.**
NSW *Rural Fires Act 1997* (RF Act)	Bushfires are a known hazard with most of the project located in Vegetation 1 and 2 category bushfire prone land. A Bushfire Risk Assessment has been prepared and is provided in **Appendix L**. The hazard and protection methods relevant to the project are discussed in **Chapter 10**.
Forestry Act 2012	The project does not incorporate land zoned as RU3, managed by NSW Forestry Corporation. Therefore, further consideration of the objectives of the *Forestry Act 2012* and consultation with the NSW Forestry Corporation is not required.
Roads Act 1993 (Roads Act)	The Roads Act sets out the rights of the public regarding access to public roads. Section 7 of the Roads Act 1993 provides that Council is the roads authority for all public roads (including classified roads) other than freeways or Crown roads. A traffic and transport impact assessment has been undertaken and is provided in **Appendix H** and summarised in **Chapter 9**. The project necessitates road upgrades as described in **Chapter 9** and **Appendix H.** Section 138 approval would be needed for approval of physical works on public roads.

Legislation	Comment
	Pursuant to Section 4.42 of the EP&A Act, a consent under section 138 of the Roads Act cannot be refused for SSD that is authorised by a development consent.
Crown Land Management Act 2016	The project affects some portions of Crown Land including existing Crown Enclosure Permits, Crown Licences, Crown leases and Crown reserves. The project includes multiple landholdings associated with Crown Land including existing Crown Enclosure Permits, Crown Licences, Crown leases and Crown reserves. These are discussed in **Section 17.1** Consent from the Land Division, Department of Primary Industries is required for the construction of access tracks over Crown Land.
Contaminated Land Management Act 1997 (CLM Act)	The project does not contain land listed on the Contaminated Lands Register.
Soil Conservation Act 1938	A CEMP will be in place to guide soil management during construction to minimise sedimentation of downstream waterways.
Dangerous Goods (Road and Rail Transport Act) 2008	Dangerous goods transportation licences would be required for vehicles and drivers (if more than 500 litres or 500 kilograms of dangerous goods are required to be delivered to the site). Controls for transport and use of dangerous goods would be included in the CEMP.
Environmentally Hazardous Chemicals Act 1985	The NSW *Environmentally Hazardous Chemicals Act 1985* regulates the use and storage of environmentally hazardous chemicals or declared chemical waste. It provides the Department of Planning, Industry and Environment with assessment and control mechanisms for chemicals and chemical wastes. **Chapter 10** and **Chapter 14** provide management measures for hazardous materials.
Waste Avoidance and Resource Recovery Act 2001 (WARR Act)	Waste impacts from the project have been considered in **Chapter 14,** including details of the types of waste, expected volumes (where known) and how the waste would be transported and disposed.

3.2.1 Other State Environmental Planning Policies

A summary of other relevant SEPPs that are applicable to the project is provided in **Table 3-6**. A detailed assessment against the relevant provisions is it **Appendix C.**

Table 3-5: Other relevant SEPPs

Legislation	Comment
State Environmental Planning Policy (Resilience and Hazards) 2021 (Resilience and Hazards SEPP)	**Chapter 3 – Hazardous and offensive development** A preliminary hazard assessment has been undertaken in accordance with *Hazard Industry Planning Advisory Paper No.6 – Guidelines for Hazard Analysis* (DoP, 2011) and *Multi-Level Risk Assessment* (DoP, 2011). The PHA shows the materials and chemicals used in the BESS infrastructure do not exceed the threshold for the preliminary risk screening, and therefore the BESS infrastructure would not be a potentially hazardous development. **Appendix X** and **Chapter 10** identifies the management measures to be implemented to further minimise the potential impacts from these materials. **Chapter 4 – Remediation of land** Chapter 4 of the Resilience and Hazards SEPP aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment. Further discussion on the contamination risks associated with the project is in **Chapter 13**.
State Environmental Planning Policy (Primary Production) 2021 (Primary Production SEPP)	The project does not affect State significant agricultural land under Primary Production SEPP. However, an assessment of the potential impacts to rural and agricultural lands associated with the project is provided in **Chapter 16** and **Section 17.1** to address the objectives of Primary Production SEPP.
State Environmental Planning Policy (Biodiversity and Conservation) 2021 (Biodiversity and Conservation SEPP)	**Chapter 4 - Koala Habitat Protection 2021** The project is in the Warrumbungle Shire Council LGA which is listed in Schedule 2 of Biodiversity and Conservation SEPP. However, Chapter 4 of the Biodiversity and Conservation SEPP does not apply to land zoned RU1 Primary Production. Regardless, **Chapter 8** and **Appendix G** assess the potential impacts**.**
State Environmental Planning Policy 44 (Koala Habitat Protection) (SEPP44)	The State Environmental Planning Policy 44 (Koala Habitat Protection) (SEPP44) was repealed in 2019 but has been specifically identified as requiring consideration in the SEARs for the project. Generally, this policy only applies to local development, where a Council is the consent authority and wouldn't apply to a State Significant Development. Regardless, an assessment under the SEPP44 has been undertaken in **Appendix G** to consider impacts to potential or core Koala habitat. The assessment concluded that the study area does not contain core Koala habitat, and as such a Koala plan of management is not required for the project.

Legislation	Comment
State Environmental Planning Policy (Resources and Energy) 2021 (Resources and Energy SEPP)	Biophysical Strategic Agricultural Land (BSAL) and Critical Industry Clusters (CIC) are considered under (Resources and Energy SEPP). BSAL occurs within the study area around Coolaburragundy River between the Mount Hope and Girragulang Road cluster. A small area of BSAL also occurs within the Leadville cluster associated with Cainbil Creek. No land within the study area is mapped as CIC land. Discussion on BSAL is provided in **Section 17.1**. No further legislated process is required as the project is not a mining or petroleum project.

3.3 Commonwealth legislation

A summary of relevant Commonwealth legislation that is applicable to the proposal is provided in **Table 3-6.** A detailed assessment against the relevant provisions is provided in **Appendix C**.

Table 3-6: Commonwealth legislation

Legislation	Comment
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Under the EPBC Act, a referral is required to be submitted to the Department of Agriculture, Water and the Environment for any 'action' that is considered likely to have a significant impact on any Matters of National Environmental Significance (MNES) and Commonwealth land. A referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was submitted to the Australian Department of Agriculture, Water and the Environment in June 2020 (EPBC 2020/8668). The referral was required because the project is considered likely to have a significant impact on Matters of National Environmental Significance (MNES) due to potential impacts to listed threatened species and ecological communities, and migratory species. Each species has been considered throughout the development of this project. On 13 July 2020, a delegate of the Federal Minister for the Department of Agriculture, Water and the Environment declared that the project was a controlled action under section 75 of the EPBC Act. The proposed action is being assessed in accordance with the bilateral assessment agreement Amending Agreement No. 1. Further discussion on MNES is provided in **Chapter 8** and a full assessment of impacts at **Appendix G.**
Native Title Act 1993	The study area includes land currently subject to Native Title Claim by the Gomeroi People (Tribunal File No. NC2011/006, Federal Court No. NSD2308/2011).

Legislation	Comment
	Claim applicants were invited to participate in the Aboriginal community consultation undertaken for the EIS and were consulted as part of the ACHAR. A summary on the consultation undertaken for the project is in **Chapter 5** and further in **Appendix N**
Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (ATSIHP Act)	**Appendix N** provides a discussion of relevant matters protected under the ATSIHP Act.
Civil Aviation Regulations 1988	The EIS may be referred to Civil Aviation Safety Authority (CASA) to assess potential impacts of the project and to address the lowest safe altitude (LSALT) impact of air route W627 which will need to be raised.
Heavy Vehicle National Law	Relevant permits under the Heavy Vehicle National Law (NSW) for the use of OSOM vehicles will be sought by the construction contractor.

3.4 Summary of licences, approvals and permits

A summary of the licences, approvals and permits that are likely to be required for the project is provided in **Table 3-7**.

Table 3-7: Summary of licences, approvals and permits required for the project

Legal instrument	Licence or approval requirement	Consent or approval authority
EP&A Act	Approval under Part 4 of the Act for SSD	Minister for Planning or delegate
EPBC Act	Controlled activity approval in accordance with the Amended Bilateral Agreement No 1	Federal Minister for the Department of Agriculture, Water and the Environment
Crown Land Management Act 2016	Part 5 Division 5.6 – Licences over Crown Land	Land Division, Department of Primary Industries
Protection of the Environment Operations Act 1997	Section 48 Environment Protection Licence	NSW Environment Protection Authority
Roads Act 1993	Section 138 permits for works involving a public road	Warrumbungle Shire Council
Civil Aviation Regulations 1988	Approval to address the LSALT impact of air route W627	CASA

4. PROJECT DESCRIPTION

4.1 Overview of the project

The project would consist of up to 148 wind turbines and supporting infrastructure, including a high voltage transmission line which would run approximately 13 kilometres to a connection point with the Central West Orana REZ (CWO-REZ) Transmission line proposed by TransGrid and the NSW Government. The project would supply approximately 800 megawatts (MW) of electricity into the National Electricity Market (NEM).

The wind farm would be located between the townships of Coolah and Leadville, with the transmission line running generally south to its connection with the CWO-REZ Transmission line. The project would be entirely within the Warrumbungle Local Government Area (LGA).

The project would involve the construction, operation and decommissioning of three clusters of wind turbines, that would be connected electrically. These are:

- Mount Hope cluster – 76 turbines
- Girragulang Road cluster – 51 turbines
- Leadville cluster – 21 turbines.

The project includes the following key components:

- Up to 148 wind turbines with a maximum tip height of 250 metres and a hardstand area at the base of each turbine
- Electrical infrastructure, including:
  - substations in each cluster and a step-up facility at the connection to the CWO-REZ Transmission line
  - underground and some overhead 33 kilovolt electrical reticulation connecting the turbines to the substations in each cluster
  - overhead transmission lines (up to 330 kilovolt) dispatching electricity from each cluster
  - other electrical infrastructure as required including a potential battery energy storage system (BESS) with a capacity of 320MW/640MWh
  - a high voltage transmission line (up to 500 kilovolt) connecting the wind farm to the CWO-REZ Transmission line
- Other permanent on-site ancillary infrastructure:
  - permanent operation and maintenance facilities
  - meteorological masts (up to 13)
- Access track network:
  - access and egress points to each cluster from public roads
  - operational access tracks and associated infrastructure within each cluster on private property
- Temporary construction ancillary facilities:
  - potential construction workforce accommodation on site
  - construction compounds
  - laydown areas
  - concrete batching plants
  - quarry sites for construction material (rock for access tracks and hardstands).

At the end of its practical life, the wind farm would be decommissioned, and the site returned to its pre-existing land use in consultation with the affected landholders. An indicative layout of the project is provided in **Figure 4-1**, **Figure 4-2, Figure 4-3** and **Figure 4-4**.

4.2 Wind farm site boundary

The wind farm site boundary corresponds with the outer boundary of properties upon which the proposed wind farm is located. The wind farm site boundary includes the three clusters but excludes the transmission line connecting to the CWO-REZ Transmission line. The potential construction workforce accommodation area is also not included in the wind farm site boundary, as it is temporary construction ancillary infrastructure and not part of the permanent wind farm site.

The wind farm would involve (wholly or partly) 25 private properties across the three clusters. The transmission line connecting to the CWO-REZ Transmission line would traverse six private properties. The number and size of properties associated with each part of the wind farm and transmission line is summarised in **Table 4-1** and discussed in more detail in **Section 4.5**. The wind farm site boundary is shown in **Figure 4-1**, **Figure 4-2, Figure 4-3** and **Figure 4-4**.

Table 4-1: Properties within the wind farm site and transmission line

Cluster/transmission line	No. of Lots	No. of landholders
Mount Hope	42	9
Girragulang Road	131	7
Leadville	1	1
Transmission line	74	8

4.3 Survey boundary

A survey boundary has been developed within the wind farm site boundary, for the specialist environmental assessments in this EIS that consider the impacts of vegetation and ground disturbance. These assessments include:

- biodiversity assessment – quantified vegetation and ground disturbance impacts
- Aboriginal and non-Aboriginal heritage assessment – ground disturbance and impacts to heritage items and cultural significance
- land use and agricultural impacts assessment – ground disturbance and loss of agriculturally productive land.

A survey boundary that provides a 200-metre corridor around access tracks and turbines has been applied to these assessments. This corridor ensures the EIS adequately identifies potential disturbance impacts, but also provides flexibility for the proposed layout to be refined within the surveyed area during detailed design. The survey boundary is shown in **Figure 4-1**, **Figure 4-2, Figure 4-3** and **Figure 4-4**.

Specialist environmental assessments that consider potential impacts relating to a broader catchment area such as noise and visual amenity, have applied issue-specific study areas in accordance with relevant guidelines. These issue-specific study areas are discussed in more detail in the methodology sections in the key issues and non-key issues chapters.

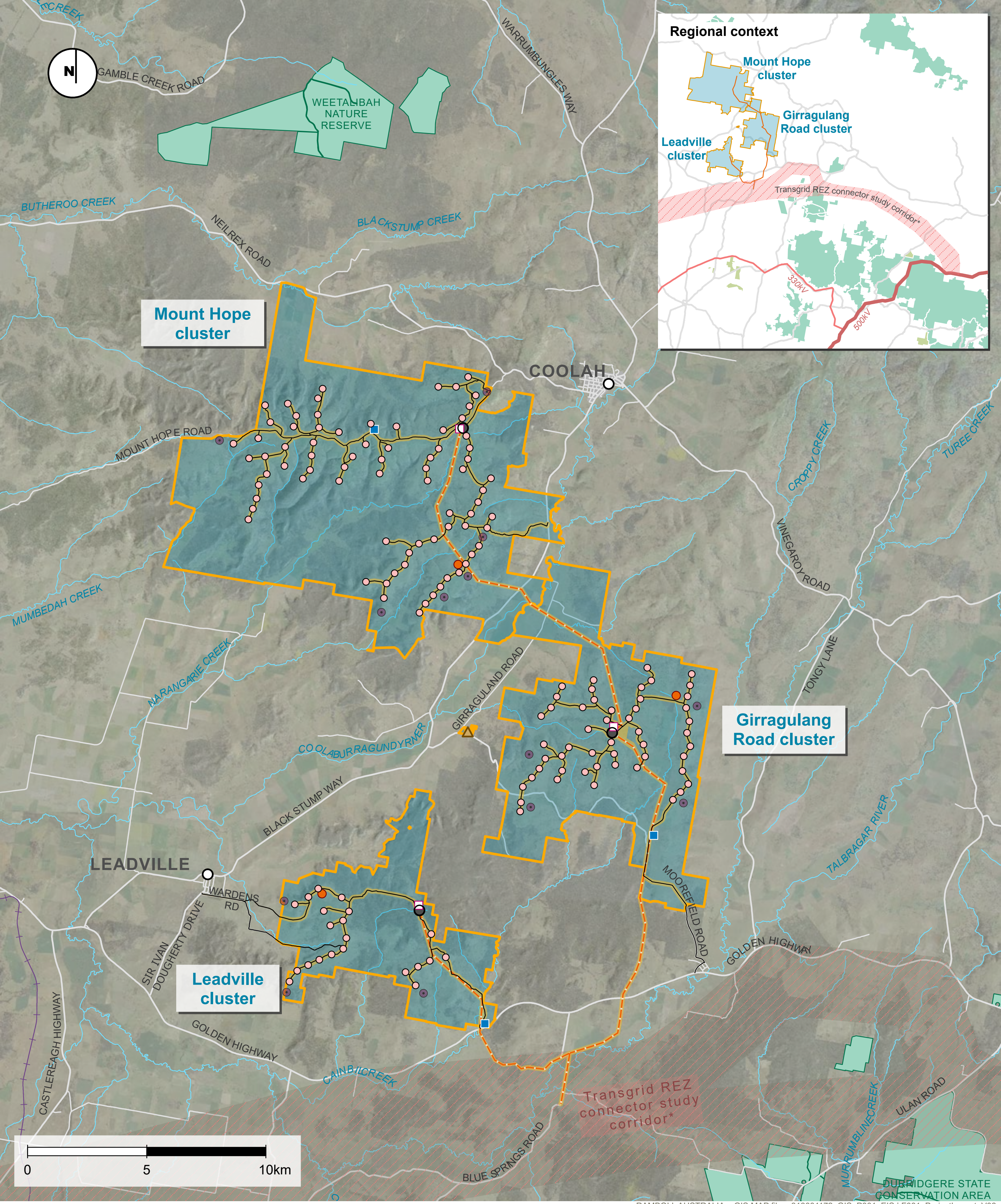
4.4 Impact footprint

Within the survey boundary shown in **Figure 4-1**, there would be an expected impact footprint. The impact footprint represents the expected maximum extent of ground disturbing work and vegetation clearing associated with construction and operation of the project. All permanent and temporary project components would be located within the impact footprint.

Based on the indicative layout presented in this EIS, the project would require an impact footprint of approximately 1,318 hectares. This includes the transmission lines connecting the wind farm to the CWO-REZ Transmission line, the potential construction workforce accommodation, and the access tracks to the wind farm clusters.

The impact footprint comprises the following:

- a corridor of 50 metres on either side of the centreline of the proposed internal access tracks and the access tracks from public roads to the clusters
- a radius of 100 metres around each wind turbine to allow for micro siting during detailed design
- a buffer of 50 metres around all permanent (operational) and temporary (construction) ancillary infrastructure
- a corridor of 100 metres for the proposed overhead transmission lines connecting the wind farm to the CWO-REZ transmission line
- an indicative area of 5 hectares for the potential construction workforce accommodation area.



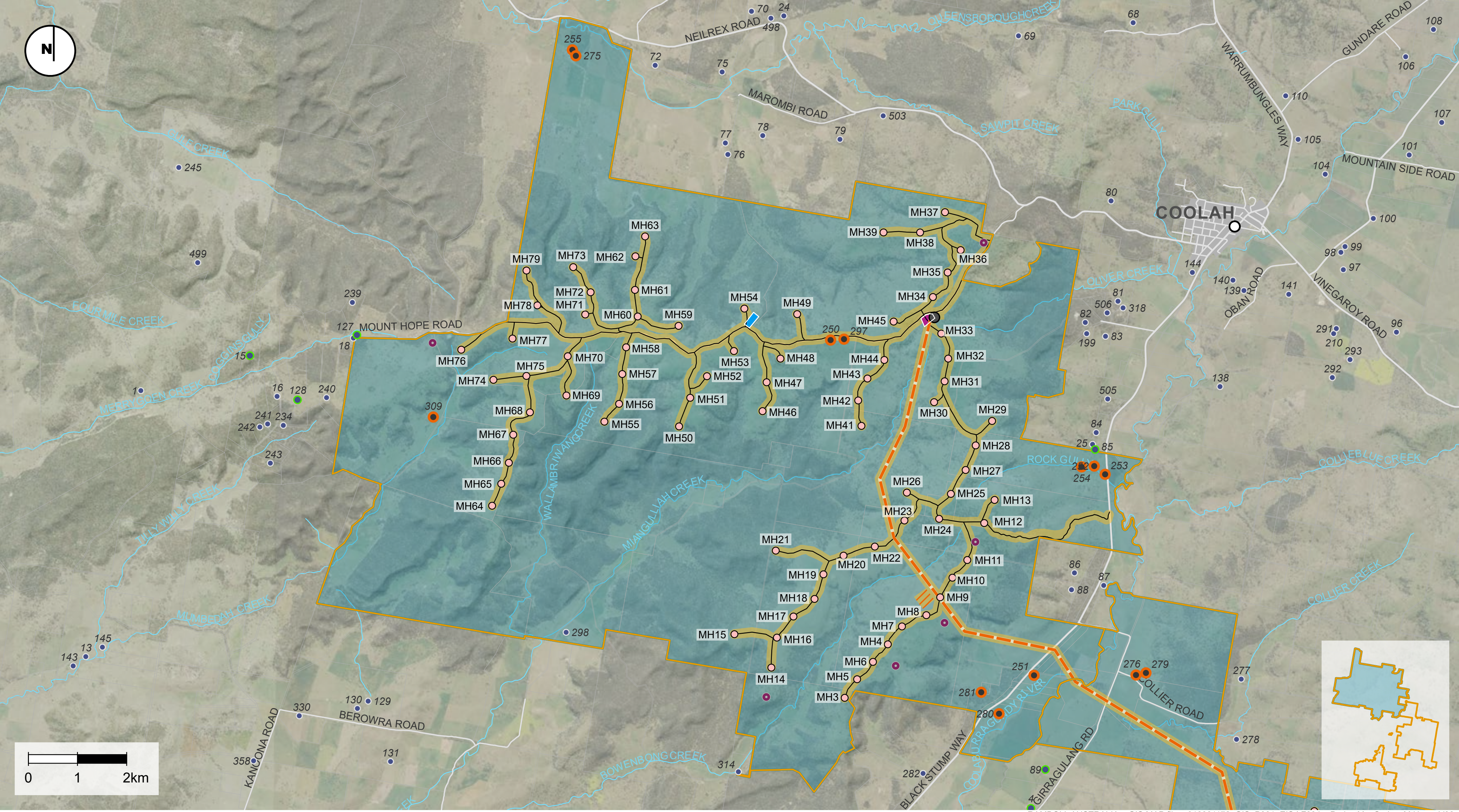
RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F001_ProjectLayout_V08
Aerial photography from NSW Government Spatial Services

KEY

- Wind farm site
- Survey boundary
- Turbine location
- Access track
- Overhead transmission line
- Potential construction workforce accommodation
- Substation location
- Permanent operations and maintenance compound (also used during construction)
- Temporary construction compound
- Indicative quarry location
- Permanent meteorological mast location
- Railway
- National Parks and Reserves

*Approximate only

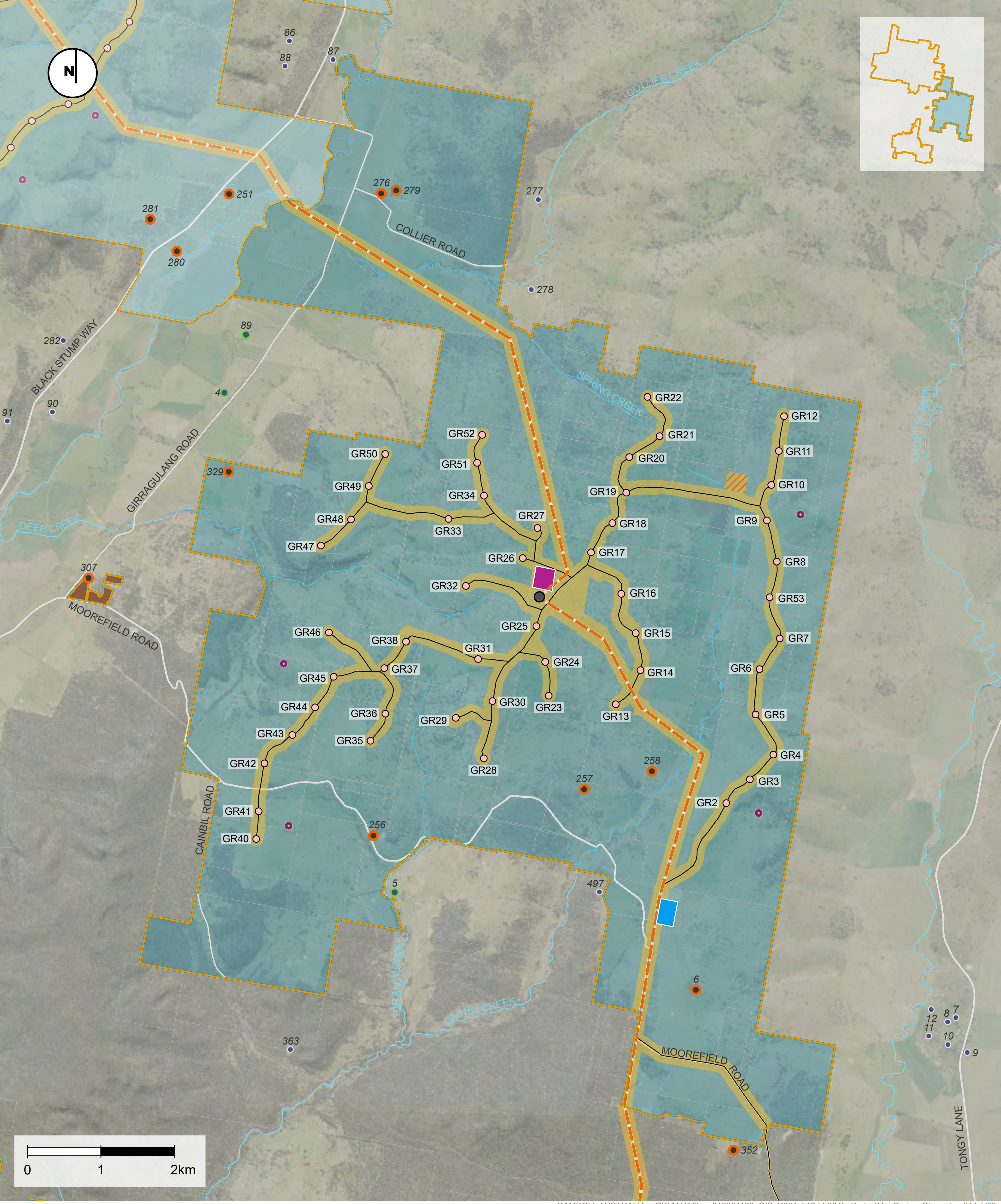
Figure 4-1 | Project overview



KEY

- Wind farm site
- Survey boundary
- Host dwelling
- Associated dwelling
- Non-associated dwelling
- Turbine location
- Access track
- Overhead transmission line
- Substation location
- Permanent meteorological mast location
- Quarry location (approximate)
- Permanent operations and maintenance compound (also used during construction)
- Temporary construction compound
- Cadastral boundary

Figure 4-2 | Project layout at the Mount Hope cluster

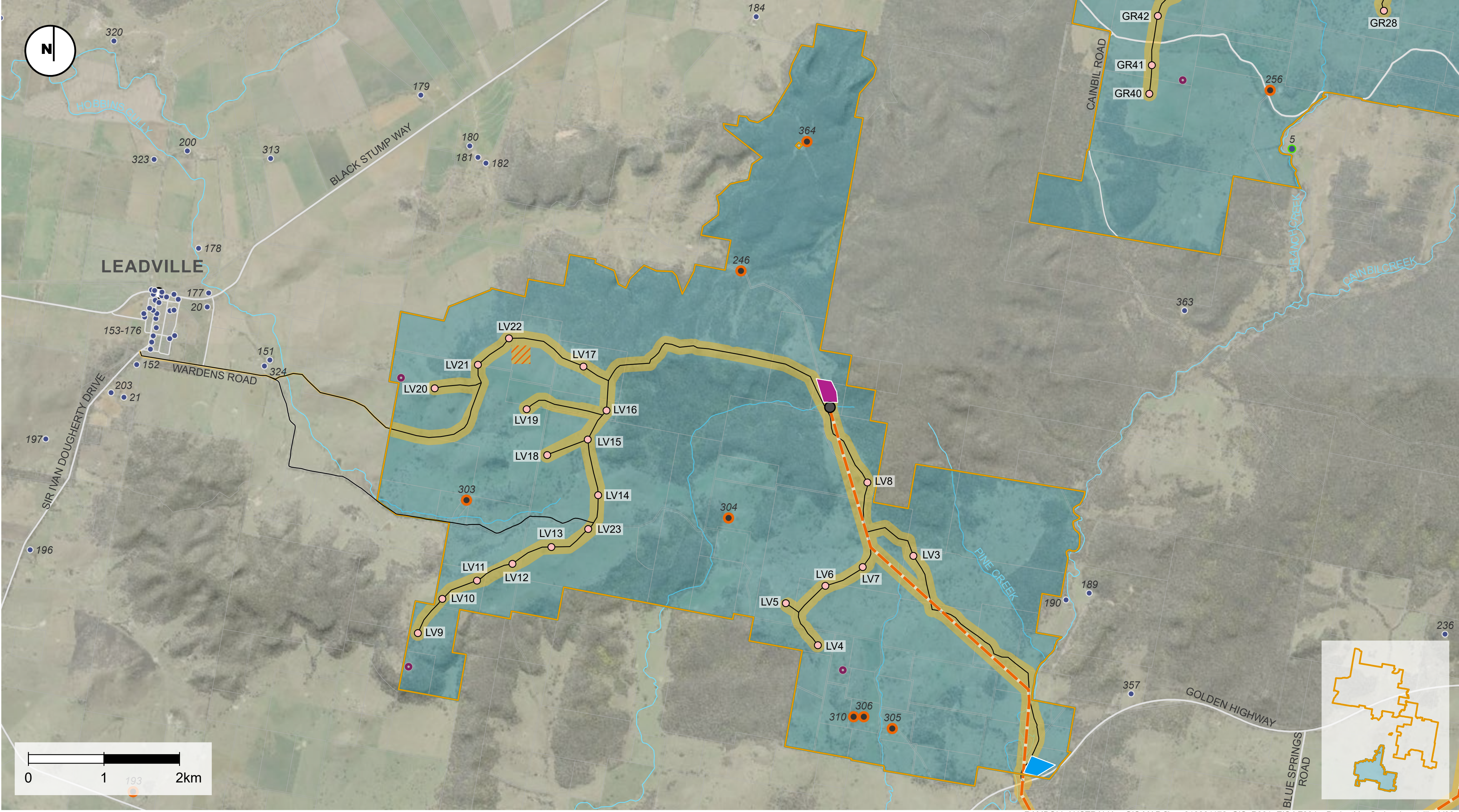


RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F004b_ProjectMapSeries_GirragulandRd_V06
Aerial photography from NSW Government Spatial Services

KEY

- Wind farm site
- Survey boundary
- Host dwelling
- Associated dwelling
- Non-associated dwelling
- Turbine location
- Access track
- Overhead transmission line
- Substation location
- Permanent meteorological mast location
- Quarry location (approximate)
- Permanent operations and maintenance compound (also used during construction)
- Temporary construction compound
- Potential construction workforce accommodation
- Cadastral boundary

Figure 4-3 | Project layout at the Girragulang Road cluster



RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F004c_ProjectMapSeries_Leadville_V06
Aerial photography from NSW Government Spatial Services

KEY

- Wind farm site
- Survey boundary
- Host dwelling
- Associated dwelling
- Non-associated dwelling
- Turbine location
- Access track
- Overhead transmission line
- Quarry location (approximate)
- Permanent meteorological mast location
- Substation location
- Permanent operations and maintenance compound (also used during construction)
- Temporary construction compound
- Cadastral boundary

Figure 4-4 | Project layout at the Leadville cluster

4.5 Property impacts

The project would involve (wholly or partly) 255 cadastral lots, and approximately 25 property owners within the wind farm site and 31 cadastral lots with six property owners within the transmission line corridor. An additional seven Crown Lands lots would be affected by the proposed intersection upgrades. Cadastral lots are listed in **Table 4-2** and property ownership is shown in **Figure 4-5**.

UPC\AC have entered into access licence agreements with associated property owners (i.e. landholder agreements) allowing the option to lease the land for the construction, operation and decommissioning of the wind farm.

The high voltage transmission line would run generally south from the southern extent of the Girragulang Road cluster to a location within the CWO-REZ study area assumed to be the point of connection.

Lease arrangements have been agreed with property owners for the construction of all required overhead transmission lines, in accordance with TransGrid's requirements.

During operation, an easement (or other agreement) would be required for the ongoing operation and maintenance of the overhead transmission lines. These agreements would include certain limitations for landholders relating to the use of the land within the easement, to ensure the safe operation of the infrastructure and minimise risks to safety.

Upon cessation of any lease arrangement, easement, or other agreement, infrastructure would be decommissioned, and land would be returned to its pre-existing condition in consultation with the landholders and use would be returned to the landholder.

Table 4-2: Cadastral lots intersecting with the study area

Lot	Deposited Plan	Lot	Deposited Plan	Lot	Deposited Plan
1	DP1091571	104	DP750740	116	DP750768
1	DP1120886	104	DP750745	116	DP750772
1	DP1187452	105	DP750740	117	DP750740
1	DP120973	105	DP750745	118	DP750740
1	DP121325	106	DP750740	119	DP750740
1	DP1214801	106	DP750745	12	DP750768
1	DP1214808	107	DP750740	12	DP750772
1	DP1227122	107	DP750745	12	DP754975
1	DP1238648	108	DP750740	12	DP820719
1	DP1252803	108	DP750745	120	DP750745
1	DP1253559	108	DP750772	122	DP750772
1	DP132142	109	DP750745	123	DP750768
1	DP132931	109	DP750772	123	DP750772
1	DP217788	11	DP132925	126	DP750740
1	DP378972	11	DP256130	126	DP750745
1	DP512844	11	DP754975	128	DP750745
1	DP596076	11	DP820719	129	DP750745
1	DP661801	110	DP750772	13	DP750772
1	DP720365	111	DP750772	13	DP754967
1	DP754975	112	DP750740	13	DP820719
1	DP812579	112	DP750772	131	DP750740
1	DP864298	113	DP750740	132	DP721774
1	DP876041	113	DP750745	132	DP750745
10	DP132925	113	DP750768	136	DP824118
10	DP256130	114	DP750740	137	DP824118
10	DP750772	114	DP750772	139	DP750740
10	DP754975	115	DP750740	14	DP750745
100	DP750745	115	DP750768	14	DP750759
101	DP750745	115	DP750772	14	DP750768
103	DP750740	116	DP750740	14	DP754967

Lot	Deposited Plan
140	DP750772
142	DP750740
142	DP750772
143	DP750772
149	DP750740
15	DP750772
150	DP750740
151	DP750772
152	DP750772
154	DP750772
155	DP750772
157	DP750772
177	DP750772
19	DP754966
195	DP750740
2	DP1091571
2	DP1105831
2	DP1120886
2	DP1187452
2	DP1227122
2	DP1253639
2	DP132931
2	DP244310
2	DP382987
2	DP512844
2	DP631136
2	DP746422
2	DP754975
2	DP876041
20	DP750740
207	DP750740

Lot	Deposited Plan
208	DP750740
21	DP750740
22	DP750740
22	DP750745
23	DP750768
24	DP750768
25	DP750745
26	DP750745
27	DP750745
28	DP750745
29	DP750745
3	DP1253547
3	DP1257054
3	DP132931
3	DP754975
30	DP750745
31	DP750745
32	DP750745
32	DP754977
33	DP750768
35	DP750740
35	DP750768
36	DP750745
36	DP750759
37	DP750745
38	DP750768
39	DP750768
4	DP1256557
4	DP132931
4	DP133873
4	DP750768

Lot	Deposited Plan
4	DP754975
4	DP820719
41	DP750768
42	DP750745
42	DP750768
43	DP750740
43	DP750768
43	DP750772
44	DP750768
45	DP750772
46	DP750772
47	DP750768
47	DP754966
48	DP750745
48	DP750768
48	DP754966
49	DP1115849
49	DP750745
5	DP132931
5	DP750768
5	DP754966
5	DP754975
50	DP754966
51	DP750745
52	DP750745
53	DP750745
53	DP750768
54	DP750745
54	DP750768
55	DP750745
5503	DP1244975

Lot	Deposited Plan
56	DP750745
57	DP750745
57	DP750768
58	DP1099077
58	DP750768
59	DP750745
6	DP132931
6	DP750740
6	DP750768
6	DP750772
61	DP750745
61	DP750768
62	DP750745
63	DP750745
63	DP754966
64	DP750745
65	DP750745
65	DP750772
65	DP754966
66	DP750745
66	DP750772
67	DP750745
67	DP750768
68	DP750745
68	DP750768
69	DP750768
69	DP754966
7	DP132931
7	DP750745
7	DP750772
7001	DP1028400

Lot	Deposited Plan
7002	DP96946
7005	DP1026530
7005	DP1028425
7006	DP1028362
7006	DP1068801
7007	DP1068801
7013	DP1028426
7014	DP1028426
71	DP750768
73	DP750745
73	DP750768
74	DP750745
75	DP750745
76	DP750745
76	DP750772
76	DP754966
77	DP750745
77	DP750772
78	DP750745
78	DP754966
79	DP750740
79	DP750745
8	DP256130
8	DP750745
8	DP750772
80	DP750740
80	DP750745
81	DP750740
81	DP750745
81	DP754966
82	DP750745

Lot	Deposited Plan
82	DP750768
82	DP754966
83	DP750740
83	DP750745
83	DP750768
84	DP750745
85	DP750745
86	DP750745
87	DP750745
88	DP750740
88	DP750745
88	DP750759
88	DP754966
89	DP750740
89	DP750745
9	DP256130
9	DP754975
90	DP750740
90	DP750745
91	DP750745
91	DP750772
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92	DP754966
93	DP750745
94	DP750745
94	DP750772
95	DP750740
95	DP750745
96	DP750740
96	DP750745
96	DP750772

Lot	Deposited Plan
96	DP754966
97	DP750740
97	DP750745
98	DP750745
98	DP754966
99	DP750740
99	DP750745
A	DP430321
176	750772
2	759014
7356	1179126
7308	1150970
1	759014
7306	1141903
7006	1068801

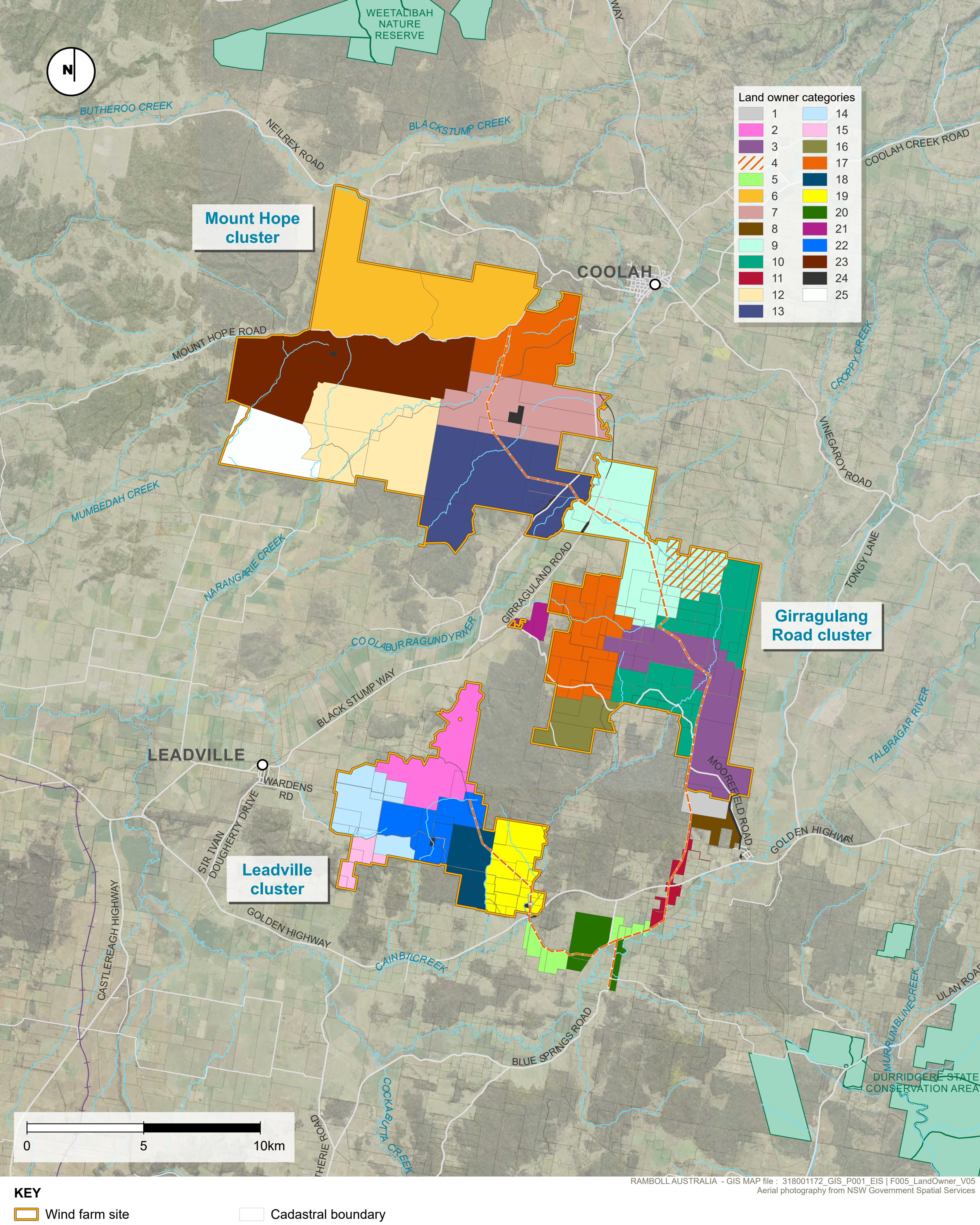


Figure 4-5 | Land ownership

4.6 Summary of built features

The built features of the various infrastructure components are summarised in **Table 4-3**.

Table 4-3: Project infrastructure - built features

Infrastructure	Quantity	Indicative height	Approximate footprint
Operational infrastructure			
Wind turbines	148	Maximum tip height of 250m	turbine foundation – approximately 27m in diameter (pending geotechnical assessment and detailed design)
Substations and step-up facilities	1 x 'collector' substation in both Mount Hope and Leadville clusters	Up to 20m high (subject to lightning protection study / requirements)	200m x 100m (2ha)
	1 x 'central' substation in the Girragulang Road cluster	Up to 20m high (Subject to lightning protection study / requirements)	200m x 100m (2ha)
	1 x step-up facility at the connection to the CWO-REZ Transmission line	Up to 20m high (Subject to lightning protection study / requirements)	100m x 100m (1ha)
Electrical reticulation	Underground cabling (up to 33kV)	n/a	Up to 240,000m
	Overhead transmission for internal connections where required (up to 33kV)	Up to 20m	Up to 20m wide easement
	Overhead transmission connecting the clusters (up to 330kV)	Up to 50m	Up to 60m wide easement
	Overhead transmission connecting the wind farm to the CWO-REZ	Up to 65m	Up to 70m wide easement

Infrastructure	Quantity	Indicative height	Approximate footprint
	Transmission line (up to 500kV)		
Operation and maintenance compound	1	Up to 5m high	100m x 100m (1ha)
Hardstand at each turbine location	148	Ground level	80m x 40m (3200m^2)
Meteorological masts	13 permanent masts	Maximum height of 150m	1.5m x 1.5m footing per mast
Access tracks	158.2km	Ground level	6m wide x 158.2km total length (total footprint of 95ha)
Total footprint of operational infrastructure			**549.33 ha**
Temporary construction infrastructure			
Potential construction workforce accommodation	Up to 400 rooms, with supporting amenities, dining facilities and common areas	Generally up to 5m high (excluding lightning protection)	A total area of up to 5ha
Construction compounds	3	Up to 10m high	100m x 200m (2ha)
Laydown areas	3	Ground level	100m x 100m (1ha)
Batching plant	3	Up to 15m high	100m x 100m (1ha)
Quarries	3 (1 in each cluster)	n/a	Up to 8ha per quarry
Access tracks (construction access tracks would remain as the permanent access tracks noted above)	158.2km	Ground level	6m wide x 158.2km total length (total footprint of 95ha)
Total footprint of temporary construction infrastructure			**1,318.08 ha**

4.7 Permanent operational infrastructure

4.7.1 Wind turbines

Arrangement
The project would include approximately 148 turbines arranged in three clusters, all connected electrically. The number of turbines within each cluster includes:

- Mount Hope – approximately 76 turbines
- Girragulang Road – approximately 51 turbines
- Leadville – approximately 21 turbines.

The indicative layout of the turbines is shown in **Figure 4-1**. Collectively, the turbines would have a total energy generation capacity of up to 800 megawatts.

Micro-siting of the wind turbines would be determined during detailed design of the project and would consider:

- environmental and social constraints
- wind conditions
- building requirements (e.g. distances to residences)
- ownership structure of the area
- accessibility (existing roads)
- influence of the wind turbine on the environment (e.g. shadow flickering, noise emission)
- distances between the individual turbines.

Any micro-siting of the turbines would not increase the environmental impacts of the project and minor adjustments in locations have been allowed for by assessing a buffer within the survey boundary as discussed in **Section 4.3**.

Components
The wind turbines would have a maximum tip height of 250 metres. Each wind turbine would comprise the following key features, subject to design development and available turbine technology:

- **blades** – which cause the rotor to spin
- **tower** – the support shaft for the wind turbine
- **nacelle** – a cover that houses the generating components of the wind turbine
- **hub** – connects the blades to the shaft
- **rotor** – made up of the hub and blades
- **step-up transformer** – convert low voltage electricity produced by the wind turbine to medium voltage electricity
- **footings** – assist in the stability of the wind turbine foundation.

Examples of the key features of the turbines are shown in **Figure 4-6**, whilst a typical turbine elevation is shown in **Figure 4-7.**

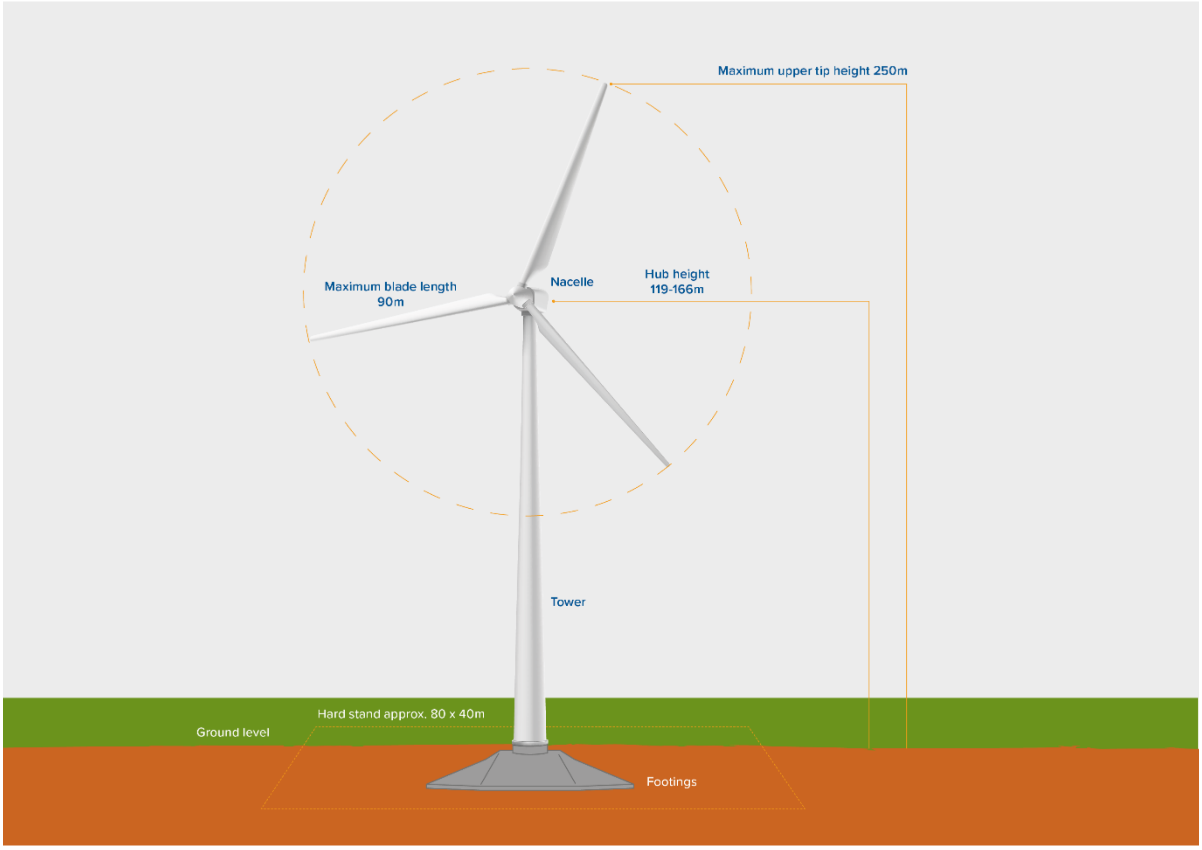


Figure 4-6: Typical turbine components

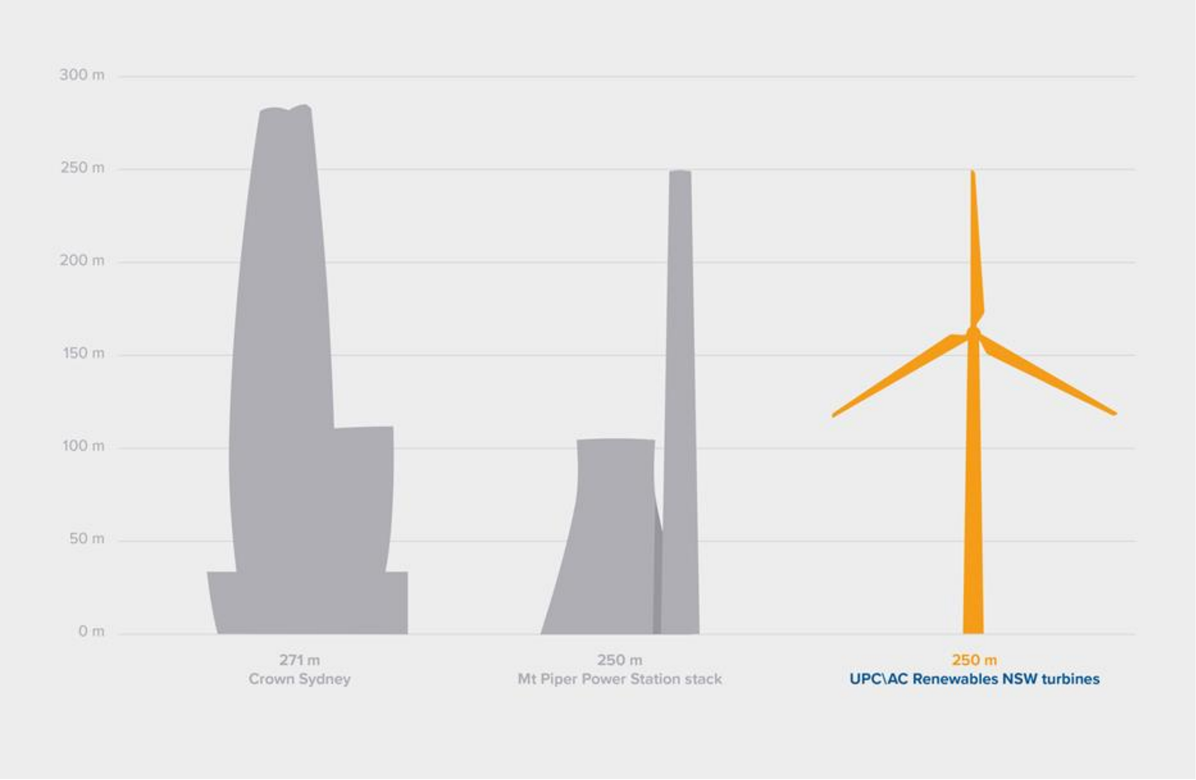


Figure 4-7: Typical turbine elevation

Blades
Electricity is generated by highly aerodynamic Wind Turbine Generator (WTG) blades being propelled by the natural power of the wind. The blades rotate a centrally geared drive shaft which feeds into an electrical generator within the turbine nacelle. This action produces electricity, which is transported via underground cables to a substation within each cluster.

The blades would be up to 90metres long and made from glass fibre reinforced with epoxy or plastic attached to a steel hub and include lightning rods for the entire length of the blade.

Tower
The tower is the supporting structure of the WTG and is typically comprised of a reducing cylindrical tower made from either a welded steel shell or a concrete steel hybrid, fitted with an internal ladder and lift.

Each tower would be up to 160 metres tall. Due to the large size, the towers would be manufactured and transported to the project site in sections for onsite assembly.

Nacelle and hub
The nacelle is mounted on top of the tower and houses the generating components of the WTG, including the generator, gearbox, drive train, and brake assembly. Weather monitoring equipment would be located on top of the nacelle to provide data on wind speed and direction for the automatic operation of the WTG.

The hub connects the three blades to the tower of the wind turbine. The hub is mounted to the nacelle.

Rotor
The rotor is made up of the hub and blades. It drives the generator within the nacelle producing electrical output and is generally selected based on site specific wind conditions to optimise performance of the turbines.

Step-up transformer
The WTGs produce electricity at low voltage which is 'stepped up' to medium voltage by a transformer located either in the nacelle, within the base of the tower, or adjacent to the base of the tower on a concrete pad.

The step-up transformer may be oil-filled or a dry type depending on the turbine design. Where oil-filled transformers are used, appropriate measures will be incorporated to prevent any oil loss and contain any spill within a bunded area.

Footings
Footings are typically a mass concrete footing of approximately 3.5 metres in depth and 20 metres in diameter. Generally, the concrete footing is then backfilled with engineered fill to 1.5 metres deep, assisting in the stability of the wind turbine foundation.

The specific footing requirements would be refined during detailed design depending on geotechnical conditions. If rock anchors are required to provided additional stability based on ground conditions, construction would include drilling and piling to a depth which would be determined during detailed design.

Lighting
Aviation Projects has undertaken a safety risk assessment of the project and based on the risk assessment set out in **Section 10.2.2** it has been concluded that aviation lighting is not required for WTGs.

4.7.2 Electrical infrastructure

Electrical infrastructure associated with the project includes:

- **Substations and step-up facility** – to transform the electricity generated by the turbines into a higher voltage. There would be one 'collector' substation in each of the Mount Hope and Leadville clusters, and one 'central' substation within the Girragulang Road cluster.
- **underground electrical reticulation** – (up to 33kV) to connect the turbines to the substations in each cluster
- **overhead transmission lines** – (up to 220kV) dispatching electricity from each cluster and connecting the Mount Hope cluster to the Girragulang Road cluster
- **high voltage transmission line and step-up facility** – (up to 330kV) connecting the wind farm to the CWO-REZ transmission line. There would also be a step-up facility required at the connection to the CWO-REZ Transmission line to transform the electricity generated by the wind farm to 500kV, for export to the NEM.
- **potential battery energy storage system** – with a capacity of 320MW/640MWh to store generated electricity and dispatch it to the NEM to meet demands
- **control cables and earthing** – to monitor winds conditions and energy output.

A detailed electrical design will be undertaken by an appointed contractor and delivered in accordance with relevant electrical standards in consultation with TransGrid and other relevant authorities. An illustration of an indicative electrical infrastructure arrangement is presented in **Figure 4-8**.

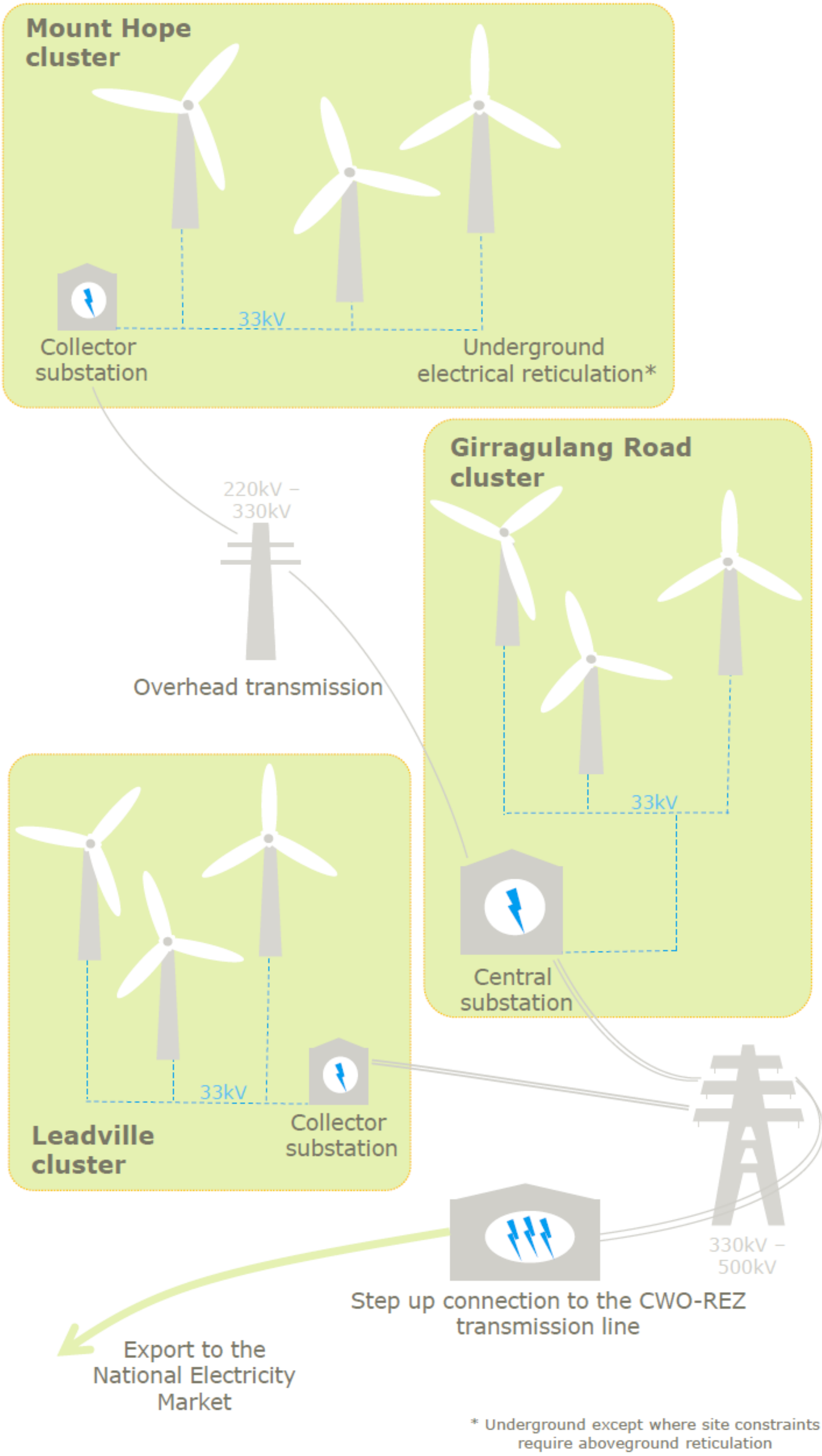


Figure 4-8: Indicative electrical infrastructure arrangement

Substations

The project would require several electrical substations to transform the electricity generated by each turbine into a higher voltage, allowing it to be dispatched from each cluster and on to the NEM via the CWO-REZ transmission line. The substations required would include:

- One 'collector' substation in both the Mount Hope and Leadville clusters, converting electricity from 33 kilovolts to 220 kilovolts for dispatch
    - The Mount Hope collector substation would dispatch electricity to a 'central' substation in the Girragulang Road cluster
    - the Leadville substation would dispatch electricity directly to the CWO-REZ Transmission line via a step-up facility at the connection point.
- A larger 'central' substation located in the Girragulang Road cluster, which would both collect the electricity generated in the Girragulang Road cluster and the Mount Hope cluster; and include a step-up facility to increase the collected electricity from 220 kilovolts, up to 330 kilovolts for export via the overhead transmission line and connection to the CWO-REZ Transmission line.

The substations would typically require an area of up to 100 metres by 200 metres (two hectares), and would consist of the following as a minimum:

- indoor switch room to house the medium voltage switchboard and circuit breakers
- outdoor switch yard to house the transformer(s)
- gantries and associated infrastructure
- buried earth grid
- operational facilities building
- lighting
- lightening protection
- on-site diesel generator and/or batteries to maintain network communications and electrical protection
- crushed rock and concrete slab ground cover
- parking
- security fence around the substation to maintain site security, public safety and exclude livestock.

The transformer(s) within the substations would likely contain upwards of 50,000 litres of oil. The substation design would include provisions for containment of oil spills or leaks, including constructed concrete bunds around each transformer and a spill oil retention basin or oil / water separator outside the substations compound.

The locations of the substation would be confirmed to minimise access distance and electrical losses, to reduce their visibility from surrounding public viewpoints, and to allow the provision for a 20-metre asset protection zone (APZ) surrounding the infrastructure.

Underground electrical reticulation

The turbines would be connected to the collector substation within each cluster via a series of underground cables that would be co-located with access tracks where possible, to minimise the need for additional vegetation clearing. The underground cables would have a maximum capacity of up to 33 kilovolts and would be installed with the relevant Australian Standard *AS/NZS 3000:2018, Electrical installations* and would be at a depth of at least 600 millimetres below ground. Location markers would be placed along the route of the underground transmission lines for safety reasons.

The final electrical layout will depend on the ease of excavation, ground stability and cost. Where ground conditions or localised topography mean that undergrounding the reticulation is not feasible, consideration would be given to including some sections of overhead transmission lines for the internal reticulation. This would be determined during detailed design.

Overhead transmission lines

The following overhead transmission lines would be required:

- transmission line(s) of up to 330 kilovolts, that would dispatch electricity from the collector substation in the Mount Hope cluster and connect it to the central substation in the Girragulang Road cluster
- high voltage transmission line(s) of up to 500 kilovolts running generally south from the central substation in the Girragulang Road cluster, connecting the wind farm to the CWO-REZ Transmission line
- transmission line(s) of up to 330 Kilovolts that would dispatch electricity from the collector substation in the Leadville cluster and connect it to the 500-kilovolt line running from Girragulang Road to the CWO-REZ Transmission line (a step-up facility from 33kV to 330kV would be required within the Leadville cluster)

New transmission poles would be timber, steel or concrete construction with single poles used for lower voltage overhead lines (under 330 kilovolts) and larger steel lattice-type towers used for the higher voltage transmission lines (330 kilovolt kV).

Indicative specifications of the overhead transmission lines required for the project are outlined in **Table 4-4**. The final designs for poles or towers, numbers, spacing and locations; would be determined during the detailed design.

Table 4-4: Indicative overhead transmission line specifications

Voltage	Approximate easement	Approximate height of tower/pole	Typical distance between towers/poles (span)
330 kV	60	35-50m	200-300m
500 kV	60	65m	200-300m

Lease arrangements have been agreed with property owners for the construction of all required overhead transmission lines, in accordance with TransGrid's requirements.

During operation, an easement (or other agreement) would be required for the ongoing operation and maintenance of the overhead transmission lines. These agreements would include certain limitations for landholders relating to the use of the land within the easement, to ensure the safe operation of the infrastructure and minimise risks to safety.

Upon cessation of any lease arrangement, easement, or other agreement, infrastructure would be decommissioned, and land would be returned to its pre-existing condition in consultation with the landholders and use would be returned to the landholder.

Battery energy storage system

The battery energy storage system (BESS) would likely be a centralised 'AC Coupled' BESS near the connection to the Central West Orana REZ Transmission line.

The centralised BESS would be housed in a secure compound adjacent to the substation at either the central substation, or at the connection to the CWO-REZ Transmission line.

The major components of the BESS would comprise:

- **Batteries** – most likely a lithium-ion technology type
- **Inverters** – convert the DC electricity generated by the wind farm into AC
- **Transformers** – there would be two types of transformers within the centralised AC Coupled BESS if this option is chosen, including a low-voltage to medium-voltage transformer and a medium-voltage to high-voltage transformer if a separate grid connection for the BESS is required. The decentralised BESS option does not require any additional transformers.
- **Heating ventilation air conditioning** (HVAC) – the HVAC would maintain the batteries at a temperature to optimise their lifetime and performance. This would include small package units and large chillers or a liquid cooling system.
- **Fire protection** - active gas-based fire protection systems would be installed within the BESS enclosure. Thermal sensors and smoke/gas detectors would be installed and connected to a fire control panel.

If an AC Coupled solution is adopted, one option is for a large building to house the inverters that would use materials similar in appearance and construction to agricultural sheds prevalent across the study area. An alternative is a compound housing the BESS comprising modified shipping containers, prefabricated switch room structures, or smaller outdoor-rated cabinets. The modified shipping containers and prefabricated switch rooms would likely be mounted on concrete footings, while the cabinets would be mounted on concrete slabs.

This infrastructure component would likely be in the order of 3.5 metres high.

Control cables and earthing

Operational controls monitor and manage the operation of the turbines in response to the wind conditions to optimise the output of the wind farm. The control cables connect the turbines to the cluster substations and the operational facilities in each of the clusters. Control cables generally consist of optic fibre, twisted pair or multi-core cable and will run underground or be attached to the overhead transmission lines.

All metal project infrastructure will require suitable earthing to ensure safety and protection, this includes met masts, wind turbines, electrical balance of plant, control buildings, overhead lines and fencing. An earthing / soil resistivity study will be conducted for Valley of the Winds, to inform appropriate earthing arrangements for each unique project infrastructure, but may include:

- 70mm – 95mm bare earthing conductor
- 70mm – 95mm insulated earthing conductor (for footings)
- grounding electrode rods
- Flat earthing bar (required for transformers, and other electrical components and supporting infrastructure).

The specific earthing requirements will be assessed and adhere to international standards for lighting protection (IEC 62305-3) and wind turbine generator systems (IEC 61400-24), and Australian earthing standards.

4.7.3 Permanent onsite ancillary infrastructure

Components

The permanent onsite ancillary infrastructure that would be required for the project includes:

- an operation and maintenance facility
- meteorological masts.

Operation and maintenance facility

Operation and maintenance facilities would be required for the whole of the project's operational life. The facility would be expected to be approximately 100 metres by 100 metres (one hectare in area) and there would be one located in each cluster. Indicative locations are provided in **Figure 4-1**.

Each operation and maintenance facility would generally comprise a control room (offices, monitoring equipment, stores and amenities), storage and maintenance facilities, laydown areas, and parking.

Meteorological masts

Up to 13 permanent meteorological masts have been included in the current indicative wind farm layout and assessed as part of the aviation risk assessment. The meteorological masts comprise free standing towers at hub height support equipment allowing for continuous monitoring of meteorological conditions. An example of a meteorological mast is provided in **Figure 4-9** and indicative locations are shown in **Figure 4-1**.

The aviation safety risk assessment set out in **Chapter 10** has concluded that aviation lighting is not required for meteorological masts to maintain an acceptable level of safety to aircraft and 'as constructed' details of the meteorological masts, including coordinates and elevations would be provided to Airservices Australia. The following markings would be considered during detailed design for the meteorological masts in accordance with the requirements set out in MOS 139 and NASF Guideline D:

- marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires
- paint markings applied in alternating contrasting bands of colour to at least the top third of the masts
- ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground/vegetation
- a flashing strobe light during daylight hours if appropriate.

Some temporary meteorological masts would be required to monitor ongoing wind and weather conditions during the detailed design phase. These temporary masts would be up to 110 metres high and would be removed no later than 30 months after their erection is completed. In accordance with the general requirements outlined under clause 2.20(2) of the Transport and Infrastructure SEPP, the proposed temporary masts would be exempt development (and therefore separate to the SSD and Commonwealth referral outlined in this EIS) for the following reasons:

- the masts would meet the relevant deemed-to-satisfy provisions of the Building Code of Australia and would be structurally adequate and installed in accordance with the manufacturer's specifications
- they would be installed in accordance with all relevant requirements of the Blue Book,
- they would not be designated development
- they would not impact any heritage items or involve any pruning or other vegetation removal
- would not involve the removal of asbestos.

Figure 4-9: Example of a meteorological mast

4.7.4 Access track network

The project would require an internal access track network connecting the turbines and associated infrastructure. The access tracks would be established for construction and maintained for use as operational access tracks. The proposed access track arrangement is shown in **Figure 4-1**.

The access track network would be appropriately designed, constructed, and maintained to allow access to all turbine componentry and electrical infrastructure throughout the site. This would include the construction of gates and fencing as required.

Tracks would comprise of an engineered gravel road with an approximate width of 6 metres, excluding drainage structures, cut and fill batters and suitable erosion and sediments control structures, as required. The detailed engineering of the access track network, access points from public roads, and construction methodology would be developed by the preferred EPC contractor during the detailed design phase.

4.8 Construction

4.8.1 Overview of construction phases

Construction of the project would be delivered in the following phases:

- **Phase 1 – Detailed design and site investigations**: Detailed design, including the design of electrical reticulation, geotechnical design, micro siting of turbines, and all supporting ancillary infrastructure. Initial investigations (e.g. geotechnical investigations) would also be undertaken during this phase to inform design and site preparations
- **Phase 2 – Site preparation and temporary construction facilities**: Pre-construction activities such as site preparation, utility adjustments, erection of site and workers compounds and accommodation as required; and upgrades to public roads required to facilitate construction
- **Phase 3 – Main construction works**: Onsite civil works, wind turbine construction and electrical reticulation
- **Phase 4 – Commissioning**: Activities to be undertaken prior to operation such as testing of turbines and energising substations.

Phase 1 also includes the undertaking of all post-approval and pre-construction additional survey commitments and the preparation of all management plans required to adequately manage potential environmental and social impacts as outlined in **Chapter 19**.

A description of Phase 2 to Phase 4 is provided below.

4.8.2 Phase 2 - Site preparation and temporary construction ancillary facilities

Prior to commencement of construction activities, the following works would be undertaken:

- detailed geotechnical investigations to confirm the ground conditions
- installation of temporary construction fencing around work areas, where required
- utilities survey and safety marking of any existing overhead transmission lines
- site survey and pegging to confirm infrastructure positioning and placement
- establishment of temporary construction compounds and workforce accommodation (as required) and site facilities including concrete batch plants and quarry sites
- establishment of laydown areas for construction materials and equipment
- preliminary earthworks and installation of environmental controls including erosion and sediment management structures
- identification and establishment of no-go zones around trees, vegetation, and culturally significant areas to be retained.

Earthworks would be limited to the locations requiring resurfacing activities for temporary construction facilities (including access tracks, laydown areas, construction compounds and carparking areas) and permanent operational infrastructure.

The need for heavy earthworks such as grading/levelling and compaction will be minimised as much as practicable during this phase and undertaken as part of phase 3.

The extent of excavations and volume of fill required for the project would depend on the geotechnical conditions and the final locations for infrastructure. These details would be determined during detailed design of the project.

Site offices and compounds

Site offices and compounds will be established in this phase of construction and will include:

- offices and meeting facilities
- amenities
- car parking
- construction compound including delivery and laydown areas
- bunded equipment maintenance and refuelling areas.

Temporary construction offices and compounds would be required in each cluster and would be expected to require an area of up to 100 metres by 200 metres (two hectares in area). The areas would be fenced for security and to allow safe movement of vehicles and storage of equipment. Indicative locations for the temporary construction facilities are provided in **Figure 4-1**. Building fit outs would include power, lighting, air-conditioning, security, fire detection, and communications.

An area approximately 100 metres by 100 metres would be retained at each location for permanent use as an operation and maintenance facility as described in **Section 4.7.3**. This would include a site office, workshop, storage, parking and facilities for operational staff.

Smaller satellite construction facilities would also be required in other locations throughout each cluster to facilitate construction. These would include amenities, laydown and storage areas. The locations of these smaller satellite facilities would be confirmed by the preferred EPC contractor to suit the construction schedule.

The final locations will be determined in accordance with the Development Consent conditions and subsequent management plans and shown on the Final Layout Plans.

Construction workforce accommodation

UPC\AC are considering two options for the accommodation of the required construction workforce. The first option is a regional distribution of the peak workforce with accommodation sourced from surrounding towns. The second option is to accommodate the entire workforce in purpose-built workforce accommodation. These two options are discussed in more detail in **Section 4.8.6** and the environmental and social impacts and benefits associated with each option are considered in the relevant impact assessment chapters.

Should a purpose-built workforce accommodation area be required, it would include rooms and amenities for up to 400 workers (the expected peak workforce), and supporting facilities such as car parking, a dining hall, gym, library, and other recreational facilities.

The location of the potential construction workforce accommodation area is shown on **Figure 4-1**. this location has been discussed with the relevant landholder and should the proposed accommodation area be required, UPC\AC would enter into a lease agreement with this landholder for the duration of the construction period.

The accommodation would consist of prefabricated demountable units, that would be delivered to site and installed during the Phase 2 construction activities. An example layout from another current UPC\AC project, is included in **Figure 4-10**, to provide an indication of a typical layout and footprint for a project of a similar scale. An indication of the typical form of the accommodation area is provided in **Figure 4-11**.

A hardstand area of up to five hectares would be required for the workforce accommodation and supporting facilities and this area would be located within the nominated parcel of land, such that vegetation clearance and other environmental and social impacts are minimised.

It is expected that the workforce accommodation area would be serviced by a pump-out sewerage system and potable water would be imported by truck. Water supply and sewerage treatment is discussed further in **Section 4.12**.

The electricity required for the construction workforce accommodation would be supplied by up to six diesel generators. Each generator would be expected to consume up to 500 litres of diesel per day.

Storage of diesel and other flammable liquids and hazardous materials required for the for the project would be within appropriately bunded stores, designed in accordance with the relevant standards and to the satisfaction of DPIE and NSW EPA.

The construction accommodation village would be managed by an experienced operator engaged by the EPC contractor. Provided appropriate reliability, quality and financial competitiveness can be satisfied, local businesses would be engaged wherever possible to service the proposed workforce accommodation. This would typically include maintenance, laundry, cleaning, catering, security, and shuttle bus services and waste management.

Following construction of the project and cessation of the lease agreement, the workforce accommodation area would be dismantled, and the land would be returned to its pre-existing condition in consultation with the landholders.

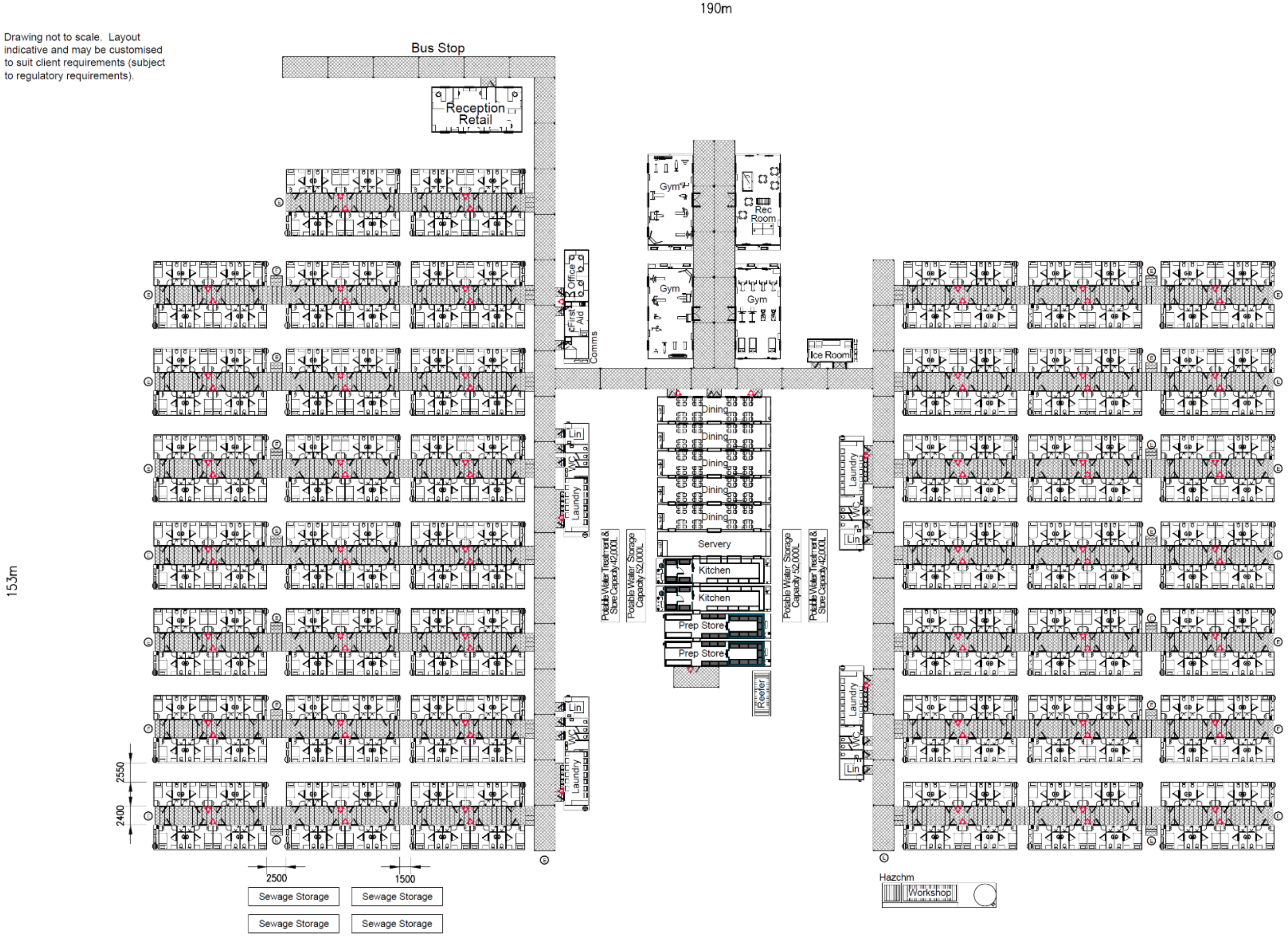


Figure 4-10: Example layout for a typical construction workforce accommodation area

Figure 4-11: Example of a typical construction workforce accommodation

Upgrades to public roads

A transport and logistics assessment has been undertaken to consider the need for upgrades to the public road network, including any structures, to facilitate construction and particularly the delivery of the turbine blades from the Port of Newcastle to site using over size-over mass (OSOM) vehicles under police escort. Discussion of this assessment is provided in **Chapter 9**.

The logistics assessment based on the transport routes outlined in **Section 4.8.7**, identified that the following road upgrades summarised in **Table 4-5** would be required prior to construction:

Table 4-5: Schedule of proposed road upgrades

Intersection / Road		Proposed upgrade	Length (km)	Timing
Road authority: Warrumbungle Shire Council				
1	Mount Hope Road	From Neilrex Road intersection to Mount Hope cluster boundary, upgrade to the standard and satisfaction of Council for general construction traffic. This upgrade would not be required under the centralised worker accommodation scenario.	1.0	Prior to commencing construction of the Mount Hope cluster
2	Mount Hope Road	Within the Mount Hope cluster boundary, upgrade to the standard and satisfaction of Council for general construction traffic and OSOM vehicles.	12.0	Prior to commencing construction of the Mount Hope cluster
3	Black Stump Way / Mount Hope Access Road intersection	Extent of required works to allow access for OSOM vehicles.	N/A	Prior to commencing construction of the Mount Hope cluster

Intersection / Road		Proposed upgrade	Length (km)	Timing
4	Short Street	From the Golden Highway to Church Street, upgrade to the standard and satisfaction of Council for general construction traffic and OSOM vehicles. UPC\AC is committed to paving this section of road in response to feedback from the local community.	0.3	Prior to commencing construction of the Girragulang Road cluster
5	Turee Street	From Short Street to Main Street, upgrade to the standard and satisfaction of Council for general construction traffic and OSOM vehicles. UPC\AC is committed to paving this section of road in response to feedback from the local community.	0.3	Prior to commencing construction of the Girragulang Road cluster
6	Main Street	From Turee Street to Wyaldra Street, upgrade to the standard and satisfaction of Council for general construction traffic and OSOM vehicles.	0.1	Prior to commencing construction of the Girragulang Road cluster
7	Wyaldra Street	From Main Street to Moorefield Road, upgrade to the standard and satisfaction of Council for general construction traffic and OSOM vehicles.	0.3	Prior to commencing construction of the Girragulang Road cluster
8	Moorefield Road (east)	From Wyaldra Street to Girragulang Road cluster boundary, upgrade to the standard and satisfaction of Council for general construction traffic and OSOM vehicles.	2.2	Prior to commencing construction of the Girragulang Road cluster
9	Turee Street / Main Street intersection	Extent of required works to allow access for OSOM vehicles.	N/A	Prior to commencing construction of the Girragulang Road cluster
10	Wyaldra Street / Moorefield Road intersection	Extent of required works to allow access for OSOM vehicles.	N/A	Prior to commencing construction of the Girragulang Road cluster
11	Moorefield Road (west)	From Black Stump Way to Girragulang Road cluster boundary, upgrade to the standard and satisfaction of Council for general construction traffic.	4.6	Prior to commencing construction of the Girragulang Road cluster

Intersection / Road		Proposed upgrade	Length (km)	Timing
12	The Leadville Stock Route	From Black Stump Way to Wardens Road, upgrade to the standard and satisfaction of Council for general construction traffic.	0.8	Prior to commencing construction of the Leadville cluster
13	Wardens Road	From The Leadville Stock Route to access track to Leadville cluster, upgrade to the standard and satisfaction of Council for general construction traffic.	1.8	Prior to commencing construction of the Leadville cluster
14	Wardens Road	From end of item 13 to access tracks to Leadville cluster, upgrade to the standard and satisfaction of Council for general construction traffic	5.4	Prior to commencing construction of the Leadville cluster
Road authority: Transport for NSW				
15	Golden Highway / Black Stump Way intersection	Extent of required works to allow access for OSOM vehicles.	N/A	Prior to commencing construction of the Mount Hope cluster
16	Golden Highway / Leadville Access Road intersection	Extent of required works to allow access for OSOM vehicles.	N/A	Prior to commencing construction of the Leadville cluster
17	Golden Highway / Short Street intersection	Extent of required works to allow access for OSOM vehicles.	N/A	Prior to commencing construction of the Girragulang Road cluster

Proposed road upgrades would be undertaken as outlined in **Table 4-5** to facilitate component deliveries and would be designed and constructed to the satisfaction of the relevant roads' authorities for the locations of the upgrades. Further details about the proposed road upgrades are provided in **Chapter 9**.

Potential environmental impacts associated with the proposed road upgrades have been assessed and discussed in the relevant sections of this EIS. This includes any additional vegetation clearing that will be required due to the swept paths of the oversized trucks.

Quarrying activities

Depending on the quality of material available on site, the project would require some on-site quarrying to source material that would typically be used for road base for access tracks and hardstand areas. On site quarrying is the preferred way to source materials required for construction as it would significantly reduce the potential traffic impacts to the surrounding road network that would otherwise be associated with the haulage of materials.

Boreholes would also be required to determine the suitability and availability of the material on site for use and the depth of bedrock as part of design development. Depending on the quality and quantity of available material, at least one quarrying area is proposed in each cluster and indicative locations are shown in **Figure 4-1**.

The size and location of these quarry locations would be confirmed by the preferred EPC contractor following detailed geotechnical investigations prior to construction. Any variations in the indicative locations would be developed in accordance with the proposed management measures outlined in **Chapter 19**.

Rock crushing and concrete batching plants

Temporary rock crushing and concrete batching plants would be required to process rock, aggregate and concrete for the WTG foundations, electrical infrastructure (footings for towers and poles, substations etc.) and other minor works such as site office and compound foundations.

The temporary rock crushing and concrete batching facilities would be located within the site compounds in each cluster to minimise material handling. Indicative locations are shown in **Figure 4-1**.

Detailed design and layout of the proposed facilities would be undertaken by the preferred EPC contractor, but it is expected that the temporary rock crushing facility would need an area of approximately 50 metres by 100 metres to accommodate a tracked mobile crushing unit, conveyor belts, feeder and engine. The area would also include capacity for safe vehicle movement and storage for materials required for up to five days of concrete batching.

Some temporary rock crushing may occur throughout each cluster using mobile plant if required following excavation of rock material to reuse in the immediate area and minimise haulage of materials around site.

The temporary concrete batching facility would require a larger area of up to 100 metres by 100 metres to accommodate a trailer-mounted concrete mixer, cement bins, sand, and aggregate stockpiles and storage container for equipment and tools.

Detailed estimates of the volumes of materials to be processed by the proposed facilities would be confirmed by the preferred EPC contractor following detailed geotechnical investigations and when the final wind farm layout is confirmed. If the extraction and processing thresholds exceed Schedule 1 of the *Protection of the Environment Operations Act 1997* (POEO Act), an Environmental Protection Licence (EPL) would be obtained from the EPA for the operation of rock crushing or concrete batching facilities.

4.8.3 Phase 3 – Main construction works

Following site preparation, construction of the project would commence which would include:

- civil works for access tracks
- construction of the WTGs
- construction of electrical infrastructure including the overhead transmission lines
- construction of permanent onsite ancillary infrastructure.

The construction methodology would be determined by the preferred EPC contractor when the final wind farm layout is confirmed. It is expected that some of these construction tasks would occur concurrently.

Civil works for access tracks
Construction of the access track network would be the first major civil works package to be delivered as part of the Phase 3 main construction works and would provide durable and reliable access to the turbine locations in each cluster for the delivery of major components.

Based on the indicative layout shown in **Figure 4-1**, up to about 150 kilometres of access track would be required across the whole wind farm area to provide access to the turbine locations and all electrical infrastructure throughout the wind farm. The access tracks would be appropriately designed and established during this stage of construction and maintained for use as operational access tracks.

The access tracks would comprise a six-metre-wide engineered gravel road surface, with drainage structures, cut and fill batters, and sediment and erosion controls as required, extending beyond the six-metre engineered road surface. Fencing, gates, and cattle grids would also be included where required.

An indicative cross-section of the proposed access tracks is provided in **Figure 4-12**.

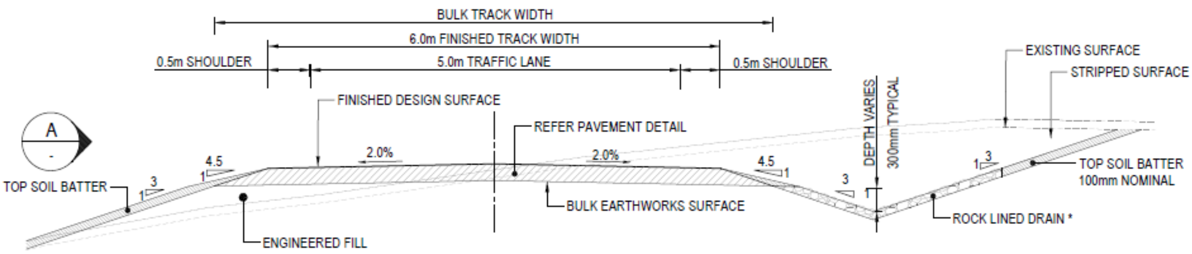


Figure 4-12:Indicative cross-section for the proposed access tracks

A typical construction sequence for the access tracks would include the following:

- topsoil stripping and stockpiling
- bulk earthworks including cut and fill, batter stabilisation and subgrade improvement where soft/wet soils require. Subgrade improvement may include any of the following:
    - stabilisation
    - geotextile strengthening
    - coarse rockfill strengthening
    - subgrade replacement
- installation of drainage structures including:
    - cross drainage
    - longitudinal drainage including rock-lined drains or vegetated swales
    - waterway crossings where required
- surfacing and compaction
- revegetation of batter slopes where required
- installation of fencing, gates, and cattle grids as required in consultation with the landholder.

As the access track formation is being constructed, drainage structures such as culverts and pipes would be installed to enable natural flows to be maintained. If any temporary diversion channels are required to enable the installation of culverts and pipes., appropriate controls would be implemented for the diversion channels to minimise the potential for scour. After the culvert or pipe is installed, the drainage line would be reinstated, and the temporary channels removed.

The design of any drainage structures would depend on the topography and expected flow of water. Rock-lined drainage would be used for longitudinal drainage where the topography is steep and erosion potential is high, and topsoil and vegetated swales or channels would be used where gradients are lesser, and the erosion potential is reduced.

The design of cross drainage, including the need for rock stabilisation and/or headwalls at the inlets and outlets of culverts and pipes would depend on flow rates and expected volumes of water during flood events. All drainage requirements would be modelled during the detailed design, and all creek crossings required for the access tracks would be designed and constructed in accordance with the following where appropriate:

- Managing Urban Stormwater: Soils and Construction (Landcom, 2004) manual, or its latest version
- Policy and Guidelines for Fish Friendly Waterway Crossings (NSW DPI, 2004)
- Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003).

A temporary disturbance footprint of about 15 metres would be considered reasonable to construct the access tracks, to allow for the co-location of trenched electrical reticulation, although this would vary depending on the topography and the amount of cut and fill required.

To allow for flexibility in the design process, a buffer of up to 50 metres on either side of the centreline of the proposed access tracks has been applied to the impact assessment for this EIS. This buffer zone provides adequate space beyond the typical construction zone of the formation for the following:

- implementation of sediment and erosion control measures
- safe and efficient circulation of construction vehicles and earthmoving plant
- temporary storage of topsoil materials, close to final placement position
- underground cabling alignments
- drainage inlet and outlet stabilisation or headwalls where required.

The detailed engineering of the access track network, access points from public roads, and construction methodology would be developed by the preferred EPC contractor during the detailed design phase.

Wind turbines

Preparation for construction of each turbine would include the development of a suitable foundation and laydown/hardstand area. This area would be large enough to provide a level working space for the required construction machinery, a permanent foundation pad, and to lay down the individual turbine and tower components during construction. Hardstands would be paved to required load-bearing specifications and would be maintained throughout construction and to facilitate ongoing maintenance and access to the WTGs during operation.

The total area required for each turbine site would be dependent on the turbine size, but it is expected that a hardstand area of approximately 80 metres by 40 metres would be required for each wind turbine location, with several configurations of this area possible.

Overhead transmission lines

Construction methods will be developed would consider site conditions, topography, accessibility, and the proposed voltage. Generally, the following indicative activities are likely to be required:

- site establishment and clearing for access provisions
- survey and mark out

- establishment of required easements, including vegetation clearing and trimming where impacts are unavoidable
- excavation for footings and installation of towers/poles
- stringing of the lines and earthing.

It is expected that most of the proposed overhead transmission lines would be easily accessible from the ground and construction could be undertaken using ground-based equipment. The exception to this may be the installation of the proposed 330 kilovolt transmission line connecting the wind farm to the CWO-REZ Transmission line. Where accessibility is challenging, the higher voltage transmission line may be strung using a helicopter as the safest construction method.

Some temporary laydown areas would be required along the alignment of the transmission lines for the storage of equipment, transmission tower components/poles and conductors.

The final construction methods for the proposed overhead transmission lines would be developed by the preferred EPC contractor when the final wind farm layout is confirmed and in consultation with TransGrid and in accordance with the relevant TransGrid transmission construction guidelines.

Underground electrical reticulation

Generally, the underground electrical reticulation would be co-located with the proposed access track network to minimise the need for additional ground disturbance during construction. Where possible the cabling would be laid during the earthworks for the access tracks and would involve the following indicative construction activities:

- site establishment, including temporary fencing for safety reasons and to exclude livestock
- temporary removal of existing fences if required and establishment of access controls to manage livestock in consultation with the property owner
- excavation of trenches and stockpiling of material next to the trench
- laying bedding sand
- laying cabling and services notification indicators
- backfilling (previously stockpiled material), compaction and rehabilitation in consultation with the landowner.

The locations and alignment of all underground electrical reticulation would be marked with marker posts, which would be maintained during operation of the wind farm and until the preferred decommissioning is agreed with the landowner. Decommissioning is discussed further in **Section 4.10**.

Other electrical infrastructure

Other electrical infrastructure including the substations and the BESS would be constructed together and where relevant, would be co-located in the same compound.

The substations will be designed and constructed in accordance with TransGrid requirements and other relevant technical, electrical and planning standards. Construction would require clearing and excavations for the reinforced concrete foundations and the compound areas around the switch room, control building and other components would be surfaced with course gravel and stone material.

4.8.4 Phase 4 – Commissioning

Following the completion of the main construction works, the site would be commissioned suitable for operations. Commissioning works would include:

- testing and commissioning of infrastructure
- removal of temporary construction facilities
- revegetation of disturbed areas.

It is expected that some of these tasks would occur concurrently.

4.8.5 Plant and equipment

Typical machinery and equipment required for construction of wind farms of this scale are listed in **Table 4-6**.

Table 4-6: Anticipated construction machinery and equipment

Plant	Plant
Cranes of varying size and lifting capacity	Grader
Drum rollers	Compactor
Dump truck	Small pile driving rig
Road truck	Water truck
Concrete truck	Cable trenching and laying equipment
Excavators	Generators
Scraper	Mobile crushing and screening plant
Forklifts	Light vehicles
Heavy vehicles for deliveries and materials haulage	Transmission pole borers
Elevated work platforms	Wire spoolers
Handheld power tools	Front-end loaders

4.8.6 Construction hours, program and workforce

Construction hours

Standard daytime construction hours consistent with the *Interim Construction Noise Guideline* (Department of Environment and Climate Change 2009) (ICNG) are as follows:

- 7am to 6pm Monday to Friday
- 8am to 1pm on Saturdays
- No works on Sunday or public holidays

UPC\AC is seeking approval for standard construction hours, plus additional time at the start and end of each day (Monday to Saturday) and Saturday afternoon, referred to as 'extended construction hours'. The extended working hours would maximise construction efficiency, maintain flexibility for large concrete pours and curing cycles and reduce the overall construction program. The proposed working hours would be:

- 6am to 6pm Monday to Friday
- 6am to 6pm on Saturdays
- No works on Sunday or public holidays.

The proposed extended hours would represent one hour at the start of each day (Monday to Friday), two hours at the start of the day on Saturdays, and five hours on Saturday afternoons in addition to the standard daytime working hours. Where possible, activities conducted within the extended hours period will be inaudible at noise sensitive receivers. High noise level activities, such as those involving noisy machinery, would be deferred to standard working hours where possible.

Out of hours work would also be required on limited occasions such as when transporting large components including turbine blades, nacelles, and transformers to site, using over-size over-mass vehicles under police escort; or to facilitate large concrete pours and curing cycles that can't be undertaken during the extended working hours. Some staff arrival/departure movements and emergency response may also be required from time to time.

The Secretary, Warrumbungle Shire Council and surrounding landholders would be notified of any planned out of hours works.

The timing of construction would be dependent on project approval however, it is expected to commence in the first quarter of 2023 and would run for a period of approximately 24 to 42 months.

Expected workforce

The project would likely require up to 400 workers during peak construction, subject to detailed design, construction methodology and scheduling.

UPC\AC will engage with Warrumbungle Shire Council and the preferred EPC contractor through detailed design to investigate options for prioritising local workers where feasible. For example, this would include introducing local workers and sub-contractors that have expressed an interest in the project during development and through an online construction register, which has already been established, to assist in maximising the local work force onsite.

Workforce accommodation

UPC\AC are considering two options for the accommodation of the required construction workforce. The first option is a regional distribution of the peak workforce with accommodation sourced from surrounding towns. The second option is to accommodate the entire workforce in purpose-built workforce accommodation.

The regional distribution of workforce option assumes that construction workers would be distributed across six localities, including the townships of Coolah, Dunedoo, Cassilis, Coonabarabran, Gulgong and Mudgee and travel to site from established accommodation facilities in these towns.

Based on feedback from Warrumbungle Shire Council and the approximate size of the closest surrounding towns, the distribution of workers for construction is expected to be close to the indicative estimates provided in **Table 4-7**. These workforce location assumptions are subject to ongoing consultation with Warrumbungle Shire Council.

Table 4-7: Indicative distribution of construction workers

Town	Percentage of workforce	Total
Coolah	15	60
Dunedoo	15	60
Cassilis	5	20
Gulgong	15	60
Coonabarabran	30	120
Mudgee	20	80
Total	**100%**	**400**

The centralised workforce option assumes the bulk of the construction workforce would be accommodated at a purpose-built construction workforce accommodation area located on site.

The environmental and social impacts and benefits associated with each option are considered in the relevant impact assessment chapters. However, key findings from the social impact assessment survey undertaken as part of this EIS suggest that one of the major recurring issues raised by the community is the difficulty of accommodating a large workforce within the surrounding towns. Issues raised in the survey include shortages of appropriate accommodation in surrounding towns and potential impacts on tourism and local housing associated with an increased pressure on available accommodation.

It would also be expected that a centralised accommodation option would result in reduced traffic impacts on the surrounding road network as the bulk of the construction workforce would be centrally located and therefore not travelling to and from site daily, using the local road network.

Noting that Warrumbungle Shire Council have expressed a preference for the construction workforce to be spread out around the nearby towns and not to be focussed in one centralised area, UPC\AC will continue to work with Warrumbungle Shire Council and the preferred EPC contractor to develop an accommodation and employment strategy, which will consider various workforce requirement scenarios for the duration of construction and propose measures to manage workforce accommodation either in surrounding towns, or at a centralised workforce accommodation area.

To the extent possible, this would include the consideration of the potential cumulative effects of other major projects and nearby mines in the area and consider measures to manage potential impacts of workforce on short-term accommodation availability and the local housing market.

4.8.7 Transport routes and traffic movements

Heavy vehicle transport routes

It is expected that many of the wind turbine components and other large components such as the electrical plant would be manufactured off-site and transported to site in sections.

Transporting large components, such as turbine blades, by road is a very complex undertaking and the final transport routes, will be confirmed by the preferred EPC contractor based on the final procurement and origin of the wind farm components. However it is expected that some components will be delivered by ship to Newcastle Port prior to transportation to site by road.

The expected delivery route from Newcastle Port to the Golden Highway near the wind farm site would be approximately 280 kilometres, and would likely comprise the following roads:

- Bourke Street from Newcastle Port
- Hannel Street
- Industrial Drive
- Pacific Highway
- New England Highway
- Golden Highway.

From the Golden Highway, access to each turbine cluster would need to be via the local road network. Proposed access routes to each cluster are shown in **Figure 4-1**. Detailed discussion of the potential impacts to the regional and local road networks associated with heavy vehicle access to site, is provided in **Chapter 9**.

Light vehicle movements

Most light vehicles trips would be associated with workers travelling to and from each cluster to work each day. The associated impacts on the local road network would be dependent on the workforce accommodation option developed for the project, as discussed in **Section 4.8.6**.

Under both assessment scenarios for the construction workforce, construction activities at the three clusters were assumed to be undertaken sequentially, with construction vehicle movements associated with one cluster at a given time. Although there may be some overlap in construction activities, this assumption provides a representative worst-case assessment for each cluster. Detailed discussion of the potential impacts to the regional and local road networks associated with light vehicle access to site during construction and operation, is provided in **Chapter 9**.

4.9 Operation and maintenance

The operational lifespan of the project would be around 30 years unless the facility is re-powered at the end of its operational life.

The project would operate 24 hours per day, seven days per week with the operations and maintenance team attending site typically five days a week during normal hours unless responding to an alarm or fault or major maintenance works.

Ongoing monitoring and maintenance would be required, including maintenance of the turbines, associated infrastructure, and access tracks. Typical activities to be undertaken during operations include:

- infrastructure and equipment maintenance and replacement as required
- site maintenance including vegetation management, weed and pest management, fence and access road maintenance and remediation of drainage channels if required
- general security and housekeeping.

Approximately 50 full time employees would be required to operate and maintain the wind farm.

Regular light vehicle access will be required throughout operations. Heavy vehicles would be required occasionally for replacing larger components of project infrastructure including inverters, transformers, or components of the BESS.

It is expected that the 330-kilovolt transmission line would be owned, operated, and maintained by TransGrid. Consultation with TransGrid and other relevant stakeholders will continue as the project design is further developed, and throughout operation of the wind farm. Consultation is further discussed in **Chapter 5**.

4.10 Decommissioning

Near the end of the wind farm's operational life, a decommissioning and rehabilitation plan will be prepared that outlines the rehabilitation objectives and strategies to return the wind farm site to its pre-existing condition for agricultural land use. The decommissioning and rehabilitation plan will be prepared in consultation with Warrumbungle Shire Council and landholders.

At the end of its operational life, the project would be decommissioned and land that is impacted by the project would be rehabilitated in consultation with the affected landholders.

UPC\AC or its contractors will attempt to recycle all dismantled and decommissioned infrastructure and equipment, where possible. Structures and equipment that cannot be recycled would be disposed of at an approved waste management facility. Further details on waste management for the project are included in **Chapter 14**.

Most of the cabling will be buried between 600mm to 1000mm below ground. This will be removed as part of the decommission process. Any underground cabling below 1000 millimetres is proposed to remain in-situ following project decommissioning as this would not interfere with safe farming practices and would reduce the impact on soils during decommissioning.

Personnel numbers required for decommissioning of the wind farm are expected to be equal to or less than those estimated for construction.

4.11 Subdivision

The land on which the substations are constructed would likely require subdivision (if required by TransGrid). However, the development footprint is located within zone 'AG' for subdivision, and under Clause 4.1 of the Warrumbungle LEP, the size of any lot resulting from a subdivision of land in zone AG is not to be less than600 hectares.

The subdivision of one or more lots may be required for any of the substations, resulting in lots that are less than the minimum 600 hectares. However, the proposed subdivision would be permissible under Section 4.38 of the EP&A Act subject to the approval of the Minister for Planning.

Following decommissioning of the project, the subdivided lots would be reconsolidated back into the original lot. Consultation would be undertaken with Warrumbungle Shire Council, DPIE and the associated landholders once the final location of the substation was determined.

4.12 Service and utility supply arrangements

4.12.1 Water supply

Water required for construction would be preferentially sourced from:

- commercial suppliers of treated wastewater in the nearby region
- opportunistically sourced from farm dams located within the study area
- sourced from town water.

Water sources would be determined in consultation with suppliers and landholders and be subject to availability. During drought conditions, it is likely that most of the water will be sourced from commercial suppliers or treated wastewater.

Anticipated water requirements for various construction activities are presented in **Table 4-8**.

Table 4-8: Construction activities and associated water requirements

Water requirement	Water use assumptions	Total estimated volume
Dust suppression (incl. concrete batching plant)	Assume 45km track length at once, 8m application width application rate 2.5L/m^2/day, 78 weeks duration = 900 kilolitres per day	421,200 kilolitres
Pavements	Access tracks, wind turbine hardstands, internal substation benches, O&M facilities, concrete batching plant, construction compounds	647,464 kilolitres
Wind turbine foundations	Concrete and binding	27,612 kilolitres
Amenities (potable water)	Assume 400 persons workforce, 40L/day/person, 78 weeks duration	7,488 kilolitres
Potential workers accommodation facility (potable water)	Assume 400 persons workforce, 40L/day/person, 78 weeks duration	7,488 kilolitres
Total construction	**-**	**1,111,252 kilolitres**

Water would primarily be used for dust suppression during construction and decommissioning activities and would likely be in the order of 900 kilolitres of non-potable water per day (the volume of approximately 45 water trucks with a capacity of 20,000 litres). An additional 40 litres of potable water would be required to service construction compounds per day.

Water use during the operational phase of the Project would be negligible and sourced from suitable and appropriately licenced water sources. Water required for staff amenities would be in the order of 10,400 litres per annum and would be sourced from onsite rainwater tanks or delivered to site as potable water. Groundwater will not be used during the operational phase of the Project staff.

Water for maintenance activities would be sourced from water trucks, opportunistically from farm dams located in the study area, from treated wastewater if available in the nearby region; or would be sourced using town water where appropriate and available. Water used for staff amenities would be sourced from treated wastewater where available or from the town water supply.

4.12.2 Electricity

Access to electricity during construction activities would be via the local distribution network where available and via diesel generators where access to the grid is unavailable.

Electricity requirements during operation would include lighting, staff computers, domestic appliances and onsite security systems during operations. Electricity generated by the wind farm would be used for most activities during operations.

4.12.3 Telecommunications

Telecommunication utilities are not available within the study area. As such, the cellular network would be used during construction. During operations connection to telecommunications would be via optical fibre with cellular backup.

4.12.4 Sewer

There is no sewer access at the site. Therefore, amenity facilities would be pumped out via tanker and delivered to the Coolah and Dunedoo sewage treatment facilities (whichever is closest to the cluster), or as agreed with Warrumbungle Shire Council during construction. UPC\AC or its contractors would consult with Warrumbungle Shire Council prior to commencement of construction to reach an agreement.

It is likely that a septic system would be installed for the operational amenities. This would be constructed and managed in accordance with the relevant Warrumbungle Shire Council requirements.

4.13 Environmental management

A description of the proposed environmental management framework that will be implemented for the project is provided in **Chapter 19** and a consolidated summary of the management measures identified within this EIS is also provided. Some of these management measures will be detailed further prior to commencement of construction and/or operation.

5. CONSULTATION

5.1 Overview

Consultation and engagement with affected parties, stakeholders, and the broader community has been an integral part of the development of the project as well as informing the scoping of investigations for this EIS. Since July 2018, UPC\AC has been building a local presence in the region through both one-on-one and group meetings with local landholders, neighbouring property owners, Warrumbungle Shire Council, Mid-Western Regional Council, Upper Hunter Shire Council, community groups and local service providers.

As part of the project refinement process, consultation has been undertaken with a range of stakeholders including Government agencies, the local community, and other industry or special interest groups.

In June 2017, the NSW Department of Environment (now DPIE) released the *Draft Environmental Impact Assessment Guidelines Series: Community and Stakeholder Engagement* guideline (NSW DPIE, 2017) to guide community and stakeholder engagement for State significant projects. In accordance with the guide, this chapter provides information on the following:

- the issues raised, and detail on how these have been addressed through project changes (refer to **Section 2.4, Section 5.7** and **Section 5.8**)
- justification for where issues raised have not been addressed through project changes– (refer to **Chapter 6 to Chapter 18** and **Appendix P**)
- overview of how the required outcomes from participation have been achieved including evaluation and measures of success (refer to **Section 19.4**)
- a list of the community and other stakeholder groups and how they participated (refer to **Chapter 5**)
- the planned approach to engaging the community and other stakeholders through construction and operation, if the proposed project is approved (refer to **Section 5.9**).

Table 5-1: Environmental impact statement phase consultation summary

Methodology	Timing	Target audience/ respondents	Quantity
One-on-one meetings	Throughout EIS development	Host Landholders	189
		Neighbouring landholders	97
		Special interest groups	17
		Wider community	203
		Government Stakeholder	23
Community information sessions	Throughout EIS between February 2020 and February 2022	Community information sessions	10 sessions attended by over 250 people

Methodology	Timing	Target audience/ respondents	Quantity
Virtual community information sessions	6 – 10 September 2021	During COVID-19 lockdowns virtual project update meetings were advertised and undertaken with interested community members.	3
Group meetings	Throughout EIS Between February 2020 and February 2022	Special interest groups	4
		Government Authorities	26
Opt-out survey (random)	17 to 28 January 2022	20k surrounding project site including Dunedoo, Coolah and Surrounds	100
Semi-structured interviews	December 2021 – February 2022	Over 100 attempted contacts	51 respondents including nearby neighbours, host landholders, community groups, elected representatives, emergency services and local business.
Online survey	September 2021	Sent directly to 92 residences via email and mail Approx. 3500 through the district diaries	27 respondents

5.2 Consultation objectives

The objectives driving community and stakeholder engagement for the project are focussed on three main areas:

1. **Relationships** – Building trusted relationships early in the development process with a view to growing and sustaining these through construction and operation
2. **Transparency and timeliness** – Providing clear and accurate information, in the right way, at the right time
3. **Sharing, understanding and incorporating** – Listening and working with stakeholders through every stage and adapting to the needs of the community as the project develops.

The main objectives of consultation for the project have been to confirm identified stakeholders have adequate understanding of:

- the contextual drivers behind the wider industry
- the project and UPC\AC
- how the project may affect them and how the project is likely to benefit the community and the region
- how they can seek information on the project and register for ongoing project updates
- how engagement contributes to the overall development of the project
- how they can participate in the development of the project.

UPC\AC is committed to adopting a model of consulting early and often, with a view to minimising surprises for the community and stakeholders. Ongoing interactions with the community and stakeholders will align with UPC\AC's engagement principles.

> ***"UPC\AC understands that we have long-term responsibilities in the communities where our projects are located. UPC\AC works in collaboration with community leaders and other stakeholders to deliver renewable energy projects safely. Every project and community is unique, and our team engages with them to create projects that are investments in the people and infrastructure of the communities. We create custom-made community programs to meet local needs with the goal that our programs have a lasting positive impact."***

The owner operator model means UPC\AC has long term motivations to be a valued member of the local community throughout its planning, construction, operation and decommissioning phases. The long-term local presence means UPC\AC can foster long term relationships with both landholders and community members, and a long-lasting positive impact on the local community. Through regular and open communication, UPC\AC aims to establish strong relationships and understand how to best share socio-economic benefits with the community.

Community and stakeholder consultation undertaken to date has assisted the development of the project and preparation of this EIS by:

- collecting information and insights for scoping the EIS and technical assessments
- helping to maximise the diversity and representativeness of project stakeholders
- helping to understand the interests and values that stakeholders have in the project and the local area, and how potential impacts are perceived
- considering the views of stakeholders in a meaningful way and using these insights to refine the project and inform management measures where required.

5.3 Stakeholder identification

UPC\AC has developed an extensive and comprehensive stakeholder list of organisations and individuals, with stakeholders categorised into sub-groups based on organisation or individual type. Key stakeholders have been identified and grouped based on organisation type, individual interest or interaction with the project.

The key stakeholder groups include the following:

- **Government** – Government and regulatory departments and consent authorities
- **Community** – near neighbours within and surrounding the study area, either directly or indirectly affected by the project, community service providers, special interest groups and Aboriginal community members
- **Mineral title holders** – including any exploration or mining licences held over the study area
- **Network service providers** – including grid connection, telecommunications, water and sewer.

An overview of key stakeholders and their relevant interests in the project is provided in **Table 5-2**.

Table 5-2: Known and potential stakeholder interests in the project

Stakeholder subgroup	Stakeholder name	Interests relevant to the project
Government		
Local	Warrumbungle Shire Council	• construction and operational traffic impacts and potential road upgrades • employment and workforce opportunities • broader benefits and stimulation of the regional economy • construction workforce accommodation strategy • materials to be used in construction • construction and operational noise and visual amenity impacts • waste quantities and disposal • agriculture and land use • community consultation
	Mid-Western Regional Council	• construction and operational traffic impacts and potential road upgrades • employment and workforce opportunities • construction workforce accommodation strategy • community consultation
	Upper Hunter Shire Council	• construction and operational traffic impacts and potential road upgrades • construction workforce accommodation strategy • community consultation
State	Department of Planning, Industry and Environment	• project details, assessment pathway and timing • approach to community and stakeholder engagement • adequate assessment of environmental impacts and ongoing environmental management • role of the project in the context of the CWO-REZ and the Government's electricity infrastructure roadmap, including the CWO-REZ transmission line
	Energy Corporation of NSW	• project details, assessment pathway and timing • approach to community and stakeholder engagement • CWO-REZ technical specifications and access rights

Stakeholder subgroup	Stakeholder name	Interests relevant to the project
	Department of Planning, Industry and Environment – Biodiversity Conservation Division	• biodiversity offsets • Aboriginal and historic heritage • water and soils • flooding
	DPI – Water and NRAR	• watercourses • water supply arrangements • surface water and groundwater impacts • flooding • erosion and sediment control
	DPI – Agriculture	• sediment and erosion controls • closure strategy • land capability • land use • biosecurity • amenity impacts from traffic • travelling stock reserves and livestock • community consultation
	DPI – Fisheries	• aquatic ecology • waterway crossings • riparian vegetation
	Mr (Roy) Royal Francis BUTLER, MP Barwon	• general project information • project benefits and opportunities • impacts on the local community, infrastructure and services
	Hon Mark Coulton, MP Parkes	• general project information • project benefits and opportunities • impacts on the local community, infrastructure and services
	EPA	• dust emissions • storage of chemicals, fuels and batteries • noise and vibration • waste management • surface water protection
	Heritage Council of NSW	• historic heritage
	NSW Department of Regional NSW – Mining, Exploration and Geoscience (MEG)	• impacts to exploration and mining of significant resources
	Transport for NSW	• traffic impacts
	Fire and Rescue NSW	• bushfire hazards and emergency planning

Stakeholder subgroup	Stakeholder name	Interests relevant to the project
	NSW Rural Fire Service	• bushfire hazards and emergency planning • impacts to asset protection zones
	Central West Local Land Services	• impacts to Aboriginal cultural heritage
	Office of The Registrar: Aboriginal Land Rights Act	• impacts to Aboriginal cultural heritage
	Service NSW Crown Lands Office	• development on crown lands
Commonwealth	DAWE	• impacts to MNES under the EPBC Act
	Hon Mark Coulton, MP Parkes	• general project information • project benefits and opportunities • impacts on the local community, infrastructure and services
	National Native Title Tribunal	• impacts to Aboriginal cultural heritage
	AEMO	• connection to the national electricity transmission network
	Royal Australian Air Force (RAAF) / Department of Defence	• general and detailed project information • impacts on military flying training operated at RAAF Base Williamtown and Danger Area D538B
	Airservices Australia	• general and detailed project information • potential impacts of the project and to address the lowest safe altitude (LSALT) impact of air route W627 which will need to be raised
	Civil Aviation Authority	• general and detailed project information • conflict with minimum obstacle clearance elevations and flight paths • mitigation and management of potential impacts
	Civil Aviation Authority	• general and detailed project information • conflict with minimum obstacle clearance elevations and flight paths • mitigation and management of potential impacts
Community		
Directly involved landowners	Associated landholders	• general project information • land acquisition, leasing and access • mitigation and management of potential impacts

Stakeholder subgroup	Stakeholder name	Interests relevant to the project
Residences located within 5 km radius of study area	Neighbours/non-associated landholders	• general and detailed project information • amenity impacts • conflict with adjacent land use • mitigation and management of potential impacts
Residences located greater than 5 km radius from study area and up to 10 km	Local community	• general project information • amenity impacts • mitigation and management of potential impacts • explore potential for involvement in the project
Broader community located outside the locality (i.e. greater than 10 km)	Broader community	• general project information • mitigation and management of potential impacts
Aboriginal community and stakeholder groups	Registered Aboriginal Parties Gilgandra Local Aboriginal Land Council (LALC) Dubbo LALC Native Title Service Corporation (NTSCORP)	• general project information • Aboriginal heritage • adequacy of consultation • mitigation and management of potential impacts to items of heritage significance
Local businesses and community service providers	Various	• general project information • project benefits and opportunities • impacts on the local community, infrastructure and services • mitigation and management of potential impacts
Nearby airports and landing areas	Aerial operators for Coolah Airport (YCAH), Coolah aircraft landing area and Royal Flying Doctors Service	• general and detailed project information • conflict with minimum obstacle clearance elevations and maximum turbine height • mitigation and management of potential impacts
Neighbouring mines	Ulan Mine	• cumulative impacts
	Wilpinjong Mine	• cumulative impacts
	Moolarben Mine	• cumulative impacts
Nearby wind farm projects	Barneys Reef Wind Farm	• cumulative impacts
	Liverpool Ranges Wind Farm	• cumulative impacts

Stakeholder subgroup	Stakeholder name	Interests relevant to the project
Local media	Coolah District Diary	• general project information • project benefits and opportunities • impacts on the local community, infrastructure and services • Advertisement of project community initiatives
	Dunedoo District Diary	• general project information • project benefits and opportunities • impacts on the local community, infrastructure and services • Advertisement of project community initiatives
	Coonabarabran Times	• general project information • project benefits and opportunities • impacts on the local community, infrastructure and services • Advertisement of project community initiatives
	Mudgee Guardian	• general project information • project benefits and opportunities • impacts on the local community, infrastructure and services • Advertisement of project community initiatives
	Facebook Page	• general project information • project benefits and opportunities • impacts on the local community, infrastructure and services • Advertisement of project community initiatives • general project information • project benefits and opportunities • impacts on the local community, infrastructure and services
Special interest groups	Coolah District Development Group inc.	• general project information • project benefits and opportunities • cumulative impacts • mitigation and management of potential impacts
	Dunedoo Farmers Association	• general project information • project benefits and opportunities • impacts on the local community, infrastructure and services • amenity impacts • mitigation and management of potential impacts

Stakeholder subgroup	Stakeholder name	Interests relevant to the project
	Coolah Chamber of Commerce	• general project information • project benefits and opportunities • impacts on the local community, infrastructure and services • amenity impacts • mitigation and management of potential impacts
	Uarbry Residents Group	• general project information • project benefits and opportunities • impacts on the local community, infrastructure and services • amenity impacts • mitigation and management of potential impacts
	Jump the Stump	• project benefits and opportunities
	Mens Shed	• project benefits and opportunities
	Coolah Rugby Club	• project benefits and opportunities
	Junior Sports Association	• project benefits and opportunities
Mineral title holders		
Metallic minerals	Bacchus Resources Pty Ltd (owner EL 8665)	• land use and potential impacts to mineral reserves
	Lachlan Cooper Pty Ltd (owner EL 9173)	• land use and potential impacts to mineral reserves
	Gilmore Metals Pty Ltd (owner EL 9268)	• land use and potential impacts to mineral reserves
Network Service providers		
Electricity grid	TransGrid	• connection to existing and/or future transmission infrastructure for evacuation of the electricity generated by the project
Distribution network	Essential Energy	• connection to the distribution network for auxiliary supply

5.4 Community and stakeholder consultation tools

An outline of the community and stakeholder consultation tools that have been used to date and that will continue to be utilised for the project is provided in **Table 5-3**.

Table 5-3: Community and stakeholder consultation tools

Tool	Objectives	Stakeholders	Timing
Project website	Provides regular updates on the project, links to key project documents, and details opportunities for participation. The project website can be accessed via the following link: https://valleyofthewinds.com.au/	• community • media • local and regional businesses • regulatory authorities and agencies • industry and other stakeholders	Ongoing
Project Facebook page	Provides regular updates on the project, links to key project documents, and details opportunities for participation. The project Facebook can be accessed via the following link: Valley of the Winds | Facebook	• community • media • other stakeholders	Ongoing
Newsletters, notifications and fact sheets	Provide key information on the project and upcoming activities. Newsletters, notifications and fact sheets were delivered via letter box drop to the local community and published on the project website.	• community • industry and other stakeholders	Ongoing
Presentations and briefings	Used to keep identified stakeholders updated on specific events and activities tailored to the stakeholder group being consulted. They involved a group of stakeholders with similar interests or one-on-one meetings with individuals or with representatives of a group.	• community • regulatory authorities and agencies • industry and other stakeholders	Ongoing
Community information sessions	A drop-in session where community members and stakeholders can ask questions and/or provide verbal or written feedback to members of the project team.	• community • local and regional businesses	During project development, EIS preparation and (planned) during EIS exhibition

Tool	Objectives	Stakeholders	Timing
Community information line	Provides an avenue for the community to enquire about the project or provide feedback. Email: vowt@upc-ac.com Community Information Line: **1800 571 185**	• community	Ongoing
Project email mailing list	An avenue for community members to subscribe to receive regular project updates. Registration link: https://valleyofthewinds.com.au/community/	• community • industry and other stakeholders	Ongoing
Media	Traditional media including print and online journalism & paid advertisements, television and radio.	• community • industry and other stakeholders	Ongoing
Work Registration	Allows registration of interest for employment opportunities during all phases of the project. Registration link: https://valleyofthewinds.com.au/employment-and-contracting-opportunities/	• community • industry and other stakeholders	Ongoing throughout development phase

5.5 Community and stakeholder engagement plan

UPC\AC developed community and stakeholder engagement plan (CSEP) to meet the consultation objectives for the scoping phase and form the basis for ongoing consultation into the EIS and future phases of the project.

The CSEP outlines how the consultation objectives for the project are implemented at the different phases of project development from scoping and early design, through to construction and operation.
A summary of the consultation methodology is included in **Table 5-4**.

Table 5-4: Consultation methodology

Phase	Objectives	Action/ tools	Stakeholders	Status
Project scoping and site selection stage	• inform potential host landholders of the project concept • gauge the level of interest from local landholders with suitable land • get a feel for the general community attitude towards renewable energy and wind farms	• letters • phone calls • face to face meetings	• landowners (potential and now involved)	Completed
EIS development and pre-lodgement	• incorporate stakeholder considerations into project design • focused assessment on the issues and impacts relevant to the community and other stakeholders • identify community values and aspirations • communicate the rationale or reason for the project and the project's strategic context • report on consultation outcomes and how matters have been considered • seek community and stakeholder comment on the project and EIS	• meetings • presentations • drop in sessions • media release and liaison • project email address • website • mailing list • letterbox drop • social impact assessment targeted consultation • feedback collation and mitigation options	• community • neighbours • landowners • Registered Aboriginal Parties • Council • government depts • media	Completed
EIS public exhibition and determination	• respond to community and stakeholder feedback via a response to submissions report • identify any project changes required following receipt of submissions • inform the community and stakeholders about the determination decision for the project • clarify any conditions of consent for the project	• UPC\AC will be available to answer questions or concerns from the community, but will avoid interfering with the Department's Public Exhibition activities • UPC\AC will respond to all public and agency submissions made in a 'Response to Submission' report to be submitted to DPIE • ongoing consultation with Council and TransGrid has been identified	• community • neighbours • government authorities including Council, TfNSW and other agencies • TransGrid • landowners	To be completed

Phase	Objectives	Action/ tools	Stakeholders	Status
		in regard to roads and access to site		
Pre-Construction	• keep the community informed on project activities and timeframes to construction start • community benefit sharing models • early works (if relevant) • introductions to local workers, contractors and businesses interested in commercial and employment opportunities	• letters • letterbox drop status update • support to landowner team • presentations or information sessions	• community • neighbours • landowners • Council • local workers • local businesses	To be completed
Construction and commissioning	• keep the community informed on construction activities • facilitate ongoing consultation and engagement throughout construction and operation including complaints handling procedures • regularly report on the environmental management outcomes	• local consultation with landowners and neighbours • local liaison officer (UPC\AC or contractor) • Council engagement and briefings • establish a complaints register, including reporting and investigating procedures and timelines, and liaison with Council • create a public hotline for rapid notification of complaints • FAQs • drop in session • letters • letterbox drop on project status update • support to landowner team	• community • neighbours • landowners • Council	To be completed

5.6 Scoping phase consultation

The preferred consultation method throughout the project's scoping phase was face-to-face discussions with targeted stakeholders. The aim was to introduce the project to individuals, seek feedback and provide further information as needed.

Consultation undertaken through the scoping phase of the project involved the following:

- **project website:** A public website has been established to provide project related information and regular community updates, https://valleyofthewinds.com.au/. This website will be maintained throughout the planning approvals process, during construction and into operation as a central public information source.
- **project inbox:** A project inbox has been established to allow the project team to receive emails from members of the community seeking clarifications or further information.
- **community information session:** A community information session was held in Coolah on 27 February 2020 and Leadville on 28 February 2020, to allow landowners and the broader community to gather more information and talk to members of the project team face-to-face. The session also allowed the project team to discuss the potential impacts and seek initial feedback on the project. Feedback and requests for further information included general questions about the project and information on some of the potential key issues, including amenity, community benefit sharing opportunities, landscape values and community values.
- **information packages**: As part of preparing for the community information session, written invitations and a project factsheet (project description and indicative layout plan) were sent to known stakeholders.
- **meetings with key stakeholders**: meetings with key stakeholders, including local councils have been conducted to seek feedback on project and raise issues and opportunities to be addressed and/or discussed further as the project develops.

A summary of the consultation and stakeholder engagement undertaken during the scoping phase are provided in **Table 5-5**. Outcomes of consultation undertaken during the scoping phase are further detailed in the Scoping Report (Ramboll, 2020).

Table 5-5: Summary of early engagement activities

Stakeholder	Engagement activities
Associated landholders	Personal phone calls Face to face meetings Information package and community information session (27-28 February 2020)
Non-associated landholders	Information package and community information session (27-28 February 2020)
Broader community	Community information session (27-28 February 2020)
Identified local influencers and community groups	Information package and community information session (27-28 February 2020)
Department of Planning, Infrastructure and Environment	Project scoping meeting (5 December 2019)

Stakeholder	Engagement activities
Warrumbungle Shire Council	Council briefing (19 December 2019) Councillors briefing (3 February 2020) Community information session (27 February 2020)
Mid-Western Regional Council	Council briefing (4 February 2020)
Upper Hunter Shire Council	Council briefing (4 February 2020)
Other Government Agencies	Ongoing consultation within DPIE (Industry)
Local Aboriginal groups	Information package and community information session (27 February 2020)
Commonwealth Government	Pre-referral meeting held with DAWE 19 February 2020
TransGrid	Ongoing meetings since July 2018

5.7 Agency response to the scoping report

In preparing the SEARs, the Department of Planning, Industry and Environment consulted with key agencies and stakeholders to provide feedback on the potential issues that should be considered by the EIS. A complete set of comments received and reference to where they have been addressed is provided in **Appendix B**.

5.8 EIS phase consultation

5.8.1 Government agency consultation

There is general support from government agencies, and local government for the project and the wider program of renewables in the region. Most notably, the NSW Government announced its Central West Orana "pilot REZ" plans in late 2019, and more recently in 2020 has made further announcements on its commitment to developing 3 gigawatts of renewables in the region under the NSW Electricity Infrastructure Roadmap. In the lead up to that announcement, DPIE consulted with Councils and the community in the region. This highlights how the project is aligned with the key strategic policy direction of the NSW Government with respect to electricity infrastructure.

A summary of the engagement activities undertaken with government agencies during preparation of the EIS is provided in **Table 5-6**.

Table 5-6: Summary of State government engagement activities

Stakeholder	Engagement activities	Key consultation outcomes
Local government		
Warrumbungle Shire Council	• Councillors briefing - 3 February 2020 • Ongoing emails/phone calls • Multiple meetings regarding VPA • Multiple meetings regarding traffic and road upgrades	• introduced the proposed project location and provided general information on the size of the project and proposed choice of technology, surrounding landowners etc • provided a general update on the project including anticipated timeframes and the communication strategy

Stakeholder	Engagement activities	Key consultation outcomes
	• General information meetings • Aboriginal cultural heritage consultation (Stages 1 and 2)	• Council assisted UPC\AC to contact near neighbours who had not responded to previous communications • a meeting was held on 21 July 2021 to discuss outcomes of the community information session (refer to **Section 5.6**) and key issues to be addressed in the EIS including traffic impacts and interactions with council infrastructure provision including waste management. • a meeting was held on 14 October 2021 to provide input into the workforce and accommodation strategy for the project • Multiple meetings were held from the 7 July 2021 regarding the VPA framework. General terms of the agreement were sent to Council for review on 8 July 2021
State government		
DPIE Assessment Branch	• Ongoing emails/phone calls and virtual meetings	• provided a general update on the project including anticipated timeframes and the communication strategy • discussed the connection strategy to the future CWO-REZ transmission line
Energy Corporation	• Ongoing emails/phone calls • Multiple face-to-face meetings • Onsite meeting on 2 February 2022	• discuss concept behind central west energy developments, consultation around proposed CWO-REZ, provide update on progress UPC\AC developments • Discuss timing and scheduling dates to assist with coordination of community information sharing
DPIE - BCD	• Ongoing emails/phone calls • Face-to-face meetings on 13 July 2021 and 23 August 2021	• refer to **Section 5.8.2** for details on consultation undertaken regarding Aboriginal Cultural Heritage Assessment Report • biodiversity offsets assessment and refinement • confirmation of scope of flooding assessment
DPIE – TfNSW	• Face-to-face meeting 21 July 2021	• Project briefing • Road and intersection upgrades • Heavy vehicle routes
Central West Local Land Services	• Aboriginal cultural heritage consultation (Stages 1 and 2)	• refer to Aboriginal Cultural Heritage Assessment Report for details on consultation undertaken
Office of The Registrar: ALRA	• Aboriginal cultural heritage consultation (Stages 1 and 2)	• refer to Aboriginal Cultural Heritage Assessment Report for details on consultation undertaken

Stakeholder	Engagement activities	Key consultation outcomes
Service NSW Crown Lands Office	• Ongoing emails	• Development on crown lands
Commonwealth government		
National Native Title Tribunal	• Aboriginal cultural heritage consultation (Stages 1 and 2)	• The survey boundary includes land currently subject to Native Title Claim by the Gomeroi People (Tribunal File No. NC2011/006, Federal Court No. NSD2308/2011) • Response received 8/01/2021 *"Records held by the National Native Title Tribunal as at 7 Jan 2021 indicate that the Gomeroi People have a determined Native Title over the identified area of the project."*
AEMO	• Phone calls and emails	• Discuss proposed project and its feasibility for connection to the NSW transmission network

5.8.2 Community consultation

Landowners

UPC\AC has been engaging with landowners since 2018 regarding the project and potential or perceived impacts to land. Discussions with the associated "host" landowners focussed initially on the project concept, commercial opportunity associated with the project, potential for agricultural co-location, risk of long-term changes to land and land security.

In the early stages of engagement, UPC\AC sent letters and made phone calls to a wide range of landholders surrounding the project. A number of these landowners expressed an interest in learning more about the project concept and the commercial opportunity and UPC\AC continued to engage with these landowners throughout the refinement of the project layout.

The landowners now associated with the project agreed to a commercial arrangement to lease land to UPC\AC and that land forms the wind farm site. UPC\AC has continued to engage with these landowners throughout refinement of the project layout and development of the EIS (see below for further information).

Neighbours and the community

UPC\AC attempted to contact all immediate project neighbours (those located within two kilometres of the wind farm site) during project development as well as a large number of residents in the broader local area. The majority of neighbours who UPC\AC were able to contact were engaged via a combination of telephone discussions, email, letterbox drop, Facebook, and materials which were sent by post or email containing detailed information and maps.

Assistance was sought from Warrumbungle Shire Council to contact any immediate neighbours who UPC\AC were not successful in contacting, to confirm that letters and fact sheets about the project were being sent to the correct addresses. Additionally, approximately two weeks before each community information session 250 factsheets and event invitations were dropped to all letterboxes within 5 kilometres of the wind farm site.

The project website and Facebook page became publicly available on February 2020 and September 2020 respectively. These were regularly updated to ensure community members were informed on the current stage of the project.
Community information sessions were held throughout the EIS phase. A summary of the community sessions is provided in

Table 5-7: Community information session summary

Date and location*	Advertisement	Attendance
Coolah Youth and Community Centre on 24 March 2021	Coolah District Diary Dunedoo District Diary Flyer on the community noticeboard at the Coolah IGA Updates on the project website and Facebook page Individual invitations were sent to everyone who had subscribed for project updates via the UPC\AC website, as well as directly to known near neighbours.	30 people
Leadville Hall on 25 March 2021	Coolah District Diary Dunedoo District Diary Flyer on the community noticeboard at the Coolah IGA Updates on the project website and Facebook page Individual invitations were sent to everyone who had subscribed for project updates via the UPC\AC website, as well as directly to known near neighbours.	25 people
September 2021, virtual project update meetings (Zoom, phone call or via email)	Coolah District Diary Dunedoo District Diary Flyer on the community noticeboard at the Coolah IGA Updates on the project website and Facebook page Individual invitations were sent to everyone who had subscribed for project updates via the UPC\AC website, as well as directly to known near neighbours.	3 people
Coolah Youth and Community Centre on 2 February 2022	Coolah District Diary Dunedoo District Diary Flyer on the community noticeboard at the Coolah IGA Updates on the project website and Facebook page Individual invitations were sent to everyone who had subscribed for project updates via the UPC\AC website, as well as directly to known near neighbours.	14 people
Leadville Hall on 3 February 2022	Coolah District Diary Dunedoo District Diary Flyer on the community noticeboard at the Coolah IGA Updates on the project website and Facebook page Individual invitations were sent to everyone who had subscribed for project updates via the UPC\AC website, as well as directly to known near neighbours.	22 people

Date and location*	Advertisement	Attendance
Dunedoo Show on 12 February 2022	Coolah District Diary Dunedoo District Diary Flyer on the community noticeboard at the Coolah IGA	40 people
Gulgong Show on 19 February 2022	Coolah District Diary Dunedoo District Diary Flyer on the community noticeboard at the Coolah IGA	20 people
Uarbry 16 February 2022	Individual invitations were sent to everyone who had subscribed for project updates via the UPC\AC website, as well as directly to known near neighbours.	14 people

* Covid-19 restrictions in place in NSW at the time were strictly observed during the sessions including deferral of face consultation sessions in line with NSW Health guidance

Key issues raised during the community sessions was incorporated into the project refinements and technical assessment scoping as discussed further in **Section 2.4**.

A community consultative committee (CCC) was initiated for the project. Due to the lack of interest in nominating as a committee member only one committee meeting held prior to EIS submission.

Social impact assessment consultation

A participatory engagement approach has been undertaken to inform this SIA and builds upon the extensive engagement carried out by UPC\AC as part of the development of the EIS. Impartial and participatory engagement was undertaken independently of the project EIS engagement activities to further inform the SIA.

<u>Opt-out survey</u>

The random survey was undertaken during January 2022 by an experienced, independent research company. The research centred around the towns of Coolah and Dunedoo, seeking a sample size of n=100 adult residents in total. Key findings included:

- 50% of respondents supported (in general) wind farms being built in their region, against 25% opposed (and the balance unsure or neutral). Of four energy infrastructure options offered, only solar farms were more popular (at 58% support) - compared to 27% support for large-scale batteries, and 18% for a gas-fired power station.
- After being informed of the Valley of the Winds wind farm, 60% of residents supported the proposed wind farm (Coolah 61%, Dunedoo 59%), against 18% opposed (Coolah 23%, Dunedoo 15%), with the balance neutral or unsure.
- In terms of their major concerns, 15% (unprompted) were worried about the visual aesthetic of wind turbines, 14% concerned about noise and traffic during constriction, and 10% worried about noise during operation. The only other concerns of note were impact on farming land, and the reliability/life cycle/disposal options for wind turbines (at 5% each).
- 63% supported a workers cam accommodation being used (against 22% opposed and the balance neutral or unsure).

<u>Semi-structured interviews</u>

Between December 2021 and February 2022, a few targeted interviews were carried out by AAP Consulting Pty Ltd to inform the SIA. The breakdown of interviews by stakeholder group is provided in **Table 5-8**.

Table 5-8: Semi-structured interviews stakeholder group representation

Stakeholder group	Respondents
Host landholders	12
Nearby neighbours	12
Special interest groups including local community groups, health, emergency services and community representatives	8
Local business and employment industry	9
Wider community including representative from a comparative project	9
Aboriginal groups	1
Total respondents	**51**

Key themes emerging from consultation are in **Chapter 15** and **Figure 15.4**. The themes are broken down into stakeholder groups by frequency of feedback. It should be noted that stakeholders were able to raise multiple issues or concerns. By stakeholder group, the most frequently raised issues include:

- **Host landholders**: Community investment, leading to improved sustainability and enhancing resilience. Distributive equity of benefits – the investment should stay in the towns most impacted by the project. Decommissioning and how turbines will be pulled down and disposed of.
- **Nearby neighbours**: Changes to the visual landscape and how they experience their surroundings and the potential negative impact on property values.
- **Community groups**: Community investment. Concerns around distributive equity and how the community funds will be administered.
- **Local business and industry**: Economic contributions and sustainability. Including employment and training opportunities, and economic benefits to local businesses and suppliers.
- **Wider community**: Community investment, employment, and job opportunities. Concerns around distributive equity and how the community funds will be administered.

<u>Online survey</u>

An online survey was administered in September 2021 to help further inform the scoped impacts and provide further direction for this assessment. The survey was advertised in local papers, included in direct mail outs and emails to nearby neighbours and host landholders and accessible via the project website. The survey included a series of open-ended and choice questions and received a total of 84 responses, which full completion rate of 25% (21 completed responses). The key themes from the online survey included:

- The positive impact on livelihoods, including the additional income to landholders and the injection of revenue into the broader community. This included increased employment opportunities, increasing local spending for businesses within the surrounding towns, and improving resilience to drought and other natural disasters experienced by rural communities.
- Distributive equity of income
- Visual impacts
- Concerns that during the construction phase, the temporary accommodation needs of workers would increase rental prices and impact the lower-income earners within the

community. As a result, they could no longer afford housing and may be forced to relocate, negatively impacting their standard of living.

Summary

The top three themes from SIA consultation were:

- Economic contribution and sustainability
- Intergenerational equity as a power source to meet future needs and future opportunities associated with the investment
- Visual impacts.

The outcomes of consultation informed the assessment of perceived social impacts and is discussed in **Chapter 15.**

Special interest groups

A number of special interest groups within the region were identified and consulted with to ensure a wide range of views, concerns and issues were considered, as well as encouraging transparent information sharing. These groups are presented in **Table 5-1**.

These groups, ranging from industry groups through to niche community groups, allowed a wide spectrum of views to be heard at an early stage of the projects development. Themes were then identified and grouped to assist in understanding the community drivers. Detail of these themes and driver are presented within the Social Impact Assessment report in **Appendix P**.

Aboriginal community and stakeholders

Aboriginal stakeholders were identified and consulted in accordance with *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW 2010a). Further details of the consultation method and activities undertaken are included in the Aboriginal Cultural Heritage Assessment Report (ACHAR) in **Appendix N**.

The Aboriginal cultural heritage consultation undertaken included four main stages:

- Stage 1 – notification of project and registration of interest
- Stage 2 – presentation of information about the proposed project
- Stage 3 – gathering information about cultural significance
- Stage 4 – review of draft cultural heritage assessment report.

Stage 1

The aim of Stage 1 is to identify the registered Aboriginal parties (RAPs) who wish to be consulted about the project. A log and copies of correspondence with Aboriginal community stakeholders, including published advertisements, is included in **Appendix N**.

An advertisement was placed in the 'Mudgee Guardian' on 8 January 2021requesting expressions of interest for those who wish to be consulted about the project. In addition, the following agencies were contacted to identify potential stakeholders for the area:

- Biodiversity and Conservation Division (BCD now Heritage NSW)
- Mudgee Local Aboriginal Land Council (LALC)
- Office of The Registrar: Aboriginal Land Rights Act
- National Native Title Tribunal
- Native Title Service Corporation (NTSCORP)
- Warrumbungle Shire Council
- Central Tablelands Local Land Services.

As a result, the following groups or individuals registered to be consulted about the project (individuals or groups who did not wish to be identified in the ACHAR are listed as 'Stakeholder 1' etc.):

- Gomeroi People NC2011/006
- Gilgandra LALC
- Dubbo LALC
- Murong Gialinga Aboriginal & Torres Strait Islander Corporation
- Paul Brydon
- AT Gomilaroi Cultural Consultancy
- Michael Long
- Kevin Sampson
- Brian Draper
- Talcon Pty Ltd
- Steve Talbott
- Cacatua General Services
- AGA Services
- Bawurra
- Stakeholder 1
- Stakeholder 2

These individuals/groups constitute the RAPs for the project.

Stages 2 and 3

The objective of Stages 2 and 3 is provide information about the project to the RAPs and to acquire information regarding Aboriginal cultural values associated with the project either through consultation and/or field work. Outcomes of Stages 2 and 3 are included in the ACHAR prepared by OzArk included as **Appendix N** and summarised in **Chapter 11**.

RAPs were sent information about the project and were provided with a copy of the proposed assessment methodology on 14 April 2021. RAPs were provided the required 28 days to review and comment on these documents (i.e. until 12 May 2021). OzArk received several comments from RAPs regarding the assessment methodology.

Comments were received on 10 May 2021 from one RAP group, being, Murong Gialinga Aboriginal & Torres Strait Islander Corporation. The feedback was as follows:

> *Murong Gialinga Aboriginal & Torres Strait Islander Corporation would like to thank you for giving us the opportunity to comment on the Assessment. Murong Gialinga community looked at the Assessment and our comments are as follows. If any area where there is Aboriginal cultural heritage is to be impacted a full 100% survey and collection is to take place all must be recorded and taken back to OzArk's office in Dubbo and placed in a fireproof lockable container .When OzArk have finished with the Aboriginal objects they should be place back on country as close as possible to where they were found GPS reading in an area which is not going to be impacted at all and one rap from each registered Aboriginal group be present.*

The comments from Murong Gialinga Aboriginal & Torres Strait Islander Corporation have been incorporated into the ACHAR, however, the procedure for the fate of any artefacts that may be collected following project approval will be set out in the ACHMP that will be considered by all RAPs. Reburial of artefacts on Country is a common desire of the Aboriginal community and is supported by OzArk.

Stage 4

Stage 4 involves issuing the draft ACHAR to the RAPs for their consideration. The draft ACHAR was issued to the RAPs for comment on 29 September 2021. RAPs were provided the required 28 days to review and comment on the draft ACHAR (i.e. until 28 October 2021). No comments were received on the draft ACHAR.

5.8.3 Aviation assessment consultation

Stakeholder consultation undertaken by Aviation The stakeholders consulted include:

- Airservices Australia
- Civil Aviation Safety Authority
- Department of Defence
- NSW Rural Fire Service
- Coolah Airport (YCAH) (Warrumbungle Shire Council)
- Royal Flying Doctor Service
- Coolah ALA

Details and results of the consultation activities are provided in **Section 10.2**.

Table 5-9: Aviation stakeholder consultation summary

Agency/ Contact	Activity/ Date	Response/ Date	Issues Raised During Consultation	Action Proposed
Airservices Australia	Email sent 10 September 2021	15 October 2021 – William Zhao (Advisor Customer Engagement)	*…Summary* *Based on the above assessment, our view is that the proposed Valley of the Winds Wind Farm would have an* ***impact*** *on the Airservices designed air routes.* *If you wish to proceed with this proposal, we request that you consult with us further to arrange a commercial agreement to make the amendments to the air routes. Note that the changes to the Aeronautical Information Package (AIP) chart is dependent on the publication cycle, for this particular change, we will need at least a minimum of 7 month lead time.*	1. Commercial agreement required to amend air route LSALT. 2. Completes the Vertical Obstacle Notification Form and submit to VOD@airservicesaustralia.com
CASA	-	-	CASA has advised that it will only review assessments referred to it by a planning authority or agency.	No further action required
Department of Defence	Email sent 10 September 2021	Reminder email sent 08 November 2021	Nil response from Defence. Defence has previously responded to other wind farm projects noting the following around obstacle lighting compatibility - *…The proposed structures will meet the above definition of a tall structure. Defence therefore requests that the applicant provide ASA with "as constructed" details. The details can be emailed to ASA at vod@airservicesaustralia.com.* *Defence understands this assessment is yet to be considered by CASA. If CASA determines that obstacle lighting is to be provided, it should be compatible with persons using night vision devices. If LED lighting is proposed, the frequency range of the LED light emitted*	*If CASA determines that obstacle lighting is to be provided, it should be compatible with persons using night vision devices. If LED lighting is proposed, the frequency range of the LED light emitted should be within the range of wavelengths 665 to 930 nanometres.*

Agency/ Contact	Activity/ Date	Response/ Date	Issues Raised During Consultation	Action Proposed
			should be within the range of wavelengths 665 to 930 nanometres. *Defence notes that the National Airports Safeguarding Framework Guideline D – Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers - Paragraph 39 recommends the top 1/3 of wind monitoring towers are painted in alternating contrasting bands of colour in accordance with the Manual of Standards for Part 139 of the Civil Aviation Safety Regulations 1998.* *…. Defence has no objection to the proposed wind farm provided that the project complies with the above conditions.*	
NSW RFS	Email sent 10 September 2021	Reminder email sent 08 November 2021	Nil response	No further action required.
Coolah Airport (YCAH) Warrumbungle Shire Council	Email sent 10 September 2021	Reminder email sent 08 November 2021	Replied 11 January 2022 Kevin Tighe (Manager Special Projects and Infrastructure) replied – *…The impact of the Valley of the Winds development on the Coolah Aerodrome should take into consideration current and future operations at the aerodrome. There is no regular passenger transport service at Coolah aerodrome and no regular commercial flights. The aerodrome is predominantly used as a landing area by small privately owned aeroplanes and it is occasionally used for crop dusting operations. The Coolah aerodrome is also used by air ambulance operators for collection or delivery of patients to the Coolah hospital.*	No further action required.

Agency/ Contact	Activity/ Date	Response/ Date	Issues Raised During Consultation	Action Proposed
Royal Flying Doctor Service	Email sent 10 September 2021	13 September 2021	Positive phone discussion with RFDS Mark Woods (13 September 2021). Nil further response.	No further action required.

5.8.4 Neighbouring mines

Discussions including potential for a transmission line connection to the mine transmission infrastructure were held early during the project development phase. Following further project development and refinement, UPC\AC did not proceed with a transmission line to connect to the existing network and instead proposes a connection to the proposed CWO-REZ transmission line.

5.8.5 Mineral title holders

UPC\AC notified the following mineral title holders of its intention to develop the project:

- Bacchus Resources Pty Ltd (owner EL 8665)
- Lachlan Cooper Pty Ltd (owner EL 9173)
- Gilmore Metals Pty Ltd (owner EL 9268)

A letter describing the proposed development and a map locating the study area and development footprint in relation to the mineral titles has been sent.

5.8.6 Network service providers

The NSW Transmission NetworkService Provider, TransGrid, has been engaged from a very early stage. The workstream of assessing the ability for the project to connect to the existing electrical transmission network is ongoing. There is a formal process which is dictated by TransGrid which must be followed in order to receive an offer to connect to the line.

A formal connection enquiry, being the first stage of this process, was submitted to TransGrid 8 December 2020. Since then, further work has been conducted in conjunction with both TransGrid and EnergyCo. to refine the access strategy for the project. This work is ongoing with any issues being resolved prior to commencement of construction.

Consultation with other service providers including for gas and telecommunications will be undertaken prior to construction. Water and sewer connections are not required for the project (refer to discussion in **Section 4.12**).

5.9 Future engagement

5.9.1 EIS exhibition and response to submissions report

When the EIS is placed on public exhibition, UPC\AC will email all the contacts in their consultation database to notify them that public consultation has begun. The notification will include details on the dates when public consultation occurs and will inform recipients of where to find the EIS and how to make a submission.

During public exhibition, UPC\AC will be available to answer questions or concerns from the community, but UPC\AC will avoid interfering with DPIE's public exhibition activities. UPC\AC proposes another community drop-in session to provide an opportunity for community members to discuss the EIS and explain any technical aspects of the project. These dates, times and locations would be advertised in the local newspapers as well as on the project website. UPC\AC would again distribute a factsheet with key details contained in the EIS and outlining the drop-in session date to the community.

UPC\AC will respond to all public submissions made during the public exhibition stage in a 'Response to Submission' report which will be submitted to the Department of Planning, Industry and Environment.

5.9.2 Ongoing key stakeholder engagement

UPC\AC has identified Warrumbungle Shire Council as a key stakeholder to assist and undertake community consultation, due to their knowledge of the area and experience in many recent projects of a similar scale. UPC\AC will continue to engage with both Warrumbungle Shire Council and the NSW State Government to seek feedback on the development of management plans and strategies as the project moves from development into pre-construction, construction and operational phases.

5.9.3 Ongoing community engagement

UPC\AC will continue to engage with the community throughout construction, operation and decommissioning of the project. Engagement activities would include:

- Regular updates on the project website and Facebook page
- Distribution of newsletters, fact sheets and FAQs to the local community
- Letter box drops
- Operation of the community enquiry line
- Operation of a complaints line and recording in a complaints register.

The project email address and hotline will remain in place, and UPC\AC representatives will continue to take responsibility for addressing feedback and concerns as and when they arise. UPC\AC representatives will be regularly stationed on site in the local area and will be available to meet with the community and local stakeholders.

5.9.4 Community benefit sharing program

As the project progresses, UPC\AC will develop a community benefit sharing program with Warrumbungle Shire Council and the local community aimed to help build and support local projects and initiatives. UPC\AC is currently trialling and implementing a similar program for the New England Solar Farm and the Stubbo Solar Farm.

As part of the program UPC\AC will provide ongoing financial assistance to ensure that there is a direct benefit from the wind farm to the local community. This could include support for local schools, training or education as well as grants or project support for local community or sporting groups.

The final strategy will be developed in consultation with Warrumbungle Shire Council and the Department of Planning, Industry and Environment and will be presented to all relevant stakeholders prior to commencement of construction.

6. LANDSCAPE CHARACTER AND VISUAL

6.1 Assessment methodology

6.1.1 Assessment approach

A landscape character and visual impact assessment (LVIA) has been prepared by Moir Landscape Architecture (Moir). The report is summarised below and provided in full in **Appendix D**.

The purpose of the LVIA is to identify and describe the existing landscape character and identify both private and public visual amenity receptors and, as a consequence of the introduction of the project, to assess potential visual impacts.

In accordance with the NSW Wind Energy: Visual Assessment Bulletin (NSW Department of Planning and Environment, 2016) (the Bulletin) the LVIA assessment includes:

- a baseline study that includes analysis of the landscape character, scenic quality and visibility from viewpoints of different sensitivity levels
- establishment of visual influence zones from viewpoints using data collected in the baseline study
- assessment of the proposed layout against visual performance objectives
- justification for the final proposed layout and identification of mitigation and management measures.

Moir have formulated a quantitative study methodology with regards to the Bulletin and with consideration of previous experience on large scale infrastructure projects and relevant literature and guidelines relating to large scale energy projects.

Extensive field work and photographic survey work for the study was undertaken in March, May, December 2021 and January 2022 from public and private properties.

Visual baseline study

<u>Scenic quality</u>

Scenic quality refers to the relative scenic or aesthetic value of the landscape based on the relative presence or absence of key landscape features known to be associated with community perceptions of high, moderate or low scenic quality.

<u>Landscape character definition</u>

The landscape character of a site refers to the distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people. The existing landscape character was defined by identifying key landscape features of the wind farm site and surrounds (The Landscape Institute with the Institute of Environmental Management and Assessment, 2013). The landscape character of the wind farm site and surrounds has been categorised into five landscape character units (LCUs) and been allocated a scenic quality class rating for the purpose of the LVIA. An overview of the LCUs and their scenic quality rating are in **Table 6-1** and a detailed description in **Appendix D.**

Table 6-1: Landscape character units

LCU	Overview	Scenic quality rating
LCU01 Vegetated hills	Steep ridges and undulating hills with densely vegetated hill slopes that are spread across the wind farm site.	Moderate
LCU02 Undulating farmlands	Gently undulating landscapes with scattered woodlands that have been partially cleared to support grazing and other agricultural activity.	Moderate
LCU03 Alluvial plains	Level, broad floodplains and alluvial terraces that have been cleared to support agricultural activity within the vicinity of the Coolaburragundy and Talbragar Rivers.	Low
LCU04 Agricultural flats	Generally flat, cleared land parcels adjacent to alluvial terraces that are utilised for low density living, grazing and cropping.	Low
LCU05 Towns and settlements	Highly modified landscape settings that have been adapted for human settlement and activity.	Low

Community perception and landscape values

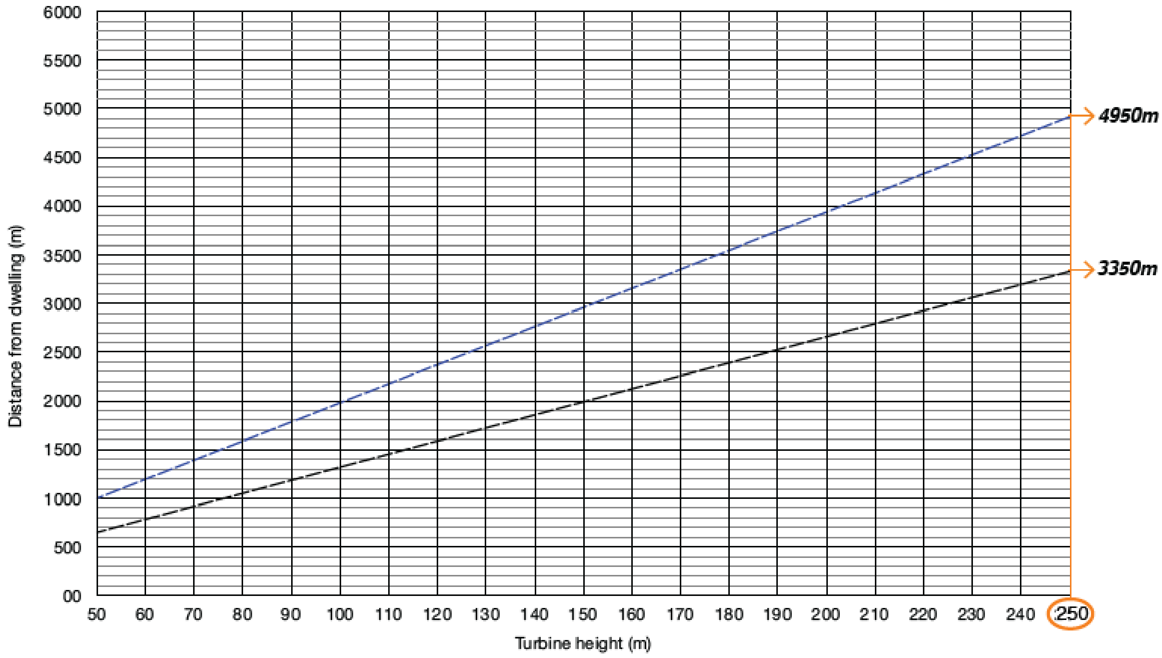
The likely changes to the visual landscape were identified throughout community engagement as a key consideration of the project. The primarily concern related to an increase of built infrastructure and associated changes to the rural character of the landscape and the how this would affect how people experienced their surroundings, as well as their lifestyle choices.

The impact varied between stakeholder groups with some nearby neighbours fearing that the size of the turbines would detract from the natural landscape – something that they highly valued and was a primary consideration for moving or remaining in the area. Some host landholders also expressed concerns over the look of the turbines and what they would potentially see from their properties, while others were more concerns about how they would be physically placed.

Generally, the impact of wind turbines on the visual landscape is a very subjective matter with perspectives differing depending on location, local context and place attachment. Some individuals enjoy seeing wind turbines in the landscape, while others find them unappealing. The wider community including business and community groups, had a lower level of concern, with some suggesting that the turbines could attract tourist to the area or provide a change in scenery for road users.

Visual catchment

The area from which the proposal is theoretically visible defines the 'visual catchment'. To assist in defining the visual catchment, preliminary assessment tools have been developed and involve the analysis of two key visual parameters. The first is the visual magnitude threshold based on the height of the proposed wind turbines to the tip of the blade and distance from dwellings or key public viewpoints. The analysis for the project was based on a worst-case scenario with a tip height of 250 metres. The analysis nominated all non-associated dwellings between 3350 metres (black line of visual magnitude) and 4950 metres (blue line of visual magnitude) of the nearest turbine. The visual magnitude threshold tool from The Bulletin with the project thresholds delineated is provided in **Figure 6-1.**



Source: (Moir Landscape Architecture, 2022)

Figure 6-1: Visual magnitude threshold for project layouts

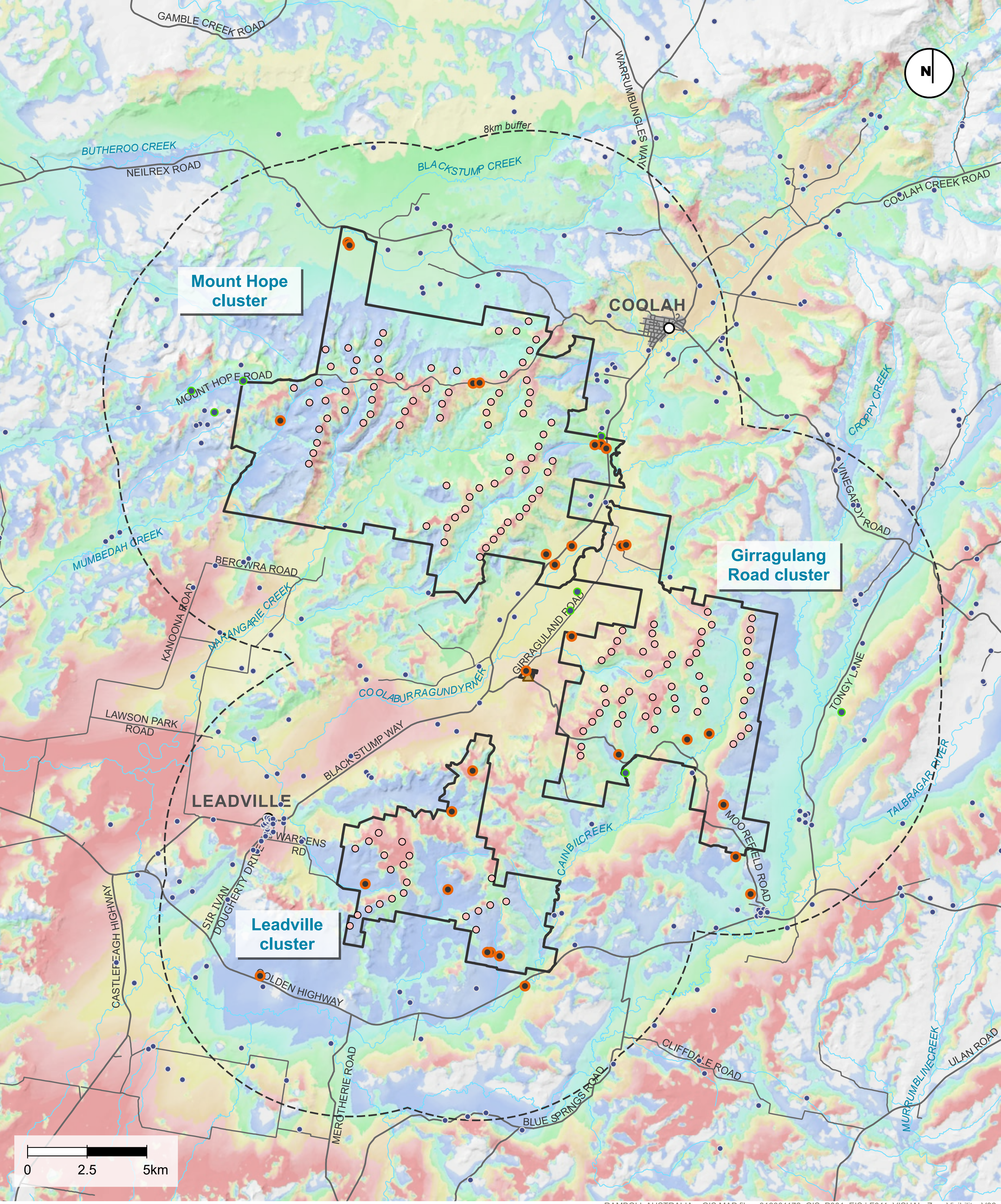
The second parameter is the multiple wind turbine tool which gives an indication of potential cumulative impacts arising from the project. This assessment tool requires the mapping of the horizontal viewpoints of each dwelling or key public viewpoints into six 60° sectors. Where wind turbines are visible within the horizontal views of three or more 60° sectors, within eight kilometres, a detailed assessment of these dwellings or viewpoints is undertaken. The assessment for the project is based on a 2D assessment and takes into account turbines associated with the approved Liverpool Range Wind Farm.

<u>Zone of visual influence</u>

The zone of visual influence illustrates the theoretical visibility of the wind farm from land surrounding the project. Zone of visual influence diagrams have been prepared for each of the clusters (refer **Appendix D). Figure 6-2** depicts the areas of land from which the project may be visible and provides an indicative number of wind turbines based on the blade tip height of 250 metres.

The zone of visual influence has been assessed to approximately 10 kilometres from the project. Although it is possible for the development to be visible from further than 10 kilometres away, it is generally accepted that beyond 10 kilometres visibility is diminished. It is important to note the zone of visual influence is based on a worst-case scenario assessment with no vegetation or structures taken into consideration.

Due to the elevated position of the turbines and maximum tip height of 250 metres above ground level, Highest visibility is identified along the ridgelines located within the wind farm site. The clusters, however, will not be viewable in their entirety due to their elevated position and topographical changes.



RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F011_VISUAL_ZoneVisibility_V06

KEY

- Wind farm site
- Turbine location
- 8km buffer from turbines
- Potential construction workforce accommodation
- Host dwelling
- Associated dwelling
- Non-associated dwelling

Number of visible turbines

- 0
- 1-25
- 26-50
- 51-75
- 76-100
- 101-125
- 126-148

Data sourced from Moir Landscape Architecture and based on turbine with blade tip of 250m

Figure 6-2 | Zone of Visual Influence

Visualisations
The process for generating the photomontages involves combining a photo of an existing view with a computer generated view of the wind turbines. As per the requirements of The Bulletin, photomontages have been prepared in accordance with the *Scottish Natural Heritage Visual Representation of Wind Farms, Version 2.2 February 2017*. The photomontages are based on a worst-case scenario of a maximum turbine height dimension of 250 metres with a hub height of 160 metres and rotor diameter of 180 metres. Moir have prepared the photomontages using the most current available version of "Wind Pro" software.

Wire frame diagrams have been utilised in this LVIA to assist in the assessment of the Project from inaccessible locations. In instances where access to a private property was not granted, wire frame diagrams have been used as an assessment tool to provide a worst case scenario view of the proposal. Wire frame images can be seen as a worst case scenario as they do not take into account factors such as vegetation, building structures.

6.1.2 Statutory context, policy and guidelines
The landscape character and visual assessment has been undertaken in accordance with the following documents:
- NSW Wind Energy: Visual Assessment Bulletin (NSW Department of Planning and Environment, 2016)
- Visual Representation of Wind Farms - Good Practice Guidance (Scottish Natural Heritage, 2017)
- Draft National Wind Farm Development Guidelines (Environment Protection and Heritage Council (EPHC) (EPHC, 2010)
- Guidelines for Landscape and Visual Impact Assessment Third edition (Landscape Institute and Institute of Environmental Management and Assessment, 2013)
- Best Practice Guidelines for Wind Energy Development (Clean Energy Council, 2018)
- Warrumbungle Shire Local Environmental Plan 2012
- The Dark Sky Planning Guideline (2016).

6.2 Existing environment

6.2.1 Warrumbungle Shire Council
The project is located within the Warrumbungle Shire Council LGA. The wind farm site and surrounding land is predominately zoned RU1 - Primary Production under the Warrumbungle Shire LEP. The objectives of the RU1 zoning relevant to landscape and visual impact within the LEP is:

''to encourage sustainable primary production; minimise fragmentation and alienation of resource lands; and encourage diversity in primary industry enterprises and systems appropriate for the area'.

Land parcels located north and southeast of the wind farm site are zoned as C1 - National Parks and Nature Reserves. These include:
- Weetalibah Nature Reserve
- Durridgere State Conservation Area.

6.2.2 Dark Sky Planning Guideline
The *Dark Sky Planning Guideline* (2016) is a matter for consideration for all development under the EP&A Act before development consent is granted within the local government areas of Coonamble, Dubbo, Gilgandra and Warrumbungle. The project falls within the Dark Sky Region

which consists of the land within a 200-kilometre radius of Siding Spring Observatory. An assessment of night lighting in regard to the project has been included in **Section 6.3.5**.

6.2.3 Existing landscape character

Land use

Land use within the wind farm site is predominantly dedicated to agricultural purposes, specifically cattle and sheep grazing. Dryland cropping is also evident. The majority of the land parcels located within the southern-most and middle section of the wind farm site are dedicated to grazing pastures with native and modified vegetation. Land parcels that are rich in biodiversity exist within the southern and northern portion of the wind farm site and in the immediate surrounds and are generally not used for agricultural land uses. Some of these areas are conserved and associated with C1 – National Parks and Nature Reserves zoning. Agricultural activity is also evident across the land surrounding the project, especially dryland cropping and modified grazing pastures.

Towns

The closest settlements that are within an eight kilometre radius of the wind farm site are Coolah, Leadville and Uarbry. Dunedoo is located about 10 kilometres west and Cassilis is about 20 kilometres east of the project. Dwellings are mainly concentrated around the villages of Leadville and Coolah which have a reported population of about 1290 people and 186 people respectively (Australian Bureau of Statistics, 2016).

Coolah lies closest to Mount Hope cluster and was established in 1840 to support agricultural activity in the region and it continues to serve the same function today. The township is located on Black Stump Way and acts as an important rest stop for commuters.

Leadville is located to the northwest of Leadville cluster and has been historically associated with the former Mount Stewart Mine. Mining took place between 1888-1894, 1913-1935 and 1950-1952. Currently the town is recognised for its low density rural residential living with large paddocks and sheep and cattle grazing over native and modified pasture lands.

The smallest settlement in proximity to the project is Uarbry, situated at the junction of the Golden Highway and Moorefield Road. The 2016 census recorded a population of 49 people. However, the Sir Ivan fire (11 February 2017) decimated the township of Uarbry, destroying all dwellings and town amenities. Only a small number of dwellings have been or are planned to be rebuilt leaving the town with only four dwellings and currently no amenities.

Roads

Major roads that connect all the towns in the region are the Golden Highway which runs east-west and Black Stump Way which runs northeast-southwest. These roads play an integral role in linking Coolah and other settlements in the region to surrounding towns such as Dunedoo, Cassilis, Merriwa.

Topography

The wind farm site is situated southwest of the Liverpool Range on the tertiary basalt of the Merriwa Pleateau. Ridgelines generally run diagonally from northeast to southwest emerging from the Liverpool Ranges where the Coolah Tops National Park is situated. The landform is characterised by gently rolling to moderately steep undulations. The undulating landform generally falls south-southwest around Leadville and Uarbry.

Vegetation
Vegetation of the wind farm site and surrounding land is described in detail in **Chapter 7**. The wind farm site is situated at the junction of three different Interim Biogeographic Regionalisation for Australia or bioregions. These are the Brigalow Belt South Bioregion, the Sydney Basin Bioregion and the Southwestern Slopes Bioregion. Native vegetation within and around the wind farm site is dominated by dry sclerophyll and shrubby woodland with grassy understorey which has mostly been cleared or slashed to encourage grazing. Prominent tree species are varieties of ironbark, white box, yellow box and kurrajong trees with some forest red gums and river oaks along lower slopes and valley floors.

Rivers and Creeks
The detailed hydrology of the site is discussed in **Chapter 12**. From a landscape character perspective, the wind farm site and surrounding land is characterised by drainage lines following northeast to southwest direction which is laid out by the ridgelines. Important rivers and creeks in the area are the Coolaburragundy River and Talbragar River, Rocky Creek, Cainbil Creek, Turee Creek and Mumbedah Creek.

Coolaburragundy and Talbragar Rivers are important waterways that feed into a number of gullies and creeks in the area. Coolaburragundy River is a perennial stream and a tributary of the Talbragar River. They both rise from the Liverpool Range and meet in Leadville. Coolaburragundy River carries enough water to support dryland cropping which is prominent in the region. The Talbragar River is an important waterway within the Macquarie catchment. Its course runs for a distance of 277 kilometres until it meets Macquarie River near Dubbo.

6.2.4 Key landscape features

High points
The wind farm site and its surrounds are studded with high points that are rocky outcrops or reminiscent of the basalt Merriwa Plateau with agricultural associations. Tourism associations have not been identified in the area. Some of the high points that prevail in the region are Salisbury Hill, Bald Hill, Paddys Knob and Dungeon Cave.

Weetalibah Nature Reserve
This Nature Reserve is located approximately 10 kilometres north of the wind farm site. The area protects a remnant portion of the once widely spread habitat of narrow leaved iron bark white-cypresses, broadleaved iron bark and tumble down gums (National Parks and Wildlife Service, 2021).

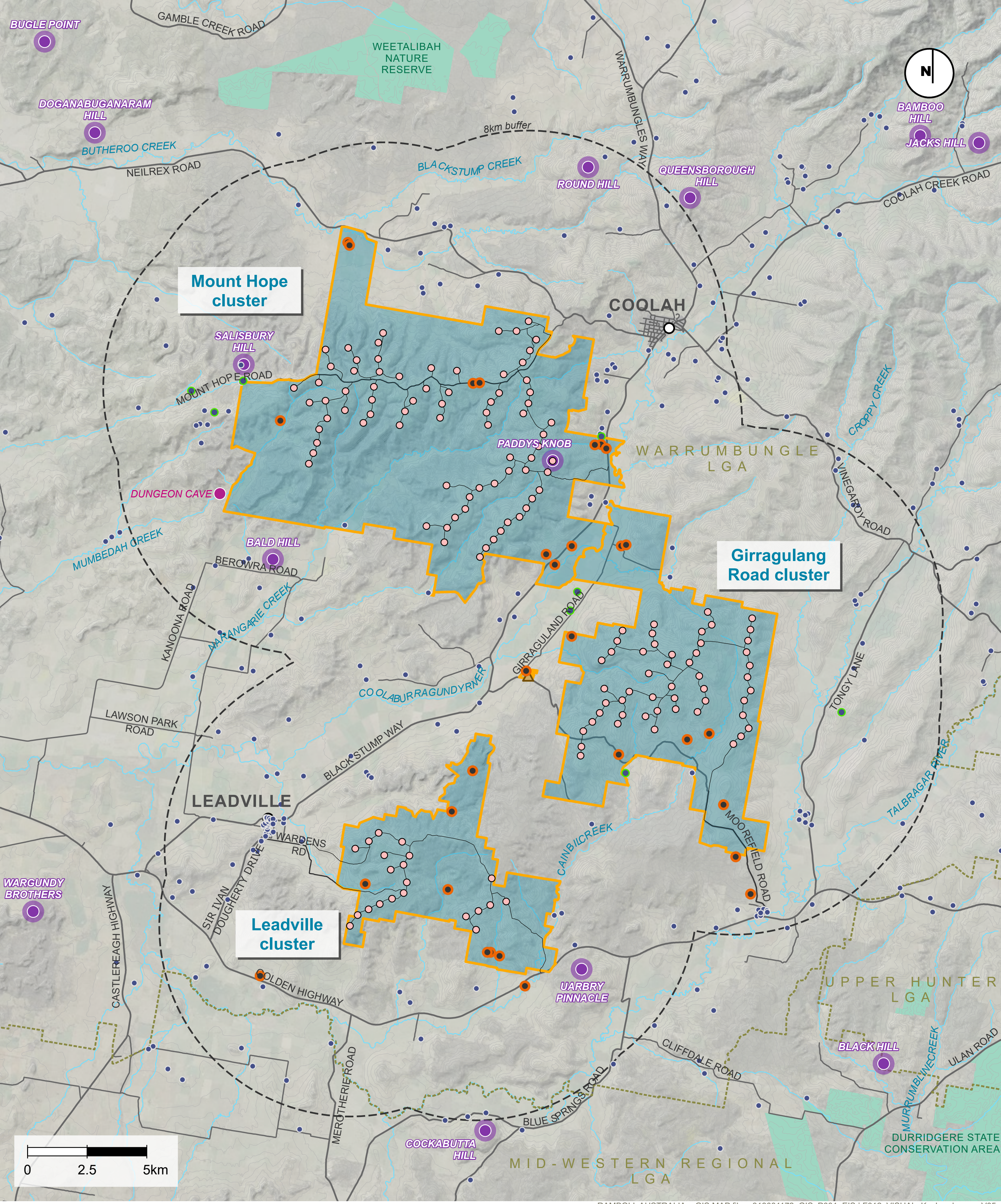
Durridgere State Conservation Area
Durridgere State Conservation Area is located southeast of the wind farm site. It was formerly a part of the Turill State Forest and exhibits typical characteristics of the Brigalow Belt South Bioregion. Predominant species include Narrow-leaved Ironbarks, Red Stringybarks, Spotted Gums, Blakey's Red Gum, Smooth-barked Apple and Scribbly Gums. The area is an important habitat for threatened bird species and mammals. The area was extensively logged and used for timber-getting (National Parks and Wildlife Service, 2021).

Other conservation areas and vegetation patches
Traces of remnant vegetation are interspersed in land parcels south of Black Stump Way and north of Golden Highway, and around Coolah. These green patches exhibit typical Brigalow Belt south Bioregion characteristics with dry sclerophyll vegetation that is spread on gently undulating rises.

Key landscape features are shown on **Figure 6-3.**

6.2.5 Community perception and landscape values

Chapter 5 and **Chapter 15** provide detail on the consultation that has been ongoing with the community on the project and the findings to date. Generally, the impact of wind turbines on the visual landscape is a very subjective matter with perspectives differing depending on location, local context and place attachment. Some individuals enjoy seeing wind turbines in the landscape, while others find them unappealing. The wider community including business and community groups, had a lower level of concern, with some suggesting that the turbines could attract tourist to the area or provide a change in scenery for road users. A small number of respondents to the random survey also noted the cumulative impact of a number of renewable energy projects in the area were negatively affecting the views in rural NSW. The cumulative impacts of the project have been assessed in **Section 6.3.7** and **Chapter 18.**



RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F012_VISUAL_KeyLandscape_V05
Aerial photography from NSW Government Spatial Services

KEY

- Wind farm site
- Turbine location
- Access track
- Potential construction workforce accommodation
- Host dwelling
- Associated dwelling
- Non-associated dwelling
- High point
- Other point of interest
- 8km buffer from turbines
- 10m contour line
- LGA boundaries
- National Parks and Reserves

Figure 6-3 | Key Landscape features

6.3 Assessment of potential impacts

6.3.1 Photomontages

Photomontages were prepared to provide a representation of the view of the project from various viewpoints within the wind farm site and up to a distance of 8000 metres from a proposed wind turbine. The photomontages illustrate the viewpoints without the inclusion of the proposed mitigation measures for the project and are therefore considered a worst-case scenario.

A number of wireframes and photomontages were prepared to illustrate the view of the project once operational. These are summarised in **Table 6-2.**

Table 6-2: Number of photomontage and wireframes

Locations	No. of photomontages	No. of wireframes
Public viewpoints	7	0
Private dwellings	19	13
Total	20	30

The potential impacts of the project on the nearby dwellings and public locations are considered in the following sections of this chapter. The viewpoints that were used for the preparation of the photomontages are at **Figure 6-4**. The photomontages prepared for the project are presented at **Appendix D**.

6.3.2 Visual impact on residences

As discussed in **Section 2.4** the project layout has a substantially smaller footprint and refined layout to those previously considered and has gone through a range of iterations to limit environmental and amenity impacts, including visual impacts. The preliminary assessment tools outlined in **Section 6.1.1** defined the 'visual catchment' and have been used to identify non-associated residences which require assessment for potential impacts. The assessment identified 112 non-associated dwellings within 4,950 metres of the nearest turbine associated with the Project. This includes:

- 42 non-associated dwellings within 3,350 metres of the nearest wind turbine associated with the project.
- 70 non-associated dwellings within 3,350 metres and 4,950 metres the nearest wind turbine associated with the project

A further six (6) non-associated dwellings in excess of 4,950 metres and have potential views to turbines associated with the project and Liverpool Range Wind Farm in multiple 60º sectors. These cumulative impacts are discussed further in **Section 6.3.7.**

The non-associated residences within 3,350 metres of a project wind turbine and project visual impact rating are summarised in **Table 6-3**. **Table 6-4** includes a summary of the project visual impact rating for non-associated residences between 3,350 metres 4,950 metres. The location of the dwellings that have been assessed within 4,950 metres of the project are shown on **Figure 6-4**. **Table 6-5** provides a summary of visual impact on non-associated residences in excess of 4,950 metres with multiple visual sectors.

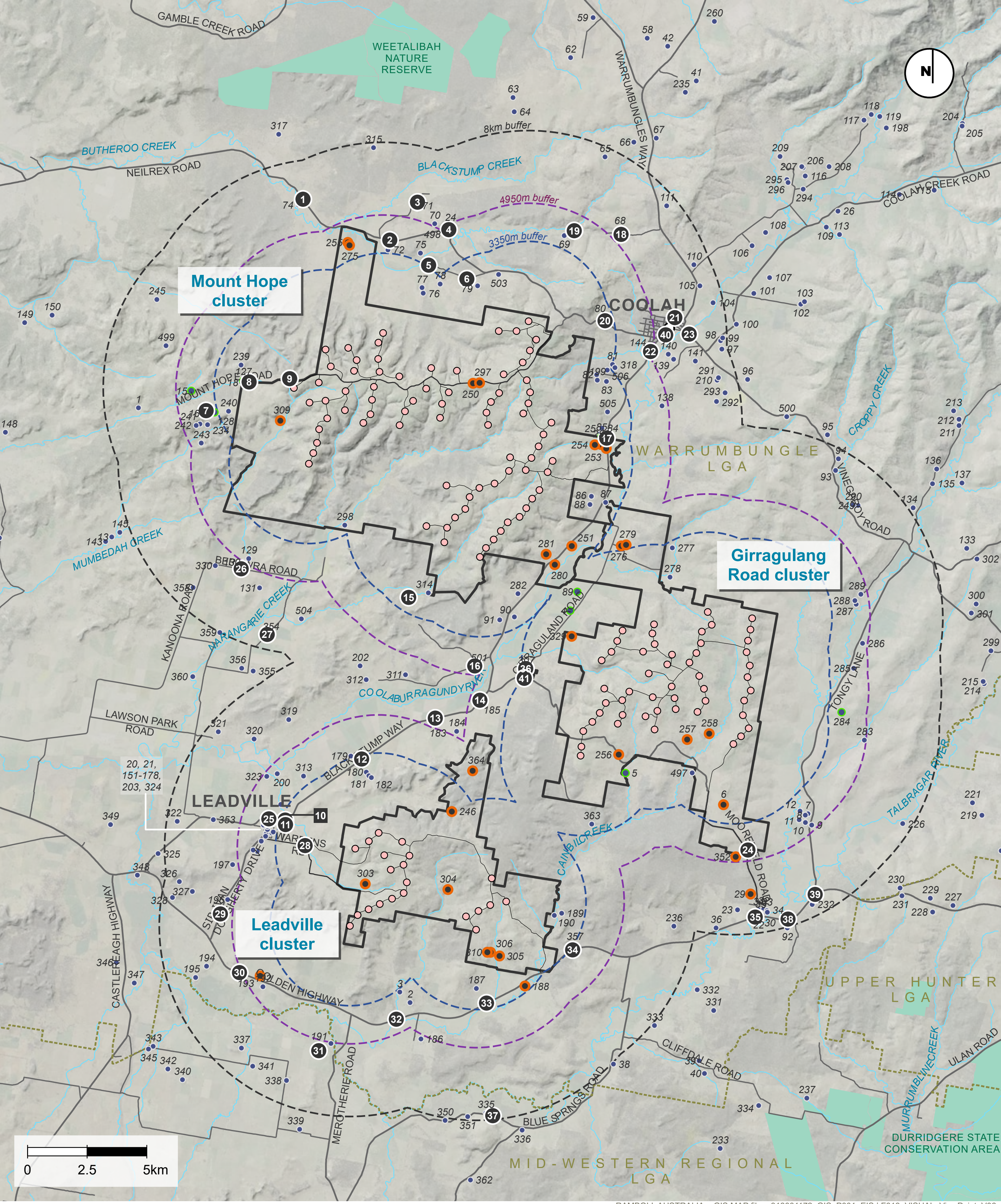
Representative assessments were undertaken for 61 of the 110 non-associated dwellings within 4,950 metres of the nearest wind turbine. Access to all non-associated dwellings was not available. The results were:

- For non-associated dwellings within 3,350 metres of the nearest turbine:
  - Six (6) rated as nil / negligible visual impact rating
  - 19 rated as having a low visual impact rating
  - 14 were assessed as having a moderate visual impact rating
  - Three (3) were assessed as having a high visual impact rating

- For non-associated dwellings within 3,350 - 4,950 m of the nearest turbine:
  - 18 were assessed as having nil / negligible visual impact rating
  - 13 were assessed as having a low visual impact rating
  - 15 were assessed as having a moderate visual impact rating
  - Zero (0) were assessed as having a high visual impact rating.

Numbers above do not include 24 non-participating linked dwellings associated with Leadville. An assessment has been undertaken from representative non-participating Dwelling 154, which was rated as having a moderate visual impact. It is worth noting the representative dwelling selected was based on a worst-case scenario on the eastern side of the township. Existing built form and vegetation within the township is likely to screen views from most dwellings within the township, resulting in a generally low visual impact from dwellings associated with the Leadville township (refer to Viewpoint 25).

Specific consultation is underway with the landholders for the three non-associated dwellings identified as having high visual impacts. It is expected that prior to submission of the EIS for public exhibition, agreements will be in place with each of these landholders.



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KEY

- Wind farm site
- Turbine location
- Access track
- 3350m buffer from turbines
- 4950m buffer from turbines
- 8km buffer from turbines
- Host dwelling
- Associated dwelling
- Non-associated dwelling
- View point (Moir Landscape Architecture)
- LGA boundaries
- National Parks and Reserves

Figure 6-4 | Zone of Visibility - Blade tip (250 metres)

Table 6-3: Summary of visual impact on non-associated residences within 3,350 metres of a project turbine

Representative Dwelling	Linked Dwellings	Distance to nearest turbine (km)	Number of 60º sectors	Number of visible turbines (based on topography alone)	Visual Impact Rating
Mount Hope Cluster					
Dwelling 18	Dwelling 127	2.21	1	14 turbines (10 at tip 4 at hub)	Nil
Dwelling 25		2.10	2	73 turbines (18 at tip 55 at hub)	Low
Dwelling 76	Dwelling 77	2.37	2	54 turbines (12 at tip 42 at hub)	Low
Dwelling 78		3.15	3	57 turbines (16 at tip 41 at hub)	Low
Dwelling 79		2.09	3	45 turbines (5 at tip 40 at hub)	Low
Dwelling 80		3.22	2	98 turbines (13 at tip 85 at hub)	Low
Dwelling 83	Dwellings 82 & 199	2.88	2	72 turbines (9 at tip 63 at hub)	Moderate
Dwelling 84		2.13	2	66 turbines (11 at tip 55 at hub)	High
Dwelling 85		2.18	2	76 turbines (17 at tip 59 at hub)	Low
Dwelling 86	Dwelling 88	2.10	2	65 turbines (4 at tip 61 at hub)	Low
Dwelling 87		2.74	2	89 turbines (18 at tip 71 at hub)	Low
Dwelling 90	Dwelling 91	2.90	3	97 turbines (17 at tip 80 at hub)	Moderate
Dwelling 239		2.42	1	94 turbines (36 at tip 58 at hub)	Negligible
Dwelling 240		2.91	2	13 turbines (6 at tip 7 at hub)	Low

Representative Dwelling	Linked Dwellings	Distance to nearest turbine (km)	Number of 60º sectors	Number of visible turbines (based on topography alone)	Visual Impact Rating
Dwelling 282		2.22	3	89 turbines (10 at tip 79 at hub)	Moderate
Dwelling 298		2.99	2	69 turbines (14 at tip 55 at hub)	Moderate
Dwelling 314		2.23	1	30 turbines (7 at tip 23 at hub)	Moderate
Dwelling 503		2.33	1	1 turbine (At tip height)	Nil
Dwelling 505		2.40	1	67 turbines (11 at tip 56 at hub)	Low
Dwelling 506		3.22	2	89 turbines (15 at tip 74 at hub)	Nil
Girragulang Road Cluster					
5		2.02	4	49 turbines (10 at tip 39 at hub)	High
277		3.07	2	48 turbines (6 at tip 42 at hub)	High
278		2.09	4	83 turbines (30 at tip 53 at hub)	Low
363		2.91	2	28 turbines (19 at tip 9 at hub)	Nil
497		2.11	3	115 turbines (34 at tip 81 at hub)	Low
Leadville Cluster					
Dwelling 20	Dwelling 177	3.20	1	122 turbines (25 at tip 97 at hub)	Low
Dwelling 151	Dwelling 324	2.21	2	121 turbines (34 at tip 87 at hub)	Low
Dwelling 181	Dwelling 180 & 182	2.43	2	89 turbines (2 at tip 87 at hub)	Moderate

Representative Dwelling	Linked Dwellings	Distance to nearest turbine (km)	Number of 60º sectors	Number of visible turbines (based on topography alone)	Visual Impact Rating
Dwelling 187		2.47	1	8 turbines (3 at tip 5 at hub)	Low
Dwelling 188		3.13	2	61 turbines (17 at tip 44 at hub)	Moderate
Dwelling 189	Dwelling 190	2.38	2	6 turbines (All at hub)	Moderate

Table 6-4: Summary of visual impact on non-associated residences between 3,350 metres 4,950 metres of a project turbine

Representative Dwelling	Linked Dwellings	Distance to nearest turbine	Number of 60º sectors	Number of visible turbines (based on topography alone)	Visual Impact Rating
Mount Hope Cluster					
Dwelling 15		4.31	1	60 turbines (24 at tip 36 at hub)	Nil
Dwelling 24	Dwelling 498	4.86	2	67 turbines (18 at tip 49 at hub)	Nil
Dwelling 69		3.89	Nil (0)	Nil	Nil
Dwelling 72		3.49	2	61 turbines (10 at tip 51 at hub)	Low
Dwelling 75		3.70	2	61 turbines (10 at tip 51 at hub)	Negligible
Dwelling 81	Dwelling 318	3.37	2	11 turbines (8 at tip 3 at hub)	Nil
Dwelling 128	Dwelling 16	3.49	1	52 turbines (24 at tip 28 at hub)	Moderate
Dwelling 129	Dwelling 130	4.71	2	45 turbines (25 at tip 20 at hub)	Low
Dwelling 138		4.69	2	38 turbines (11 at tip 27 at hub)	Low
Dwelling 144		4.74	2	98 turbines (25 at tip 73 at hub)	Low

Representative Dwelling	Linked Dwellings	Distance to nearest turbine	Number of 60º sectors	Number of visible turbines (based on topography alone)	Visual Impact Rating
Dwelling 234	Dwellings 241 & 242	3.94	1	2 turbines (All at tip)	Nil
Dwelling 243		4.52	Nil (0)	Nil	Nil
Dwelling 501		4.59	3	92 turbines (16 at tip 76 at hub)	Low
Girragulang Road Cluster					
Dwelling 12	Dwellings 7-11	3.97	1	48 turbines (11 at tip 37 at hub)	Moderate
Dwelling 185		4.51	2	100 turbines (23 at tip 77 at hub)	Moderate
Dwelling 283		4.88	1	57 turbines (22 at tip 35 at hub)	Moderate
Dwelling 285		4.36	1	69 turbines (26 at tip 43 at hub)	Low
Dwelling 286		4.74	1	67 turbines (18 at tip 49 at hub)	Low
Dwelling 288	Dwellings 287 & 289	4.37	1	22 turbines (8 at tip 14 at hub)	Low
Dwelling 352		4.73	2	21 turbines (10 at tip 11 at hub)	Low
Leadville Cluster					
Dwelling 2		4.09	2	17 turbines (8 at tip 9 at hub)	Nil
Dwelling 3		3.48	2	31 turbines (10 at tip 21 at hub)	Moderate
Dwelling 21	Dwelling 203	4.11	1	145 turbines (15 at tip 130 at hub)	Moderate
Dwelling 154	Dwellings 152,153 & 155-176	3.51	1	143 turbines (29 at tip 114 at hub)	Moderate

Representative Dwelling	Linked Dwellings	Distance to nearest turbine	Number of 60º sectors	Number of visible turbines (based on topography alone)	Visual Impact Rating
Dwelling 178		3.63	1	148 turbines (27 at tip 121 at hub)	Low
Dwelling 179		3.43	1	141 turbines (15 at tip 126 at hub)	Nil
Dwelling 193	Dwelling 192	4.31	1	21 turbines (4 at tip 17 at hub)	Nil
Dwelling 313		3.74	1	131 turbines (20 at tip 111 at hub)	Moderate
Dwelling 323	Dwelling 200	4.79	1	108 turbines (16 at tip 92 at hub)	Nil
Dwelling 357		3.41	1	62 turbines (29 at tip 33 at hub)	Nil

Table 6-5: Summary of visual impact on non-associated residences in excess of 4,950 metres with multiple visual sectors

Representative Dwelling	Linked Dwellings	Distance to nearest turbine	Number of 60º sectors	Number of visible turbines (based on topography alone)	Visual Impact Rating
Dwelling 183		5.15	2	130 turbines (30 at tip 100 at hub)	Low
Dwelling 184		5.17	2	127 turbines (20 at tip 107 at hub)	Low
Dwelling 311		5.79	2	43 turbines (16 at tip 27 at hub)	Low

6.3.3 Visual impact on public land

In addition to the detailed assessment of dwellings identified within the visual catchment, a view point analysis has been prepared across 41 public locations. The locations of the viewpoints are also shown in **Figure 6-4**.

Visual influence zones have been established from the wind farm site from dwellings and key public viewpoints across the area. The visual influence zones establish relative landscape significance against which the potential impacts of wind turbines can be assessed. The 'Visibility Distance Zone', 'Viewer Sensitivity Level' and the 'Scenic Quality Class' of each viewpoint in accordance with The Bulletin have been used to establish the overall visual influence zones. The detailed methodology and evaluation of each viewpoint is in **Appendix D**. The visual influence zones are:

- Visual Influence Zone 1: High (VIZ1)
- Visual Influence Zone 2: Moderate (VIZ2)
- Visual Influence Zone 3: Low (VIZ3)

Table 6-6 presents a breakdown of the 41 viewpoints assessed.

Table 6-6: Visual influence zone assessment from public viewpoints

Visual influence zone	No. of viewpoints
VIZ1	0
VIZ2	2
VIZ3	39
Total	**41**

The potential visual impacts at each viewpoint are summarised in **Table 6-7**.

Table 6-7: Viewpoint analysis results

Viewpoint	VIZ rating	Distance to nearest turbine (km)	Description	Potential visual impact	Visual performance objectives
VOW01	VIZ3	6.02	Neilrex Road, Coolah near the driveway of dwelling 74	Approximately 51-65 turbine s would be visible. Existing vegetation scattered on the paddocks and along Neilrex Road would fragment some views.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW02	VIZ3	3.93	Neilrex Road, Coolah	Approximately 51-65 turbines in the Mount Hope cluster would be visible in the near middle ground. Scattered vegetation in the foreground would help limit some views.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW03	VIZ3	5.71	Aerodrome Road, Coolah near dwelling 71	Approximately 50- 60 tubrines in the Mount Hope cluster would be visible. The likelihood for the turbines to become a major feature in the landscape is low. Most views would be fragmented by existing vegetation.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW04	VIZ3	4.51	Neilrex Road, Coolah near dwellings 24, 70 and 303.	Approximately 35-45 turbines will be visible. Scattered vegetation would fragment some views. Although the turbines will be distinctly visible in the landscape, the views will be limited and fleeting	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.

Viewpoint	VIZ rating	Distance to nearest turbine (km)	Description	Potential visual impact	Visual performance objectives
VOW05	VIZ3	3.46	Marombi Road, Coolah which is a low use road that is used to access dwellings south of Neilrex Road.	Approximately 35-45 turbines will be visible. Existing vegetation would fragment some views but majority of the Mount Hope cluster would be visible. It is possible that there would be brief moments when the turbines would be a major feature in the landscape, however, this would be fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW06	VIZ3	2.34	Marombi Road, Coolah VOW06 Marombi Road, Coolah near the entrance of house no. 3230 (dwelling 78).	Approximately 35-45 turbines will be visible. Existing vegetation would fragment some views but majority of the Mount Hope cluster would be visible. It is possible that there would be brief moments when the turbines would be a major feature in the landscape, however, this would be fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW07	VIZ3	4.10	Tillie Willie Road (off Mount Hope Road), Coolah in front of dwelling 16 and near dwelling 128 which can be accessed via Tillie Willie Road off Mount Hope Road	Approximately 1-15 turbines would be visible but most views fleeting and limited by the surrounding topographic character.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.

Viewpoint	VIZ rating	Distance to nearest turbine (km)	Description	Potential visual impact	Visual performance objectives
VOW08	VIZ3	2.49	Mount Hope Road, Coolah	Approximately 26-35 turbines would be visible. Scattered vegetation in the foreground would fragment these views. Although the turbines will be distinctly visible, this will be limited to fleeting views as this is a low use road.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW09	VIZ2	1.27	Mount Hope Road, Coolah	Approximately 26-35 turbines would be visible. Scattered vegetation in the foreground would fragment these views. Although the turbines will be distinctly visible, this will be limited to fleeting views as this is a low use road.	Visual magnitude: Located within 3,350m and mitigation measures would be considered for dwellings 238 to 239 Landscape Scenic Integrity: Turbines are unlikely to be a major element in the landscape, as roadside vegetation would make it difficult to discern the turbines. Key feature description: Turbines are likely to be visible amidst the trees in the foreground. These views would be fragmented by the tall canopy cover. The rural agricultural character of this location is likely to be the key feature of the landscape.

Viewpoint	VIZ rating	Distance to nearest turbine (km)	Description	Potential visual impact	Visual performance objectives
VOW10	VIZ3	3.02	Intersection of Black Stump Way and The Leadville Stock Route, Leadville near dwellings 178 and 20.	Approximately 10-20 turbines would be visible however the views would be fragmented and fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW11	VIZ3	2.94	The Leadville Stock Route, Leadville near the driveway of House no. 3061, Leadville Stock Route (Dwelling 324).	Approximately 7-15 turbines in the Leadville cluster will be visible and possible that briefly the turbines would be a major feature in the landscape, however, this would be fragmented and fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW12	VIZ3	3.70	Black Stump Way, Leadville	Approximately 7-15 turbines in the Leadville cluster would be visible and possible that briefly the turbines would be a major feature in the landscape, however, this would be fragmented and fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW13	VIZ3	5.45	Black Stump Way, Leadville near dwellings 183 and 184	Approximately 15-25 Mount Hope cluster turbines and 15-25 Girragulang Road cluster turbines would be visible. It is possible that briefly the turbines would be a major feature in the landscape, but would be fragmented and fleeting because of the distance.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.

Viewpoint	VIZ rating	Distance to nearest turbine (km)	Description	Potential visual impact	Visual performance objectives
VOW14	VIZ3	4.54	Black Stump Way, Leadville near dwelling 185	Approximately 10-20 Mount Hope cluster turbines and 20-30 Girragulang Road cluster turbines would be visible. It is possible that briefly the turbines would be a major feature in the landscape, however, this would be fragmented and fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW15	VIZ3	2.17	Bong Bong Road, Coolah	Approximately 15- 25 turbines. It is possible that briefly the turbines would be a major feature in the landscape, however, this would be fragmented and fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW16	VIZ3	3.49	Intersection of Narangaria Road & Bong Bong Road, Coolah	Approximately 10-20 Mount Hope cluster turbines and 20-30 Girragulang Road cluster turbines. It is possible that briefly the turbines would be a major feature in the landscape, but would be fragmented and fleeting because of the distance.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW17	VIZ3	2.45	Black Stump Way, Coolah at the entry of 'Woodvale' (dwellings 84-85)	Approximately 5-15 Mount Hope cluster turbines and 20-30 Girragulang Road cluster turbines. It is possible that there may be brief moments when the turbines would be a major feature in the landscape but would be fragmented and fleeting given the distance.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.

Viewpoint	VIZ rating	Distance to nearest turbine (km)	Description	Potential visual impact	Visual performance objectives
VOW18	VIZ3	5.03	Brown Springs Road, Coolah near dwelling 68	No turbines would be visible.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW19	VIZ3	3.99	Brown Springs Road, Coolah near dwelling 69	Approximately 1-5 turbines would be visible but limited by landform and vegetation in the southeast.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW20	VIZ3	2.94	Neilrex Road, Coolah, outside of Coolah's town centre	Approximately 45-55 turbines would be visible. Scattered vegetation in the foreground will help limit some views. Turbines would be a key feature in the landscape but limited to fleeting fragmented views.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW21	VIZ3	5.85	Near Coolah Sporting Club, Golf course and Bowen Oval, Coolah	Approximately 20-30 turbines would be visible. Existing vegetation fragments and limits most views. Possible that there may be brief moments when some turbines will be visible on the ridgeline. However, these views will be fleeting and limited due to vegetation in the foreground.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW22	VIZ3	4.87	Black Stump Way, Coolah near dwelling 114	20-30 turbines might be visible. Existing vegetation in the middle ground may help screen certain aspects of the Project. The riparian vegetation in the west fragments views, reducing the number of turbines visible.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.

Viewpoint	VIZ rating	Distance to nearest turbine (km)	Description	Potential visual impact	Visual performance objectives
VOW23	VIZ3	6.42	Vinegaroy Road, Coolah which emerges from the eastern side of the settlement of Coolah.	Approximately 20-30 turbines would be visible. Vegetation in the foreground may help fragment some views. Although the turbines will be partially visible, they will not impact the visual catchment from this location	No visual performance objectives apply to this viewpoint due to the VIZ3 rating. However, additional mitigation measures may be required for certain dwellings along Vinegaroy Road.
VOW24	VIZ3	3.76	Moorefield Road, Uarbry at the entrance gate of 'Kensington' (dwelling 6) and near dwelling 352	Approximately 30-40 WTGs would be visible but the landform and associated vegetation in the northwest would limit views.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW25	VIZ3	3.67	Norman Horne Memorial Park, Clarke Street/Black Stump Way, Leadville. near dwelling 167 & 171. The view is a general representation of views from the town	Approximately 5-15 turbines would be visible. Vegetation associated with most residences plays an important role in screening views. Views are directed towards the rising topography but they are partially filtered by vegetation in the foreground.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW26	VIZ3	5.34	Berowra Road, Dunedoo near dwellings 129 and 130	10-20 turbines would be visible Vegetation associated with dwellings 129 and130 may screen some views. It is possible the turbines may form a part of the visual catchment of the landscape but views would be limited and fleeting as this is a low use road.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.

Viewpoint	VIZ rating	Distance to nearest turbine (km)	Description	Potential visual impact	Visual performance objectives
VOW27	VIZ3	7.42	Berowra Road, Dunedoo near dwelling 354	Approximately 55-65 turbines would be visible from this location. Landform and vegetation in the east would limit views. It is possible that there may be brief moments when the turbines would be a major feature in the landscape, however, the views would be fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW28	VIZ2	1.91	Wardens Road, Leadville near dwellings 151 and 324	Approximately 5-15 turbines would be visible but the landform and vegetation in the east would limit some views. The blade tips would be visible due to proximity and for brief fleeting moments. The turbines would be a major feature in the landscape.	Visual magnitude: Located within 3,350m and mitigation measures would be considered for nearby residences. Landscape Scenic Integrity: Turbines are unlikely to be a major element in the landscape, but a number of turbines would be a part of the visual catchment form this location. Key feature description: The rural agricultural character of this location is likely to continue to be the key feature of the landscape.

Viewpoint	VIZ rating	Distance to nearest turbine (km)	Description	Potential visual impact	Visual performance objectives
VOW29	VIZ3	5.36	Sir Ivan Doherty Drive, Leadville	Approximately 1-3 turbines would be visible from this location. However, due to distance and topographical changes in the middle ground, views of the turbines would be limited.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW30	VIZ3		This viewpoint indicates views from dwelling 192 and 193 located north and south of Golden Highway	Approximately 5-15 turbines would be visible from this location. It is possible that there may be brief moments when the turbines would be distinctly visible in the landscape but views would be fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW31	VIZ3	4.87	Viewpoint adjacent to dwelling 191 off Merotherie Road, Merotherie	Approximately 10-20 WTGs would be visible but fragmented by the vegetation in the foreground. It is unlikely the turbines would become a major feature in the landscape and most views would be fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW32	VIZ3	4.02	Viewpoint from the Golden Highway, Leadville indicating views from dwellings 2, 3 and 186	Approximately 5-15 WTGs would be visible from this location. Turbines to the north-northwest would be partially screened by the rising terrain and associated vegetation. There may be brief moments when the turbines would be visible. The views would be fleeting and fragmented.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.

Viewpoint	VIZ rating	Distance to nearest turbine (km)	Description	Potential visual impact	Visual performance objectives
VOW33	VIZ3	2.5	Viewpoint from Golden Highway, Leadville at the driveway entrance of dwelling 187	Approximately 1-8 WTGs would be visible and there may be brief moments when the Leadville turbines would be a major visual feature in the landscape, however, the views would be limited and fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW34	VIZ3	2.57	Viewpoint from Golden Highway, Uarbry near dwellings 357, 189 and 190	There would be views of approximately 5-15 Leadville cluster turbines and 25-35 Girragulang cluster turbines. It is possible that there may be brief moments when the turbines would be a major feature in the landscape, however they would be fragmented and fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW35	VIZ3	6.59	Viewpoint from Turee Street / Short Street, off Golden Highway, Uarbry,	5-10 turbines would be visible, but views would be fragmented by the vegetation in the foreground and middle ground. It is unlikely that the turbines would become a major feature in the landscape and most views will be fleeting and limited.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW36 (viewing north)	VIZ3	2.95	Viewpoint north from Orana Road / Girragulang Road, Coolah, a low use road that provides access to dwellings 307-309	20-30 turbines would be visible from this location. Views would be fragmented by the dense windbreak vegetation in the foreground. The views will be limited and fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.

Viewpoint	VIZ rating	Distance to nearest turbine (km)	Description	Potential visual impact	Visual performance objectives
VOW36 (viewing east)	VIZ3	2.95	Viewpoint east from Orana Road / Girragulang Road, Coolah, a low use road that provides access to dwellings 307-309	45-35 turbines would be visible from this location. Views would be fragmented by the dense windbreak vegetation in the foreground. The views will be limited and fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW37	VIZ3	7.23	Viewpoint from Birkalla Road in Bungara near dwelling 335	5-14 turbines would be visible from this location. The landform and associated vegetation in the north would limit views of the project	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW38	VIZ3	7.08	Viewpoint from dwelling 92 located just south of Golden Highway in Uarbry	Approximately 15-25 turbines would be visible from this location. Scattered vegetation in the distant middle ground would help fragment some views.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.
VOW39	VIZ3	6.71	Viewpoint from intersection of Tongy Road and Golden Highway, Uarbry, near dwelling 232	Approximately 30-40 turbines would be visible from this location. There would be clear views of the project and possible brief moments when the wind turbines would be a major feature in the landscape. The views would be fleeting.	No visual performance objectives apply to this viewpoint due to the VIZ3 rating.

6.3.4 Shadow flicker and blade glint

Shadow flicker impacts

Shadow flicker is defined as the visual effect that occurs when rotating turbines cause moving shadows as the blades pass in front of the sun. The effect will occur under circumstances where the turbine is located such that at certain times of day the sun's rays pass through the swept area of the rotating blades, potentially affecting the viewpoint. The effect is diminished by the distance of the viewpoint from the turbine. Shadowing is also influenced by increased cloud cover and is dependent on the angle of the sun's rays (EPHC, 2010).

A Shadow Flicker Assessment was undertaken in accordance with the Draft National Wind Energy Guidelines (NSW DPIE, 2016) to determine the level of impact of shadow flicker from the proposed turbines on non-associated dwellings.

As a worst-case scenario, the Shadow Flicker Assessment was based on a viewing height of 1.7 metres and on topography alone. Therefore, the extent of impact may be decreased by a number of variables including:

- the aspect of the residence relative to the turbine(s) (window locations, living area locations etc)
- the extent of natural or screening vegetation between the turbine(s) and the receptor;
- the existence of other screening elements (buildings, structures etc) between the turbine(s) and the receptor
- the time of year
- the proportion of daylight hours in which the turbines operate
- the frequency of bright sunshine and cloudless skies (particularly at low elevations above the horizon).

In accordance with the Bulletin, shadow flicker at non-involved dwellings should not exceed 30 hours per year. A total of 14 non-associated dwellings were identified with potential shadow flicker hours. Of those 14 non-assocaited dwellings, three have the potential to experience 20 or more hours per year:

- Dwelling 5: very limited intervening elements exist. Vegetation to the north and northwest is likely to reduce some potential shadow flicker.
- Dwelling 86: existing screen planting to the north and east is likely to reduce any potential shadow flicker.
- Dwelling 88: existing vegetation to the northeast and east is likely to reduce potential shadow flicker.

The shadow flicker analysis also concluded that shadow flicker may occur on small sections of Black Stump Way, Orana Road, Wardens Road, Mount Hope Road and Moorefield Road. The potential impact is likely to be low on Moorefield Road, Orana Road, Wardens Road and Mount Hope Road as these roads have a low frequency of use. The impacts on the extents of Black Stump Way would be low to moderate. There is a negligible risk associated with distraction of motorists who experience shadow flicker and would potentially cause interest rather than risk.

Blade glint impacts

Blade Glint (also referred to as blade reflectivity) refers to the regular reflection off one or more rotating blades. This can be a temporary effect at any particular location, though the vast bulk of any glint occurs where the viewer is located above the altitude of the turbine hub. As recommended by The Bulletin, the turbine blades would be finished with a low reflectivity surface treatment to ensure any actual or perceived blade glint impact is minimised.

6.3.5 Assessment of associated infrastructure

Access tracks
The construction and maintenance of the project would require construction of approximately 137 kilometres of private access roads. Civil engineering concept designs have identified the most suitable location for roads and hardstands to avoid earth works where practicable. The benefits this brings to the project is that the ancillary infrastructure is integrated into the existing topography where possible.

The internal roads would be up to six metres wide (excluding drainage) with localised widening where required to support transportation of the turbine components. The internal road network would be aligned on the route of existing farm or other access roads where possible to reduce impacts.

Transmission line

Internal 33 kilovolt underground electrical cables
Each of the clusters would be internally connected to an onsite substation via 33 kilovolt underground electrical cables, where possible. If in some locations, the electrical transmission is unable to be trenched, sections of overhead transmission lines would be constructed and would likely be located adjacent to the footprint of internal access roads.

High Voltage transmission lines
The project includes 220 kilovolt overhead transmission lines connecting the substations to an overhead 330 kilovolt transmission line which will be located south of the wind farm site The high-voltage transmission line will connect to the overall Central West Orana Transmission line to feed into the larger grid.

New transmission poles would be timber, steel or concrete construction with single poles used for lower voltage overhead lines (under 330 kilovolts) and larger steel lattice-type towers used for the higher voltage transmission lines (330 kilovolt kV).

Generally, the above ground transmission lines transverse a large area of uninhabited land surrounded by undulating topography. Opportunities to view the transmission lines would be limited due to distance, topography and vegetation. The mitigation measures described in **Section 6.4** would assist in mitigating the visual impacts of the transmission lines.

Potential construction workforce accommodation
Two options for accommodation of the construction workforce are being considered and are discussed in detail in **Section 4.8.6**.

The potential workforce accommodation would consist of prefabricated demountable units, that would be delivered to site and installed during the Phase 2 construction activities and removed at the completion of construction.

A hardstand area of up to five hectares would be required for the workforce accommodation and supporting facilities and this area would be located within the nominated parcel of land, such that vegetation clearance and other environmental and social impacts are minimised.

The surrounding landscape is generally flat with minor undulations and moderately dense vegetation in the east. Land parcels to the west of the dwelling are currently utilised for non-intensive dryland cropping. Views from dwelling 307 are likely to screened by the trees that are in the south, southeast direction.

The nearest non-participating dwelling is dwelling 501 which is located 1.7 kilometres west of the potential construction workforce accommodation. Dwelling 501 is surrounded by dense windbreak vegetation which will inhibit views in all directions. Dwelling 185 is located approximately 2 kilometres southwest of the potential construction workforce accommodation. Although the dwelling is not surrounded by vegetation, the distance of the dwelling from this camp would not allow clear or distinct views of the worker cabins. The resultant visual impact of the potential workforce accommodation is low.

Ancillary structures

<u>BESS and substations</u>
Ancillary structures including the BESS and substations are of a relatively small scale in the overall landscape. They are likely to be screened by topography and vegetation. If deemed necessary during the detailed design phase, mitigation methods included in **Section 6.4**, such as screen planting could be employed to reduce any potential visual impacts.

<u>Meteorological monitoring masts</u>
The project includes the decommissioning of two current monitoring masts and installation of up to thirteen additional monitoring masts. Of these, six masts would be associated with the Mount Hope cluster, four masts would provide monitoring for the Girragulang Road cluster and three masts for the Leadville cluster. The thirteen monitoring masts would be located close to a turbine location and would have the same height as the turbine hub height. The exact number and location would be further refined at the detailed design stage of the project. The masts would be difficult to discern from a distance and are an existing element in the landscape.

<u>Night lighting</u>
It has been concluded that aviation night lighting is not required for the wind turbines or wind monitoring towers, based on the detailed risk assessment in **Appendix I.** If CASA determines that obstacle lighting should be provided by the project, relevant lighting standards and guidelines can be incorporated at the detailed design stage of the project.

6.3.6 Visual impact on landscape character

As discussed in **Section 6.1.1**, the landscape character been categorised into five LCUs and has been allocated a scenic quality class rating for the purpose of assessing the visual impact of the project. **Table 6-8** provides an overview of the assessment of the potential visual impacts on the existing landscape character of the local area for each LCU.

The project is likely to be visible from all the five LCU’s identified and assessed, to varying degrees. Due to the undulating topography surrounding the project area, there would be limited opportunities to view the project in its entirety.

Table 6-8: Summary of visual impact on landscape character units

LCU	Scenic quality rating	Landscape integrity	Key landscape features
LCU 01 Vegetated hills	Moderate	• The number of publicly accessible locations combined with the existing topographical changes and dense vegetation means the view of the project is likely to be limited. • Landscape elements such as the terrain and native vegetation which define and contribute to the scenic quality of LCU 01 would therefore remain unchanged • Minor alterations to LCU1 from a few of the Leadville cluster turbines would not impact its scenic integrity.	• The project is likely to alter minor aspects of the existing ridgeline, but the dominant heavily wooded character would remain unchanged. • The dense vegetation in LCU 01 limits opportunities for views from within the public domain to the project and the proximity would reduce views to include only a small portion of the project at a time. • The project would be a noticeable element in the landscape, but the key features of the LCU are likely to remain undisturbed.
LCU 02 Undulating farmlands	Moderate	• The wind turbines would alter small areas of LCU 02, but the moderately dense vegetation and topographical changes typical of the LCU will largely remain unchanged. • The existing character of LCU 02 is defined by a highly modified landscape that has been partially cleared to support agricultural activity. • The project would be discernible from some public areas within the LCU, however it would not modify the visual catchment or scenic integrity of the undulating farmlands. • The project would form a minor element in the overall visual landscape and the scenic quality of the LCU would be slightly altered.	• The key features include cleared undulating valleys used for grazing and views to the foothills. These features are a result of continuous human intervention, and the character is likely to remain largely unchanged. • Views to partially vegetated ranges (including the wind farm site) form a visual backdrop when travelling along Black Stump Way to Coolah or along Golden Highway to Dunedoo. Although visible in the distance and in some areas the turbines would be a dominant feature, the project is likely to occupy a small portion of the vegetated ridgelines and has the potential to have a low impact on visitors of the LCU. • The rolling hills are likely to remain a key feature of the landscape from areas surrounding LCU 02 • Views to undulating farmlands (including the wind farm site) characterise the arrival to Coolah from the northeast, and into Leadville from the west. Although visible in the distance, it is unlikely that the project would dominate the existing visual character.

LCU	Scenic quality rating	Landscape integrity	Key landscape features
LCU 03 Alluvial plains	Low	• The proposed wind turbines are likely to be noticeable along the ridgelines from areas within the LCU due to the local topographical changes and proximity to the wind farm site. The entire extent of the project, however, would not be visible from any location. • LCU 03 has a highly modified landscape character which makes the most of the rich fertile plains to support agriculture. The landscape is a result of human intervention over time. The landscape elements which contribute to the scenic quality of the LCU would remain unchanged as a result of the project.	• The key features include the vast, open landscapes spread across a flat terrain with scattered vegetation. Most vegetation corridors existing within the extents of LCU 03 formulate the moderately dense and intermittent riparian vegetation associates with rivers and creeks. Other areas are cleared to accommodate grazing lands. • Although the proposed wind turbines are likely to slightly alter views toward the undulations from some limited locations, the landscape's riparian and agricultural character would remain the key feature of the landscape within LCU 03.
LCU 04 Agricultural flats	Low	• The LCU is in close proximity of LCU03 Alluvial Plains, and therefore, the landscape has similar scenic values. The terrain is largely flat with scattered vegetation in a cleared landscape. • The project would be a noticeable element from some areas within the LCU, however they would not dominate the existing landscape character. • The project would form a minor element in the overall visual landscape. The landscape elements which contribute to the scenic quality of the LCU would remain unchanged as a result of the project.	• This LCU is identified for its agricultural associations and generally flat landscape character. It also comprises of scattered low density dwellings on large rural lots. Residents engage in light agricultural activities such as grazing. • Views to rolling hills form a visual backdrop when travelling along Neilrex Road, Sir Ivan Ducherty Drive and Moorefield Road. The views towards the hills, however, are generally limited by roadside vegetation. • Whilst the project would be a noticeable element in the landscape, the key features of the LCU are likely to remain undisturbed.

LCU	Scenic quality rating	Landscape integrity	Key landscape features
LCU 05 Towns and settlements	Low	• The wind farm site is likely to be noticeable from some areas within the LCU. However, for the most part would not dominate the visual catchment of LCU 05. • There are limited opportunities to view the wind farm site within the LCU due to local screening factors and topographical undulations. • The current landscape character and scenic quality of the LCU is likely to be slightly altered in some locations due to the project.	• Defined by moderately dense residences, the LCU spreads across the settlements of Coolah, Leadville and Uarbry. • These settlements comprise of low density residences within the extents as well as scattered dwellings on the outskirts of these towns and villages. • It is important to note that whilst the proposed wind turbines would be a noticeable element on top of the ranges that these towns look toward, and in some areas would be a dominant feature, they will not disrupt central line of sight to the range because of their distance from these settlements.

6.3.7 Cumulative visual impact

Liverpool Range Wind Farm is located approximately ten kilometres northeast of the project. The Liverpool Range Wind Farm gained development consent in March 2018, for 267 turbines with a blade tip height of up to 165 metres. A modification has been made to the approved layout to reducing the number of wind turbines to 217 and increase the tip height to 250 metres. The nearest Liverpool Range Wind Farm turbine would be approximately 10.38 kilometres northwest of the project.

Cumulative visual impact on residences

Seventeen non-associated dwellings are located within eight kilometres of both the project and Liverpool Range Wind Farm. The zone of visual influence indicates that of the seventeen dwellings identified, eight have the potential to view both projects in more than three 60-degree sectors. **Figure 6-5** presents the findings of the assessment. A detailed assessment of these dwellings found that the potential visual impact would be negligible on all three.

A summary of the potential cumulative visual impacts on the eight non-associated dwellings with more than three sectors identified is provided in **Table 6-9.**

Cumulative visual impact on public locations

Due to the undulating landscape character, there are limited opportunities to view both the project and Liverpool Range Wind farm simultaneously from publicly accessible locations. Views to both projects would be available from the town of Coolah and from dwellings scattered along Vinegaroy Road. Although Coolah is located at a higher elevation, the town's undulating character and dense vegetation corridors help screen many views towards both projects.

Some of the southern-most locations within the town of Coolah would have opportunities to view the projects. The Cunnigham Caravan Park which is located adjacent to the Coolaburragundy River on Vinegaroy Road is located in a position where it may have views to both projects in certain locations. The accommodation at the caravan park, is generally orientated towards the south to maximise views of the river, and as a result views to the projects are likely to be limited.

Due to the consistent turbine height of the both the projects (250 metres), when viewed simultaneously it is anticipated viewers would identify the project as one entity, although opportunity for such a view would be limited.

Cumulative visual impact on broader landscape character

The potential cumulative visual impact on the landscape character may arise when the projects are viewed sequentially. The re-occurrence of wind farms within a region has the potential to alter the perception of the overall landscape character irrespective of being viewed in a single viewshed.

If several wind farms are viewed in succession as a traveller moves through the landscape (for example, motorist travel routes or walking tracks) this may result in a change in the overall perception of the landscape character. The viewer may only see one wind farm at a time, but if each successive stretch of the road is dominated by views of a wind farm, then that can be argued to be a cumulative visual impact (EPHC, 2010).

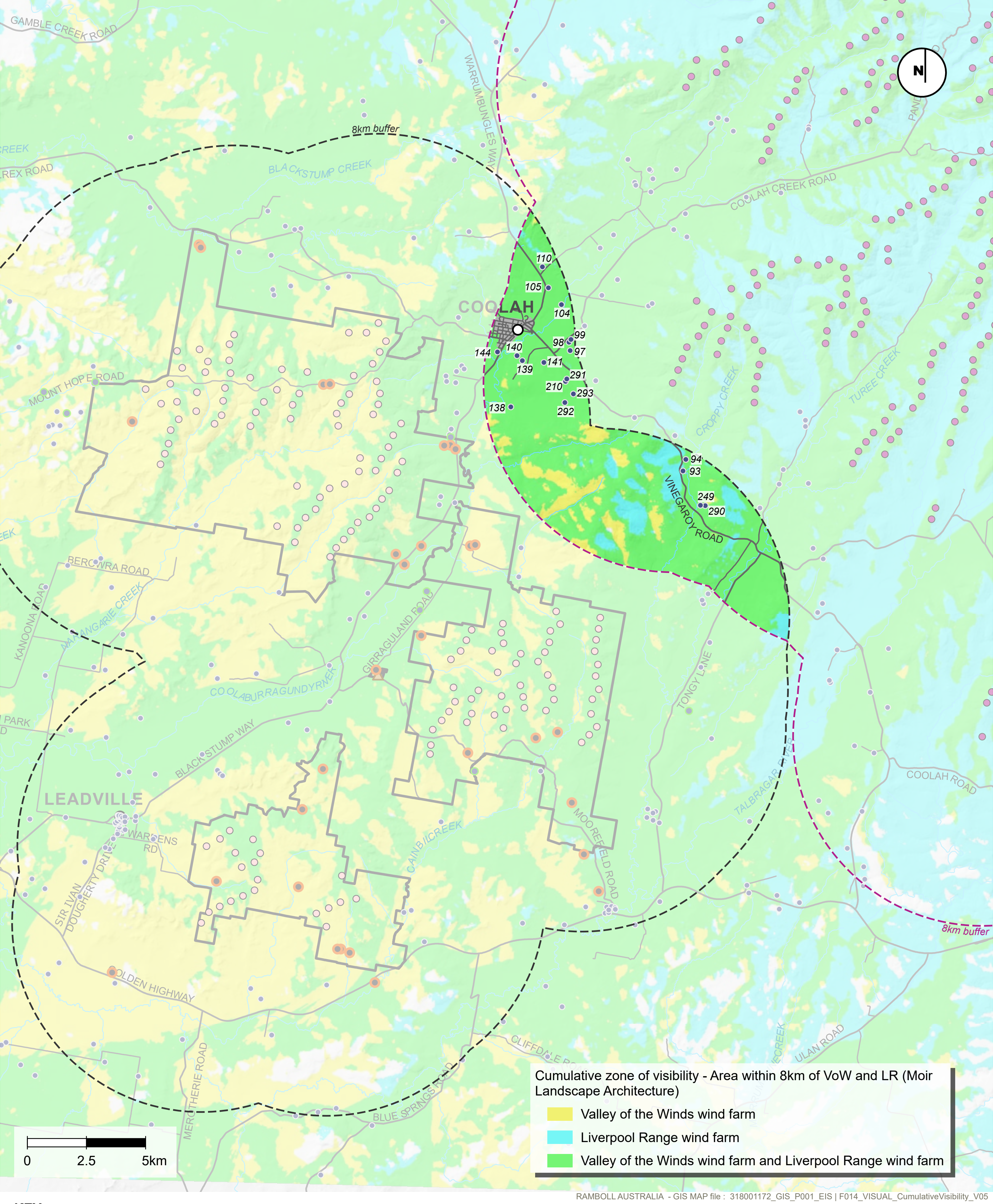
Given that the project clusters are located on ridgelines that are surrounded by scattered dwellings and setback from major travel corridors, it is unlikely the perception of the regions broad landscape character would be altered as a result of the project.

Table 6-9 Summary of cumulative impacts on non-associated dwellings

Distance to nearest VoW turbine:	Distance to nearest LRWF turbine:	Number of VoW turbines visible:	Number of 60º sectors with turbines (Based on assessment):	Cumulative Visual Impact Rating:	Assessment Notes:
Dwelling 93: 'Willandra', Vinegaroy Road, Coolah					**Dwelling 93 Assessment Notes:**
7.12 km (GR12)	3.74 km	Nil	Nil	Nil	Aerial imagery indicates Dwelling 93 is surounded by dense screening vegetation. Views to the VoW Project will be screened by the dense vegetation to the west of the dwelling. It is anticipated there will be no visibility towards the VoW Project and therefore no ciumulative visual impact from this dwelling.
Dwelling 94: Vinegaroy Road, Coolah					**Dwelling 94 Assessment Notes:**
7.60 km (GR12)	3.27 km	Nil	Nil	Nil	Aerial imagery indicates Dwelling 94 is surounded by dense screening vegetation. Views to the VoW Project will be screened by the dense vegetation to the west of the dwelling. It is anticipated there will be no visibility towards the VoW Project and therefore no ciumulative visual impact from this dwelling.
Dwelling 138:					**Dwelling 138 Assessment Notes:**
4.69 km (MH29)	6.92 km	Approx. 26	Two (2)	Low	Aerial imagery indicates Dwelling 138 is orientated towards the north. Turbines associated with the VoW Project with potential visibility (based on an assessment of topography alone) are located to the east of the dwelling. Views to the LRWF Project are in excess of 6 km to the west of the dwelling. Existing structures visible on the aerial imagery are anticipated to screen views to a large portion of the VoW Project, reducing the potential visibilty to two (2) sectors from this dwelling, which is deemed acceptable.

Distance to nearest VoW turbine:	Distance to nearest LRWF turbine:	Number of VoW turbines visible:	Number of 60º sectors with turbines (Based on assessment):	Cumulative Visual Impact Rating:	Assessment Notes:
Dwelling 139: 'Mianga' Oban Road, Coolah					**Dwelling 139 Assessment Notes:**
5.77 km (MH29)	6.42 km	Approx. 33	Two (2)	Low	Aerial imagery indicates Dwelling 139 is orientated towards the north towards the township of Coolah. Turbines associated with the VoW Project with potential visibility (based on an assessment of topography alone) are located to the north east and east of this dwelling. Turbines associated with the LRWF Project are located to the north west and west of this dwelling (in excess of 6 kms). Existing shed and vegetation to the east of the dwelling is likely to fragment views to the VoW Project from this dwelling. If deemed neccessary, additional screen planting to the east would reduce the visibility of the VoW Project and subsequently reduce the potential cumulative visual impact.
Dwelling 140: 'Oban' Oban Road, Coolah					**Dwelling 140 Assessment Notes:**
5.57 km (MH36)	6.68 km	Nil	Nil	Nil	Aerial imagery indicates Dwelling 140 is surounded by screening vegetation. Views to the VoW Project will be screened by the dense vegetation to the east of the dwelling. It is anticipated there will be no visibility towards the VoW Project and therefore no ciumulative visual impact from this dwelling.
Dwelling 144:					**Dwelling 144 Assessment Notes:**
4.73 km (MH36)	7.52 km	Approx. 73 @ hub	Two (2)	Low	Aerial imagery indicates Dwelling 144 orientated to the north towards surounded by screening vegetation. Views to the VoW Project are likely to be fragmented by vegetation to the south of the dwelling. Views to the LRWF Project are likely to be fragmented to the east. The resulting cumulative visual impact is likely to be low due to the intervening vegetation and distance to the turbines.

Distance to nearest VoW turbine:	Distance to nearest LRWF turbine:	Number of VoW turbines visible:	Number of 60º sectors with turbines (Based on assessment):	Cumulative Visual Impact Rating:	Assessment Notes:
Dwelling 249: Vinegaroy Road					**Dwelling 249 Assessment Notes:**
6.49 km (GR12)	4.83 km	Approx.	Nil	Nil	Aerial imagery indicates Dwelling 249 is surounded by dense screening vegetation. Views to the VoW Project will be screened by the dense vegetation to the south west of the dwelling. It is anticipated there will be no visibility towards the VoW Project and therefore no ciumulative visual impact from this dwelling.
Dwelling 290: Vinegaroy Road					**Dwelling 290 Assessment Notes:**
6.35 km (GR12)	4.90 km	Approx. 45	One (1)	Nil	A desktop assessment undertaken for Dwelling 290 indicates views to the LRWF turbines will be screened by vegetation. Views to the VoW Project are likely to be available, however fragmented by vegetation. There would be no resulting vcumulative visual impact from this dwelling.



KEY

- Wind farm site
- Potential construction workforce accommodation
- Host dwelling
- Associated dwelling
- Non-associated dwelling

Valley of the Winds wind farm (VoW)

- Turbine location
- 8km buffer from turbines

Liverpool Range wind farm (LR)

- Turbine layout
- 8km buffer from turbines

Figure 6-5 | Cumulative zone of visibility

6.4 Environmental management and mitigation measures

Proposed measures to manage and/or mitigate landscape and visual impacts from the project are detailed in **Table 6-10**.

Table 6-10: Management and mitigation measures – landscape and visual

ID	Management/mitigation measure	Timing
LCV1	The turbines selected for the project will be finished with a low reflectivity surface treatment in accordance with the requirements of The Bulletin. The blades, nacelle and tower will use consistent colouring.	Detailed design
LCV2	The wind farm site will not include unnecessary lighting, signage or logos.	Detailed design
LCV3	Access tracks: • where possible existing roads, trails or tracks will be used as access tracks to reduce the need for new roads • new roads will minimise cut and fill where feasible and avoid the need for vegetation clearing where possible • local materials will be used in the construction of access tracks where possible and practical.	Detailed design
LCV4	Transmission lines: • where possible underground cabling will be used for electrical reticulation • the route for any proposed overhead transmission lines should be chosen to reduce visibility from surrounding areas. • routes for overhead transmission lines will be planned to minimise vegetation loss	Detailed design
LCV5	Visual screening planting for dwellings will be undertaken in consultation with the landowners of residences identified as requiring mitigation measures in Table 6-3 and Table 6-4.	During construction

7. NOISE AND VIBRATION

7.1 Assessment methodology

7.1.1 Assessment approach

Overview of assessment methodology
A noise and vibration assessment has been prepared by Marshall Day Acoustics (Marshall Day). The report is summarised below and provided in full in **Appendix F**.

The noise and vibration assessment included the following methodology:

- undertake initial desktop review to identify noise sensitive receivers from aerial photography
- undertake noise monitoring to determine ambient and background noise levels
- establish project noise goals for the construction and operation of the project
- identify the likely principal noise sources during construction and operation, and their associated noise levels
- assess the potential noise, vibration and sleep disturbance impacts associated with construction, operational and decommissioning aspects of the project using a noise prediction method
- provide feasible and reasonable noise and vibration mitigation and management measures where noise or vibration objectives may be exceeded.

<u>Background noise</u>
Preliminary noise modelling was prepared by Marshall Day as part of a preliminary noise assessment for the project (Marshall Day, 2020) (the preliminary noise report) **(Appendix E).**

Background noise monitoring was conducted at 13 locations in the vicinity of the wind farm between 1 June and 2 September 2021, equating to up to approximately 13 weeks at each location. A summary of background noise levels is tabulated in **Appendix F** . The background noise monitoring locations were determined based on proximity to proposed turbines, the location of receivers, and the predicted noise contours obtained through updated noise modelling.

As stated in the NSW Wind Energy: Noise Assessment Bulletin (NSW Department of Planning and Environment, 2016) (the Noise Assessment Bulletin), at the wind speeds when the value of the background noise is above 30 dB L_{A90}, the background noise levels are used to set the noise limits for the wind farm. Review of measured background noise levels shows that L_{A90} noise levels during the day, evening and night periods are typically below 30 dB L_{A90} for extended periods at low wind speeds.

NSW Noise Policy for Industry (NSW Environmental Protection Authority, 2017) (NPfI) recognises that very low background noise levels, particularly at night, can present challenges with the derivation of reasonable assessment criteria and provides minimum assumed rating background noise levels that have been adopted for the project. These minimum levels are used for derivation of the project noise trigger levels in **Section 7.3.4** and the Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009) (ICNG).

<u>Operational noise</u>
The method selected to predict noise levels is International Standard ISO 9613-2: 1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation (ISO 9613-2). The prediction method is consistent with the guidance provided by South Australia EPA

Wind farms environmental noise guidelines, dated July 2009 (SA Guideline referenced in the NSW Noise Assessment Bulletin) and has been shown to provide a reliable method of predicting the typical upper levels of the noise expected to occur in practice. The method is generally applied in a comparable manner to both wind turbine and substation noise levels. For example, for both types of sources, equivalent ground and atmospheric conditions are used for the calculations. However, when applied to wind turbine noise, additional and specific input choices apply, as detailed in **Appendix F**.

Construction Noise

Predicted noise levels have been calculated in general accordance with the method detailed in Australian Standard 2436:2010 Guide to noise and vibration control on construction, demolition and maintenance sites (AS 2436). This method enables the prediction of noise levels for sound propagation over hard or soft ground but does not provide the ability to calculate predicted noise levels for mixed ground cover with varied soil conditions. The standard also notes that caution must be applied when considering predicted noise levels at distances beyond 100 metres. For these reasons, predicted noise levels have been determined as the arithmetic average of the hard and soft ground prediction methods. This approach is broadly consistent with the equivalent prediction procedure in British Standard 5228-1:2009 Code of practice for noise and vibration control on construction and open sites: Noise (BS 5228, referenced in AS 2436).

7.1.2 Statutory context, policy and guidelines

The noise and vibration assessment has been undertaken in accordance with the following:

- NSW Wind Energy: Noise Assessment Bulletin (NSW Department of Planning and Environment, 2016)
- NSW Noise Policy for Industry (NSW Environmental Protection Authority, 2017)
- Interim Construction Noise Guideline (NSW Department of Environment and Climate Change, 2009) (ICNG)
- NSW Road Noise Policy (NSW Department of Environment, Climate Change and Water, 2011) (RNP)
- Assessing Vibration: A Technical Guideline (NSW Department of Environment and Climate Change, 2006) (AVTG)
- Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (Australian and New Zealand Environment Council, 1990) (ANZEC 1990 Report) (ANZEC 1990)
- Warrumbungle LEP 2013.

7.2 Existing environment

7.2.1 Sensitive receivers

The study area and land immediately surrounding, is zoned as primary production (RU1) under the Warrumbungle LEP and is therefore sparsely populated with a limited number of residential receivers. A total of 57 noise sensitive locations (sensitive receivers) have been identified within three kilometres of the project and are shown in **Figure 7-1**. This includes 22 sensitive receivers where a noise agreement has been formalised between the landowners and the UPC\AC, which are referred to as associated receivers in this chapter. The remaining sensitive receivers, without an agreement with the UPC\AC, are referred to as non-associated receivers.

The 35 non-associated sensitive receivers are listed in **Table 7-1** along with their distance to the nearest turbine. The 22 associated receivers are listed in **Table 7-2.**

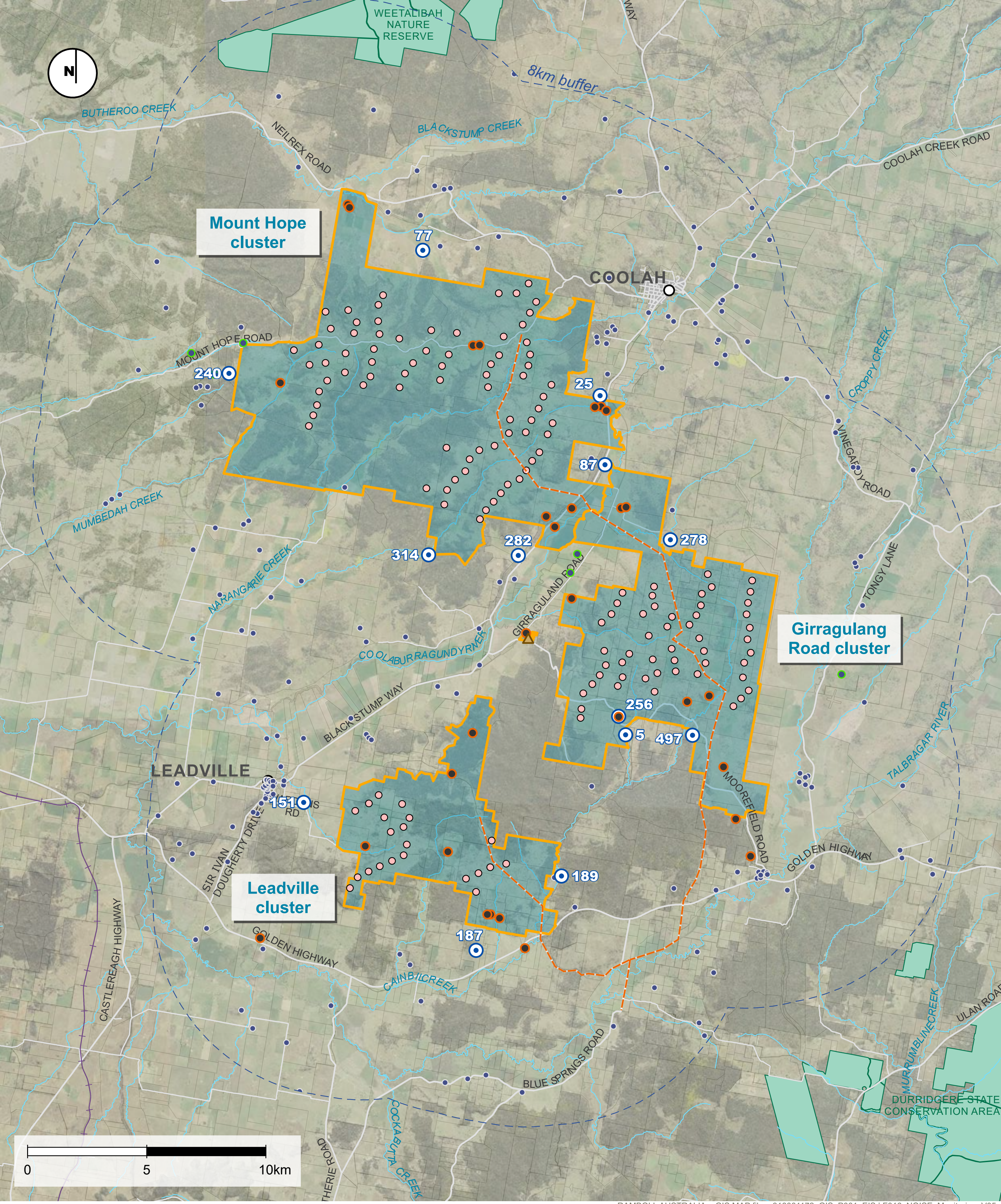
Table 7-1: Non-associated receivers within three kilometres of the proposed turbines

Receiver ID	Distance to the nearest turbine (m)	Nearest turbine
5	2,026	GR40
18	2,212	MH76
25	2,103	MH29
76	2,375	MH63
77	2,512	MH63
79	2,098	MH39
82	2,764	MH29
83	2,885	MH29
84	2,135	MH29
85	2,179	MH29
86	2,101	MH12
87	2,746	MH12
88	2,210	MH11
90	2,903	MH3
91	2,769	MH3
127	2,148	MH76
151	2,216	LV20
180	2,602	LV22
181	2,434	LV22
182	2,342	LV22
187	2,470	LV4
189	2,381	LV3
190	2,106	LV3
199	2,624	MH29
239	2,420	MH76
240	2,913	MH76
278	2,095	GR52
282	2,221	MH3
298	2,988	MH64
314	2,229	MH14

Receiver ID	Distance to the nearest turbine (m)	Nearest turbine
324	2,275	LV20
363	2,911	GR40
497	2,115	GR2
503	2,335	MH37
505	2,398	MH29

Table 7-2: Associated receivers within three kilometres of the proposed turbines

Receiver ID	Distance to the nearest turbine (m)	Nearest turbine
4	2,348	GR49
6	2,582	GR2
89	2,503	GR50
246	2,442	LV17
250	869	MH49
251	2,489	MH9
252	2,147	MH13
253	2,314	MH13
254	1,899	MH13
256	1,299	GR35
257	1,242	GR13
258	1,045	GR13
280	2,497	MH8
281	1,930	MH8
297	931	MH44
303	1,047	LV12
304	1,364	LV5
305	1,483	LV4
306	1,131	LV4
309	1,445	MH74
310	1,065	LV4
329	1,616	GR47



RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F016_NOISE_Monitoring_V05
Aerial photography from NSW Government Spatial Services

KEY

- Wind farm site
- Turbine location
- Overhead transmission line
- Potential construction workforce accommodation
- Noise monitoring location
- Host dwelling
- Associated dwelling
- Non-associated dwelling
- National Parks and Reserves

Figure 7-1 | Noise sensitive receivers and noise monitoring locations

7.2.2 Background noise levels

The ambient noise environment is considered to be rural with the primary noise sources being wildlife and occasional road noise.

As discussed in **Section 7.1.1** the noise monitoring results analysed as part of the preliminary noise report resulted in background noise levels typically below 30 dB L_{A90} for extended periods at low wind speeds. A summary of background noise levels determined in accordance with the NSW Noise Assessment Bulletin, for the range of surveyed wind speeds are summarised in **Table 7-4** on the following page.

The minimum assumed rating background noise levels set out by NPfI have been adopted for the project and are in **Table 7-3.**

Table 7-3: Minimum assumed rating background noise levels for NPfI and ICNG, dB L_{A90}

Time of day[1]	Minimum assumed RBL
Day	35
Evening	30
Night	30

Note:
1 Time of day is defined as: Day: 7:00-18:00 Monday to Saturday and 8:00-18:00 Sundays and public holidays; Evening: 18:00-22:00 Monday to Sunday and public holidays; Night: the remaining periods.

7-4: Background noise levels, dB L_{A90}

	Hub height wind speed, m/s																	
Receiver																		
	3	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
5[1]	22.6	22.8	23.4	24.2	25.3	26.5	28.0	29.6	31.3	33.1	34.9	36.8	38.6	40.5	42.2	43.8	45.3	46.6
25 [2]	-	28.6	28.6	28.6	28.8	29.0	29.4	29.9	30.4	31.1	31.9	32.9	33.9	35.1	36.4	37.9	39.5	41.2
77 [2]	22.1	22.4	22.8	23.3	23.8	24.3	24.9	25.5	26.1	26.8	27.5	28.1	28.8	29.5	30.3	31.0	31.7	32.4
87 [2]	-	-	-	30.4	30.4	30.5	30.9	31.4	32.2	33.1	34.3	35.6	37.1	38.8	40.7	42.8	45.1	47.5
151[1]	24.8	25.8	26.7	27.5	28.3	29.2	30.0	30.9	31.9	33.1	34.4	35.9	37.6	39.6	41.8	44.4	47.3	50.6
187 [1]	-	24.0	24.0	24.1	24.5	25.2	26.0	27.0	28.2	29.6	31.1	32.8	34.6	36.6	38.6	40.7	42.9	45.2
189 [1]	-	22.8	22.9	23.2	23.6	24.2	25.1	26.1	27.2	28.6	30.1	31.9	33.8	35.9	38.1	40.6	43.3	46.1
240 [2]	24.4	24.6	25.0	25.6	26.4	27.3	28.4	29.7	31.1	32.5	34.0	35.6	37.2	38.8	40.4	41.9	43.4	44.8
256 *[1]	-	27.1	27.2	27.6	28.3	29.1	30.2	31.5	32.9	34.6	36.3	38.2	40.3	42.4	44.6	46.9	49.3	51.7
278 [1]	-	21.5	21.5	22.1	23	24.3	25.8	27.6	29.5	31.5	33.6	35.6	37.6	39.4	41.0	42.3	43.3	43.9
282 [2]	-	-	-	27.7	27.7	28.2	29.1	30.4	31.9	33.7	35.7	37.9	40.1	42.4	44.7	47.0	49.1	51.1
314 [2]	-	23.6	23.6	23.9	24.5	25.4	26.5	27.9	29.5	31.3	33.1	35.2	37.2	39.4	41.5	43.7	45.8	47.8
497 [1]	-	23.1	23.4	24.2	25.4	27.0	28.9	31.0	33.3	35.7	38.1	40.5	42.8	45.0	46.9	48.5	49.7	50.5

Note:
1 Girragulang Rd Met Mast at 757,267 E / 6,460,616 N (GDA 2020 Zone 55)
2 Mount Hope Met Mast at 751,564 E / 6,470,185 N (GDA 2020 Zone 55)
* Background noise levels measured at this associated receiver are provided for information only

7.2.3 Noise and vibration criteria

Construction noise criteria

The ICNG sets out noise management levels (NMLs) for recommended standard construction hours and for works undertaken outside these recommended standard hours. The recommended standard hours are:

- Monday to Friday 7am to 6pm
- Saturday 8am to 1pm
- no work on Sundays or public holidays.

In relation to residential receivers considered for the project, and based on the recommended standard hours, the ICNG provides two primary management levels for consideration in the assessment of noise at residential receivers:

- the noise affected management level is the NPfI's rating background noise level +10 dB
- the highly noise affected management level is prescriptively set at 75 dB $L_{Aeq,\ 15\ min}$.

The ICNG requires a strong justification for construction works to be undertaken outside standard hours and defines additional assessment and reporting requirements that apply if out of hours work is proposed.

Construction road traffic noise

Road traffic noise assessment is only considered for the construction stage of the project as the volume of vehicle access to the project is much greater during the construction stage than the operational stage.

Noise from construction traffic on public roads is not covered by the ICNG. However, the RNP provides noise level criteria for increased traffic flow because of a project with the potential to create additional traffic, as detailed in **Table 7-5.**

Table 7-5: Road traffic noise assessment criteria for residential land uses

Type of development	Day (7:00-22:00)	Night (22:00-7:00)
Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	60 dB $L_{Aeq,\ 15\ hr}$ (external)	55 dB $L_{Aeq,\ 9\ hr}$ (external)
Existing residences affected by additional traffic on existing local roads generated by land use developments	55 dB $L_{Aeq,\ 1\ hr}$ (external)	50 dB $L_{Aeq,\ 1\ hr}$ (external)

The RNP states that any increase in the total traffic noise level as a result of the project should be limited to 2 dB above that of the 'no build option'. This limit applies wherever the noise level without the project is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.

Where night-time construction traffic is likely to occur, an assessment of sleep disturbance is appropriate. The RNP provides guidance on this matter:

- maximum internal noise levels below 50–55 dB L_{Amax} are unlikely to awaken people from sleep
- one or two noise events per night, with maximum internal noise levels of 65–70 dB L_{Amax}, are not likely to significantly affect health and wellbeing.

Based on the assumption that an open window provides 10 dB attenuation (which would be typical facade with partially open windows), noise levels below 60-65 dB L_{Amax} outside an open bedroom window would be unlikely to cause awakening reactions. It is considered that one or two events with a noise level of 75-80 dB L_{Amax} outside an openbedroom window would be unlikely to significantly affect health and well-being.

Vibration criteria

The AVTG identifies three vibration categories:

- **Continuous** – vibration continues uninterrupted for a defined period and includes sources such as machinery and continuous construction activities
- **Impulsive** – vibration is a rapid build up to a peak followed by a damped decay. It may consist of several cycles at around the same amplitude, with durations of typically less than two seconds and no more than three occurrences in an assessment period. This may include occasional dropping of heavy equipment, occasional loading and unloading
- **Intermittent** – vibration occurs where there are interrupted periods of continuous vibration, repeated periods of impulsive vibration or continuous vibration that varies significantly in magnitude. This may include intermittent construction activity, impact pile driving, jack hammers.

<u>Continuous and impulsive vibration</u>

Vibration criteria applicable to the residential receivers for the project for continuous and impulsive vibration sources, for both daytime and night time hours are presented in **Table 7-6**.

Table 7-6: Preferred and maximum vibration levels for human disturbance limits, m/s2 – daytime period

Vibration type		Preferred values		Maximum values	
		Z axis	**X and Y axes**	**Z axis**	**X and Y axes**
Continuous vibration	Day-time	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Impulsive vibration	Day-time	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14

Note:
Daytime is 0700 hr to 2200 hr and night-time is 2200 hr to 0700 hr
The preferred and maximum values are weighted RMS acceleration values
These values are only indicative, and there may be a need to assess to other sensitive areas against the relevant criteria.

<u>Intermittent vibration</u>

The vibration characteristics of most construction activities (e.g. excavation and pilling) are considered to be intermittent. Higher vibration levels are allowed for intermittent vibration compared with continuous vibration on the basis that the higher levels occur over a shorter time period. Vibration Dose Value (VDV) is based on the level and the duration of the vibration events. Vibration criteria applicable to the site for intermittent vibration sources, are summarised in **Table 7-7**.

Table 7-7: Preferred and maximum vibration levels for human disturbance limits, vibration dose value

	Day (7:00 – 22:00)	
Location	**Preferred value**	**Maximum value**
Residences	0.2	0.4
Offices, schools, educational institutions and places of worship	0.4	0.8

Note: These values are only indicative, and there may be a need to assess to other sensitive areas against the relevant criteria.

Blasting

Blast-induced vibration effects are assessed using the ANZEC 1990 Report.
The recommended criteria specified in the report are:

- air blast overpressure at sensitive sites should be:
  - below 115 dB L_{Zpeak} for 95 % of all blasts
  - below 120 dB L_{Zpeak} at all times
- ground vibration at sensitive sites should be:
  - below 5 mm/s Peak Particle Velocity (PPV) for 95 % of all blasts
  - below 10 mm/s PPV at all times.

From Australian and overseas research, damage has not been found to occur at air blast levels below 115 dB L_{Zpeak}. Windows are the building element currently regarded as most sensitive toair blast, and damage to windows is considered as improbable below 140 dB L_{Zpeak}.

A limit of 115 dB L_{Zpeak} is referenced to practically minimise the risk of cosmetic or structural damage to typical residential constructions from air blast.

7.3 Assessment of potential impacts

7.3.1 Construction noise and vibration

The following construction activities of the project have the potential for noise impacts:

- access road construction
- cable trench digging
- concrete batching plant
- site compound construction
- substation construction
- BESS construction
- turbine foundations
- turbine assembly
- gravel quarry
- construction workforce accommodation.

The typical major equipment items associated with the above construction activities are detailed in **Appendix F**. Typical construction plant sound power levels range from approximately 100-120 dB LWA per equipment item. Based on the groupings of major plant items during key construction tasks, the total aggregated noise emissions of the activities listed above typically ranges from 115 to 125 dB LWA.

Modelling has focused on aggregated noise emissions as a worst-case, with other construction stages expected to generate lower noise levels at the nearest receivers. Noise levels associated with each of the main construction tasks have been predicted at the nearest noise sensitive receivers to provide an indication of the upper range of noise levels. Given that the precise equipment selections and methods of working would be determined by the head contractor of the project, and that the noise associated with construction plant and activity varies significantly, the predicted noise levels are provided as an indicative range of levels which may occur in practice.

Table 7-8 details the predicted noise level ranges for each of the main construction tasks at the nearest non-associated and associated receivers.

The predicted noise levels indicate the highly noise affected management levels would be exceeded at some of the nearest non-associated receivers, generally located at the entrance of access roads to each wind farm cluster, during the construction of access roads. Exceedances above the highly noise-affected and noise affected management levels are not unique to this project and are characteristic of most construction noise impact assessments and typical for the construction of a wind farm.

Due to the proximity of the subject receivers to the subject sources, the highest predicted noise levels are noted to occur during access road construction and cable trench digging.

Access road construction

It is expected that during site access works, two non-associated receivers and no associated receiver would be located less than 60 metres from this type of construction activities. Most of the non-associated receivers within 500 metres of the access road construction activities are located within the intersection of the main roads (such as Golden Highway and Black Stump Way) and the proposed access roads and the predicted noise levels for the project construction activities are comparable to, and typical of, noise levels produced by general road maintenance works and activity.

Cable trench digging

It is expected that during cable trench digging, only one associated receiver and no non-associated receivers would be located less than 60 metres from this type of construction activities. These works would generally move along the intended routes reasonably quickly.

Vibration

The AVTG indicates that intermittent vibration should be assessed in terms of the Vibration Dose Value (VDV). These values for intermittent construction activities are highly specific to site conditions, equipment selections and operational durations. As such, calculation of VDV levels is not typical or practical at the planning stage but will need to be considered as part of a later detailed vibration assessment.

For continuous vibration, Construction Noise & Vibration Guideline (CNVG) sets out minimum working distances from sensitive receivers for typical items of vibration intensive plant. The minimum distances, reproduced in **Table 7-9**, are quoted for effects relating to human comfort.

Construction work force accommodation

It is proposed to construct a workers accommodation camp for 400 people, approximately 3 kilometers west of the Girragulang Road cluster, near to Receiver 307. Considering the separation distance between the proposed accommodation facility and construction activities, the noise and vibration impact at this location would be negligeable.

Table 7-8: Indicative range of construction noise predictions, dB L_{Aeq}

Construction task	Nearest receiver	Predicted level range	Noise affected management level	Exceedance	Highly noise affected management level	Exceedance
Non-associated receivers						
Access road construction	31	80-85	45	35 - 40	75	5 - 10
Cable trench digging	5	35-40	45	-	75	-
Concrete batching plant	497	40-45	45	-	75	-
Site compound construction	497	45-50	45	0 - 5	75	-
Substation construction	82	30-35	45	-	75	-
BESS construction	497	25-30	45	-	75	-
Turbine foundations	5	35-40	45	-	75	-
Turbine assembly	5	35-40	45	-	75	-
Gravel quarry	182	40-45	45	-	75	-
Associated receivers						
Access road construction	297	70-75	45	25 - 30	75	-
Cable trench digging	297	70-75	45	25 - 30	75	-
Concrete batching plant	6	40-45	45	-	75	-
Site compound construction	6	45-50	45	0 - 5	75	-

Construction task	Nearest receiver	Predicted level range	Noise affected management level	Exceedance	Highly noise affected management level	Exceedance
Substation construction	297	35-40	45	-	75	-
BESS construction	257	30-35	45	-	75	-
Turbine foundations	250	45-50	45	0 - 5	75	-
Turbine assembly	250	45-50	45	0 - 5	75	-
Gravel quarry	303	40-45	45	-	75	-

Table 7-9: Recommended minimum working distances for human response limits for vibration intensive plant at nearest receivers

Plant item	Rating / description	Minimum working distance (m)
Vibratory roller	< 50 kN (typically 1-2 tonnes)	15 to 20
	< 100 kN (typically 2-4 tonnes)	20
	< 200 kN (typically 4-6 tonnes)	40
	< 300 kN (typically 7-13 tonnes)	100
	> 300 kN (typically 13-18 tonnes)	100
	> 300 kN (> 18 tonnes)	100
Small hydraulic hammer	(300 kg – 5 to 12 t excavator)	7
Medium hydraulic hammer	(900 kg – 12 to 18 t excavator)	23
Large hydraulic hammer	(1600 kg – 18 to 34 t excavator)	73
Vibratory pile driver	Sheet piles	20
Pile boring	≤ 800 mm	4
Jackhammer	Handheld	2

If blasting is required during the construction or operation of the project, blast impacts would comply with the guidelines contained in ANZEC 1990.

Traffic noise

From the traffic data discussed in **Chapter 9** and a review of receivers adjoining the affected roads, traffic noise levels have been predicted to the nearest identified receivers on each road using the following method and assumptions:

- traffic speed assumed at 50 km/h except for Nailrex Road and Blackstump Way at 100 km/h outside of townships
- heavy vehicles are assumed to make up 15 % of total traffic flows
- when calculating construction traffic flows the daily traffic is assumed to be spread evenly across an 11 hr day period
- Nailrex Road, Queensborough Street and Black Stump Way assessed as sub-arterial roads per RNP definitions. All other roads assessed as local roads as defined in the RNP
- predicted noise levels include an additional +2.5 dB correction for facade reflection as required by the RNP
- L_{Aeq}, 1h levels calculated as LA10, 1h predicted using CoRTN - 3 dB per RMS practice.

The additional vehicle flows during construction, particularly on roads carrying very little existing traffic, would increase noise levels noticeable for some residents. However, the total vehicle flows are still low (less than 800 vehicles per day in all cases). Calculated noise levels indicate that compliance would be achieved with the RNP during the construction phase at all identified receivers, both for absolute noise levels and the relative increase criteria.

7.3.2 Wind turbine noise emissions

Sound power levels

The noise emissions of the wind turbines are described in terms of the sound power level for different wind speeds. The sound power level is a measure of the total sound energy produced by each turbine and is distinct from the sound *pressure* level which depends on a range of factors such as the distance from the turbine.

The sound power level data of three wind turbine models was analysed, these models are:

- Vestas V162-6.2 MW
- Siemens Gamesa SG 6.2-170
- General Electric GE 6.0-164.

Although these turbine models can operate at hub heights ranging from 119 metres to 166 metres, sensitivity analysis demonstrated that a hub height of 119 metres resulted in the highest predicted noise levels at receivers. As such, a hub height of 119 metres has been used to assess wind turbine noise levels for all candidate turbine models.

Based on the specifications for each of the turbine models, the noise modelling conducted for this assessment involved conversion of third octave band levels to octave band levels and adjustment by addition of +1.0 dB at each wind speed to provide a margin for typical values of test uncertainty.

The specifications of each turbine model are set out in **Table 7-10.** The overall sound power levels (LWA) (including the +1 dB addition) are presented in **Table 7-11** with the octave band values presented in **Table 7-12.**

Table 7-10: Candidate wind turbine model specifications

Item	Details		
Model	**SG 6.2-170**	**GE 6.0-164**	**V162-6.2 MW**
Rated power (MW)	6.2	6.0	6.2
Rotor diameter (m)	170	164	162
Modelled hub height (m)	119	119	119
Operating mode	AM0	N/A	PO6200
Serrated trailing edge	No	Yes	Yes
Highest sound power (dB LWA)	107.0	108.0	105.8

Table 7-11: Sound power levels +1 dB uncertainty vs. hub height wind speed, dB LWA

Model	Hub height wind speed (m/s)									
	3	4	5	6	7	8	9	10	11	≥12
SG 6.2-170	93.0	93.0	95.5	99.4	102.8	105.7	107.0	107.0	107.0	107.0
GE 6.0-164	-	94.8	96.7	100.2	103.5	105.7	107.7	108.0	108.0	108.0
V162-6.2 MW	-	95.1	95.3	97.2	100.2	103.0	105.3	105.8	105.8	105.8

Table 7-12: Octave band sound power levels, dB LWA

Model	Octave band centre frequency (Hz)									
	31.5	63	125	250	500	1000	2000	4000	8000	Total
SG 6.2-170[1]	-	87.8	95.7	98.1	97.6	101.0	101.8	97.0	85.8	107.0
GE 6.0-164[2]	79.8	89.1	94.6	99.1	101.7	103.3	101.1	93.6	77.8	108.0
V162-6.2 MW[2]	76.7	87.1	94.6	99.2	100.9	99.8	95.7	88.8	79.0	105.8

Note:
1 Based on one-third octave band levels at 9 m/s
2 Based on one-third octave band levels at 10 m/s

The noise limits presented are considered typical of the range of noise emissions associated with comparable multi-megawatt wind turbines. Further, the overall noise emissions of a turbine are dependent on a range of factors, including the turbine size, power output, the blade design and rotational speed of the turbine. Therefore, while turbine sizes and power ratings of contemporary turbines have increased, the noise emissions of the turbines are comparable to, or lower than, previous generations of turbines resulting from design improvements (notably, measures to reduce the speed of rotation of the turbines, and enhanced blade design features such as serrations for noise control).

Considering the rural settings of the project, it would be required to adhere to strict noise controls. Wind farm policies in Australia are among the most stringent international standards, and set limits using a combination of a base (or fixed value) limit and an allowable margin above the background. These limits will form part of the noise management plan

Tonality

The occurrence of tonality in the noise of contemporary multi-megawatt turbine designs is unusual. This is supported by evidence of operational wind farms in Australia which indicates that the occurrence of tonality at receivers is atypical.

Nonetheless, the third octave band data detailed in the manufacturer's specification has been assessed against the additional tonality test prescribed in the NSW Noise Assessment Bulletin This test did not indicate the presence of tonality at any of the available hub height windspeeds for all the candidate turbine models.

Even though this is the case, the tonality would be subject to further review and controls during the turbine procurement stage of the project, following approval of the wind farm, and again following the construction of the wind farm.

Low frequency noise

There are no commonly used, practical methods to accurately predict the wind turbine low frequency noise levels at receivers however, C-weighted noise levels have been predicted for the worst-case hub height wind speed of 10 m/s and used for the purpose of assessing the impacts of low frequency noise on the receivers for the project. The approach is considered sufficiently conservative for the purposes of this study. The detailed risk assessment for low frequency noise has been included in **Appendix F.**

The results in **Appendix F** show that preliminary C-weighted noise levels are predicted to be below the most stringent criteria of 60 dB L_{Ceq} at all assessed non-associated receivers by a margin of at least 1 dB.

The low frequency noise levels would be below the applicable thresholds at all non-associated receivers.

7.3.3 Noise limits

The Noise Assessment Bulletin defines noise limits at relevant receiver locations (residences) as follows:

> ***"The predicted equivalent noise level (LAeq,10 minute), adjusted for tonality and low frequency noise in accordance with these guidelines, should not exceed 35 dB(A) or the background noise (LA90(10 minute)) by more than 5 dB(A), whichever is the greater, at all relevant receivers for wind speed from cut-in to rated power of the wind turbine generator and each integer wind speed in between."***

The NSW Noise Assessment Bulletin notes the following in relation to the types of receivers where the noise limits apply:

> ***"The criteria in this Bulletin have been developed to address potential noise impacts on the amenity of residents and other relevant receivers in the vicinity of a proposed wind energy project. Wind energy proponents commonly negotiate agreements with private land owners where applicable noise limits may not be achievable at relevant receiver locations. A negotiated agreement will be considered as part of the assessment of a wind energy project, as will the requirements of SA 2009 and this Bulletin. The proponent's EIS should clearly identify the expected noise levels at all receiver locations including host properties to ensure that affected persons are appropriately informed regarding the development proposal."***

Accordingly, the NSW Noise Assessment Bulletin noise limits only apply to non-associated receivers. Noise levels at associated receivers will ultimately need to be managed in accordance with the commercial agreements established between the UPC\AC and the landowners. A base reference level of 45 dB L_{Aeq} is applied to all associated receivers for the purpose of assessing potential impacts.

At non-associated receivers, the applicable noise limit in accordance with the NSW Noise Assessment Bulletin is 35 dB L_{A90} or background L_{A90} + 5 dB, whichever is higher. Based on the background noise levels detailed in **Section 7.2.2**, applicable noise limits for all non-associated receivers where monitoring was undertaken is summarised in **Appendix F**.

The receivers where operational wind turbine noise levels are predicted to be higher than 30 dB L_{Aeq} are listed in **Table 7-13** for non-associated receivers. The highest predicted noise level for associated receivers is in **Appendix F** for information purposes. Predicted noise levels for each integer wind speed for all considered receivers, including those where the highest predicted noise level is below 30 dB L_{Aeq} are also detailed in **Appendix F**. The location of the total predicted 30 dB, 35 dB 40 dB and 45 dB L_{Aeq} noise contours for the candidate turbine with the highest predicted noise levels (GE 6.0-164) is illustrated in **Figure 7-2**.

The predicted wind turbine noise levels from the project would be below the NSW Noise Assessment Bulletin base (minimum) criterion of 35 dB L_{Aeq} at all of the assessed non-associated receivers for two of the three candidate turbine models outlined in **Section 7.3.1** (SG 6.2-170 and V162-6.2 MW). The predicted noise levels for these turbines are below the derived limits.

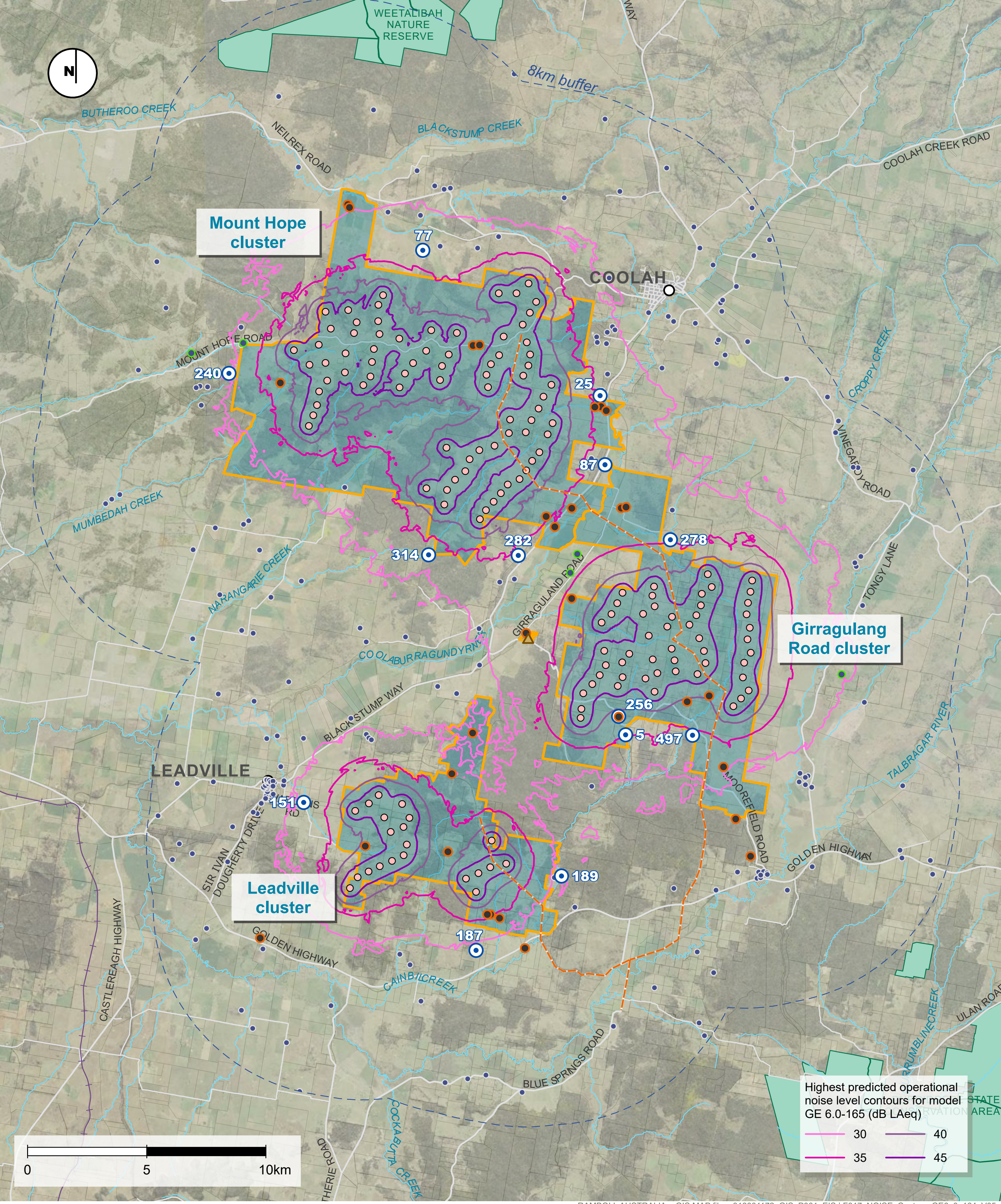
The predicted noise level of the GE 6.0-164 reaches a maximum value of 35.2 dB at Receiver 5. The predicted noise levels of the GE 6.0-164 at Receiver 5 are below the derived noise limits at all wind speeds other than 10 m/s where a marginal excess of 0.2 dB is predicted.

The predicted noise levels in **Table 7-13** support that the project could be designed and operated to comply with theoperational noise requirements of the NSW Noise Assessment Bulletin.

Table 7-13: Highest predicted noise level at non-associated receivers with predicted levels above 30 dB L_{Aeq}, dB L_{Aeq}

Receiver	SG 6.2-170	GE 6.0-164	V162-6.2 MW
5	33.7	35.2	34.1
18	29.2	30.4	29.4
25	32.5	33.9	32.8
72	29.4	30.5	29.6
75	29.7	30.7	29.9
76	32.5	33.8	32.8
77	31.9	33.2	32.3
78	31.1	32.3	31.4
79	31.4	32.8	31.8
81	29.1	30.3	29.3
82	30.7	31.9	30.9
83	30.2	31.4	30.5
84	31.4	32.7	31.7
85	32.5	33.9	32.8
86	32.6	34.0	32.9
87	31.3	32.5	31.6
88	32.3	33.6	32.6
90	31.8	33.0	32.0
91	31.7	32.8	31.9
127	29.9	31.2	30.2
151	29.1	30.5	29.4
180	29.4	30.7	29.6
181	29.8	31.2	30.1
182	30.1	31.5	30.4
199	30.9	32.2	31.2
239	29.7	31.0	30.0
240	28.8	30.0	29.1
277	30.7	31.9	31.0
278	33.2	34.6	33.5

Receiver	SG 6.2-170	GE 6.0-164	V162-6.2 MW
282	32.9	34.2	33.1
298	30.7	31.8	30.9
307	31.0	32.1	31.2
314	31.3	32.5	31.5
318	29.3	30.5	29.5
324	29.3	30.7	29.6
497	33.2	34.6	33.6
501	29.4	30.3	29.4
503	29.1	30.4	29.3
505	30.6	31.9	30.9
506	30.3	31.5	30.5



KEY

- Wind farm site
- Turbine location
- Overhead transmission line
- Potential construction workforce accommodation
- Noise monitoring location
- Host dwelling
- Associated dwelling
- Non-associated dwelling
- National Parks and Reserves

Figure 7-2 | Highest predicted operational noise level contours for model GE 6.0-165 (dB LAeq)

7.3.4 Ancillary infrastructure

The associated infrastructure includes power transmission networks, three 250 MVA electrical substations and potential BESS components. Noise levels associated with these components have been predicted at the nearest non-associated receivers and are presented in **Table 7-14** and **Table 7-15**. for associated receivers. As equipment selections are not known, the tonality characteristics of the transformers cannot be anticipated. To provide a conservative assessment an adjustment of +5 dB (as per the NPfI) has been applied to the predicted noise levels to account for the potential tonal characteristics of transformer noise.

Noise from the ancillary electrical infrastructure would be below the most stringent applicable noise level criteria, even accounting for any adjustments (if applicable at the receptor) for the potential tonal characteristics associated with transformers.

Table 7-14: Predicted noise levels at the nearest non-associated receivers (including +5 dB tonality penalty), dB L_{Aeq}

Infrastructure item	Nearest non-associated receiver	Distance, m	L_{Aeq}
Mount Hope substation	82	3,074	<15
Girragulang Road substation	497	4,107	<15
Leadville substation	190	4,034	<15

Table 7-15: Predicted noise levels at the nearest associated receivers (including +5 dB tonality penalty), dB L_{Aeq}

Infrastructure item	Nearest associated receiver	Distance, m	L_{Aeq}
Mount Hope substation	297	1,893	21
Girragulang Road substation	257	2,694	19
Leadville substation	304	1,988	20

7.3.5 Cumulative noise assessment

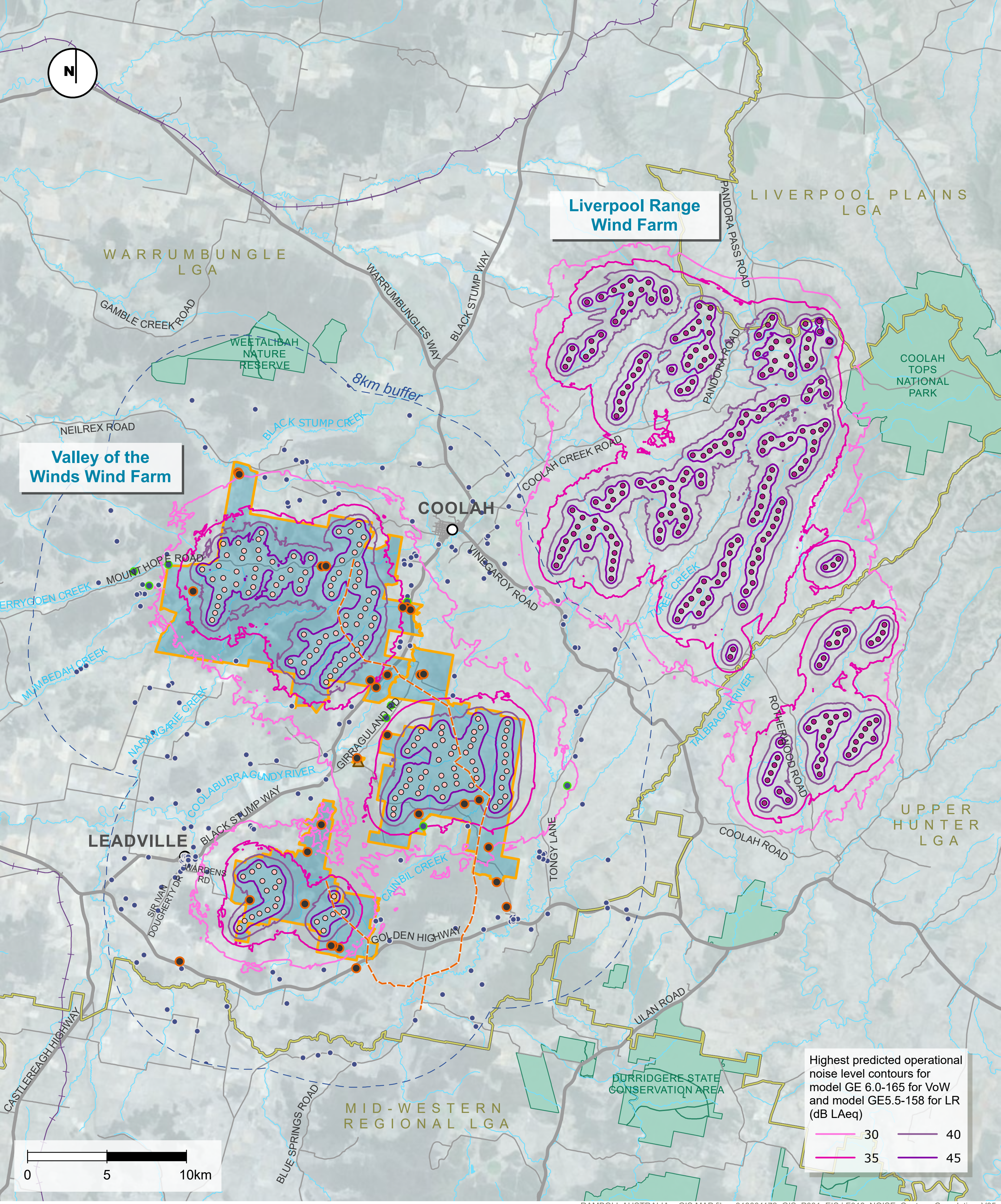
The Liverpool Range Wind Farm, located approximately 10 km northeast of the proposed Valley of the Winds wind farm received development consent in March 2018 for approximately 267 wind turbines with a tip height of up to 165 m. However, a modification application has been submitted to reduce the total number of turbines, but enable an increased tip height of 239 m. Details on the methodology and assumptions used to undertake the cumulative assessment of potential noise impacts is provided in detail in **Appendix F**.

Appendix F presents predicted cumulative noise levels for receivers where predicted wind farm noise levels are higher than 32 dB LAeq12 as a result of the project (using the GE 6.0-164 candidate turbine model) and The Liverpool Range Wind Farm respectively. The location of the total predicted 30 dB, 35 dB, 40 dB and 45 dB L_{Aeq} noise contours for the candidate turbine with the highest predicted noise levels (GE 6.0-164) is illustrated in **Figure 7-3**.

The predicted cumulative noise levels presented are for the wind speeds which give rise to the highest noise emissions from each project respectively. It is also noted that the noise level contours are predicted on the basis of downwind propagation from each turbine. In most instances where cumulative noise is considered, a noise sensitive receiver cannot be simultaneously downwind of all wind turbines of adjoining projects. The predictions are therefore conservative for the purpose of considering cumulative noise levels.

The change in predicted wind turbine noise levels attributable to the influence of the Liverpool Range Wind Farm is up to 0.4 dB. For context, a 1 dB difference is generally not measurable or discernible in practice, particularly in the context of the much larger variations in ambient noise levels. The contribution of the Liverpool Range Wind Farm does not result in a change of compliance outcome with respect to the 35 dB L_{Aeq} base criterion which applies to each wind farm.

At Receiver 5, using the GE 6.0-164, the influence of the Liverpool Range Wind Farm is predicted to increase the marginal excess at 10 m/s over the applicable criterion from 0.2 dB to 0.3 dB.



RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F018_NOISE_ContoursCumulative_V05

KEY

- Wind farm site
- Overhead transmission line
- Potential construction workforce accommodation
- Turbine location (Valley of the Winds wind farm)
- Turbine layout (Liverpool Range wind farm)
- Host dwelling
- Associated dwelling
- Non-associated dwelling
- National Parks and Reserves

Figure 7-3 | Highest predicted cumulative operational noise level contours

7.3.6 Decommissioning

Similar construction activities, and therefore impact levels, to those detailed in **Section 7.3.1** are expected to be required during the decommissioning of the project. As such, noise impacts associated with the decommissioning of the project are expected to be similar in nature to those experienced during construction.

7.4 Environmental management and mitigation measures

Proposed measures to manage and/or mitigate noise and vibration impacts from the project are detailed in **Table 7-16**.

Table 7-16: Management and mitigation measures – noise and vibration

ID	Management/mitigation measure	Timing
NV1	The predicted operational wind turbine noise levels will be updated with final layout and sound power levels of the final turbine technology selected, to verify compliance with the criteria in accordance with the NSW Assessment Bulletin.	Detailed design
NV2	The predicted operational related infrastructure noise levels will be updated with the final design and sound power levels of the final equipment selection to verify compliance with the criteria in accordance with the NPfI.	Detailed design
NV3	The procurement contract for the supply of turbines to the site will typically include specifications concerning the allowable total noise emissions from the turbine, and the permissible characteristics of the turbine. In the event that turbine emissions are found to exceed the contracted values, the supplier will be required to implement measures to reduce the noise to the contracted value. This can include measures to rectify manufacturing defects or appropriate control settings.	Detailed design
NV4	A noise management plan will be prepared which identifies how compliance with the wind farm's operational noise limits will be demonstrated, including details of testing procedures and reporting time frames following commencing of operation of the wind farm.	Prior to construction
NV5	Construction noise and vibration management measures will be implemented consistent with recommendations contained within the ICNG as relevant to the project.	Construction
NV6	Compliance monitoring will be conducted to satisfy the NSW Noise Assessment Bulletin including evaluation of special noise characteristics.	Operation

8. BIODIVERSITY

8.1 Assessment methodology

8.1.1 Assessment approach

Overview of assessment methodology
A biodiversity development assessment report (BDAR) has been prepared to meet the requirements of the Biodiversity Assessment Method (BAM) established under Section 6.7 of the NSW BC Act. The accredited BAM assessor who prepared the assessment is Alex Pursche (BAAS17019).

The BDAR is provided in full in **Appendix G**.

The preparation of the BDAR included the following methodology:

- desktop review of available background information, mapping, and publicly available databases
- field surveys of the study area
- assessment of impacts to biodiversity values, determination of required biodiversity offsets for the project
- provision of management and mitigation measures to minimise identified impacts.

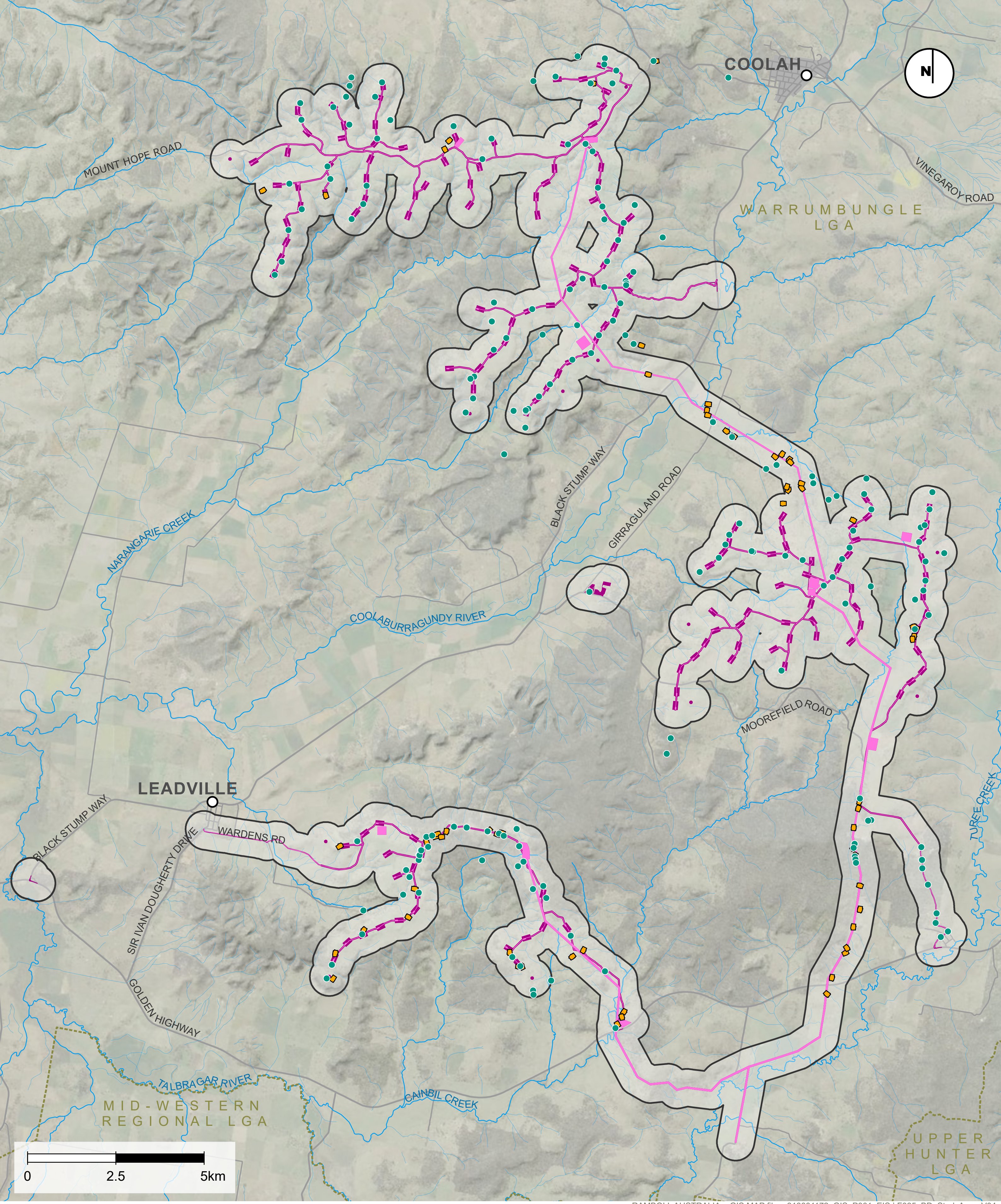
The project was also referred to the Commonwealth Department of Agriculture, Water and the Environment for potential impacts to matters of national environmental significance protected by the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

On 13 July 2020, a delegate of the Federal Minister for the Department of Agriculture, Water and the Environment determined that the project was a controlled action under section 75 of the EPBC Act and therefore requires assessment and approval under the EPBC Act. The assessment of environmental impacts for the project is being undertaken under the *Amended Bilateral Agreement* between the Australian Department of Agriculture, Water and the Environment and the New South Wales Department of Planning, Industry and Environment.

Desktop review
The desktop review involved a search of the following:

- BioNet Vegetation Classification
- Bionet Atlas Database (accessed December 2021)
- BioNet Threatened Biodiversity Data Collection
- PlantNET (The NSW Plant Information Network System). Royal Botanic Gardens and Domain Trust, Sydney (PlantNET, 2021)
- Atlas of Living Australia (ALA 2021)
- Australian Virtual Herbarium (AVH 2020).

Survey area
The survey area applied to inform the BDAR includes a 500-meter buffer around the project's expected construction and operational footprint to provide a conservative assessment of potential impacts related to direct ground disturbance, vegetation clearance, and indirect impacts. The survey area also allows flexibility in the design and micro siting of project components during the detailed design phase, whilst providing a complete and robust assessment of potential impacts. The BDAR survey boundary and the project footprint are presented in **Figure 8-1.**



RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F035_BD_StudyArea_V04
Aerial photography from NSW Government Spatial Services

KEY

- Study area (biodiversity)
- Operational footprint
- Construction footprint
- LGA boundaries
- Waterway (NSW Spatial Services)
- Rapid data point (EcoLogical)
- Biodiversity Assessment Method (BAM) plot (EcoLogical)

Figure 8-1 | Study area (biodiversity)

Survey effort

Site inspections and vegetation validation

The initial site inspections were carried out by ELA Senior Ecologists during three survey periods in 2019 and 2020. Data was collected within the project investigation area, with the primary aim of these initial site surveys being to:

- collect rapid data points (RDPs) to validate vegetation and assist in developing a plant community type (PCT) map across the wind farm study area.
- consider the extent of threatened ecological communities (TECs) listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) or Commonwealth Environment Protection and *Biodiversity Conservation Act 1999* (EPBC Act) across the project investigation area.
- identify habitats for threatened species.
- validate suitability of regional spatial datasets for use for the project (such as land use history and cliff line mapping).

The majority of the study area was accessible by existing tracks or paddocks. Approximately 230 RDPs were taken within vegetation patches, as well as locations where changes in vegetation community boundaries occurred.

All field data was collected using mobile devices loaded with ESRI Collector for ArcGIS software and relevant datasets (target plots, aerial imagery, vegetation mapping, drainage, contours etc.) and ESRI Survey123.

Vegetation validation RDPs recorded the following:

- dominant canopy
- midstorey and groundcover species
- structural cover condition
- vegetation structure
- potential PCT
- priority or environmental weed species and cover
- threatened species and count
- soil texture
- fire history
- vegetation condition
- landform element and pattern.

RDPs are less comprehensive than full floristic vegetation plots, however they allow for rapid identification of PCTs which could then be extrapolated through interpretation of aerial photography (API).

Unmanned Aerial Vehicle survey

An unmanned aerial vehicle (drone) was utilised to enhance the accuracy of PCT mapping and 570 high resolution photographs were taken across the study area. Aerial photographs allowed for post flight analysis of dominant canopy species, vegetation structure, condition and interpretation of cover of various PCTs.

This assessment includes areas of the development site that have not yet been surveyed due to access restrictions or project refinements in response to the findings of other environmental and social impact assessments. All unsurveyed areas will be surveyed at the appropriate time, as a commitment of the proponent to understanding the whole and finite extent of environmental impacts of the project.

Vegetation integrity assessment
Vegetation surveys were undertaken September 2020, April 2021, May 2021 and June 2021, and a total of 62 full-floristic vegetation integrity plots were surveyed to identify PCTs and to assess the composition, structure and function components of each vegetation zone in accordance with the BAM.

Determination of plant community types
The following process was undertaken to determine which PCT aligns best to each vegetation pattern in the survey area:

- compile a preliminary PCT list via database searches of VIS and SEED
- site inspection to collect RDPs, develop PCT shortlist and preliminary vegetation mapping
- undertake full floristic plots to collect data used in quantitative PCT selection
- identify additional data sources for PCT selection e.g. soil landscapes mapping
- quantitatively compare field data to PCT database to find best fit
- finalise PCT mapping.

In determining the PCT for the development site, various attributes were considered in combination to assign vegetation to the best fit PCT. Attributes included dominant species in each stratum and relative abundance, community composition, soils and landscape position. Reference was made to the PCT descriptions in the BioNet Vegetation Classification and the final scientific determinations for TECs.

Threatened ecological communities
Assessment of each PCT was undertaken to determine if any of the vegetation communities present were consistent with Threatened Ecological Communities (TEC's) listed under the BC Act and/or the EPBC Act.

Assessment of the assemblage of species in each vegetation type was considered against potential TECs and their relevant Final Determination (BC Act) or Listing Advice (EPBC Act).

Consideration of fire history
Consideration was given to the Guideline for applying the *Biodiversity Assessment Method at severely burnt sites* (DPIE, 2020), to determine if any areas of the development site were also burned in the 2019-2020 summer bushfires.

There are no areas of land that include any of the Burnt Area Classes, and so the BAM was applied, rather than apply any of the burn severity rules.

8.1.2 Statutory context, policy and guidelines
The biodiversity assessment has been undertaken in accordance with the following statutory documents:

- EPBC Act
- NSW EP&A Act
- BC Ac
- LLS Act
- Planning Systems SEPP
- SEPP Infrastructure
- SEPP Koala Habitat
- NSW Fisheries Management Act 1994
- Guideline to the Biodiversity Assessment Method assessment
- Policy and Guidelines for Fish Friendly Waterway Crossings.

8.2 Existing environment

8.2.1 Landscape features

The study area spans three bioregions, five subregions and nine Mitchell Landscapes, reflecting the diversity of the underlying geology and soil properties, geomorphology, and microclimates in the area. These landscape features and the area relative to the study area are summarised in **Table 8-1** and presented in **Figure 8-2.**

Table 8-1: Landscape features

Landscape feature	Development site	Survey boundary
IBRA region(s)	• Brigalow Belt South (BBS) • Sydney Basin (SB) • NSW South Western Slopes (SWS)	• BBS • SB • SWS
IBRA subregion(s)	• Liverpool Range • Pilliga • Kerrabee • Inland Slopes	• Liverpool Range • Pilliga • Kerrabee • Inland Slopes • Talbragar Valley
Rivers and streams	There are numerous first and second order streams across the Project development area. Major waterways identified in the database review include: • Coolabaragundy River • Talbragar River	
Estuaries and wetlands	The study area does not contain any mapped wetlands.	
Connectivity of different areas of habitat	Areas of connectivity are mapped on **Figure 8-2**. Areas of connectivity reflect denser vegetation within the wind farm site that may facilitate movement of threatened species across their local range.	
Geological features of significance and soil hazard features	None present	
Areas of outstanding biodiversity value	The assessment area does not contain any Areas of Outstanding Biodiversity Value.	
NSW (Mitchell) Landscapes	• Liverpool Range Valleys and Footslopes • Cape Hills Granite • Cassilis Slopes • Coolah Tops • Gulgong Ranges • Merrygoen Hills and Slopes • Upper Castlereagh Alluvial Plains • Trinkey Plateau • Talbragar – Upper Macquarie Terrace Sand	
Additional features required to be assessed	No additional landscape features identified	

Landscape feature	Development site	Survey boundary
Percent (%) native vegetation extent	There are no differences between the mapped vegetation extent and the aerial imagery. The development footprint is approximately 1,344 ha and contains approximately 289 ha of native vegetation. Brigalow Belt South IBRA Region: The assessment area is approximately 12,322 ha and contains approximately 4,818 ha of native vegetation (39%) Sydney Basin IBRA Region: The assessment area is approximately 3,447 ha and contains approximately 1,220 ha of native vegetation (35%) NSW South West Slopes IBRA Region: The assessment area is approximately 1,022 ha and contains approximately 310 ha of native vegetation (30%)	

Source: (ELA, 2022)

The region has been subject to agricultural land use since settlement in the mid 1800's. Historic aerial imagery (from 1955 till present) shows that the cleared areas of the study area have been cleared for over 50 years, and that also the paddock trees observed in the present day predate this clearing event. Historic imagery also reveals that existing areas of vegetation on steep sandstone slopes, are not regenerated from previous events and are potentially pre-European remnant patches of forest.

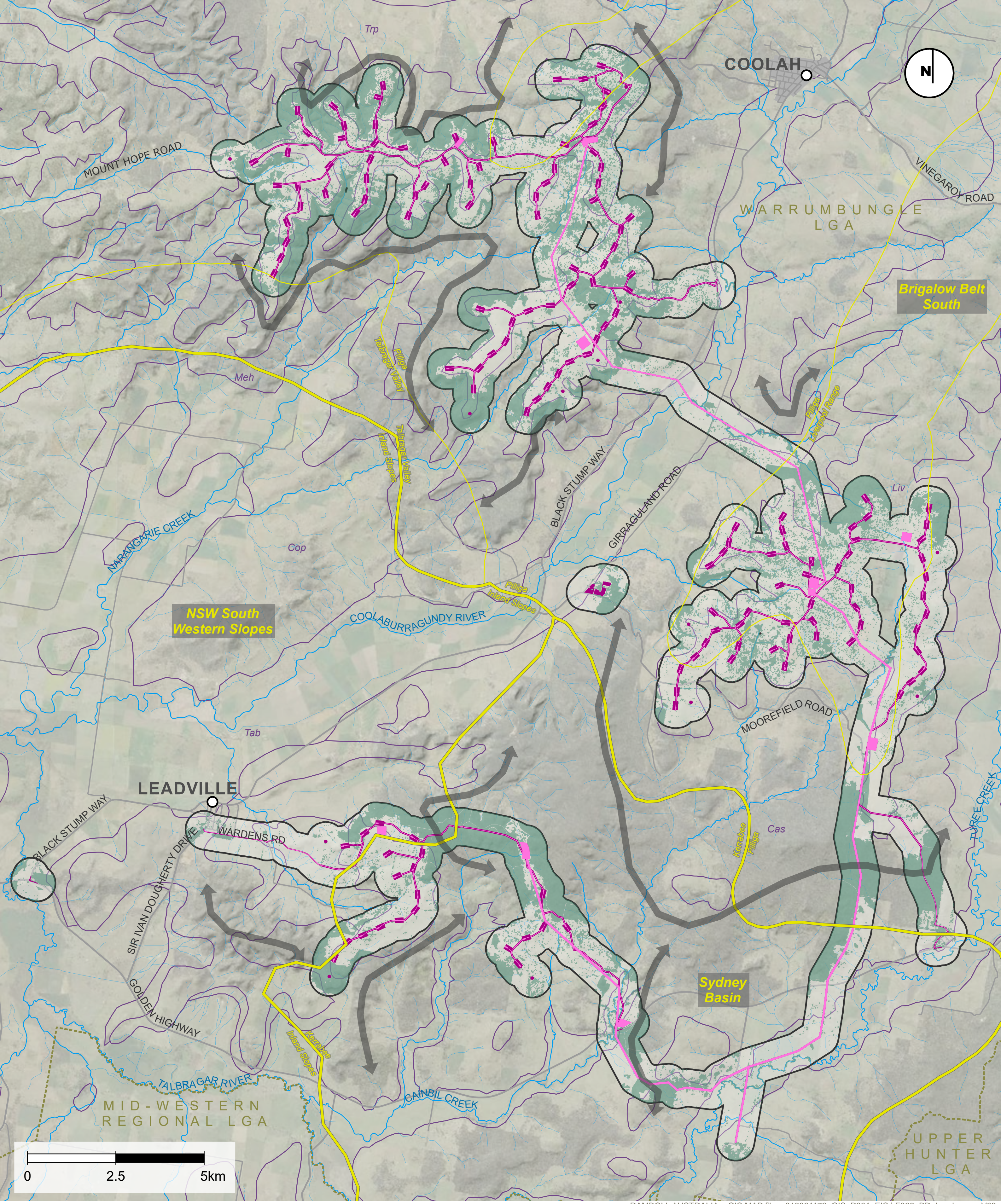
The study area consists almost entirely of moderate to high intensity agricultural use. The majority of host landholders operate agricultural enterprises as their primary income, and as such all accessible areas of land are continuously used for cropping, grazing, or pasture improvement. The main crops utilised in the study area main crops utilised in the study area include *Avena sativa* (Oats) and *Hordeum vulgare* (Barley).

A significant portion of wind farm site was devastated by the Sir Ivan Fire in February 2017 which was started by a lightning strike near Leadville. The fire burned over 55,000 hectares, more than 2,000 stock, and over 5,700 kilometres of fencing. The greatest intensity of the fire was within the forested area between the towns of Leadville and Uarbry, where the heat of the fire resulted in near total loss of biodiversity.

The following vegetation formations are identified across the study area:

- Dry sclerophyll Forests (Shrubby sub-formation)
- Forested Wetlands
- Grassy Woodlands
- Rainforests.

In addition, Low Condition Native Grassland and Exotic/cleared areas were also identified within the study area.



RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F038_BD_Landscape_V03
Aerial photography from NSW Government Spatial Services

KEY

- Study area (biodiversity)
- Operational footprint
- Construction footprint
- LGA boundaries
- Waterway (NSW Spatial Services)
- Connectivity (EcoLogical)
- Tab Landscapes (Mitchell v3.1, DPIE)
- Native vegetation (EcoLogical)
- IBRA region*
- IBRA subregion*

*Australian Government Department of Environment and Energy

Figure 8-2 | Key landscape features

8.2.2 Native vegetation

Native vegetation regulatory map

Under the LLS Act, all land in NSW is categorised into three broad types:

- Category 1 – Exempt land where clearing of vegetation is unregulated
- Category 2 – Regulated land where a biodiversity assessment is required for any activity requiring clearing of native vegetation
- Category 3 – where LLS Act does not apply.

A BDAR for an SSD project is not required to assess the impacts of any clearing of native vegetation and loss of habitat on land classified as Category 1 Land under the LLS Act, other than impacts 'prescribed' in Clause 6.1 of the NSW *Biodiversity Conservation Regulation 2017*.

The location of Category 1, Category 2, and Excluded land is not shown on the available Native Vegetation Regulatory map (NVR map). Therefore, ELA have developed a mapping approach to provide a completed NVR Map, to be applied to this assessment. The land category criteria and mapping approach was confirmed by the NSW Biodiversity Conservation and Science Division (BCSD) in Dubbo and the final NVR map for the study area is presented at **Appendix G**.

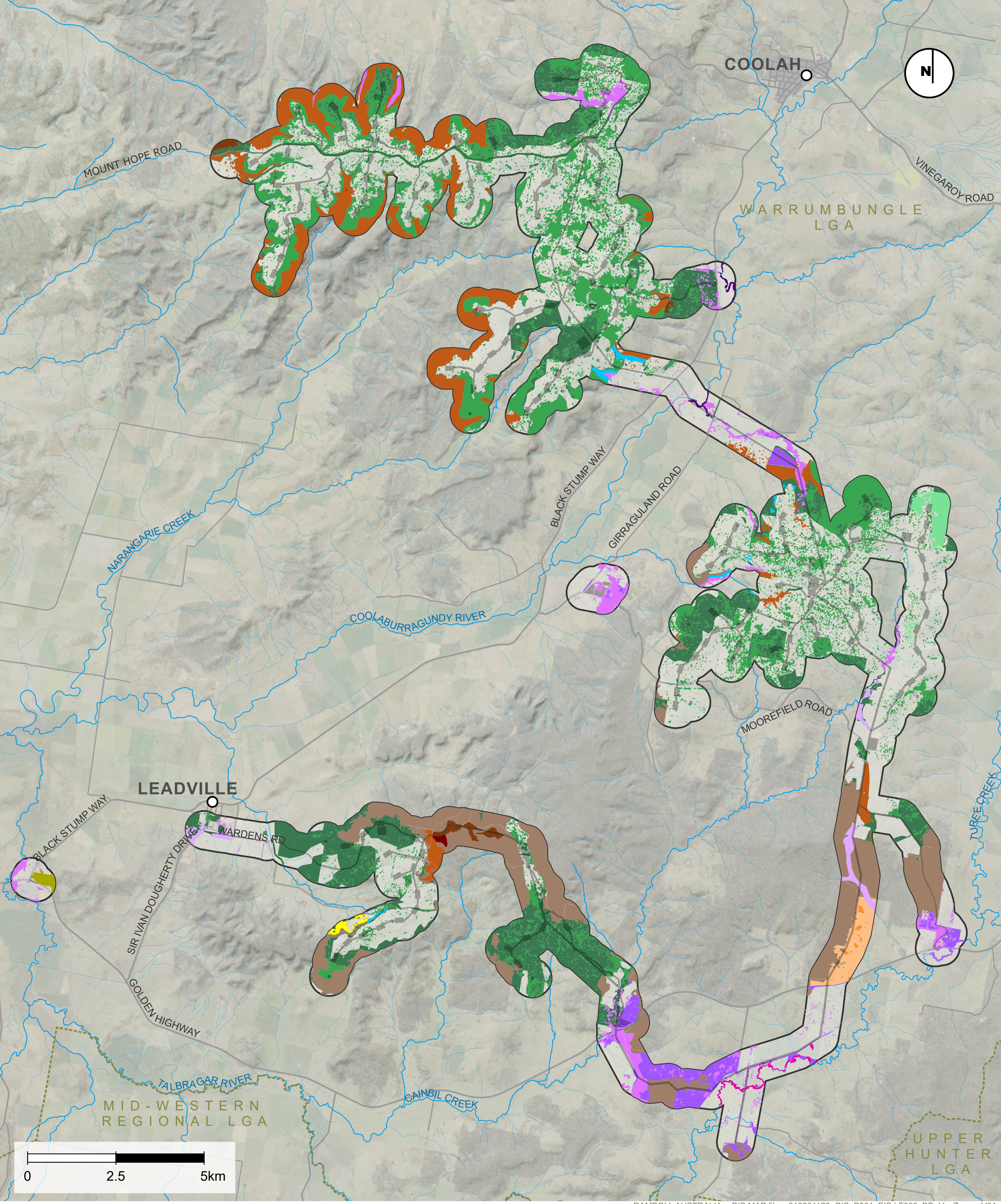
Native vegetation patterns

The majority of the study area is located on land that is currently, and historically, used for grazing and agriculture. In these areas the native understorey and midstorey are diminished and contain significant amounts of non-native vegetation.

Vegetation within the Leadville area is the most poorly degraded within the study area, due to ongoing agricultural practices and the Sir Ivan Fire in February 2017 (see **Section 8.2.1** above). There are some patches of better condition native vegetation around the slopes adjacent to the study areas at the Girragulang Road and Mount Hope clusters, as well as in riparian areas in steep gullies north of the study area.

Twelve vegetation communities in variable condition states were identified across the study area and are shown in **Figure 8-3.** The communities and their condition are listed below:

- *Eucalyptus 'albemol'* Grassy Woodland on basalt derived soils (moderate and high condition)
- Derived Native Grassland on basalt and sandstone derived soils (low condition)
- Rusty Fig Rainforest on basalt derived soils in sheltered sites (moderate condition)
- Narrow-leaved Ironbark Open Woodland on sandstone derived soil with basalt influence (moderate condition)
- Inland Grey Box woodland on low sandstone foothills (moderate condition)
- Narrow-leaved Ironbark – Cypress Pine shrubby open forest on sandstone (low, burnt, regenerating and good condition)
- Tumbledown Red Gum on slopes and exposed cliffs (moderate condition)
- Inland Scribbly Gum – Narrow-leaved Stringybark shrubby open forest on sandstone (good condition)
- Yellow Box on black alluvial soils (moderate and good condition)
- River Oak woodland fringing creeks on lower alluvial plains (moderate condition)
- River Red Gum riparian woodland (moderate condition)
- Crops.



RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F039_BD_VegZones_V04
Aerial photography from NSW Government Spatial Services

KEY

- Study area (biodiversity)
- Development footprint
- LGA boundaries
- Waterway (NSW Spatial Services)

Vegetation zones* (EcoLogical)

- 01 42 M
- 02 84 M
- 03 272 M
- 04 272 L
- 05 281 G
- 06 281 M
- 07 281 L
- 08 461 B
- 09 461 M
- 10 478 G
- 11 479 B
- 12 479 M
- 13 479 Reg
- 14 483 G
- 15 483 M
- 16 483 L
- 17 616 M

**Vegetation zone number, PCT ID, condition (L=Low, M=Moderate, G=Good, B=Burnt, Reg=Regenerating)*

Figure 8-3 | Vegetation zones

8.2.3 Plant community types

The best fitting PCT selections determined following the methodology outlined in **Section 8.1.1**, are provided in **Table 8-2** and the locations within the study area are shown **Figure 8-4**.

Table 8-2: Plant Community Types

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Percent cleared
42	River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	Inland Riverine Forests	Forested Wetlands	40%
84	River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	Eastern Riverine Forests	Forested Wetlands	40%
272	White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes	Western Slopes Grassy Woodlands	Grassy Woodlands	65%
281	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	67%
461	Tumbledown Gum woodland on hills in the northern NSW South Western Slopes Bioregion and southern Brigalow Belt South Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	50%
478	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	29%
479	Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	40%
483	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Western Slopes Grassy Woodlands	Grassy Woodlands	90%
616	Grey Myrtle - Rusty Fig dry rainforest in sandstone gorges of the upper Hunter Valley	Dry Rainforests	Rainforests	0%

Source: (ELA, 2022)

8.2.4 Threatened ecological communities

Based on the location and assemblage of species, two potential BC Act TECs occur within the study area:

- BC Act Inland Grey Box Woodland TEC - Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions
- BC Act Box Gum Woodland TEC - White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverine Bioregions.

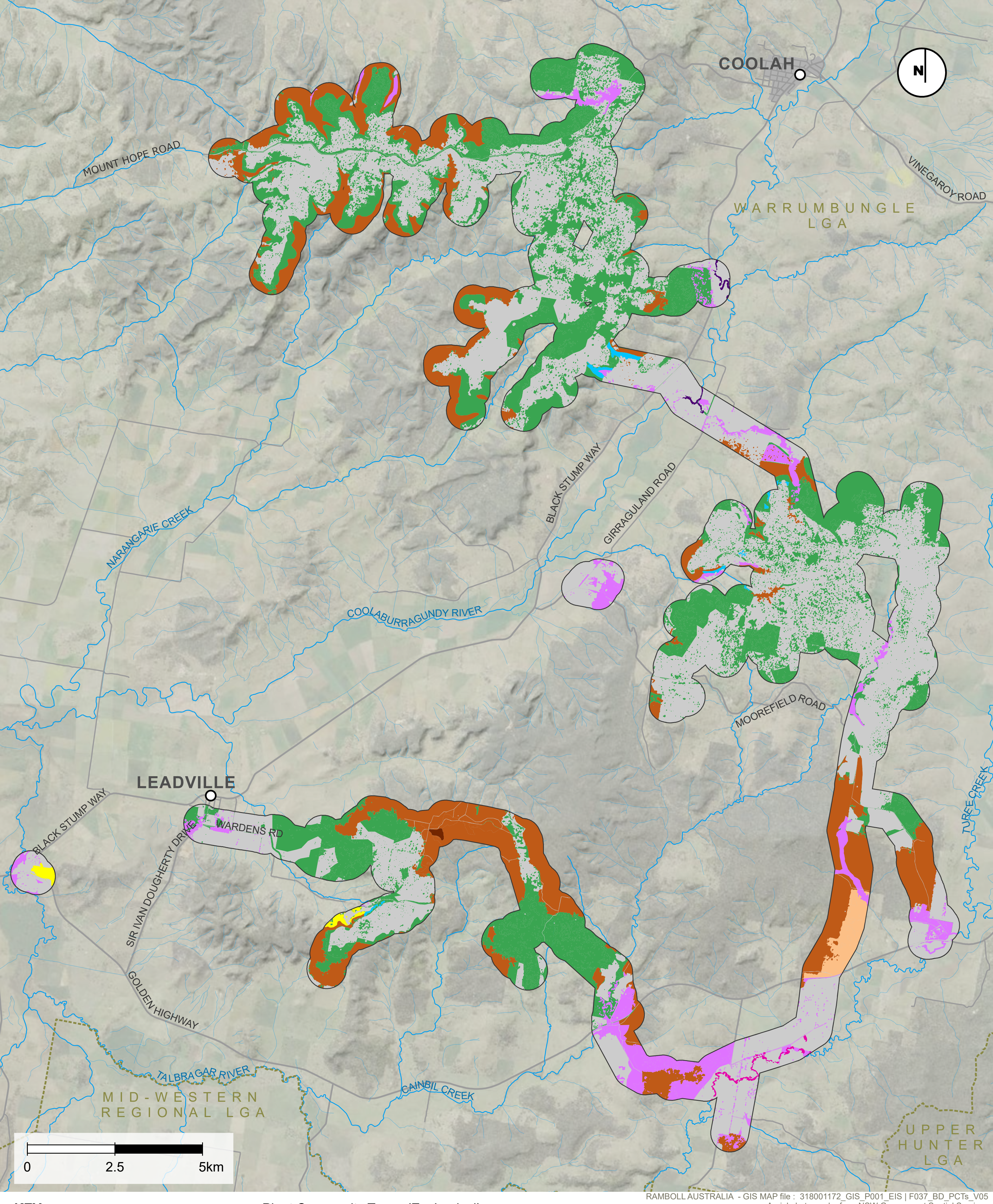
Whilst the majority of occurrences of *Eucalyptus macrocarpa* (Inland Grey Box) within the study area are within PCT 272 and occur on low lying areas in the southern portion of the study area, this occurrence is outside of the spatial extent of the TEC identified in the Final Determination. There is a small portion of this TEC present as scattered paddock trees in PCT272, (within the spatial extent of the TEC identified in the final determination) hence, Inland Grey Box Woodland TEC is considered present within the study area.

All occurrence of PCTs 281 and 483 are consistent with Box Gum Woodland.

To determine a list of candidate TECs under the EPBC Act, assessment of the Listing Criteria was undertaken for two potential TECs within the study area:

- Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia (EPBC Act Inland Grey Box Woodland)
- White box - yellow box - Blakely's red gum grassy woodlands and derived native grasslands (EPBC Act Box Gum Woodland).

An assessment of the species composition and patch size was undertaken using floristic data collected at Biodiversity Assessment Method (BAM) Plot locations. Based on the assessment, all occurrences of 281 (in good condition), 483 (in good condition), larger patches of 281 (in moderate condition), and portions of 483 (in moderate condition) connected to those patches described above, are the EPBC Act Critically Endangered Ecological Community (CEEC).



KEY

Study area (biodiversity)
LGA boundaries
Waterway (NSW Spatial Services)

Plant Community Types (EcoLogical)

42
84
272
281
461
478
479
483
616
Exotic/cleared

Figure 8-4 | Plant Community Types (PCTs)

8.2.5 Threatened species populations

Ecosystem credit species
Ecosystem credit species predicted to occur at the development site, their associated habitat constraints, geographic limitations and sensitivity to gain class is included in the BAM predicted species reports in Appendix G of **Appendix G**.

Species credit species
Species credit species are threatened flora and fauna species that cannot be predicted by vegetation type. Candidate species credit species with the potential to occur within the study area, based on the presence of suitable habitat, must be surveyed to determine presence or absence.

An assessment was undertaken to determine the threatened species that are likely to be present in the study area, including a consideration of their habitat constraints, geographic limitations, and site degradation. This process therefore excluded several species credit species from further assessment that were identified in the desktop assessment. The species considered for further assessment are summarised in **Table 8-3.**

Table 8-3: Candidate species requiring further assessment

Species Name	Common Name	BC Act	EPBC Act
Acacia ausfeldii	Ausfeld's Wattle	Vulnerable	Not listed
Aprasia parapulchella	Pink-tailed Legless Lizard	Vulnerable	Vulnerable
Burhinus grallarius	Bush Stone-curlew	Vulnerable	Not listed
Callocephalon fimbriatum	Gang-gang Cockatoo	Vulnerable	Not listed
Cercartetus nanus	Eastern Pygmy Possum	Vulnerable	Not listed
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	Vulnerable
Commersonia procumbens	Commersonia procumbens	Vulnerable	Vulnerable
Cynanchum elegans	White-flowered Wax Plant	Endangered	Endangered
Dichanthium setosum	Bluegrass	Vulnerable	Vulnerable
Lophochroa leadbeateri	Major Mitchell's Cockatoo	Vulnerable	Not listed
Miniopterus australis	Little Bent-wing Bat	Vulnerable	Not listed
Miniopterus orianae oceanensis	Large Bent-winged Bat	Vulnerable	Not listed
Monotaxis macrophylla	Large-leafed Monotaxis	Endangered	Not listed
Ninox connivens	Barking Owl	Vulnerable	Not listed
Ninox strenua	Powerful Owl	Vulnerable	Not listed
Persoonia marginata	Clandulla Geebung	Vulnerable	Vulnerable
Petaurus volans	Greater Glider	Not listed	Vulnerable
Petaurus norfolcensis	Squirrel Glider	Vulnerable	Not listed

Species Name	Common Name	BC Act	EPBC Act
Petrogale penicillata	Brush-tailed Rock Wallaby	Vulnerable	Vulnerable
Phascogale tapoatafa	Brush-tailed Phascogale	Vulnerable	Not listed
Phascolarctos cinereus	Koala	Vulnerable	Vulnerable
Polytelis swainsonii	Superb Parrot	Vulnerable	Vulnerable
Prasophyllum petilum	Tarengo Leek Orchid	Endangered	Endangered
Prasophyllum sp. Wybong	Prasophyllum sp. Wybong	Not listed	Critically Endangered
Swainsona sericea	Silky Swainson-pea	Vulnerable	Not listed
Tylophora linearis	Tylophora linearis	Vulnerable	Endangered
Tyto novaehollandiae	Masked Owl	Vulnerable	Not listed
Vespadelus troughtoni	Eastern Cave Bat	Vulnerable	Not listed
Zieria obcordata	Granite Zieria	Endangered	Endangered

Targeted flora surveys were undertaken in February, April, May and September 2021 and identified *Dichanthium setosum* (Bluegrass) in two locations in the Girragulang Road cluster. Bluegrass is listed under the BC Act as Vulnerable and EPBC Act as Vulnerable. No additional threatened flora species were identified during the surveys.

Targeted threatened fauna surveys included the following targeted surveys:

- targeted Microchiropteran bat surveys using harp traps and songmeters in summer
- diurnal avifauna surveys
- targeted arboreal mammal surveys in spring, summer, and autumn using call playback, IR cameras, spotlighting
- targeted forest owl surveys in winter using call playback, spotlighting, and songmeters
- targeted Koala surveys using the Spot Assessment Technique (SAT) in suitable vegetation
- active searches for reptiles in all areas of potential rocky habitat in September 2021.

The effort and detailed methods for each targeted survey are described in **Appendix G.**

An assessment under SEPP44 has been undertaken (refer to **Section 3.2.1**) to consider impacts to potential or core Koala habitat. Potential Koala Habitat is defined in SEPP44 as areas of native vegetation where the trees of the types listed in Schedule 2 (of the SEPP44) constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

Only one species of tree present (*Eucalyptus albens*) is present within the project, conservatively identified as the hybrid *E. albemol*. Surveys conducted across the study area including spot assessment technique (SAT) surveys, spotlighting, and remote cameras, did not record any individual Koalas or indications of likely Koala presence.

It is therefore concluded that the study area does not contain core Koala habitat and the project would not impact on core Koala habitat.

Species credit summary

Following completion of targeted surveys, six species credit species were confirmed to be present in the study area. These species credit species are outlined in **Table 8-4**.

8.2.6 Rivers and streams

There are numerous first and second order streams across the wind farm area. Major waterways identified in the review of the NSW LPI waterway mapping include:

- Coolabaragundy River
- Talbragar River.

8.2.7 Key fish habitats

The Coolaburragundy Creek and Talbragar River are Key Fish Habitat (KFH) for Eel-tailed Catfish and Purple Spotted Gudgeon. There are numerous named and unnamed drainages across the study area that are KFH for Purple-spotted Gudgeon only.

Table 8-4: Species credit species included in the assessment and identified in the study area

Species	Common Name	Species polygon mapping method	Number of individuals / habitat (ha) in study area	Biodiversity Risk Weighting
Dichanthium setosum	Bluegrass	30m buffer from all known occurrences	3 patches of approximately 6 tussocks occupying 0.84 ha	2
Chalinolobus dwyeri	Large-eared Pied Bat	Breeding habitat is 100m from cliffs and escarpments, total species polygon includes 2km from cliffs and escarpments.	256 ha of potential breeding habitat 4,155 ha of foraging habitats	3
Miniopterus orianae	Large Bentwing-bat	Breeding habitat is 100m from cliffs and escarpments	256 ha of potential breeding habitat	3
Tyto novahollandiae	Masked Owl	A 100m buffer has been applied to potential nest trees which includes trees with hollows >400mm and more than 3m from the ground.	3.13 ha (one potential breeding tree)	2
Ninox connivens	Barking Owl	100m buffer around potential nest trees (being trees with hollows >200mm and >4m above the ground). This has been calculated within the Mount Hope Cluster only	49.16 ha	2
Petaurus norfolcensis	Squirrel Glider	All habitat is mapped as being woodland or forest in moderate to good condition, with an intact acacia understorey or variety of winter-flowering eucalypts, connected to those locations the species was detected. This includes areas of PCT281 along the transmission line, areas of PCT479 moderate and burnt in the transmission line and Leadville clusters, and PCT281 and PCT479 in the Mount Hope cluster.	2,864 ha	2

Source: (ELA, 2022)

8.3 Assessment of potential impacts

8.3.1 Prescribed impacts for wind farm developments

Wind turbine strikes

A baseline collision risk assessment was undertaken for aerial fauna species identified as species of concern within the wind farm site. A species of concern is any species that:

- is a threatened species listed under the BC Act and/or EPBC Act recorded within the study area
- is a species known to be prone to collision, as evidenced by fatality at another wind farm in NSW
- was recorded flying within the rotor swept area of the turbines (greater than 80 metres above ridge line).

The collision risk assessment is detailed in **Appendix G**. The Nankeen Kestrel and the Wedge-tailed Eagle were identified as species of moderate concern. Based on the assessment for collision frequency, between 0.002 and 0.173 Nankeen Kestrels would be struck each year and between 0.029 and 2.89 Wedge-tailed Eagles would be struck each year by the project.

8.3.2 Avoidance of impacts

The project has been continually refined with consideration to the findings of the BDAR to avoid and minimise impacts to biodiversity values. This has included locating the wind farm components and infrastructure in areas of lowest biodiversity value (cleared paddock – Category 1 Land) and avoiding larger woodland areas where possible.

The project has aimed to minimise impacts to CEEC and species habitat by avoiding higher quality remaining vegetation within and surrounding the development site and limiting interruption to connectivity values surrounding the development site.

Project elements have been sited to avoid habitat for species and limiting impacts if they can't be avoided, to areas where native vegetation or threatened species habitat is in the poorest condition. Project refinements are discussed in **Section 2.4**, and refinements specifically responding to the findings of the BDAR are summarised in **Table 8-5**.

The project has also been refined to minimise prescribed impacts where possible. Technology and construction solutions would be selected during detailed design with the aim that the project would not result in any impacts to bedrock underlying features of geological significance and is unlikely to impact any connectivity or movement corridors.

Turbines have been positioned along ridgetops as these are the areas that contain the least biodiversity values, whilst providing optimal wind generation. There are numerous turbine free zones within the wind farm site that allow for movement of species of concern without producing a barrier effect.

Table 8-5: Project development design changes to limit impacts on vegetation and habitat

Development feature	Initial proposal (Scoping Study 2019)	Final proposal	Result
Wind turbine locations	175 wind turbines proposed across three wind farm clusters.	Reduced to 148 turbines.	15% reduction in wind turbines. Turbines in high-risk locations have been removed from the development. Final turbine layout maximises category 1 land and low condition native grassland.
Internal access tracks and electrical reticulation	Not included in original design	Internal access follows existing cleared farm tracks where possible.	Majority of all other tracks would be located in category 1 land and low condition native grassland. Electrical reticulation would be trenched along access tracks to consolidate areas of ground disturbance.
Internal transmission lines (between wind farm clusters)	Connector transmission line between Girragulang Road and Mount Hope not included in original design. Connector transmission lines proposed directly between Leadville and Girragulang Road clusters through approximately 7.2km of forested vegetation.	Connector transmission line between Girragulang Road and Mount Hope crosses valley floor that is predominately cleared for cropping. Connector transmission lines proposed directly between Leadville and Girragulang Road abandoned, in preference for direct connection to REZ Transmission line from Leadville.	Areas of better-quality vegetation would generally been avoided by following cleared areas.
External transmission lines (wind farm to REZ Transmission line)	Approximately 75km of 500kv transmission line proposed from Girragulang Road cluster to Mount Piper to Bayswater Transmission line south of Merriwa, impacting CEEC and Regent Honeyeater important areas.	Approximately 15km of up to 500kV transmission line between Girragulang Road/Leadville clusters, to connect to the Central West Renewable Energy Zone Transmission line	Avoidance of significant areas of native vegetation. Significant reduction in area of CEEC impacted and avoidance of Regent Honeyeater important areas.
Substations	Not included in original design	Located within category 1 land with little to no biodiversity value	Low impact and preservation of better-quality areas

Development feature	Initial proposal (Scoping Study 2019)	Final proposal	Result
Component haulage and construction access	Access to Mount Hope cluster via Neilrex Road and Mount Hope Road, resulting in potential major road upgrades through moderate condition native vegetation	Access to Mount Hope now follows existing farm tracks off Black Stump Way, no upgrades to public roadways required.	Low impact and preservation of better-quality areas
Ancillary infrastructure (site offices, laydown areas, etc)	Not included in original design	Located within category 1 land with little to no biodiversity value	Low impact and preservation of better-quality areas

8.3.3 Direct and indirect impacts

The main impact of the project on biodiversity values would result from the removal of vegetation required for the construction of access tracks, electrical reticulation and substations, turbine footings and pads, and operation and maintenance facilities. Disturbance and clearing of vegetation may also arise from additional footprint required for construction including lay down areas for turbine components and construction compounds.

The project may have direct impacts on:

- native vegetation and threatened ecological communities
- threatened species and threatened species habitat
- prescribed biodiversity impacts.

The project would unavoidably impact approximately 1,340 hectares of native vegetation, no threatened species and 269.45 hectares of threatened species habitat within the study area based on the current development footprint (construction and operational footprint). This includes vegetation communities and species listed under the BC Act and EPBC Act.

Potential indirect impacts associated with the project include:

- inadvertent impacts on adjacent habitat or vegetation such as trampling grass and ground cover by site vehicles during construction and decommissioning
- reduced viability of adjacent fauna species and their habitat from noise, dust or light spill predominantly during construction works and decommissioning but also noise generated daily throughout the operation of the project
- potential to transport weeds and pathogens from the site to adjacent vegetation during construction and decommissioning.

The project is not expected to significantly impact groundwater (refer to **Chapter 12**), and no impacts to Groundwater Dependent Ecosystems (GDE), if present, are expected to occur.

26 Koala Spot Assessment Technique (Phillips and Callaghan 2011) surveys were completed in June 2021, targeting areas that represent the highest quality and most connected habitat across the wind farm for Koala. No evidence of Koala was recorded, and no further analysis has been undertaken.

The project may impact on the connectivity of different areas of habitat for threatened species that facilitate the movement of those species across their range. Impacts on connectivity are expected to be minor as the main connectivity features within the wind farm site would be retained. However, the easement associated with the transmission line connection to the CWO-REZ would require land to be cleared and maintained (up to 70 metres wide for up to 15 kilometres) and would limit habitat connectivity within this location. The vegetation in this location is predominantly burned bushland.

A detailed bird and bat wind turbine strike risk assessment (**Appendix G**) found there would be minor ongoing risk of impacts to common species including the Nankeen Kestrel and the Wedge-tailed Eagle.

Potential indirect impacts on aquatic habitat include:

- impacts to water quality (if water is present) during construction of creek crossings required for the access tracks
- potential increase in run-off/sedimentation during construction, operation and decommissioning.

Transmission line crossings of the Coolaburragundy Creek and Talbragar River would span the watercourses to avoid impacts on the bed and banks. Potential impacts to key fish habitats would be through consideration of Policy and Guidelines for Fish Friendly Waterway Crossing (Department of Primary Industries, Undated) during detailed design and construction.

Given the degraded nature of the aquatic habitat present and mitigation measures proposed in **Section 8.5**, the direct impacts to aquatic habitat are unlikely to be significant.

8.3.4 Serious and irreversible impacts

One threatened ecological community, the White Box Yellow Box Blakely's Red Gum Grassy Woodland has been considered a potential entity to meet the serious and irreversible impacts principle.

The development has candidate Serious and Irreversible Impacts (SAII) values as outlined in **Table 8-6**, and the rationale for listing that entity is provided in **Table 8-7**. Detailed consideration of whether impacts on TECs that are serious and irreversible is included in **Table 8-8.**

Table 8-6: Serious and Irreversible Impacts Summary

Species / Community	Common Name	Direct impact individuals / area (ha)	Threshold
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions	Box Gum Woodland	234.76 ha of good to moderate woodlands 193.76 ha of poor condition grasslands	No threshold identified.

Table 8-7: Determining whether impacts are serious and irreversible

Determining whether impacts are serious and irreversible	Assessment
Principle 1	
Does the proposal impact on a species, population or ecological community that is a candidate entity because it is in a rapid rate of decline?	Yes, the White Box Yellow Box Blakely's Red Gum Woodland is identified as potentially being SAII.

Determining whether impacts are serious and irreversible	Assessment
If yes, is the impact in excess of any threshold identified and therefore likely to be serious and irreversible?	There is no threshold for impacts that may trigger a serious and irreversible impact. Therefore, the determination of a serious and irreversible impact is to be assessed on a case-by-case basis
Principle 2	
Does the proposal impact on a species that is a candidate entity because it has been identified as having a very small population size?	Yes
If yes, is the impact in excess of any threshold identified and therefore likely to be serious and irreversible? Note: where candidate entities have no listed threshold, any impact is considered likely to be serious and irreversible	No threshold is identified, and the community is widespread in several bioregions NSW. Further consideration of potential serious and irreversible impacts is outlined in **Appendix G.**
Principle 3	
Does the proposal impact on the habitat of a species or an area of an ecological community that is a candidate entity because it has a very limited geographic distribution?	No
If yes, is the impact in excess of any threshold identified and therefore likely to be serious and irreversible? Note: where candidate entities have no listed threshold, any impact is considered likely to be serious and irreversible.	N/A
Principle 4	
Does the proposal impact on a species, a component of species habitat or an ecological community that is a candidate entity because it is irreplaceable?	No
If yes, is the impact in excess of any threshold identified and therefore likely to be serious and irreversible? Note: where candidate entities have no listed threshold, any impact is considered likely to be serious and irreversible.	N/A

Table 8-8: Evaluation of an impact on a TEC consistent with 9.1.1 of the BAM

Impact Assessment Provisions	Assessment
1. the action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII	Measures to avoid direct and indirect impacts are detailed in **Appendix G**.

Impact Assessment Provisions	Assessment
2a. evidence of reduction in geographic distribution (Principle 1, clause 6.7(2)(a) BC Regulation) as the current total geographic extent of the TEC in NSW AND the estimated reduction in geographic extent of the TEC since 1970 (not including impacts of the proposal)	The current total geographic extent of the TEC has been estimated by calculating the area of associated PCTs as mapped on the Brigalow Belt South – Nandewar, Central West – Lachlan, Upper Hunter, and Riverina PCT Maps **(Appendix G)** Based on this mapping, there is potentially 3,690,648 ha of the TEC currently in NSW. The reduction of the TEC since 1970 is not known, however Section 8 of the Final Determination identified that: *"White Box Yellow Box Blakely's Red Gum Woodland has been drastically reduced in area and highly fragmented because of clearance for cropping and pasture improvement. Austin et al. (2000) found the community had been reduced to less than 1% of its pre-European extent in the Central Lachlan region. Comparable degrees of reduction have been documented for NSW south western slopes and southern Tablelands (estimated <4% remaining, Thomas et. al. 2000), and for the Holbrook area (estimated <7% remaining, Gibbons and Boak (2000). Gibbons and Boak (2000) found remnants of woodlands dominated by Eucalyptus albens, E. melliodora and E. blakelyi were severely fragmented."*
2b. extent of reduction in ecological function for the TEC using evidence that describes the degree of environmental degradation or disruption to biotic processes (Principle 2, clause 6.7(2)(b) BC Regulation) indicated by: i. change in community structure ii. change in species composition iii. disruption of ecological processes iv. invasion and establishment of exotic species v. degradation of habitat, and vi. fragmentation of habitat	Within the operational footprint of the development site, the community structure will be entirely removed. Within the construction footprint there will be removal of trees that interfere with construction activities. There may also be temporary disturbance to the ground layer in set down areas and temporary parking areas. Species composition is expected to be reduced to 0, within all areas of the development footprint. There is unlikely to be any invasion or establishment of exotic species, beyond those that already occur throughout the study area. Habitats within the development site will be removed. Habitats that occur outside the development site may be fragmented from each other, however the majority of the development site is located in an already fragmented landscape and is unlikely to further reduce connectivity of the TEC.

Impact Assessment Provisions	Assessment
2c. evidence of restricted geographic distribution (Principle 3, clause 6.7 (2) (c) BC Regulation), based on the TECs geographic range in NSW according to the: i. extent of occurrence ii. area of occupancy, and iii. number of threat-defined locations.	The TECs geographic range in NSW includes the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions. The current extent of occurrence based on the Brigalow Belt South – Nandewar, Central West – Lachlan, Upper Hunter, and Riverina PCT Maps (Figure 59 in **Appendix G**) is potentially 3,690,648 ha of the TEC currently in NSW. There are no threat-defined locations for this TEC.
2d. evidence that the TEC is unlikely to respond to management (Principle 4, clause 6.7 (2) (d) BC Regulation).	From section 11 of the Final Determination: *"Disturbed remnants are still considered to form part of the community including remnants where the vegetation, either understorey, overstorey or both, would, under appropriate management, respond to assisted natural regeneration, such as where the natural soil and associated seed bank are still at least partially intact."*
3. Where the TBDC indicated that data is 'unknown' or 'data deficient' for a TEC for a criterion listed in subsection 9.1.1(2), the assessor must record this in the BDAR or BCAR.	N/A
4a. the impact on the geographic extent of the TEC (Principles 1 and 3) by estimating the total area of the TEC to be impacted by the proposal: i. in hectares, and ii. as a percentage of the current geographic extent of the TEC in NSW.	The total area of the TEC to be impacted by the proposal is 428.51 ha. The percentage of impact to the TEC across the current geographic extent is 0.01 %.
4b. the extent that the proposed impacts are likely to contribute to further environmental degradation or the disruption of biotic processes (Principle 2) of the TEC by: i. estimating the size of any remaining, but now isolated, areas of the TEC; including areas of the TEC within 500 m of the development footprint or equivalent area for other types of proposals ii. describing the impacts on connectivity and fragmentation of the remaining areas of TEC measured by: • distance between isolated areas of the TEC, presented as the average distance if the remnant is retained	The extent of the TEC within 500m of the development is shown on Figure 60 of **Appendix G.** The current connectivity and isolation of patches of the TEC was measured using Euclidean distance analysis between patches of the TEC (Figure 61 of **Appendix G**). The change in the proportion of area between patches (i.e. future separation of the TEC) changed from an average separation of 55.06m before development to 57.16 after development. The project is unlikely to isolate any patches of the TEC, as the extent of the TEC is so prevalent locally.

Impact Assessment Provisions	Assessment
AND the average distance if the remnant is removed as proposed, and • estimated maximum dispersal distance for native flora species characteristic of the TEC, and • other information relevant to describing the impact on connectivity and fragmentation, such as the area to perimeter ratio for remaining areas of the TEC as a result of the development iii. describing the condition of the TEC according to the vegetation integrity score for the relevant vegetation zone(s) (Section 4.3). The assessor must also include the relevant composition, structure and function condition scores for each vegetation zone.	The maximum dispersal distance for native flora species before and after the development is unchanged. The area to perimeter ratio before the development is 21.44 m2/m. The area to perimeter ratio after the development is 20.92 m2/m. The condition of the TEC according to the vegetation integrity score is provided in **Appendix G**.

8.3.5 Impacts requiring offsets

The impacts of the wind farm requiring offset for native vegetation are outlined in **Table 8-9**.

The impacts of the wind farm requiring offset for species credit species and their habitat are outlined in **Table 8-10.** In addition to those species that have been identified as present within the development site, species have been assumed present where they are likely to occur on lands that have not yet been surveyed. The areas of assumed presence of species credit species will be surveyed at the appropriate time, as a commitment of the proponent to understanding the whole and finite extent of environmental impacts of the project.

Table 8-9: Impacts to native vegetation that require offsets

Vegetation Zone	PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
01 42 M	42	River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	Inland Riverine Forests	Forested Wetlands	0.66
02 84 M	84	River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	Eastern Riverine Forests	Forested Wetlands	1.14
03 272 M	272	White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes	Western Slopes Grassy Woodlands	Grassy Woodlands	0.31
04 272 L	272	White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes	Western Slopes Grassy Woodlands	Grassy Woodlands	12.37
05 281 G	281	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	4.27
06 281 M	281	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	28.43

Vegetation Zone	PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
09 478 G	478	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	0.11
10 479 B	479	Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	35.73
11 479 M	479	Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	7.39
12 479 Reg	479	Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	8.57
13 483 G	483	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Western Slopes Grassy Woodlands	Grassy Woodlands	1.67
14 483 M	483	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Western Slopes Grassy Woodlands	Grassy Woodlands	200.1

Vegetation Zone	PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
15 483 L	483	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Western Slopes Grassy Woodlands	Grassy Woodlands	172.45

Table 8-10: Impacts on threatened species and threatened species habitat that require offsets

Species	Common Name	Direct impact number of individuals / habitat (ha)	BC Act listing status	EPBC Act Listing status
Dichanthium setosum	Bluegrass	0 – species not impacted	Vulnerable	Vulnerable
Chalinolobus dwyeri	Large-eared Pied Bat	0.0 ha of breeding habitats 180.49 ha of foraging habitat	Vulnerable	Vulnerable
Tyto novahollandiae	Masked Owl	0.0 ha of breeding habitat	Vulnerable	Not listed
Ninox connivens	Barking Owl	32.20 ha of potential breeding habitat including assumed areas	Vulnerable	Not listed
Petaurus norfolcensis	Squirrel Glider	63.28 ha of foraging habitat including assumed areas	Vulnerable	Not listed

Credit summary

The number of ecosystem credits required for the development are outlined in **Table 8-11.**

The number of species credits required for the development are outlined in **Table 8-12.**

Table 8-11: Ecosystem credits required

Vegetation Zone	PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Total direct impact (ha)	Total credits required
01 42 M	42	River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	Inland Riverine Forests	Forested Wetlands	0.66	41
02 84 M	84	River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland) of the Brigalow Belt South Bioregion and Nandewar Bioregion	Eastern Riverine Forests	Forested Wetlands	1.14	11
03 272 M	272	White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes	Western Slopes Grassy Woodlands	Grassy Woodlands	0.31	8
04 272 L	272	White Box - Black Cypress Pine - red gum +/- Mugga Ironbark shrubby woodland in hills of the NSW central western slopes	Western Slopes Grassy Woodlands	Grassy Woodlands	12.37	123
05 281 G	281	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	4.27	212

Vegetation Zone	PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Total direct impact (ha)	Total credits required
06 281 M	281	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	28.43	1,434
07 281 L	281	Rough-Barked Apple - red gum - Yellow Box woodland on alluvial clay to loam soils on valley flats in the northern NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	20.81	0
08 461 B	461	Tumbledown Gum woodland on hills in the northern NSW South Western Slopes Bioregion and southern Brigalow Belt South Bioregion	Western Slopes Grassy Woodlands	Grassy Woodlands	0	0
09 461 M	461	Tumbledown Gum woodland on hills in the northern NSW South Western Slopes Bioregion and southern Brigalow Belt South Bioregion	Western Slopes Dry Sclerophyll Forests	Grassy Woodlands	0	0
10 478 G	478	Red Ironbark - Black Cypress Pine - stringybark +/- Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern Brigalow Belt South Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	0.11	3

Vegetation Zone	PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Total direct impact (ha)	Total credits required
11 479 B	479	Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	35.73	723
12 479 M	479	Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	7.39	191
13 479 Reg	479	Narrow-leaved Ironbark- Black Cypress Pine - stringybark +/- Grey Gum +/- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern Brigalow Belt South Bioregion and Sydney Basin Bioregion	Western Slopes Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	8.57	105
14 483 G	483	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Western Slopes Grassy Woodlands	Grassy Woodlands	1.67	73
15 483 M	483	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Western Slopes Grassy Woodlands	Grassy Woodlands	200.1	3,910

Vegetation Zone	PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Total direct impact (ha)	Total credits required
16 483 L	483	Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley	Western Slopes Grassy Woodlands	Grassy Woodlands	172.45	2137
17 616 M	616	Grey Myrtle - Rusty Fig dry rainforest in sandstone gorges of the upper Hunter Valley, mainly Sydney Basin Bioregion	Dry Rainforests	Rainforests	173.45	0
Total native vegetation credits						**8,966**

Table 8-12: Species credit summary

Species	Common Name	Direct impact number of individuals / habitat (ha)	Total credits required
Chalinolobus dwyeri	Large-eared Pied Bat	159.33	4336
Ninox connivens	Barking Owl	32.30	912
Petaurus norfolcensis	Squirrel Glider	63.28	2,108
Assumed species*			
Acacia ausfeldii	Ausfeld's Wattle	20.10 ha assumed habitats	651
Burhinus grallarius	Bush Stone-curlew	20.10 ha assumed habitats	651
Callocephalon fimbriatum	Gang-gang Cockatoo	20.10 ha assumed habitats	651
Calyptorhynchus lathami	Glossy Black-Cockatoo	18.80 ha assumed habitats	606
Cercartetus nanus	Eastern Pygmy-possum	18.80 ha assumed habitats	606

Species	Common Name	Direct impact number of individuals / habitat (ha)	Total credits required
Commersonia procumbens	Commersonia procumbens	20.10 ha assumed habitats	651
Cynanchum elegans	White-flowered Wax Plant	18.80 ha assumed habitats	606
Hoplocephalus bitorquatus	Pale-headed Snake	0.60 ha assumed habitats	30
Hoplocephalus stephensii	Stephens' Banded Snake	0.60 ha assumed habitats	30
Lophoictinia isura	Square-tailed Kite	18.80 ha assumed habitats	455
Monotaxis macrophylla	Large-leafed Monotaxis	20.10 ha assumed habitats	651
Petauroides volans	Greater Glider	18.80 ha assumed habitats	606
Petrogale penicillata	Brush-tailed Rock-wallaby	20.10 ha assumed habitats	976
Phascolarctos cinereus	Koala	20.10 ha assumed habitats	651
Prasophyllum petilum	Tarengo Leek Orchid	20.10 ha assumed habitats	651
Prasophyllum sp. Wybong	Prasophyllum sp. Wybong	20.10 ha assumed habitats	976
Pteropus poliocephalus	Grey-headed Flying-fox	18.80 ha assumed habitats	606
Tylophora linearis	Tylophora linearis	20.10 ha assumed habitats	651
Tyto novaehollandiae	Masked Owl	20.10 ha assumed habitats	651
Vespadelus troughtoni	Eastern Cave Bat	20.10 ha assumed habitats	976
Total species			**19,688**

** Species not identified during targeted surveys, assumed present in unsurveyed areas only.*

A biodiversity credit report is included in **Appendix G.**

8.4 Matters of national environmental significance

The project was referred to the Commonwealth Minister for the Environment in 2020, and was declared a controlled action due to potential impacts primarily to Box Gum Woodland CEEC (Referral 2020/8668).

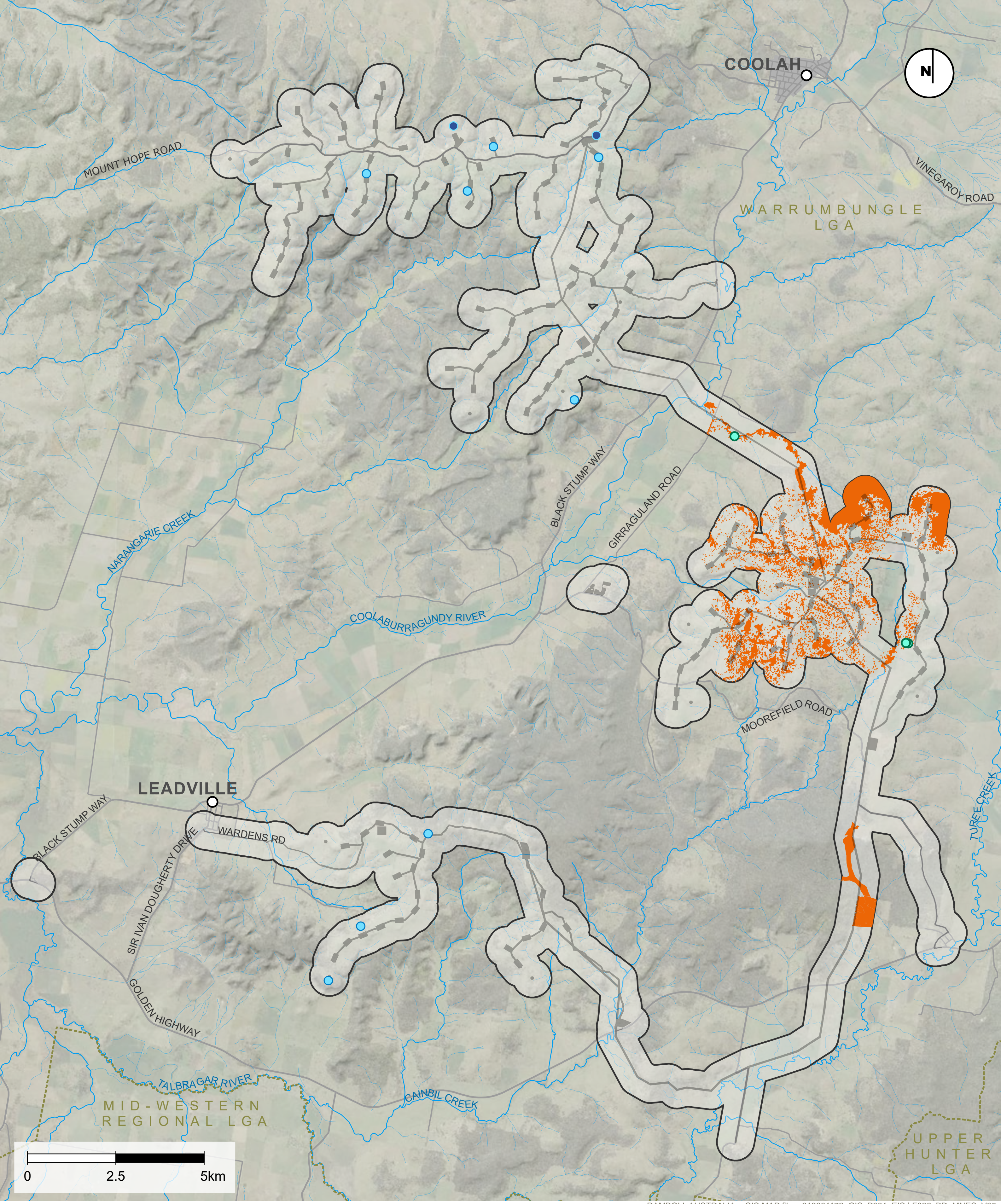
The referral identified potential impacts to two communities and 29 species listed under the EPBC Act. These species were derived from the project footprint identified in the referral, which has been significantly reduced through design refinements (refer **Section 2.4** and **Section 8.3.2**). Each species has been considered throughout the development of the project, and the list of all identified MNES and whether they may be impacted is described in Table 70 of **Appendix G**. Species that were not identified during field surveys have not been considered further. The location of all MNES is shown on **Figure 8-5**.

A revised significant impact criteria has been prepared in accordance with the EPBC Act for two communities and three species and is at **Appendix G.** A summary of the findings is provided in **Table 8-13.**

Table 8-13: Revised significant impact criteria

Species / Community Common Name	Location in the study area	Removal of community or habitat	Conclusion
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	This community was identified in the southern portion of the wind farm site, along the transmission line route between Girragulang Road and the CWO-REZ transmission line. It occurs as patches of remnant vegetation and derived grasslands.	Approximately 3.58 hectares of this community would be removed by the project. The project involves significant development of internal access tracks and transmission lines that will fragment remnant occurrences of the community. This fragmentation however will be narrow and is unlikely to impede any genetic transfer between retained patches.	The project is unlikely to significantly impact this community as the impacts are confined to small remnant patches in an existing degraded landscape.
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	This community was identified throughout the majority of the wind farm site. It occurs as patches of remnant vegetation. Grasslands within the development site are not consistent with the EPBC Act definition of this community.	Approximately 64.23 ha of this community will be removed by the project. The project involves significant development of internal access tracks and transmission lines that will fragment remnant occurrences of the community. This fragmentation however will be narrow and is unlikely to impede any genetic transfer between retained patches.	The project will significantly impact this community due to the reduction in the extent of the community only.

Species / Community Common Name	Location in the study area	Removal of community or habitat	Conclusion
Large-eared Pied Bat	This species was recorded in very low numbers, indicative of a low regional population utilising the project site for foraging only. The occurrence of this species within the development site is not considered to be an important population as described in *Matters of National Environmental Significance Significant impact guidelines 1.1* (Commonwealth of Australia, 2013)	The project will not reduce the area of occupancy of an important population. The project will not fragment an existing important population. The project will remove 180.49 ha foraging habitat for the species.	This species will not be significantly impacted.
White-throated Needletail	This species was recorded on several occasions within the Mount Hope cluster. This species is a spring/summer migrant to Australia. This species is listed as both migratory and vulnerable and so has been assessed under both significant impact criteria provisions as appropriate. The occurrence of the species within the study area is not considered to be an important population.	The project will not reduce the area of occupancy of an important population. The project will not fragment an existing important population. The project will not remove foraging habitat for the species.	This species will not be significantly impacted.
Bluegrass	This species was identified at two locations within the study area.	The project will not affect any individuals of this species.	This species will not be significantly impacted.



RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F036_BD_MNES_V05
Aerial photography from NSW Government Spatial Services

KEY

- Study area (biodiversity)
- Development footprint
- LGA boundaries
- Waterway (NSW Spatial Services)

EPBC Act listed items (EcoLogical)

- Threatened ecological community

Threatened species

- *Dichanthium setosum*
- Large-eared Pied Bat
- White-throated Needletail

Figure 8-5 | Matters of National Environmental Significance

8.5 Environmental management and mitigation measures

Proposed measures to manage and/or mitigate biodiversity impacts from the project are detailed in **Table 8-14**.

Table 8-14: Management and mitigation measures – biodiversity

ID	Management/mitigation measure	Timing
B1	Measures proposed to mitigate and manage prescribed biodiversity impacts at the development site will be documented in a biodiversity management plan, that includes an approved bird and bat adaptive management plan (BBAMP). The BBAMP is to include: • up to 12 months of bird utilisation studies at the 33 designated sites described in this report, across four (4) seasons, to provide more accurate risk data • carcass monitoring during the first 2 years of the operation of the wind farm, to estimate the number of birds and bats struck by turbine blades • scavenger assessment, to allow adjustment of carcass search data for carcasses removed prior to surveys. • bird Utilisation Studies at a subset of the 33 sites, to measure the ongoing impacts of the wind farm on bird populations locally • monitoring of bats across four seasons, to measure the ongoing impacts of the wind farm on microbat populations locally. • a strategy and notification protocol in the event that the wind farm significantly impacts protected or threatened species. The BBAMP will be implemented for the first 5 years of operation of the project.	Prior to construction / during operation
B2	Pre-clearance surveys will be undertaken prior to tree clearing. A qualified ecologist/licenced wildlife handler will supervise tree removal in accordance with best practise methods.	Prior to construction / construction
B3	Active breeding or nesting identified during pre-clearance surveys will be avoided in August, September and October which is the breeding/nesting period for most fauna species.	Prior to construction / construction
B4	A procedure will be developed for the relocation of habitat features (e.g. fallen timber, hollow logs) to adjacent retained habitat.	Prior to construction
B5	Clearing protocols will be developed that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance (e.g. removal of native vegetation by chainsaw instead of heavy machinery where only partial clearing is proposed). Fencing (or other barriers as required) and signage will be placed around those areas of vegetation to be maintained to prevent any accidental construction damage and provide a permanent barrier between the development footprint and retained areas. The type of fencing during construction may be of a temporary nature and scale that is robust enough to withstand damage during this stage of work.	Prior to construction / construction

ID	Management/mitigation measure	Timing
B6	All waterway crossings will be designed in accordance with *Policy and Guidelines for Fish Friendly Waterway Crossing* (DPI, n.d.) where appropriate.	Detailed design
B7	Appropriate controls will be implemented to manage exposed soil surfaces and stockpiles to prevent sediment discharge into waterways. All works within proximity to the drainage lines will have adequate sediment and erosion controls (e.g. sediment barriers, sedimentation ponds). Revegetation will also commence as soon as is practicable to minimise risks of erosion. Suitable species will be used as ground cover species in any revegetation areas.	Prior to construction / construction
B8	Construction works will predominately be undertaken during daylight hours. Occasionally night lights will be used during concrete pours. Lights associated with operation will be directional to avoid unnecessarily shining light into adjacent retained vegetation where possible. Noise impacts around batch plants and compounds to be managed where they impact on residents.	Construction
B9	Dust suppression measures will be implemented to limit dust on site. Revegetation will also be commenced as soon as practicable to minimise areas likely to create dust. Suitable species will be used as ground cover species in any revegetation areas.	Construction
B10	Temporary fencing will be installed when works are within 100m of any threatened flora that provides a 10m exclusion zone around known locations. Temporary fencing will also be used to demarcate the exact easement of the transmission line during construction.	Construction
B11	All machinery will be cleaned prior to entering and exiting the construction site to minimise the transport of weeds to vegetated areas to be retained. Weeds that are present within the study area that are listed under the NSW Biosecurity Act 2015 will be managed in accordance with a weed management plan.	Construction
B12	All personnel working on the project will undertake an environmental induction as part of their site familiarisation. This will include: • site environmental procedures (vegetation management, sediment and erosion control, exclusion fencing and noxious weeds) • what to do in case of environmental emergency (e.g. chemical spills, fire, injured fauna) • key contacts in the case of an environmental emergency.	Construction

9. TRAFFIC AND TRANSPORT

9.1 Assessment methodology

9.1.1 Assessment approach

The traffic and transport impacts of the project would largely be confined to the construction phase and a quantitative assessment has therefore been undertaken to determine the potential impacts of additional light and heavy vehicle movements on the local road network during construction. This includes an assessment of over-size over-mass (OSOM) vehicles that would be required to transport large project components, such as turbine blades and nacelles to site.

Similar traffic volumes and ratio of heavy vehicles to light vehicles would be expected during the decommissioning phase as the construction phase and a similar assessment approach was undertaken.

Because ongoing traffic impacts during operation are expected to be very minor, a qualitative assessment has been undertaken to assess broadscale impacts on local roads, access, public and active transport, and parking during operation.

A qualitative assessment has also been undertaken to assess the cumulative impacts of the project, involving a review of nearby developments including Liverpool Range Wind Farm, Barneys Reef Wind Farm, Wollar Solar Farm, Stubbo Solar Farm, Dunedoo Solar Farm and the Birriwa Solar Farm, and consideration of the likely traffic volumes, distribution and access routes (refer to **Chapter 17**).

A traffic and transport assessment has been prepared by SCT Consulting (SCT). The report is summarised below and provided in full in **Appendix H**. The report includes an assessment of the logistical requirements of transporting large components to site from the Port of Newcastle and consideration of OSOM vehicle turning movements and any potential upgrades to local roads and intersections to accommodate the required swept paths.

9.1.2 Assessment of background conditions

Traffic surveys were undertaken on 9 June 2021 at the following six key intersections (see **Figure 9-1):**

1. Golden Highway / Black Stump Way
2. Queensborough Street / Binnia Street
3. Neilrex Road / Mount Hope Road
4. Golden Highway / Short Street
5. Golden Highway / Sir Ivan Dougherty Drive
6. Sir Ivan Dougherty Drive / Wardens Road.

The surveys were undertaken between 6am and 9am and 4pm and 7pm which represent peak traffic periods.

An automatic tube counter was installed on Black Stump Way, 1 kilometre north of the Golden Highway intersection from 3 June 2021 to 9 June 2021 to capture a 7-day, 24-hour mid-block traffic profile.

Future year (2023) traffic generation was estimated for construction, operation, and decommissioning phases and an analysis of future year conditions with and without the project.

There are no specific generation rates for wind farms in the Guide to Traffic Generating Developments version 2.2 (RTA, 2002). The traffic generation was therefore determined through the forecast employee, workforce distribution and construction vehicles to cater for the construction phase, operation phase and decommissioning phase for the project. The forecast volumes include light and heavy vehicles and present the highest construction volume associated with each cluster, based on the assumption that construction of the three clusters would be undertaken sequentially, with construction vehicle movements associated with one cluster at a given time.

A safe intersection sight distance (SISD) assessment was undertaken for the proposed site access roads based on Austroads Guide to Road Design Part 4A. The SISD refers to the minimum sight distance that should be provided at a basic intersection with design speeds of 100 kilometers per hour or more.

9.1.3 Statutory context, policy and guidelines

The traffic and transport assessment has been undertaken in accordance with the following statutory documents:

- Guide to Traffic Generating Developments version 2.2 (RTA, 2002)
- Austroads Guide to Road Design Part 3: Geometric Design (Austroads, 2016a)
- Austroads Guide to Road Design Part 4: Intersections and Crossings: General (Austroads, 2017)
- Austroads Guide to Traffic Management Part 12: Traffic Impacts of Development (Austroads, 2016b).

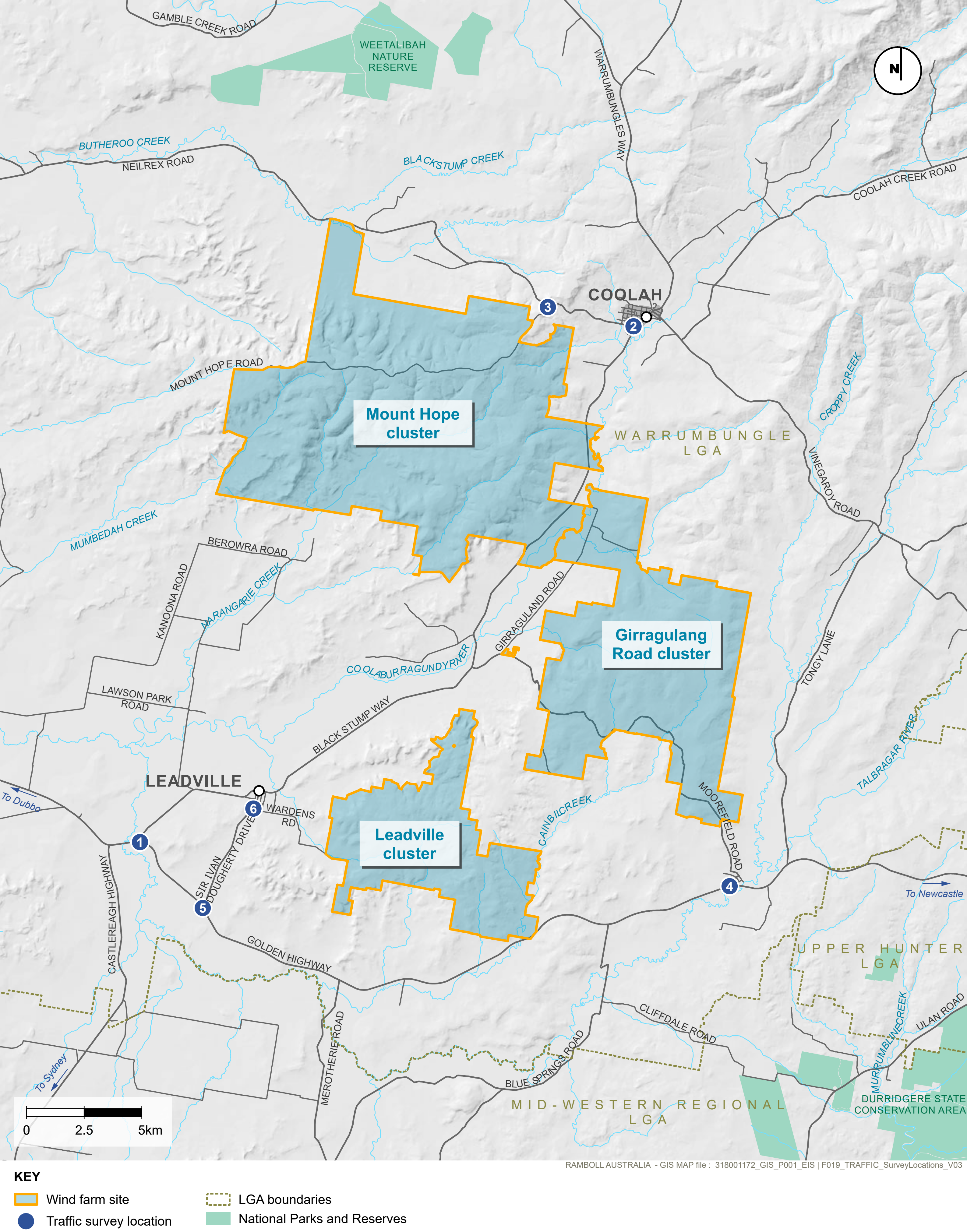


Figure 9-1 | Existing road network and traffic survey locations

9.2 Existing environment

9.2.1 Surrounding road network

The existing road network is shown above on **Figure 9-1** including the possible construction traffic routes. A description of the major and minor roads near the project is provide in **Table 9-1.**

Table 9-1: Major and minor roads

Road	Description
Golden Highway	A B-Double approved state road (B84), with a signposted speed limit of 100km/h, connecting the New England Highway at Belford in the Hunter Valley to the Newell Highway at Dubbo. It is a two-lane highway and intersects with Black Stump Way, Sir Ivan Dougherty Drive and Short Street between Dunedoo to the west and Merriwa to the east in the vicinity of the site.
Black Stump Way	A north south regional road providing a connection between Oxley Highway to the north and Golden Highway to the south. It serves as the main high street for the Coolah township, where it is named Binnia Street. It is a two-lane highway with a signposted speed limit of 100km/h for the majority of the corridor, with reduced speed limit of 50km/h within Coolah and Leadville. In addition, a 40 km/h school zone is effective within Coolah between Cunningham Street and Goddard Street.
Queensborough Street / Neilrex Road	An east west road providing a connection between Black Stump Way at Coolah and Neilrex, located about 40km west of Coolah. The road within the Coolah township is named Queensborough Street and once the road leaves the township, it is named Neilrex Road. The majority of the road is signposted with a speed limit of 100 km/h, with a reduced speed limit of 50 km/h in the Coolah township. At present, there are no centre line or road edge pavement markings. However, localised pavement improvements were recently undertaken near the intersection with Mount Hope Road.
Mount Hope Road	An east west road, which extends from Neilrex Road to Digilah Road to the west. The road is sealed for about 900m from the intersection of Neilrex Road, beyond which the road is unsealed.
Sir Ivan Dougherty Drive	A sealed road providing access to properties within the Leadville locality. It is aligned north south and spans between Wardens Road and the Golden Highway. It is a two-lane road with no centre line or road edge pavement marking except at the intersection with the Golden Highway. A speed limit of 100 km/h is signposted for the majority of the length, except for a segment adjacent to Wardens Road where the speed limit is reduced to 50 km/h.
Wardens Road	An unpaved road providing a local connection between Sir Ivan Dougherty Drive / Garland Street and the rural properties east of the Leadville township.
Short Street	An unsealed local road, providing access to the village of Uarbry from the Golden Highway.
Moorefield Road	A local road, which extends from Black Stump Way to Short Street (via Wyaldra Street, Main Street and Turee Street in Uarbry). The road is sealed for about 4.5km from the intersection of Black Stump Way, beyond which the road is unsealed.

9.2.2 Intersections

Key intersections on the road network that would be used by project related traffic include:

- Golden Highway / Short Street
- Golden Highway / Sir Ivan Dougherty Drive
- Sir Ivan Dougherty Drive / Wardens Road
- Golden Highway / Black Stump Way
- Black Stump Way / Leadville Stock Route
- Black Stump Way / Moorefield Road
- Black Stump Way / Queensborough Street
- Neilrex Road / Mount Hope Road.

Basic left turn / right turn treatments exist on most intersections currently except for the Golden Highway / Black Stump Way intersection, where channelised turning lanes are provided for the right turn and left turn movements on the Golden Highway and the Black Stump Way / Moorefield Road intersection, which has a channelised left turn lane on Black Stump Way. The layouts for each intersection are presented in Section 3.1.2 of **Appendix H.**

9.2.3 Existing traffic conditions

Traffic volumes along the Golden Highway, recorded by the permanent count station (ID 6163), show that there had been a steady decline in traffic volume prior to 2000. However, post 2000, there has been a sharp increase. The increase in traffic volumes is like due to the construction activities at similar wind and solar farm projects, as well as mining activities, in the region, that use the Golden Highway to access their worksites.

The surveyed peak hour traffic volumes for critical intersections around the wind farm site are presented in **Table 9-2.** Based on the aggregated traffic demand for all surveyed intersections, morning and afternoon peak traffic hours are generally low with Binnia Street and Queensborough Street intersection experiencing the highest traffic during the afternoon peak hour. All remaining intersections experience traffic flows less than 100 vehicles during the hours surveyed.

There are no distinct weekday morning or afternoon peak hours evident for the traffic profile along Black Stump Way (based on the data obtained from the automatic tube counter which is presented in **Appendix H**). There is generally consistent traffic throughout the day (about 7am to 5pm) in both directions of travel. Hourly traffic flows are low, with the highest flow recorded at fewer than 45 vehicles observed for each direction of travel, which equates to fewer than 90 vehicles two-way per hour. Daily total flow data for Black Stump Way shows that traffic fluctuates throughout the weekdays with the lowest two-way daily traffic observed on Wednesday (889 vehicles) and the highest two-way daily traffic occurring on Friday (1,057 vehicles).

The nearest Transport for NSW maintained permanent count station along the Golden Highway is located about 100km east of Black Stump Way (station ID 6163), east of the regional township of Merriwa. The count station is located beyond the study region and may correspond to higher flows given the higher density of Merriwa compared to the study region but offers an opportunity to appreciate the daily fluctuations along the Golden Highway. The data recorded at this count station shows traffic fluctuates throughout the week with the lowest average two-way daily traffic recorded on a Monday (1,397 vehicles) and the highest on a Friday (2,696 vehicles).

Table 9-2: Existing intersection peak hour traffic volumes

Intersection	Peak hour	Total Vehicle Volume	Major Road			Minor Road		
			Vehicles	Heavy vehicle	% heavy vehicle	Vehicles	Heavy vehicle	% heavy vehicle
Golden Highway (Major) / Black Stump Way (Minor)	AM	99	65	19	29%	34	9	26%
	PM	89	58	15	26%	31	8	26%
Binnia Street (Major) / Queensborough Street (Minor)	AM	85	68	10	15%	17	1	6%
	PM	111	104	18	17%	7	1	14%
Neilrex Road (Major) / Mount Hope Road (Minor)	AM	25	20	2	10%	5	0	0%
	PM	16	15	1	7%	1	0	0%
Golden Highway (Major) / Sir Ivan Dougherty Drive (Minor)	AM	54	54	11	20%	0	0	0%
	PM	61	61	17	28%	0	0	0%
Sir Ivan Dougherty Drive (Major) / Garland Street / Wardens Road (Minor)	AM	7	7	2	29%	0	0	0%
	PM	1	1	0	0%	0	0	0%

Source: SCT Consulting, based on Matrix traffic survey data, 2021

9.2.4 Road design standards

The Austroads Guide to Road Design Part 3 Geometric Design specifies road width design standards for low volume (generally rural) roads based on daily traffic volumes. The corresponding design standards, based on 2021 surveyed traffic volume for the rural roads around the study area, are shown in **Table 9-3.**

It is noted that the existing daily traffic volume along Black Stump Way is lower than the daily traffic volume category suggested by Austroads design standards, for the existing road width which suggests that Black Stump Way could accommodate greater volumes of traffic than currently exists along the corridor.

Table 9-3: Daily traffic volumes and corresponding design standards

Daily traffic volume category	Applicable roads	Existing daily traffic volume	Austroads (2021) design standards*
1-150 vehicles	Short Street, Turee Street, Main Street, Wyaldra Street and Moorefield Road	< 100	8.7m wide total carriageway (if unsealed); or minimum 3.7m wide seal
	Sir Ivan Dougherty Drive	< 100	
	Wardens Road	< 50	
	Garland Street	< 50	
	Mount Hope Road	< 50	
150-500 vehicles	Neilrex Road	< 200	Minimum 7.2m wide seal
	Queensborough Street	< 250	
500-1,000 vehicles	-	-	Minimum 7.2m – 8m wide seal
1,000-3,000 vehicles	Black Stump Way	~1,000	Minimum 9m wide seal
	Golden Highway	~2,200	
>3,000 vehicles	-	-	Minimum 10m wide seal

9.2.5 Road safety

The most recent available crash data has been obtained for a five-year period between 2015 to 2019, using the Transport for NSW interactive accident history database. The data shows that the Golden Highway recorded eight serious injuries, there were six serious injuries along Black Stump Way, two serious injuries along Vinegaroy Road and one serious injury along both Sir Ivan Dougherty Drive and Castlereagh Highway. A total of eight moderate injuries occurred along Black Stump Way and Golden Highway.

Four single-vehicle fatal crashes were recorded in the area over the five years, including two on the Golden Highway, where fatigue was deemed a factor in the incidents, one on Black Stump Way, where the vehicle struck an animal, and one on Neilrex Road, during the evening hours. This is considered a relatively high proportion of fatal accidents in comparison with the NSW average. The crash data for fatal injuries is presented in **Table 9-4** below.

Table 9-4: Crash data analysis (Fatal Injury only)

Location	Year	Severity	RUM* code	Natural lighting	Description
Golden Highway (1.5km to the west of Sir Ivan Dougherty Drive)	2017	Fatal	71	Daylight	Left off carriageway into object / parked vehicle
Golden Highway (2km to the west of Sir Ivan Dougherty Drive)	2017	Fatal	71	Daylight	Left off carriageway into object / parked vehicle
Neilrex Road (4.3km to the west of Black Stump Way)	2017	Fatal	67	Dark	Struck animal
Black Stump Way (1.7km north of Vinegaroy Road	2016	Fatal	62	Dusk	Accident / broken down

Source: SCT Consulting, based on TfNSW crash data, 2020

*Road User Movement referenced from Definitions and notes to support road crash data, TfNSW, 2019

9.2.6 Rail services

There are remnants of the disused Coolah Branch rail track, which historically branched off the Gwabegar Line, but there are no train active operations within the vicinity of the wind farm site and there are no rail crossings close by.

9.2.7 Bus services and active transport

There are no regular public bus services or active transport facilities in the vicinity of the wind farm site given the rural setting of the area with very limited pedestrian demands. There is a coach service that operates as part of Transport for NSW TrainLink and provides single weekly service connections between Lithgow rail station and Coolah.

A school bus service is operated by Grace Coaches to Sacred Heart Catholic Primary School (Coolah), Coolah Central School and Mendooran Central School with operational times aligning with school start and finish times.

9.3 Assessment of potential impacts

9.3.1 Access routes

Construction

Light vehicle access routes

The potential traffic impacts associated with the construction workforce on the surrounding road network have been assessed under two scenarios:

- Regional distribution of workforce accommodation: this scenario assumes that construction worker accommodation would be distributed across six localities, including the townships of Coolah, Dunedoo, Cassilis, Coonabarabran, Gulgong and Mudgee; and workers would travel from established accommodation facilities in these towns. These workforce location assumptions are subject to confirmation of the final social impact assessment outcomes and ongoing consultation with Warrumbungle Shire Council. This scenario is considered the worst-case for traffic impacts and assumes travel to site using a mix of private vehicles and project shuttle services.

- Centralised workforce accommodation: this scenario assumes the bulk of the construction workforce is accommodated at a temporary workers accommodation camp located on site. It is expected that this scenario would result in reduced traffic impacts on the surrounding road network as the bulk of the construction workforce would be centrally located and therefore not travelling to and from site daily, using the wider road network. Traffic movements would occur between the workers accommodation and work zones within each of the clusters under this scenario.

Under both assessment scenarios for the construction workforce, construction activities at the three clusters were assumed to be undertaken sequentially, with construction vehicle movements associated with one cluster at a given time. Although there may be some overlap in construction activities, this assumption provides a representative worst-case assessment for each cluster. Both scenarios are detailed below.

Regional distribution of workforce
It is assumed that the construction workers would be distributed across six localities with established accommodation facilities. Based on the existing levels of short-term accommodation, the distribution of the workers is summarised in **Table 9-5.**

Table 9-5: Location of construction workforce accommodation

Location	Workers	Percentage
Coolah	60	15%
Dunedoo	60	15%
Cassilis	20	5%
Gulgong	60	15%
Coonabarabran	120	30%
Mudgee	80	20%
Total	**400**	**100%**

Black Stump Way would be used for light vehicle access to all three clusters. Neilrex Road would also provide light vehicle access to the Mount Hope cluster for traffic coming from the north and from Coolah. Girragulang Road cluster would be accessed from Moorefield Road; and Wardens Road, The Leadville Stock Route and the Golden Highway would be used for access to the Leadville cluster.

These expected access routes assume quickest travel time, road condition (sealed or unsealed) and posted speed limits. It is expected that work at the three clusters would be undertaken sequentially. As such, all staff would arrive at the common cluster site by either private vehicle or shuttle bus. To provide a conservative assessment of potential impacts (a worst-case assessment), shuttle services are only assumed for two furthest accommodation sites of Coonabarabran and Mudgee. In reality, the proportion of shuttle buses may be higher with a reduced traffic impact. The light vehicle routes to the three clusters are shown in **Figure 9–2**.

Centralised workforce accommodation
In this scenario, it is assumed that the bulk of the construction workforce is accommodated at a temporary workers accommodation camp located on site, accessed off Moorefield Road.
The light vehicle routes from the workers camp to the three clusters are shown in **Figure 9–3**.

Heavy vehicle access routes
Transportation of some project components, such as wind turbine blades, nacelles and transformers, would require OSOM vehicles that exceed the regulatory limits of standard vehicle dimensions. Large components, such as wind turbine blades, would be shipped to Australia from overseas and transported to the site from the Port of Newcastle, accessing the worksites by the following route:

- Industrial Drive
- Pacific Highway
- New England Highway
- Hunter Expressway
- New England Highway
- Golden Highway (and on to Black Stump Way for access to Mount Hope).

If heavy vehicles are required to travel from the Sydney region, they would traverse M1 Motorway / Hunter Express to join onto the New England Highway and the Golden Highway. These roads are all approved B-double routes and would be suitable for transporting OSOM materials under escort and under a Traffic Management Plan.

The heavy vehicle access routes to each cluster from the Golden Highway are shown in **Figure 9-4**. The transport route assessment found that there would be significant impacts at the Sir Ivan Dougherty / Wardens Road intersection and parts of Neilrex Road that are likely to prevent access for OSOM vehicles without significant tree removal, road widening and upgrades. This is due to due to potential impacts on a number of shallow pipe culvert crossings along the length of Sir Ivan Dougherty Drive, the sharp right-hand turn from Sir Ivan Dougherty Drive onto Wardens Road, and the bends and longitudinal grades along Neilrex Road.

To reduce these identified impacts, the following heavy vehicle and OSOM access routes to the three clusters from the Golden Highway are proposed:

- **Mount Hope cluster**: OSOM access via Black Stump Way including a new access constructed on Black Stump Way, south of Coolah. The section of Mount Hope Road located within the Mount Hope cluster boundary would be used by heavy vehicles and OSOM vehicles to access the internal access tracks to the turbine locations.
- **Girragulang Road cluster**: OSOM access via Short Street, Turee Street and Moorefield Road.
- **Leadville cluster**: OSOM access via a new access on the Golden Highway.

The two new access locations mentioned above on Black Stump Way and the Golden Highway are shown on **Figure 9-4** and have been located to provide safe intersection sight distances. The detailed intersection assessment to determine these locations was undertaken using SIDRA 9.0 and is at **Appendix H**. The extent of road and intersection upgrades necessary to facilitate OSOM vehicle movements are summarised in **Section 9.3.2**.

The impacts on the proposed access routes would be reduced by implementing the measures described in **Section 9.4.** Further structural investigation and detailed design would also be undertaken in collaboration with Warrumbungle Shire Council and TfNSW once the final routes have been selected and the vehicle loads can be confirmed by the EPC contractor based on the available technology at the time.

Detailed OSOM routes and appropriate traffic management would be prepared as part of the construction traffic management plan (CTMP) and in consultation with the relevant road authorities.

Operation

Access routes used during the operational phase of the project are expected to be the same as during the construction phase however, as described in **Section 9.3.2** the anticipated volume of traffic will be significantly less.

As such, no greater impacts during the operation phase than what has been considered for the construction phase are expected to occur.

Decommissioning

The decommissioning phase is expected to utilise similar access routes and therefore result in similar impacts as described for the construction phase.

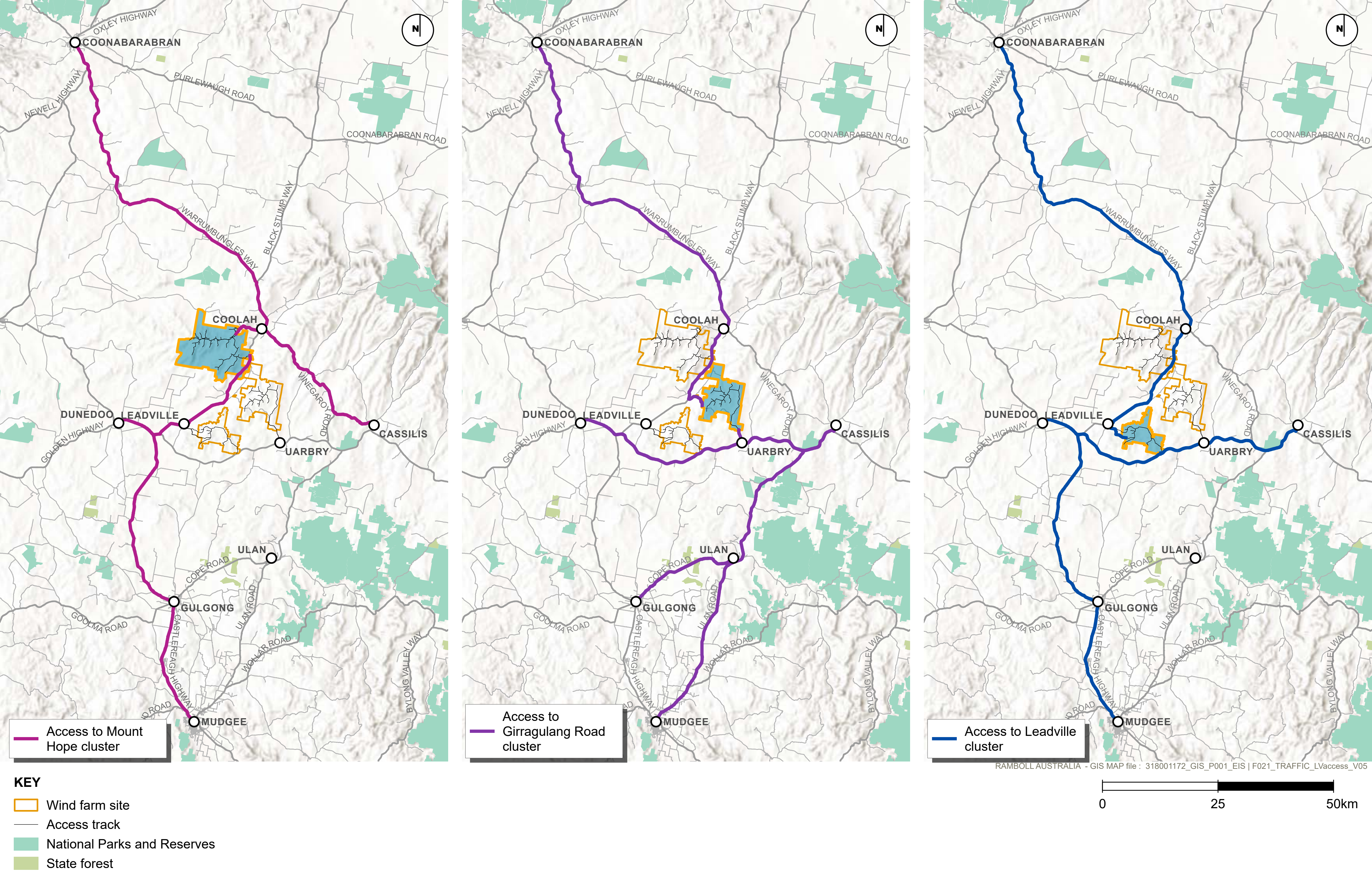
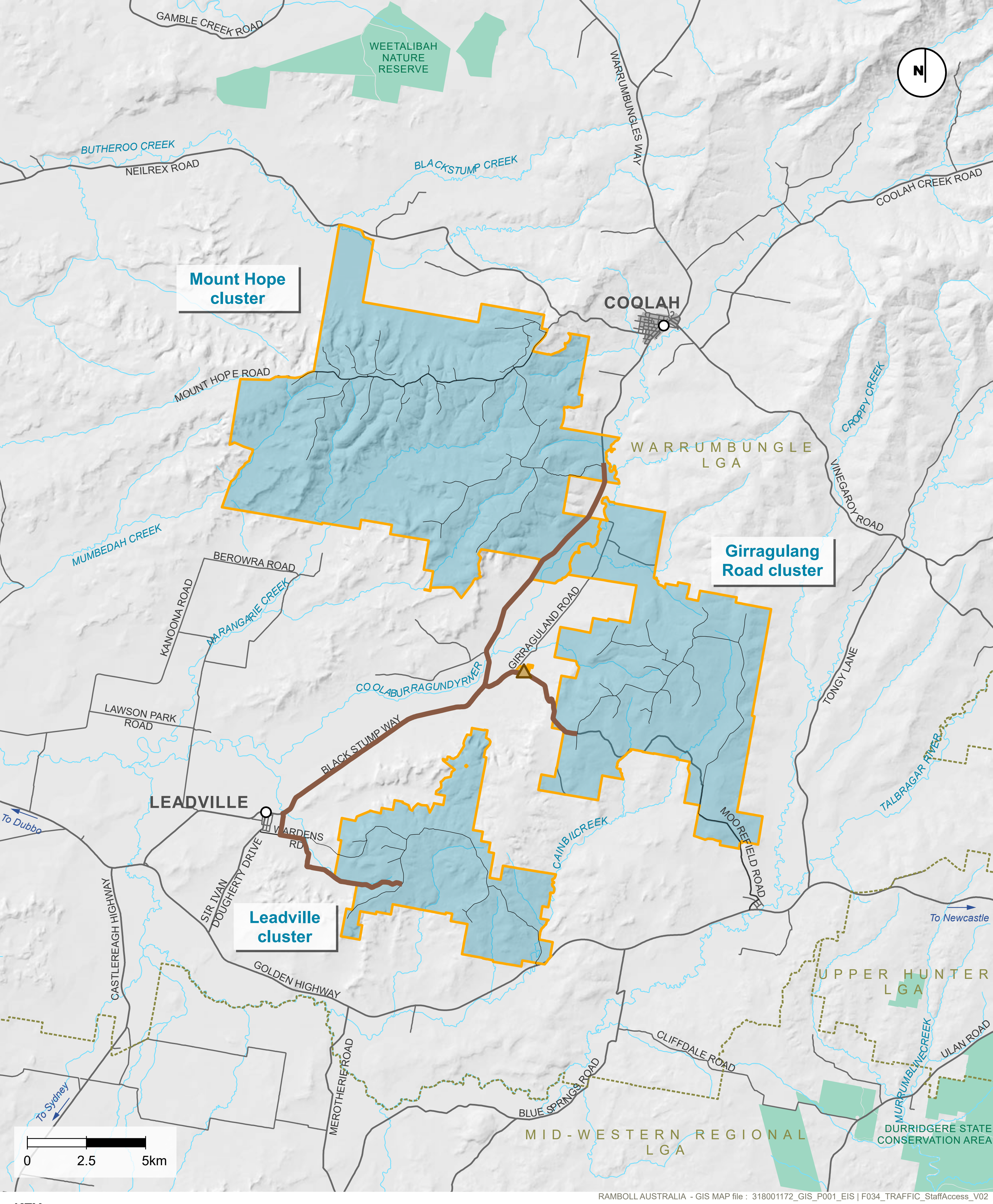


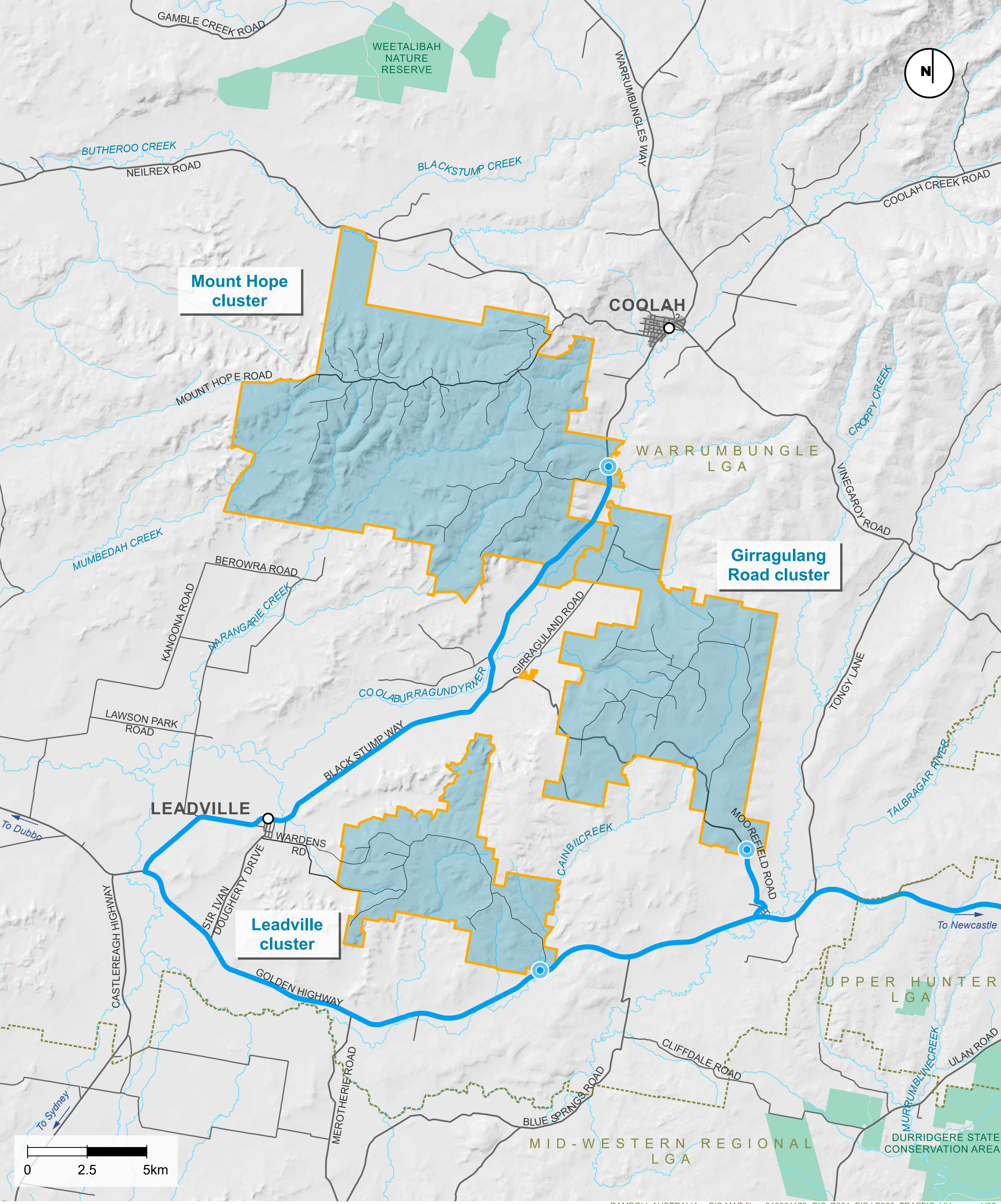
Figure 9-2 | Staff access routes to the three clusters: Regional distribution of workforce accommodation



KEY

- Wind farm site
- Potential construction workforce accommodation (centralised accomodation)
- Access track
- Staff access route from potential centralised workforce accomodation
- LGA boundaries
- National Parks and Reserves

Figure 9-3 | Staff access routes to the three clusters: Centralised workforce accommodation



KEY

- Wind farm site
- Access track
- Heavy vehicle access point
- Heavy vehicle access route
- LGA boundaries
- National Parks and Reserves

Figure 9-4 | Construction traffic - heavy vehicle routes assessed

9.3.2 Traffic generation

Construction

The construction phase of the project is expected to generate the following peak daily construction traffic volumes:

- 72 heavy vehicle trips per day

The construction phase of the project is expected to generate the following peak daily construction traffic volumes to transport construction staff to and from the site:

- 506 light vehicles per day if the construction workforce were distributed regionally
- 128 light vehicles per day if the construction workforce were centralised in a construction workers accommodation.

The peak heavy vehicle trip generation would be expected during the construction peak period for the Mount Hope Cluster, as it has the most wind turbines and if the workforce was distributed regionally. The peak daily traffic demand listed above equates to eight heavy vehicle trips and 253 light vehicle trips during the peak hours. That is, four heavy vehicles entering and four heavy vehicles leaving the wind farm site in each peak hour, and 253 light vehicles accessing the worksite in the morning peak hour and 253 light vehicles leaving in the afternoon peak hour.

If the bulk of the construction workforce is accommodated at a temporary workers accommodation camp located on site, it would be accessed off Moorefield Road. This scenario assumes travel to site with up to 90% shuttled staff, due to the remote centralized location, with the remainder using private vehicles. As such, it is forecast that only 128 light vehicle trips per day would be generated to transport construction staff (64 light vehicles to site in the morning and 64 light vehicles from site in the evening).

These traffic generation numbers also include other construction materials such as gravel, sand, concrete, water trucks. On either side of this peak time period, the vehicle movements would be fewer than at the peak, as the level of activity onsite and the number of deliveries would be ramping up/down.

The forecast daily traffic volumes during the construction phase with the workforce distributed regionally are presented in **Table 9-6**. The forecast volumes include light and heavy vehicles and present the highest construction volume associated with each cluster and compare the 'future year (2023) base' and the 'future year (2023) with construction).

Table 9-6: Forecast daily traffic volumes for construction traffic with regional distribution of workforce accommodation

Daily traffic volume category for future year base	Applicable roads	Future year base daily traffic volume (2023)	Additional construction daily traffic volume	Future year with construction daily traffic volume category
1-150 vehicles	Short Street, Turee Street, Main Street, Wyaldra Street and Moorefield Road (east) – Girragulang Road Cluster	<100	344	150-500
	Moorefield Road (west) – Girragulang Road Cluster	<50	210	150-500
	Wardens Road – Leadville Cluster	<50	210	150-500
	The Leadville Stock Route – Leadville Cluster	<50	210	150-500
	Mount Hope Road – Mount Hope Cluster	<50	210	150-500
150-500 vehicles	Neilrex Road – Mount Hope Cluster	<200	244	150-500
	Queensborough Street – Mount Hope Cluster	<250	244	150-500
1,000-3,000 vehicles	Black Stump Way – Mount Hope Cluster	<400	334	1,000-3,000

The forecast daily traffic increases indicate that upgrades would be required for Short Street, Turee Street, Main Street, Wyaldra Street, Moorefield Road, Wardens Road, The Leadville Stock Route and Mount Hope Road. These roads would require upgrade to the standard and satisfaction of Council for general construction traffic and OSOM vehicles because the traffic generated by the project would move these roads into a higher daily traffic volume category. For all access roads except the Golden Highway, the road authority is Warrumbungle Shire Council.

The forecast daily two-way traffic volumes with a centralised workforce accommodation site during the peak construction phase are presented in **Table 9 7**. The forecast volumes include light and heavy vehicles and present the highest construction volume associated with each cluster, as described in above.

Valley of the Winds

Table 9-7: Forecast daily traffic volumes for construction traffic with centralised workforce acccomodation

Existing daily traffic volume category	Applicable roads	Future year base daily traffic volume (2023)	Additional construction daily traffic volume	Future year with construction daily traffic volume category
1-150 vehicles	Short Street, Turee Street, Main Street, Wyaldra Street and Moorefield Road (east) – Girragulang Road Cluster	< 100	48	< 150
	Moorefield Road (west) – Girragulang Road Cluster	< 50	128	150-500
	The Leadville Stock Route – Leadville Cluster	< 50	128	150-500
	Wardens Road – Leadville Cluster	< 50	128	150-500
1,000-3,000 vehicles	Black Stump Way – Mount Hope Cluster	< 400	200	1,000-3,000

The forecast daily traffic increases indicate that upgrades would be required for Moorefield Road, Wardens Road and The Leadville Stock Route. They would require upgrade to the standard and satisfaction of Council for general construction traffic and OSOM vehicles. For all access roads except the Golden Highway, the road authority is the Warrumbungle Shire Council. This includes paving sections of Short Street and Turee Street in response to feedback from the local community.

9.3.3 Traffic management requirements

Transportation of some project components, such as turbine blades, nacelles and transformers, would require OSOM vehicles that exceed the regulatory limits of standard vehicle dimensions. OSOM vehicles would require a permit to access the public roads with escort vehicles as part of a convoy. A transport management plan detailing the route, duration, road closures, traffic detours, notification as well as any traffic control plans would also need to be prepared to facilitate the OSOM vehicle movements.

Two key locations where traffic management measures may be needed for the OSOM vehicles are the New England Highway and Hunter Expressway interchange and the Denman Bridge, Golden Highway, Denman. The measures may include short-term temporary road closure of the Hunter Expressway to allow OSOM movements to enter the Hunter Expressway during outbound OSOM movements from the Port of Newcastle. Also, alternate route investigations may be required to investigate the use of the New England Highway via Scone, if the Denman Bridge truss structure, does not provide sufficient vertical and horizontal clearance and load for the OSOM movements.

9.3.4 Intersection performance and road upgrades

The following key intersections for the project currently operate as basic intersection arrangements with design speeds of 100km/h or more and would be relevant to a regional distribution of the workforce:

- Neilrex Road / Mount Hope Road (during construction of Mount Hope cluster)
- Black Stump Way / Mount Hope Cluster Access Road (during construction of the Mount Hope cluster)
- Golden Highway / Short Street (during construction of the Girragulang Road cluster)
- Golden Highway / Leadville Cluster Access Road (during construction of the Leadville cluster)
- Black Stump Way / The Leadville Stock Route (during the construction of the Leadville cluster).

The following key intersections for the project currently operate as basic intersection arrangements with design speeds of 100km/h or more and would be relevant to a centralised workforce accommodation:

- Black Stump Way / Mount Hope Cluster Access Road (during construction of the Mount Hope cluster)
- Black Stump Way / The Leadville Stock Route (during the construction of the Leadville cluster).

As Black Stump Way / Moorefield Road intersection already has a left-turn auxiliary lane, it has not been reassessed for the centralised workforce scenario. A comparison of the 'future year (2023) base without project and the 'future year (2023) with project' scenarios for the centralised workforce accommodation show that the forecast turn movements fall within the limits of the basic intersection arrangement. As such, the project does not warrant any additional left or right turn turning lanes in either of the AM or PM peak flow periods during the construction period.

Based on the Austroads warrant design charts which have been used to assess the warrant for any additional intersection treatments, the project does not warrant any additional left or right turn turning lanes in either of the morning or afternoon peak flow periods during the construction of the project apart from those necessitated by the OSOM vehicular movements.

The road and intersection upgrades that would be required by the project are detailed in **Table 9-8** and shown in **Figure 9-5.** The extent of the proposed road upgrades that would be required to accommodate OSOM vehicle movements is discussed following.

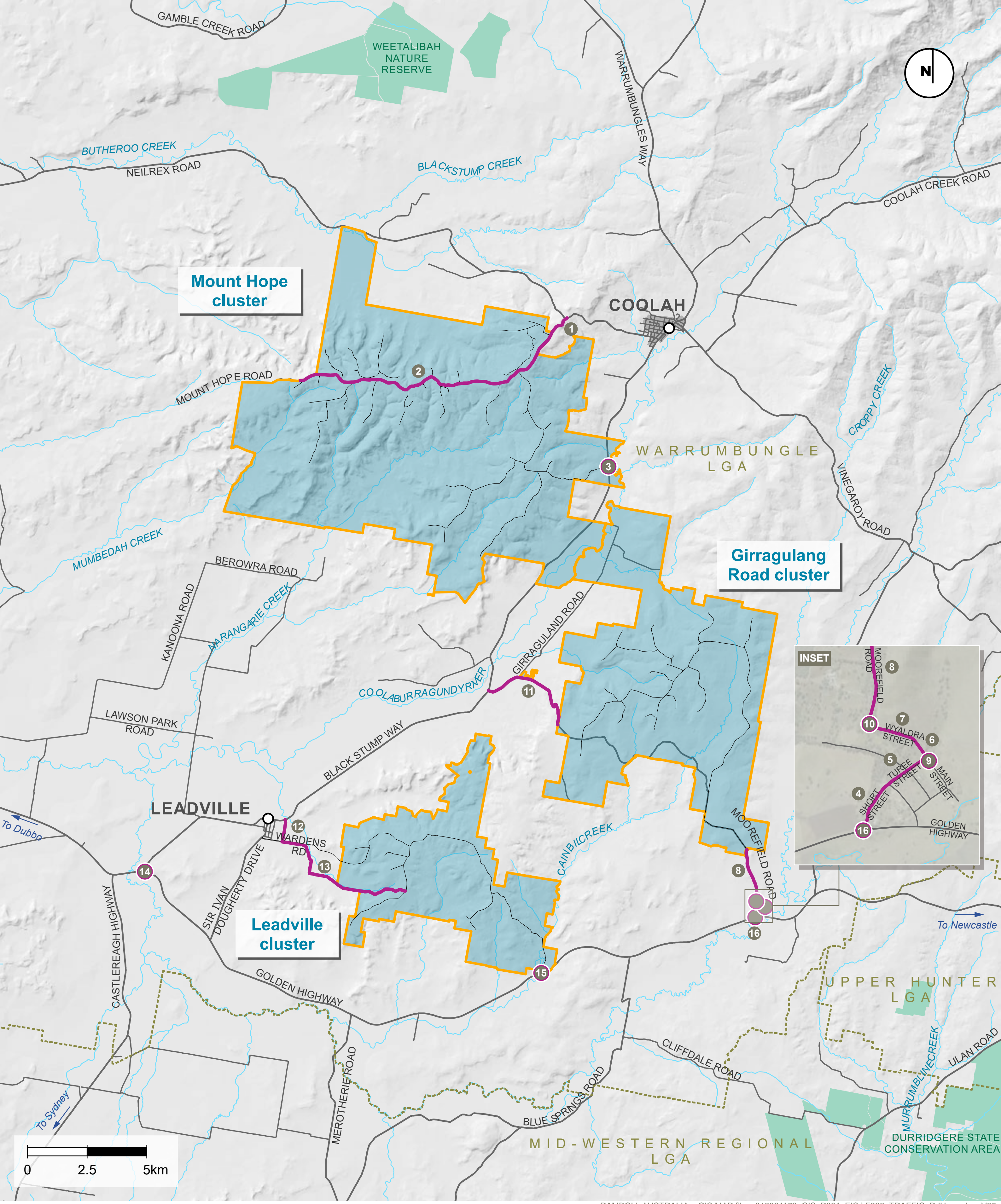
Table 9-8: Road upgrades and timing

Intersection / Road		Proposed upgrade	Length (km)	Timing
Road authority: Warrumbungle Shire Council				
1	Mount Hope Road	From Neilrex Road intersection to Mount Hope cluster boundary, upgrade to the standard and satisfaction of Council for general construction traffic. This upgrade would not be required under the centralised worker accommodation scenario.	1.0	Prior to commencing construction of the Mount Hope cluster

Intersection / Road		Proposed upgrade	Length (km)	Timing
2	Mount Hope Road	Within the Mount Hope cluster boundary, upgrade to the standard and satisfaction of Council for general construction traffic and OSOM vehicles.	12.0	Prior to commencing construction of the Mount Hope cluster
3	Black Stump Way / Mount Hope Access Road intersection	Extent of required works to allow access for OSOM vehicles.	N/A	Prior to commencing construction of the Mount Hope cluster
4	Short Street	From the Golden Highway to Church Street, upgrade to the standard and satisfaction of Council for general construction traffic and OSOM vehicles. UPC\AC is committed to paving this section of road in response to feedback from the local community.	0.3	Prior to commencing construction of the Girragulang Road cluster
5	Turee Street	From Short Street to Main Street, upgrade to the standard and satisfaction of Council for general construction traffic and OSOM vehicles. UPC\AC is committed to paving this section of road in response to feedback from the local community.	0.3	Prior to commencing construction of the Girragulang Road cluster
6	Main Street	From Turee Street to Wyaldra Street, upgrade to the standard and satisfaction of Council for general construction traffic and OSOM vehicles.	0.1	Prior to commencing construction of the Girragulang Road cluster
7	Wyaldra Street	From Main Street to Moorefield Road, upgrade to the standard and satisfaction of Council for general construction traffic and OSOM vehicles.	0.3	Prior to commencing construction of the Girragulang Road cluster
8	Moorefield Road (east)	From Wyaldra Street to Girragulang Road cluster boundary, upgrade to the standard and satisfaction of Council for general construction traffic and OSOM vehicles.	2.2	Prior to commencing construction of the Girragulang Road cluster
9	Turee Street / Main Street intersection	Extent of required works to allow access for OSOM vehicles.	N/A	Prior to commencing construction of the Girragulang Road cluster

Intersection / Road		Proposed upgrade	Length (km)	Timing
10	Wyaldra Street / Moorefield Road intersection	Extent of required works to allow access for OSOM vehicles.	N/A	Prior to commencing construction of the Girragulang Road cluster
11	Moorefield Road (west)	From Black Stump Way to Girragulang Road cluster boundary, upgrade to the standard and satisfaction of Council for general construction traffic.	4.6	Prior to commencing construction of the Girragulang Road cluster
12	The Leadville Stock Route	From Black Stump Way to Wardens Road, upgrade to the standard and satisfaction of Council for general construction traffic.	0.8	Prior to commencing construction of the Leadville cluster
13	Wardens Road	From The Leadville Stock Route to access track to Leadville cluster, upgrade to the standard and satisfaction of Council for general construction traffic.	1.8	Prior to commencing construction of the Leadville cluster
14	Wardens Road	From end of item 13 to access tracks to Leadville cluster, upgrade to the standard and satisfaction of Council for general construction traffic	5.4	Prior to commencing construction of the Leadville cluster
Road authority: Transport for NSW				
15	Golden Highway / Black Stump Way intersection	Extent of required works to allow access for OSOM vehicles.	N/A	Prior to commencing construction of the Mount Hope cluster
16	Golden Highway / Leadville Access Road intersection	Extent of required works to allow access for OSOM vehicles.	N/A	Prior to commencing construction of the Leadville cluster
17	Golden Highway / Short Street intersection	Extent of required works to allow access for OSOM vehicles.	N/A	Prior to commencing construction of the Girragulang Road cluster

Note: Should the Golden Highway / Leadville Access Road intersection (road upgrade no. 16) not be able to proceed, an alternative access for OSOM vehicles to the Leadville cluster would be provided via Sir Ivan Dougherty Drive, Wardens Road and a new private access road. In this case, road upgrade no. 14 to Wardens Road would not be required, as general construction vehicles would use the new private access track rather than the section of Wardens Road past road upgrade no. 13, and road upgrades along Sir Ivan Dougherty Drive and intersection upgrades at the Golden Highway / Sir Ivan Dougherty Drive and Sir Ivan Dougherty Drive / Wardens Road intersections would be required.



RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F023_TRAFFIC_RdUpgrades_V05
Aerial photography from NSW Government Spatial Services

KEY

- Wind farm site
- Access track
- Proposed road upgrade*
- Proposed intersection upgrade*
- LGA boundaries
- National Parks and Reserves

*Refer to table 9-7

Figure 9-5 | Overview of proposed road upgrades

Extent of road upgrades for OSOM vehicles

Black Stump Way / Mount Hope Access Road intersection:

- Augmentation of existing farm access point as required to facilitate OSOM swept path that extends into the neighbouring property to the east of Black Stump Road
- The works would include minor earthworks, widening, removal of existing fence and approval from affected landowners
- Existing swale drains would be diverted around any widening or piped.

Turee Street / Main Street intersection:

- Appropriate surface treatment and associated works such as culverts, swales and vegetation clearing for both Turee Street and Main Street
- UPC\AC is committed to paving this section of Short Street in response to feedback from the local community
- Permission would be required from the adjacent property owners to construct new surface treatment and travel across their property
- Existing power poles may require relocation.

Wyaldra Street / Moorefield Road intersection:

- Wyaldra and Moorefield Road would require appropriate surface treatment and associated works such as culverts, swales and vegetation clearing.

Golden Highway / Black Stump Way intersection:

- Vegetation clearing along Black Stump Way, relocation of existing signage, minor earthworks to provide level roadside environment while maintain swale drains, installation of guard rails over the existing culvert to protect vehicles from steep batter, road widening
- A structural assessment would be required for all the bridge and culvert crossing points in collaboration with Warrumbungle Shire Council asset maintenance team.

Golden Highway / Leadville Access Road intersection:

- Earthworks and tree removal on the southern side of Golden Highway and construction of entirely new intersection and access road to facilitate access into Leadville cluster. Safe intersection sight distance would need to be assessed.

Golden Highway / Short Street intersection:

- Short Street verge would need level transition from Golden Highway
- A slip lane towards the south of Golden Highway utilising the existing unformed road reserves would allow for the angle of the OSOM vehicle to be perpendicular to the Golden Highway, crossing the highway directly into Short Street
- Widening and surface upgrade including associated culverts, swale drains and vegetation clearing on both Short Street and Turee Street
- UPC\AC is committed to paving this section of Short Street in response to feedback from the local community.
- Existing signposts and telecommunications services will need to be relocated and augmentation or replacement of existing drainage culvert to suit the new extent pavement.

The preliminary concept drawings in **Appendix H** indicate the extent of work required at intersections along the access routes, such as pavement widening, vegetation clearing and signage relocation to allow OSOM vehicles to access the work sites.

Operation
Traffic generation during the operational phase of the project is forecast to be much less than the construction phase, with 50 operational staff forecast to generate about 100 daily light vehicle trips, consisting of 50 cars entering the site during AM peak hour and 50 cars exiting the site during the PM peak hour, with no ride sharing amongst the staff.

Heavy vehicles would only be required for infrequent repairs and maintenance and are not expected to occur on an hourly basis, unlike during the construction phase. As such, minimal hourly heavy vehicle generation is expected during the operational phase.

Decommissioning
The decommissioning phase is expected to have a similar labour force and therefore result in similar traffic generation impacts as described for the construction phase.

9.3.5 Parking
All project-associated parking is proposed to be accommodated within the project worksites. As there are no formal parking provisions on the road network surrounding the wind farm site, due to the rural nature of the area, it is unlikely that there would be any increased demands for on-street parking adjacent to the worksites.

Increased parking demands at or adjacent to the staff accommodation sites, would need to be assessed within the CTMP when the accommodation locations are confirmed. However, it is anticipated that the accommodation locations would include off-street parking and as such would generally not impact on the on-street parking supply of the associated localities.

9.3.6 Road safety
The volume of traffic generated by construction is expected to be low compared to existing traffic on the Golden Highway. The effect of the short-term increase is not expected to substantially impact road safety in and around the wind farm site, although there is always a risk associated with construction traffic interacting with general traffic, with elevated risk when construction-related vehicles are entering and leaving construction sites.

This risk during construction would be managed through the provision of a CTMP which would be developed in consultation with Transport for NSW and Warrumbungle Shire Council and the mitigation measures described in **Section 9.4.**

9.3.7 Cumulative traffic assessment
A cumulative impact review was conducted with adjacent approved developments using common traffic routes, including the Liverpool Range Wind Farm, Uungula Wind Farm, Wollar Solar Farm, Stubbo Solar Farm and Dunedoo Solar Farm. The status of each project and the common traffic routes with construction vehicle movements are indicated in **Table 9-9.**

The greatest combined volume of these projects occurs along the Golden Highway with 623 vehicles per day, east of Cassilis. West of Cassilis, the combined traffic volume is 279 vehicles. The traffic volumes associated with the project, east of Cassilis, would be associated with heavy vehicle movements, of which 70 vehicles are forecast, which equates to a cumulative traffic increase of 693 vehicles along the Golden Highway. The cumulative impact would be reduced slightly under the scenario of a central workers accommodation.

Noting that the existing daily traffic volume along Golden Highway is 2,185 vehicles per day, the resultant cumulative traffic volume along the Golden Highway would be approximately 2,900 daily vehicles, which still satisfies the Austroads roadway design standards for a rural highway.

Table 9-9: Projects considered in the cumulative assessment

Project	Status	Common access route and construction vehicle movements
Liverpool Range Wind Farm	Development approval was granted in March 2018	The Traffic and Transport Report[1] for the project identifies the following common access route: • Newcastle Port to Cassilis via New England Highway and Golden Highway with peak daily traffic generation of 344 construction vehicle movements.
Uungula Wind Farm	Development approval was granted in May 2021	Although the transport assessment[2] of the project does not address traffic volumes along Golden Highway, it is assumed that the traffic flows along Saxa Road stems from Golden Highway. As such, the following common access route is assumed: • Saxa Road via New England Highway and Golden Highway with peak daily traffic generation of 46 construction vehicle movements.
Wollar Solar Farm	Development approval was granted in February 2020	The Wollar Solar Farm Traffic Impact Assessment[3] identified the following common access route: • Ulan Road via New England Highway and Golden Highway with peak daily traffic generation of 9 construction vehicle movements.
Stubbo Solar Farm	Development approval was granted in June 2021	The Stubbo Solar Farm Traffic and Transport Report[4] identified the following common access route: • Ulan Road via New England Highway and Golden Highway and with peak heavy vehicle generation of 120 vehicle movements.
Dunedoo Solar Farm	Development approval was granted in September 2021	The proposed Dunedoo Solar Farm Traffic Assessment[4] identifies the following common access route: • Golden Highway with peak daily traffic generation of 104 construction vehicle movements.

Sources::
1 Epuron (2017) Traffic and Transport Report
2 Samsa Consulting (2020), Uungula Wind Farm Project Transport Assessment
3 Ontoit (2018), Wollar Solar Farm Traffic Impact Assessment
4 SCT Consulting (2020), Stubbo Solar Farm Traffic and Transport Report
5 Stantec (2020), Dunedoo Solar Farm Traffic Assessment

As noted in **Section 9.2.3**, traffic volumes along the Golden Highway have seen a sharp increase in recent years, which is likely due to construction activities at similar wind and solar farm projects, as well as mining activities, in the region. This traffic and transport impact assessment assumed a conservative annual growth rate of three per cent per annum for background traffic on the Golden Highway and Black Stump Way, which has therefore also accounted for the planned and proposed projects within the region.

9.4 Environmental management and mitigation measures

Proposed measures to manage and/or mitigate traffic and transport impacts from the project are detailed in **Table 9-10**.

Table 9-10: Management and mitigation measures – traffic and transport

ID	Management/mitigation measure	Timing

TT1	A construction traffic management plan (CTMP) will be prepared in consultation with Transport for NSW and Warrumbungle Shire Council.
	The plan will include the following (with consideration given to potential cumulative impacts of the project with other developments where relevant):
	• details of the transport routes to be used for all project-related traffic
	• details of any road upgrade works required by the Development Consent
	• a protocol for undertaking independent dilapidation surveys to assess the existing condition of the proposed construction routes prior to and post-construction, and post-decommissioning
	• a protocol for the repair of the construction routes if dilapidation surveys identify these roads to be damaged during construction, operation or decommissioning works
	• details of the measures that will be implemented to minimise traffic impacts during construction, operation and decommissioning works, including:
	  ◦ traffic control plans, including detours and signage
	  ◦ notifying the local community about project-related traffic impacts
	  ◦ procedures for receiving and addressing complaints from the community about project-related traffic
	  ◦ minimising potential for conflict with coach and school bus services, other road users during peak hours as far as practicable (measures also required during operation of the project) including consultation with service providers
	  ◦ minimising dirt tracked onto the public road network from project-related traffic
	  ◦ scheduling of haulage vehicle movements to minimise convoy length or platoons
	  ◦ responding to local climate conditions that may affect road safety, such as fog, dust and wet weather
	  ◦ responding to any emergency repair or maintenance requirements
	  ◦ a traffic management system for managing OSOM movements.
	• a program to ensure drivers associated with the project receive suitable training on the Driver Code of Conduct and any other relevant obligations under the CTMP
	• a flood response plan detailing procedures and options for safe access to and from the site in the event of flooding
		Prior to construction

ID	Management/mitigation measure	Timing
	• controls for transport and use of dangerous goods in accordance with State Environmental Planning Policy No. 33 – Hazardous and Offensive Development, Australian Dangerous Goods Code and Australian Standard 4452 Storage and Handling of Toxic Substances.	
TT2	An engineered detailed design based on full 3D swept path analysis for the OSOM access intersections and proposed road upgrades will be developed in consultation with the relevant road authority. The design will be developed to the standard and satisfaction of Warrumbungle Shire Council and referred to TfNSW under Section 138 of the *Roads Act 1993* as appropriate.	Prior to construction
TT3	Parking requirements for the project construction and operation workforce will be provided onsite and parking will not be provided on public roads adjacent to the worksites.	Prior to construction
TT4	UPC\AC will undertake consultation with landholders affected where proposed upgrades impact on land outside of the road reserve.	At all times

10. HAZARDS AND RISKS

10.1 Assessment methodology

10.1.1 Assessment approach

Specialist consultants were engaged to undertake the hazards and risks assessment for the following matters:

- **Aviation** – assessment undertaken by Aviation Projects (refer to **Appendix I**)
- **Human health impacts** – assessment undertaken by DNV GL (refer to **Appendix J**)
- **Bushfire** – assessment undertaken by Cool Burn Fire & Ecology (refer to **Appendix K**)
- **Blade throw** – assessment undertaken by DNV GL (refer to **Appendix L**)
- **Preliminary Hazard analysis** – assessment undertaken by Ramboll (refer to **Appendix M)**.

The purpose of these assessments is to identify and assess the associated risks and constraints relevant to the project in accordance with the SEARs, and applicable NSW legislation and guidelines. This chapter provides a summary of the specialist assessments including key impact assessment findings, as well as management measures.

The other matter considered in within this chapter relates to the hazards and risks associated with the potential BESS.

10.1.2 Statutory context, policy and guidelines

The hazards and risks assessment has been undertaken in accordance with the following statutory documents and guidelines:

- National Airports Safeguarding Framework Guideline D: Managing Wind Turbine Risk to Aircraft (NASF Guideline D)
- Civil Aviation Regulations 1988 (CAR)
- ISO 31000:2018 Risk Management –Guidelines
- Aeronautical information publication
- NSW Wind Energy Guideline
- Draft National Wind Farm Development Guidelines
- NSW Rural Fires Act 1997
- Planning for Bushfire Protection 2019 (NSW RFS, 2019a) (PBP)
- NSW RFS Fire Trail Standards V1.1 2019
- Wind turbine risk zoning handbook (Rijksdienst voor Ondernemend Nederland, 2014) (the Dutch Handbook)
- Hazardous Industry Advisory Paper No. 4, 'Risk Criteria for Land Use Safety Planning *Planning* (Department of Planning, 2011a)
- Hazardous Industry Planning Advisory Paper No.6 – Guidelines for Hazard Analysis (Department of Planning, 2011b) (HIPAP),
- Multi-Level Risk Assessment (Department of Planning, 2011c)
- Hazardous and Offensive Development Application Guidelines Applying SEPP 33 (Department of Planning, 2011d) (SEPP 33 Guideline).

10.2 Aviation

10.2.1 Existing environment

Aerodrome airspace and air routes

The wind farm site is located close to the certified Coolah Airport (YCAH), which is approximately 3.24 nautical miles (six kilometres) north from the nearest Wind Turbine (MH39). Coolah Airport is a certified Code 2 non-instrument airport, operated by Warrumbungle Shire Council, with a published aerodrome elevation of 1654 feet (504 metres). Coolah Airport has one brown gravel grass runway that is 1074 metres in length and 30 metres wide, with a 90 metre runway strip.

The wind farm site is beyond 30 nautical miles (55.56 kilometres) of any other certified airports. The next closest certified airport is Mudgee Airport (YMDG). Mudgee Airport lies approximately 30.3 nautical miles (56 kilometres) to the south of the closest boundary of the wind farm site. The next four closest certified airports are:

- Coonabarabran (YCBB) approximately 32.4 nautical miles (60 kilometres) to the north
- Quirindi (YQDI) approximately 48 nautical miles (89 kilometres) to the northeast
- Dubbo (YSDU) approximately 51.3 nautical miles (95 kilometres) to the west
- Scone (YSCO) approximately 54 nautical miles (100 kilometres) to the east.

A search on the OzRunways website, which sources its data from Airservices Australia, returned 10 nearby aircraft landing areas (ALA) from the project, three of which are located within three nautical miles of the proposed wind turbines. The ALA that are within three nautical miles of a wind turbine are as follows:

- Coolah ALA (separate to Coolah Airport (certified))
- Unknown ALA 1
- Ozton Tongy ALA.

The location of nearby ALAs relative to the project are shown at **Figure 10-1**.

Military low level flying

The wind farm site is located within Danger Area D538B and a Restricted Area R559B associated with Military Flying Training operated by No 453 Squadron at RAAF Base Williamtown. Military flying in this area is restricted from the ground surface up to 10,000 feet (3048 metres) above mean sea level.

Radar

The closest aviation radar facility is the Mount Sandon Secondary Surveillance Radar, which is located approximately 92 nautical miles (170 kilometres) east of the wind farm site. The second closest radar facility is Mount Boyce Route Surveillance Radar located approximately 96.65 92 nautical miles (179 kilometres) south of the wind farm site.

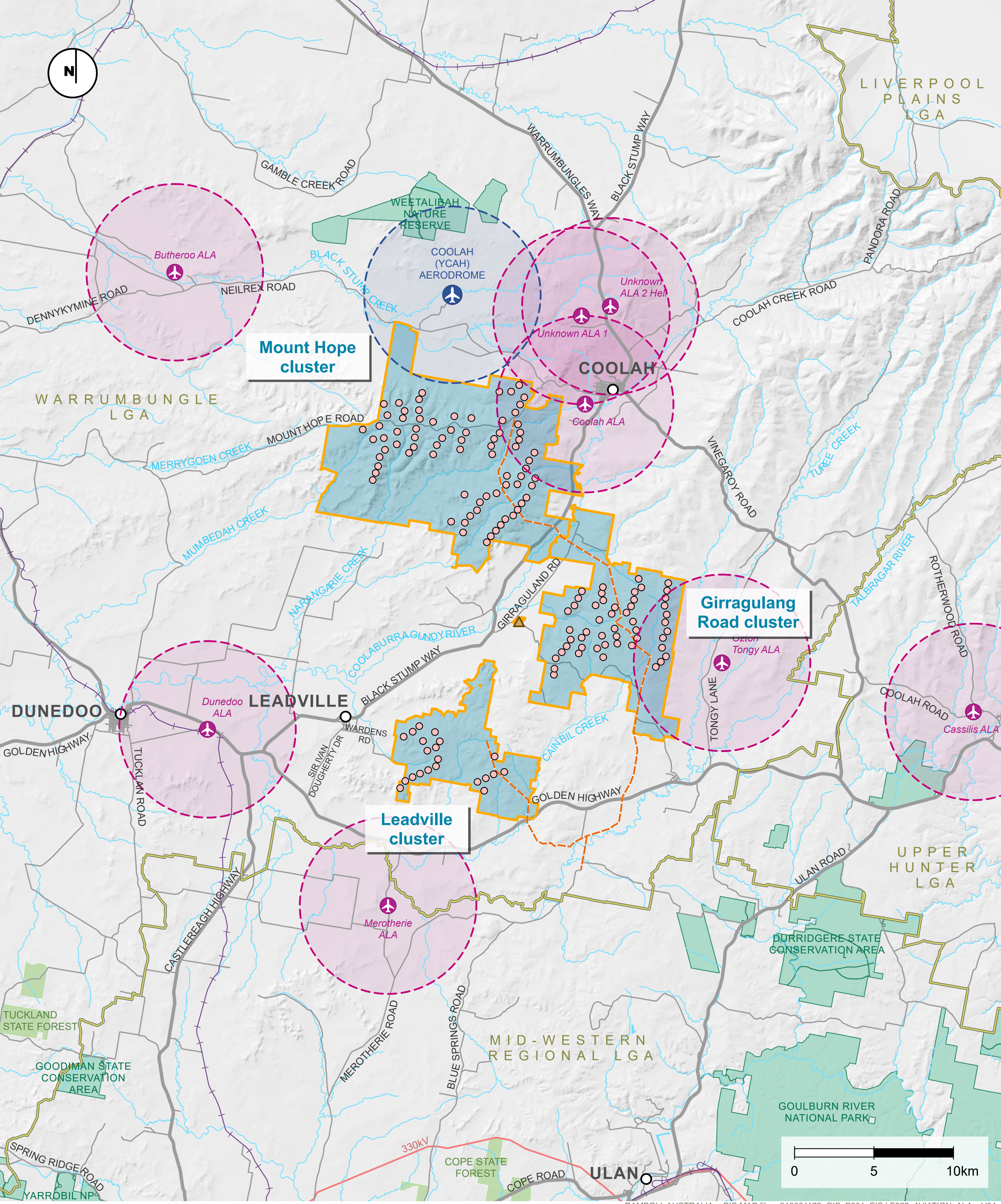
Other aviation activities

It is possible that other aviation activities may intermittently occur over the wind farm site such as aerial spraying or bushfire control.

Aerial agricultural operations, including fertiliser, pest and crop spraying, are generally conducted under day visual flight rules (VFR) below 500 feet (152.4 metres) above ground level; usually between 6.5 feet (2 metres) and 100 feet (30.5 metres) above ground level. There are no known aerial agriculture operations conducted at night in the vicinity of the project.

Aerial firefighting operations (firebombing in particular) are conducted under day VFR, sometimes lower than 500 feet (152.4 metres) above ground level with certain conditions such as smoke and haze reducing visibility. Most aerial firefighting organisations have formal risk management programs to assess the risks associated with their operations and implement applicable treatments to ensure an acceptable level of safety can be maintained. For example, pilots require specific training and approvals, additional equipment is installed in the aircraft, and special procedures are developed.

There is also likely to be other privately-owned, unlicensed airstrips within the in the area that are not published in the aeronautical information publication.



KEY

- Wind farm site
- Turbine location
- Overhead transmission line
- Potential construction workforce accommodation
- Electricity transmission line
- Railway
- LGA boundary
- National Parks and Reserves
- State forest
- Airport (NSW Spatial Services)
- Aircraft landing area (ALA)*
- Airport landing area buffer of 3 nautical miles
- Aircraft landing area buffer of 3 nautical miles*

**Data derived from the Aviation Impact Assessment prepared by Aviation Projects Pty Ltd.*

Figure 10-1 | Location of nearby airports and ALAs relative to the project

10.2.2 Assessment of potential impacts

Circuit operations and approach and take of surfaces

The maximum overall height (tip height) of the project is 250 metres (820.2 feet) above ground level. The highest turbine (MH25) has a maximum overall height of 1028 metres Australian Height Datum (AHD) (3373 feet above mean sea level). The thirteen permanent and fifteen temporary meteorological masts have a maximum height of up to 150 metres (361 feet) above ground level. These structures have potential to impact on aviation operations during construction and operation of the project.

<u>Coolah Airport (YCAH)</u>

Coolah Airport is not served by any instrument procedures. For a Code 2 non-instrument runway, the inner horizontal and approach surfaces extend up to 8202 feet (2,500 metres). The closest wind turbine (MH39) is over three nautical miles (six kilometres) to the south and will therefore have no impact on any airport obstacle limitation surfaces (OLS).

As Coolah Airport is non-instrument and satisfies the OLS, an area of interest within a three nautical mile radius was assessed for potential impacts on aircraft operations at or within the vicinity of the airport. There are no wind turbines proposed to be located inside the area of interest. Therefore, Coolah Airport would not be impacted by the project.

<u>Coolah ALA</u>

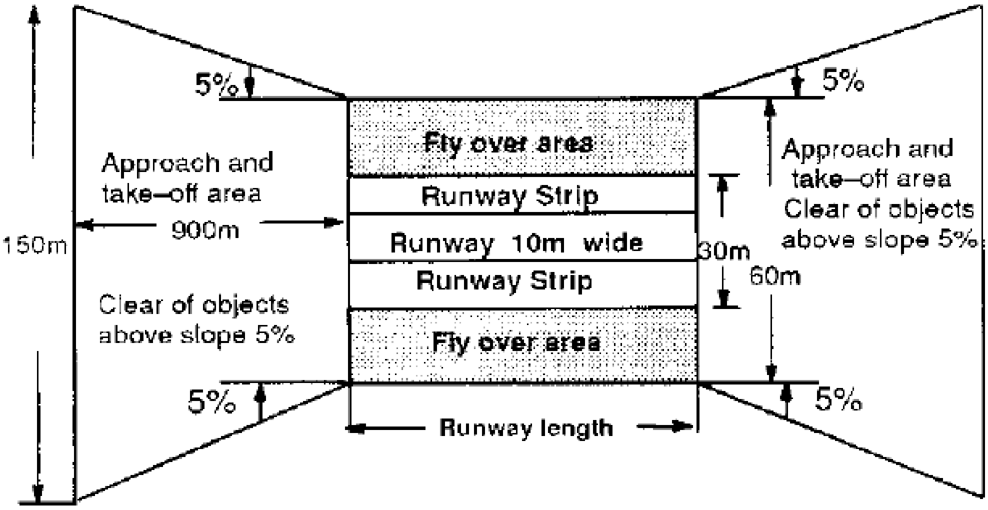
There is no published data available for Coolah ALA therefore the Civil Aviation Advisory Authority Publications (CAAP) 92-1(1) Figure 2A was used as a conservative approach for flight circuit operations for Coolah ALA. A copy of CAAP 92-1(1) Figure 2A is shown at **Figure 10-2**. The approach and take-off surfaces for each runway end commence at the runway end (threshold) at 98.4 feet (30 metres) either side of the runway centreline and diverge at a rate of 5 percent to a distance of 2952.75 feet (900 metres). The end of the runway is located approximately 2.1 nautical miles (3.9 kilometres) from the closest wind turbine is MH36. It is unlikely that the project will impact on circuit operations and approach and take-off surfaces at Coolah ALA.

<u>Ozton Tongy ALA</u>

Ozton Tongy ALA has two runways. The approach and take-off surfaces for each runway end commence at the runway end (threshold) at a distance of 98.4 feet (30 metres) either side of the runway centreline and diverge at a rate of five percent to a distance of 2952.75 feet (900 metres). The closest wind turbine to Ozton Tongy ALA would be GR4, which would be located approximately 1.8 nautical miles (3.3 kilometres) from the end of the runway. It is unlikely that the project will impact on circuit operations and approach and take-off surfaces at Ozton Tongy ALA.

<u>Unknown ALA</u>

The proposed wind turbines would be located outside the horizontal extent of indicative flight circuits of Unknown ALA 1. It is therefore unlikely that the circuit operations of Unknown ALA 1 would be affected by the project.



Source: (CAAP, 1992)

Figure 10-2: CAAP 92-1(1) Figure 2A

Wake turbulence

NASF Guideline D states:

> ***"Wind farm operators should be aware that wind turbines may create turbulence which noticeable up to 16 rotor diameters from the turbine. In the case of one of the larger wind turbines with a diameter of 200 metres, turbulence may be present two kilometres downstream. At this time, the effect of this level of turbulence on aircraft in the vicinity is not known with certainty. However, wind farm operators should be conscious of their duty of care to communicate this risk to aviation operators in the vicinity of the wind farm."***

The effects of wake turbulence may be noticeable at a distance of 9448.82 feet (2880 metres) from the proposed wind turbines, based on a conservative rotor diameter of 590.55 feet (180 metres) and Guideline D for wake turbulence as outlined above.

Coolah Airport and Unknown ALA 1 circuit areas remain outside the 9448.82 feet (2880 metres) so no wake turbulence would be expected. Coolah ALA and Ozton Tongy ALA circuit areas are within 9448.82 feet (2880 metres) from a proposed wind turbine and may experience wake turbulence effect on aircraft in the circuit area.

Military operations

The project could potentially impact on flight operations up to a vertical surface limit of 10,000 feet associated with Military Flying Training. All turbines within Restricted Area R559B and adjacent to Restricted Area R559D will be below the applicable vertical restriction limits. However, the proposed wind turbines are located within the Danger Area D538B, which is operated between surface and 10,000 feet (3048 metres) above mean sea level. The project could potentially impact on flight operations within the Danger Area D538B. The risks associated with military flying training within Danger Area D538B can be managed with the measures described in **Section 10.8** and ongoing consultation with Department of Defence.

Radar
The wind farm site is located in Zone 4, (an accepted zone) and outside the radar line of site of both Mount Sandon and Mount Boyce radar facilities and so would not interfere with the serviceability of the facilities.

Other aviation activities
Aerial agriculture pilots are subject to rigorous training and assessment requirements to obtain and maintain their licence to operate under these conditions. The Aerial Application Association of Australia (AAAA) has a formal risk management program which is recommended for use by its members.

Agricultural and firefighting activities or other scenarios that require low level flight must only be undertaken in good conditions (high visibility) in accordance with aviation regulations, during which wind turbines can be considered as highly visible structures.

Owners of unpublished private grass airstrips are responsible for ensuring the condition of the airstrip and surrounding terrain is still operationally safe. Ongoing consultation as described in **Chapter 5** will create community awareness for any privately owned airstrips.

Other aviation risks
Based on an extensive review of accident statistics data (refer to **Appendix I** for a summary of the data) and input from stakeholders, five identified risk events associated with the project are:

1. potential for an aircraft to collide with a wind turbine, controlled flight into terrain (CFIT)
2. potential for an aircraft to collide with a wind monitoring tower (CFIT)
3. potential for a pilot to initiate manoeuvring in order to avoid colliding with a wind turbine or monitoring tower resulting in collision with terrain
4. potential for the hazards associated with the project to invoke operational limitations or procedures on operating crew
5. effect of obstacle lighting on neighbours.

It has been concluded that aviation lighting is not required for the wind turbines or wind monitoring towers, based on the detailed risk assessment in **Appendix I**. If CASA determines that obstacle lighting should be provided by the project, relevant lighting standards and guidelines are summarised in **Annexure 5** of **Appendix I** and can be incorporated at the detailed design stage of the project. Therefore, the fifth identified risk event is the potential visual impact associated with obstacle lighting (if fitted) on surrounding residents.

The key hazards and the associated risk levels are summarised in **Table 10-1**. The residual risk relates to the level of risk associated with the hazard if the recommended treatments described in **Appendix I** are adopted. Tolerable residual risks can be managed with the measures inherent to the project (as described in **Chapter 19**), the controls described in **Appendix I** and the additional measures describe in **Section 10.8**.

Table 10-1: Aviation hazard and risk analysis summary

Risk ID	Event	Consequence (to People)	Untreated likelihood	Risk	Residual risk
1	Aircraft collision with wind turbine (CFIT)	Catastrophic	Possible	Unacceptable	7 - Tolerable

Risk ID	Event	Consequence (to People)	Untreated likelihood	Risk	Residual risk
2	Aircraft collision with a wind monitoring tower (CFIT)	Catastrophic	Possible	Unacceptable	7 - Tolerable
3	Harsh manoeuvring leads to controlled flight into terrain (CFIT)	Catastrophic	Possible	Unacceptable	7 - Tolerable
4	Effect of the project on operating crew	Minor	Possible	Medium	5 - Tolerable
5	Effect of obstacle lighting on neighbours	Moderate	Almost Certain	Unacceptable	7 - Tolerable

10.3Telecommunications

10.3.1 Existing environment

Radiocommunication towers
Wind turbines located close to radiocommunication sites have the potential to cause interference through near field effects or reflection or scattering of signals. According to the Draft National Guidelines, any radiocommunication site within one kilometre of a proposed wind turbine location is considered to have the potential to be impacted by near-field effects.

A review of the Australian Communications and Media Authority (ACMA) Register of Radiocommunications Licences (RRL) database found that there are 295 radiocommunication towers within 75 kilometres of the wind farm site. There are no radio communication towers within two kilometres of the proposed wind turbine locations. The closest tower is within the wind farm site and is approximately 4.1 kilometres from a wind turbine.

Fixed point to point links
Point to point licence permits communication between two static sites and are links that are usually used for line-of-sight connections for data, voice and video and often exist on mobile phone and television broadcast towers.

There are 42 links over 11 link paths that cross the wind farm site that are recorded in the ACMA RRL data base. These are operated by Essential Energy, NBN Co Limited (NBN), NSW Government Telecommunications Authority, NSW Police Force, NSW RFS, Telstra Corporation Limited (Telstra), and Warrumbungle Shire Council. There are 27 links over five link paths crossing the transmission line route that are operated by Essential Energy, NBN, NSW Government Telecommunications Authority, and Telstra.

The details of these inks are presented in **Appendix J** together with the link paths shown in greater detail in relation to the project in Figure 7 of **Appendix J**

Fixed point to multipoint links
A point to multipoint licence permits communication between one or more static sites and multiple points or between the points. There are 64 point to multipoint licences within approximately 75 kilometres of the wind farm site and one point to multipoint base station within 20 kilometres of the wind farm site. This station is operated by Ulan Coal Mines Ltd.

Emergency services

Licence types operated by emergency services such as state ambulance, police, fire, and rescue services typically comprise fixed point to point link and mobile radio communications. The nearest licence is associated with a tower within the wind farm site, which is approximately 4.1 kilometres from a wind turbine.

Metrological radar

The Bureau of Meteorology operates a network of weather radars across Australia consisting of high-resolution Doppler radars and standard weather watch or weather surveillance radars. There are ten weather radars operated by the Bureau of Meteorology within 460 kilometres of the wind farm site. The closest radar is "Namoi" which is located approximately 106 kilometres northeast of the wind farm site.

Trigonometrical stations

A review of Geoscience Australia (Australian Government, 2021), shows there are 26 trigonometry points within 20 kilometres of the wind farm site. The closest is Collier, located approximately 197 metres north of a proposed wind turbine.

The project is located within the first order and second order triangulation region. The closest Global navigation satellite system is located approximately 2.9 kilometres northeast of the wind farm site at Coolah.

Mobile phones

The nearest mobile phone tower is located within the wind farm site, approximately 4.1 kilometres from a wind turbine.

Mobile phone network coverage maps have been obtained for Optus, Telstra and Vodafone. Figures showing network coverage across the wind farm site are presented in **Appendix J.** Optus 3G and 4G coverage is available in areas around Coolah and Dunedoo to the northeast and the southeast of the wind farm site. In most other locations across the wind farm site coverage is either not available or requires the use of an external antenna. Telstra 3G and 4G coverage is available in many locations across the wind farm site and the surrounding areas, although in some areas to the east, south and northwest, coverage is not available. Vodafone signal coverage is very limited across the wind farm site and the surrounding area, with only some isolated locations able to receive outdoor 3G coverage.

Wireless internet

Optus and Telstra wireless broadband services may be used by some residents in the vicinity of the project. These broadband services use the same networks as mobile phone services which are outlined in the mobile phones discussion above.

Satellite television and internet

Some residents in the vicinity of the wind farm site may use satellite television or internet. The main satellites that transmit Australian free to air or subscription television channels are the Optus C1, D1 and D3 satellites and the Intelsat 19 satellite. IPSTAR, Optus D2 satellites and the NBN SkyMuster I and II satellites provide satellite internet in Australia.

Radio broadcasting

A review of the AM Broadcast Transmitters Database found one tower to the south of the wind farm site within a 75 kilometres buffer. The closest FM broadcast transmission tower is located approximately 3.4 kilometres northeast of the wind farm site and 5.7 kilometres from the nearest wind turbine. The location of broadcast transmitters in the vicinity of the wind farm site are presented in **Appendix J**. The wind farm site is outside the intended service area for digital radio broadcasts.

Television broadcasting

The main digital television transmitter used by residents in the vicinity of the wind farm site is the Central Western Slopes transmitter at Mount Cenn Cruaich. It is also possible that the residents to the northeast of the wind farm site can receive digital television signals from the Coolah transmitter. The signal coverage for the Central Western Slopes transmitter is generally 'variable' to 'poor' across most of the wind farm site and surrounding area with no signal available in some regions across the site. Good coverage is associated with the Coolah transmitter for areas immediately around the tower in the northeast of the wind farm site. Coverage maps for these broadcast transmitters are presented in **Appendix J.**

10.3.2 Assessment of potential impacts

Radiocommunication towers

As the nearest radiocommunication tower is 4.1 kilometres from the nearest wind turbine, it is not expected that the project would cause interference to the signals from the tower through reflection or scattering of signals or nearfield effects.

Fixed point to point links

There are three wind turbines (LV7, MH47 and MH48) located within the exclusion zones in the horizontal and vertical planes for point to point links operated by NBN, NSW Police Force and Warrumbungle Shire Council. The turbines and transmission line will likely cause interference to these point to point links through diffraction of the signals. The proposed transmission line may also cause reflection or scattering effects to links operated by Essential Energy and NBN.

Fixed point to multipoint links

It is not possible to know the link paths in a point to multipoint network without obtaining further information about the locations of each station in the network and consultation with the relevant operators is needed to determine the potential for interference from the turbines and the transmission lines. The details of the licence holders obtained from the ACMA database are provided in Table 12 of **Appendix J**. Ongoing consultation by UPC\AC and implementation of the mitigation measures outlined in **Section 10.8** would reduce the interference on these services by the project.

Metrological radar

The World Meteorological Organisation currently states that wind turbines should not be located within five kilometres of a meteorological radar site due to the high potential for complete or partial blockage of the radar signal and subsequent loss of weather data. They also note that at distances of between 20 kilometres and 45 kilometres, the wind farm may produce radar echoes or signal clutter. Significant impacts are generally not expected or wind farms s that are located more than 45 kilometres from a meteorological radar system. According to the Draft National Guidelines, operators of weather radars within 250 nautical miles (463 kilometres) of the wind farm site should be consulted.

The distance between the wind farm site and the nearest radar ("Namoi") is considerably greater than the distances at which the World Meteorological Organisation suggests impact may occur. However, the Bureau of Meteorology suggests that there may be potential for interference to metrological radar operations over much greater distances than recommended by the World

Meteorological Organisation. The project may impact the radar frequency signals through diffraction or 'bending' as the turbines create obstructions over the terrain.

Trigonometrical stations
It is unlikely that the trigonometry points that are close to the wind farm site host electronic distance measuring devices or other equipment that may be subject to electromagnetic interference (EMI).

Mobile phones
Mobile phone networks typically operate at frequencies of either between 700 and 900 MHz or between 1800 MHz and 2600 MHz, however some new services may operate at up to 3500 MHz. At such frequencies, signals may be impacted by the project. For areas with good coverage, interference to mobile signals is generally considered unlikely and can be rectified by the user moving a short distance to a new or higher location until the signal improves or by using an external antenna to improve signal reception.

Wireless internet
It is unlikely that the wind turbines or the transmission lines would cause interference to mobile internet services from the proposed wind turbines in areas with marginal reception. There is potential for interference to NBN services if the transmission lines intersect the line of sight between the receiver and the tower.

Satellite television and internet
From an analysis of the line of sight to dwellings for satellites which provide television and internet services to eastern Australia the project may intercept signals from 16 satellites at 40 nearby dwellings. Of the dwellings that may be impacted, 14 are associated dwellings for the project. All potentially impacted satellites provide signals intended for international audiences and not services that are specifically intended for Australia. It is unlikely that the residents in the vicinity of the wind farm site will be currently receiving signals from these satellites.

Radio broadcasting
The wind farm site is outside the intended coverage area for digital radio signals. The AM and FM signals may experience interference in close proximity to the turbines, however it is unlikely that any permanent AM or FM receivers would be located sufficiently close to the wind farm site to be affected by interference.

Digital television broadcasting
A clearance of at least one kilometre is recommended for relay transmitters and at least six kilometres for primary transmitters. As the closest transmitter is Coolah, located approximately 7.2 kilometres away, it is unlikely that the project will cause large scale interference to signal from this transmitter.

Reflection or scattering of the signals transmitted for the Coolah tower may occur. 32 dwellings (11 associated dwellings) are in the potential interference zone. Coverage maps suggest that most of the dwellings located in the potential interference zone for the Coolah tower are unlikely to be receiving signals from this tower. However, dwellings located outside the interference zone that may be receiving weak signals may be susceptible to interference as a result of possible reflected signals from the turbines.

Potential interference zones for the Central Western Slopes broadcast tower are mapped in Figure 20 and 21 of **Appendix J**. 52 dwellings (22 associated dwellings) are in the potential interference zone. Although digital transmission signals are generally unlikely to be susceptible to interference from wind turbines in areas with adequate coverage, interference could be encountered in areas where the coverage is marginal. Therefore, dwellings located within the wind farm site and to the south and east of the wind farm site have increased potential to experience interference to the signal from the Central Western Slopes tower as coverage from this tower is either marginal or non-existent for dwellings within the potential interference zones. Although that is the case, it is possible that many of the dwellings in these areas are unlikely to be receiving signal from the tower in the first place.

10.4Human health

10.4.1 Existing environment

Electromagnetic field exposure
An electromagnetic field (EMF) is a physical field produced by a moving electric charge that consists of both and electric field component and a magnetic field component. The strength of the electric field is proportional to the voltage of the EMF source, while the strength of the magnetic field is proportional to the current. The strengths of both electric and magnetic fields decrease with the increasing distance from the source. Electric fields are shielded by opaque objects such as building materials, vegetation, and human skin while magnetic fields can pass through most materials without attenuation.

EMF associated with the generation, distribution and use of electricity is classified as extremely low frequency (ELF) EMF. In Australia, ELF EMF is often called power frequency EMF and correspond to a frequency of 50Hz. ELF EMF contains very little energy. In wind farms, ELF EMF is produced by transmission lines, electrical transformers, underground networks cabling, any overhead cabling and electrical cabling and equipment within the turbines.

Exposure refers to the circumstance of being in the immediate presence of electric or magnetic field, or having such fields cause electric currents to flow through the body. Short term exposure to very high levels of EMF can be detrimental to human health, however, there is currently no evidence to conclusively link ELF EMF to any long-term adverse health effects (National Health and Medical Research Council, 2015). Further, research suggests that if there is a risk of adverse health effects, the risk is more likely to be associated with the magnetic field than the electric field.

10.4.2 Assessment of potential impacts

EMF would only occur during the operational phase of the project, when the wind farm is in use and capable of generating electricity. Simulations were performed in the vicinity of the medium voltage (33 kilovolt) underground electrical cables from the wind turbines. Only the magnetic field strength was considered for the underground cables as the electric field strength, once at ground level for these cables is expected to be negligible due to the attenuation effect of the ground cover.

Simulation of the EMF produced by the medium voltage underground cabling network has shown that the maximum magnetic field strength is at ground level. The strength of the maximum value decreases as the distance from the source increases and therefore, the field strength at all other locations would be within the exposure limits recommended for the protection of the general public. The result of the modelling is detailed in **Appendix J** and summarised in **Table 10-2**. The magnetic field strengths associated with the medium voltage cabling at all locations across the wind farm site are expected to be within the limits recommended by the International Commission on Non-Ionizing Radiation Projection (ICNIRP) at ground level.

The two closest dwellings are located approximately 55 metres and 70 metres away from the underground cabling network. As magnetic field strengths decrease with increasing distance from the source, the EMF produced by the proposed cabling within the wind farm site would be well below the relevant exposure limits at these dwellings and is expected to be indistinguishable from background levels. All other dwellings are located more than 1,000 metres from the underground cabling at which the EMF from the project would be negligible.

Table 10-2: Summary of electric and magnetic field strengths evaluated

Source and measurement location	Maximum electric field [kV/m]	Maximum magnetic field [μT]
Underground cable, measured at ground level	Not evaluated	20
ICNIRP 2010 reference level for general public exposure	5	200
World Health organisation recommendation for general public exposure	Not specified	100

As the electrical equipment including the substation, step-up facility and high voltage transmission lines would be designed and installed in accordance with the relevant guidelines for EMF exposure. The EMF levels produced by the project would be expected to be within the recommended exposure limits at all publicly accessible locations in and around the wind farm site and there is no need to carry out further avoidance.

10.5 Bushfire

10.5.1 Existing environment

Landscape
Land surrounding the wind farm site is characterised by pastoral hills and open flat valleys. The ridgelines are generally scattered with vegetation. Patches of denser remnant vegetation exists on the steeper terrain near rocky outcrops and between saddles, and generally the gentler gradient hillslopes are cleared of vegetation.

Fire season and weather
The wind farm site is located within the Castlereagh Bushfire Management Committee (BFMC) region and falls within land to which the Castlereagh Bush Fire Risk Management Plan 2012 applies. Within this area, the bushfire season generally runs from October through to March with the worst months for large fires being mid-November to the end of December. The wind farm site is located on land that has been subject to fire activity that can occur until February or March during drier years. Summer rainfall is generally the result of storms caused by cold fronts moving in from the west and dry lightning storms can occur during dryer conditions across much of the Castlereagh BFMC region.

Bushfire frequency and ignition sources
Historically, the Castlereagh BFMC region has experienced an average of 80 bushfires per year with an average of three major fires a year. The most recent and significant fire in the region (Sir Ivan fire) was triggered by a lightning strike on 11 February 2017. This fire burnt approximately

55,0000 hectares of remnant vegetation and agricultural land including land surrounding the Leadville and Girragulang Road clusters.

The main sources of bushfire ignition in the Castlereagh BFMC are:

- lightning
- escape from legal burns
- farm machinery and rural operations ignition (for example harvesting or baling)
- incendiaries, arson, or accidental ignition
- campfires.

Vegetation structure and fuel loads

The vegetation types within the wind farm site as mapped in the Greater Hunter Vegetation mapping V4 (NSW DPIE, 2012) consists broadly of:

- managed agricultural and rural enterprise on the valley flats and lower slopes (non native vegetation)
- derived native grasslands and grassy woodland remnants on lower slopes (western slopes grassy woodlands and derived native grasslands)
- forest (and woodland) vegetation on steeper upper slopes (for example western slopes dry sclerophyll forests)

The associated fuel loads, derived from the NSW RFS Comprehensive Vegetation Fuel Loads (NSW RFS, 2019b), based on the vegetation types listed above are:

- managed grasslands and rural enterprise are low threat vegetation (<4t/ha when managed)
- native and derived grasslands (up to 4-6t/ha)
- woodlands: Western Slopes Grassy Woodland (10.5t/ha surface/elevated – 18.3t/ha overall)
- forests: North West Slopes Dry Sclerophyll Forest (14t/ha surface/elevated – 24.47t/ha overall).

Fire intensity modelling highlights that the highest expected fire intensity would arise from a southeast – south – southwest based wind and fire direction.

10.5.2 Assessment of potential impacts

The locality surrounding the wind farm site is undulating, and the wind turbines and tracks are predominantly on slopes exceeding five degrees but less than 15 degrees. However, some slopes within the wind farm site are 15–20-degree slopes and exceeding 20 degree which would have a significant impact on fire behaviour. This is particularly notable but not limited to the Mount Hope cluster.

Based on the detailed assessment provided in **Appendix K** the following elements are potentially at risk from bushfire:

1. Life and Safety: employees and staff, attending contractors, community and visitors, other land users (energy providers, emergency management services including aerial firefighting operations)
2. Built infrastructure associated with the project as described in **Section 4.7**. Due to the inherent fire safety construction for industrial use facilities, the design and materials of the project would be somewhat resilient to the impacts of bushfire.
3. Environmental Values: the landscape surrounding the assets as well as surrounding natural vegetation areas and agricultural management areas. These values are resilient to

bushfire impact, can potentially be contained, and would regenerate naturally or with assistance.

The key hazards and the associated unmitigated risk levels are summarised in **Table 10-3**. Bushfire risks can be managed with the measures inherent to the project (as described in **Chapter 19**), the measures described in **Section 10.8**.and the additional strategies recommended in **Appendix K**

Table 10-3: Bushfire hazard and risk analysis summary

Risk ID	Asset	Consequence	Likelihood	Overall risk
1	Life and safety	Moderate (Injuries requiring medical treatment)	Likely 65% - 90% chance it will occur	High
2	Project infrastructure assets	Moderate (Substantial damage, prolonged repair period)	Likely 65% - 90% chance it will occur	High
3	Environment	Moderate (Contained, reversible impact through natural regeneration)	Likely 65% - 90% chance it will occur	Moderate

10.6 Blade throw

10.6.1 Existing environment

Blade throw refers to an incident in which a structural failure in the blade of a wind turbine occurs during operation and results in parts of the blade detaching and being thrown into the surrounding area. Such incidents may involve the detachment of the entire blade or a portion of the blade.

Detailed, publicly available information on actual blade throw incidents is limited. There is currently no comprehensive database of blade throw incidents that includes accurate measurements of the throw distance and fragment size, details of the wind turbine model and the environmental and operating conditions involved, or information about the consequence of the incident. In response to this, the risk assessment methodology presented in the Dutch Handbook and a review of literature that adopts a conservative interpretation of historical data and supplements it with theoretical modelling where appropriate has been used.

The estimated frequency and probability of a blade throw incident occurring based on researchers' conservative values is presented in **Table 10-4**.

Table 10-4: Frequency and probability of blade throw incident occurring

Blade throw scenario	Estimated frequency of occurrence (incidents per turbine per year)		Probability (per year per turbine) recommended for use in blade throw risk analyses, considering uncertainty in estimated frequencies
	Based on data recorded from 1984 to 2000	Based on data recorded from 2001 to 2010	
Detachment and throw of entire blade or large portion of blade			
All operating conditions [1]	6.3×10^{-4}	6.3×10^{-4}	8.4×10^{-4} (1 incident per year per 1,190 turbines)
Normal operating conditions (rated rotor speed) [2]	3.1×10^{-4}	6.2×10^{-4}	8.4×10^{-4} (1 incident per year per 1,190 turbines)
Mechanical braking conditions (1.5 times the rated rotor speed) [3]	3.1×10^{-4}	Included with normal operating condition	Not applicable to modern turbines
Overspeed conditions (2 times the rated rotor speed) [4]	Less than 5.0×10^{-6}	Less than 5.0×10^{-6}	5.0×10^{-6} (1 incident per year per 200,000 turbines)
Detachment and throw of blade tip or other small blade fragment			
All operating conditions [1]	1.2×10^{-4}	Not explicitly considered	2.6×10^{-4} (1 incident per year per 3,846 turbines)
Overspeed conditions (2 times the rated rotor speed) [3]	5.0×10^{-6}	Not explicitly considered	5.0×10^{-6} (1 incident per year per 200,000 turbines)

1. Derived directly from the number of recorded blade throw incidents. For the detachment and throw of an entire blade under all operating conditions, the actual rate of blade throw incidents observed in data recorded from 2001 to 2010 was slightly less than 6.3×10^{-4}. However, for the sake of conservatism, the researchers conducting the review chose to retain the blade throw frequency derived in the previous analysis.
2. Assumed, based on probability of a blade throw incident under all operating conditions expected proportion of incidents occurring for turbines operating under normal conditions, under mechanical breaking, and under over speed conditions.
3. Assumed, based on expected likelihood of compete failure of the turbine overspeed protection system.

The Dutch Handbook notes that the frequencies presented in this table are likely to be conservative in comparison to the actual probability of a blade throw incident occurring for a modern wind turbine. Statistical data shows a downward trend in the frequency of recorded blade throw incidents over time. The five-year average frequency for the detachment and throw of an entire blade decreases from approximately one incident per year per 2,857 turbines (2001-2005) to less than one incident per year per 4,000 turbines (2006 – 2010).

A number of theoretical studies have been undertaken to assess the likely distribution of turbine blade fragments in the event of a blade throw incident. The predicted throw distances increase slightly as the size of the turbine increases but are not directly proportional to the turbine dimensions. That is, a doubling of the turbine rotor diameter or tip height does not correspond to a doubling of the predicted throw distance for either an entire blade or a blade fragment. The studies therefore suggest that the turbine dimensions do not significantly influence maximum blade throw distance under normal operating conditions. It has been determined that the blade tip speed plays the most important role in determining the maximum potential throw distance for any turbine.

The blade throw risk assessment at **Appendix L** reviews the results of various studies with modelled turbine parameters ranging from a diameter of 47 metres and a tip height of 73.5 metres to 294 metres diameter and 441 metres tip height. The most comparable turbine parameters to the project is the study by Sarlak and Sørensen (H. Sarlak and J. N. Sorensen, 2016) which models a range between 100- and 294-metres diameter and 150 metre tip height to 441 metres tip height. The results of Sarlak and Sørensen model are summarised in **Table 10-5**.

Table 10-5: Theoretical maximum blade throw distances for wind turbines

	Modelled turbine parameters			Maximum throw distance (m)	
	Diameter (m)	Tip height (m)	Tip speed (m/s)	Entire blade	Blade fragment
Operating under normal conditions (rated rotor speed)					
Entire blade, 20% of entire blade by length	100	150.0	70.0 [3]	140 [1]	450 [1]
	147	220.5	70.0 [3]	180 [1]	500 [1]
	208	312.0	70.0 [3]	200 [1]	580 [1]
	294	441.0	70.0 [3]	210 [1]	610 [1]
	100	150.0	100.0 [4]	200 [1]	510 [1]
	147	220.5	100.0 [4]	220 [1]	860 [1]
	208	312.0	100.0 [4]	250 [1]	930 [1]
	294	441.0	100.0 [4]	300 [1]	1000 [1]
Operating under overspeed conditions (2 to 2.5 times the rated rotor speed)					
Entire blade, 20% of entire blade by length	100	150.0	150.0	390 [1]	780 [1]
	147	220.5	150.0	450 [1]	1450 [1]
	208	312.0	150.0	480 [1]	1800 [1]
	294	441.0	150.0	500 [1]	2000 [1]

1. Value has been approximated from graphed results presented in original source.
2. 99th percentile (1-in-100) result, assuming medium air drag. Throw distances of 203 metres and 1395 metres were predicted for the entire blade and a blade fragment respectively assuming very low air drag, but it is unclear whether these conditions would be experienced in reality.
3. Representing normal operating conditions.
4. Representing high tip speed conditions.

10.6.2 Assessment of potential impacts

Maximum blade throw distance

The turbine parameters for the project are 180 metre diameter and 250 metre tip height which are closest to those modelled by Sarlak and Sørensen presented in **Section10.6.1**. Therefore, the maximum potential throw distance for the turbines at the wind farm site would be approximately 200 metres for an entire blade and approximately 580 metres for a blade fragment under normal operating conditions at the nominal rated rotor speed; and approximately 250 metres for an entire blade and approximately 930 metres for a blade fragment at the maximum rated rotor speed. In the unlikely event of overspeed conditions, the throw distances for turbines at the wind farm site could potentially reach approximately 480 metres for an entire blade and approximately 1800 metres for a blade fragment.

The blade throw distance determined is a theoretical maximum and does not consider the probability of those scenarios (combination of specified turbine behaviour and wind conditions at the time of the incident) occurring. The probability for a blade or blade fragment being thrown from a turbine at the wind farm site under normal operating conditions and reaching a maximum throw distance presented in **Table 10-6** is expected to be very low. In fact, it is estimated to be 10^{-5} incidents per turbine per year (that is one incident per year per 100,000 turbines). So, for the 148 turbines proposed at the wind farm site, it would be expected that a blade or blade fragment being thrown the maximum theoretical distance for normal operating conditions to occur once every 676 years, and to the maximum theoretical distance for overspeed conditions once every 67,567 years.

Table 10-6: Turbine parameters proposed for the project

Turbine	Modelled turbine parameters			Maximum throw distance (m)	
	Diameter (m)	Tip height (m)	Tip speed (m/s)	Entire blade	Blade fragment
Normal operating conditions				200	580
Maximum rated rotor speed	180	250	Not specified (theoretical turbine only)	250	930
Overspeed conditions				480	1800

Blade throw risks at dwellings and other sensitive locations

The maximum throw distance for an entire blade at a maximum rotor speed is 250 metres. There are no dwellings or other sensitive locations within 250 metres of the proposed turbine locations. All dwellings are more than 860 metres from the nearest proposed turbine location, which is 610 metres beyond the expected maximum throw distance for an entire blade.

The risk of a person being killed by a blade or blade fragment thrown from the project is expected to be considerably less than 10^{-6} per year (one in one million). This is based on an unprotected person who remains at this fixed location, continuously for a whole year at a distance of 860m from a proposed wind turbine. This risk factor would be described as "extremely remote" to "improbable" probability and "low to "routine" risk using the United States national renewable energy laboratory (NREL) risk classification. The NREL risk classifications are presented in Table 7 of **Appendix L.**

Blade throw risks at nearby properties
There are no neighbouring properties located within half a turbine rotor diameter (90 metres) of the proposed turbine locations.

The probability of a person who remains at any fixed location on a neighbouring property for a whole year being hit and killed by a blade or blade fragment thrown from the project is less than 10^{-5} per year (one in 100,000). This is lower than the risk of death for people working in agriculture in Australia and would be described as having an "extremely remote" probability and a "low" risk using the NREL classification.

Blade throw risks on nearby roads
There are no roads located within half a turbine rotor diameter (90 metres) of the proposed turbine locations.

The possibility of a person who remains at a fixed location on a neighbouring road for a whole year being hit by a blade or fragment thrown from the project is less than 10^{-5} per year (one in 100,000). This is less than the annual risk of death on Australian roads and would be "extremely remote" probability and "low" risk using the NREL classification.

To understand the likely risks for road users in the vicinity of the wind farm site, the blade throw risk assessment estimated the individual risk for the section of Mount hope Road passing within 1800 metres of the proposed turbine locations and the traffic volume for this road as determined in the transport and traffic assessment (see **Chapter 9**). This section of road was chosen for the worst-case risk scenario given it has the largest number of turbines in close proximity to the road corridor of any of the roads within the vicinity of the wind farm site. According to the analysis, the individual risk along Mount hope Road for death caused by blade throw incident is one in 31 million per person per year. This is 30 times less than the limit identified as acceptable in the Dutch Handbook and would be described as "improbably" probability and "routine" risk using the NREL risk classification.

10.7 Battery storage

10.7.1 Existing environment

A Preliminary Hazard Analysis (PHA) is required to be prepared in accordance with *State Environmental Planning Policy (Resilience and Hazards) 2021* (Resilience and Hazards SEPP) for a potentially hazardous or offensive development. Appendix 3 of the *Hazardous and Offensive Development Application Guidelines Applying SEPP 33* (Department of Planning, 2011) (SEPP 33 Guideline) lists industries that may be potentially hazardous or offensive development. Appendix 3 of the SEPP 33 Guideline does not include wind farms and energy storage facilities.

For developments where the applicability of Resilience and Hazards SEPP is not immediately apparent, a risk screening procedure is provided in Appendix 2 of the guideline as a checklist to identify other potential developments that may be hazardous or offensive. The risk screening process considers the type and quantity of hazardous materials to be stored on site, distance of the storage area to the nearest site boundary, as well as the expected number of transport movements. A preliminary risk screening was prepared for the project and is included in **Appendix M.**

'Hazardous materials' are defined in the SEPP 33 guideline as substances that fall within the classification of the Australian Dangerous Goods Code (ADGC) and have a Dangerous Goods (DG) classification. A development which exceeds the screening thresholds in the guidelines would be considered potentially hazardous and a PHA would be required.

Hazardous materials

Hazardous materials to be handled during the project and the potential hazards associated with each material are presented in **Table 10-7**.

The majority of vehicle movements presented in **Table 10-7** would either: only occur during construction and/ or commissioning of the project; or be substantially lower during operation of the project.

In addition to the hazardous materials described in **Table 10-7** the project would also require storage and use of the following chemicals:

- Transformer oil
- MCPA (2-methyl-4-chlorophenoxyacetic acid) (for use as herbicide/pesticide).

Both of these chemicals are not classified as hazardous material and are therefore excluded from the risk screening. They would not be stored with other flammable materials and therefore they are not considered to be potentially hazardous under the Resilience and Hazards SEPP.

Table 10-7: Hazardous materials and potential hazard

Material/ Usage	Dangerous Goods Class	Hazardous material Category	Peak storage project stage
Liquefied Petroleum Gas (LPG)	2.1	Flammable gas	Construction
Refrigerant	2.2	Non-flammable Non-toxic gas	Operation
Gasoline	3 PG II	Flammable liquids	Construction
BESS	9	Miscellaneous dangerous goods	Operation

Other hazards and risks

A hazard identification has been undertaken with consideration of the following project factors:

- project infrastructure
- type of equipment
- hazardous materials present
- proposed operation and maintenance activities
- external factors.

Events with the potential to result in major consequence impacts to people (injury and/or fatality), the environment and project assets (excluding workplace health and safety hazards such as slips, trips and falls) were identified:

- **electrical**: exposure to voltage
- **arc flash**: release of energy
- **electromagnetic fields (EMF)**: exposure to EMF
- **fire**: infrastructure fire and bushfire

- **chemical**: release of hazardous materials
- **reaction**: battery thermal runaway
- **external factors**: bushfire, vandalism, lightning storm.

The PHA is at **Appendix M** with the outcomes presented in Section **10.7.2** and mitigation measures in **Section 10.8**.

10.7.2 Assessment of potential impacts

The PHA was undertaken for the project in accordance with the HIPAP and *Multi-Level Risk Assessment* (Department of Planning, 2011c). A qualitative assessment has been undertaken for the PHA. The SEPP 33 Guideline says that a qualitative assessment can be undertaken if the criteria listed in **Table 10-8** are met (which is achieved by the project and this assessment).

Table 10-8: PHA qualitative assessment criteria and how achieved

PHA qualitative assessment criteria	How criteria has been achieved
Screening and risk classification and prioritisation indicate there are no major offsite consequences and societal risk is negligible	The quantities of hazardous materials to be stored onsite do not exceed the Resilience and Hazards SEPP threshold levels
The necessary technical and management safeguards are well understood and readily implemented	Technical and management safeguards are inherent to the project elements that store and use the hazardous materials
There are no sensitive surrounding land uses	The nearest residence is more than 1500 m from the proposed location of the hazardous material storage areas

As described in **Section4.7.2**, the project is considering a centralised “AC Coupled” BESS adjacent to one the grid substation within the development footprint.

The major components of the BESS would comprise:

- **Batteries** – most likely a lithium-ion technology type
- **Inverters** – convert the DC electricity generated by the wind farm into AC.
- **Transformers** – there would be two types of transformers within the centralised AC Coupled BESS if this option is chosen: low-voltage to medium-voltage transformers and medium-voltage to high-voltage transformers (33kV/330kV) at the grid connection point (substation). The BESS connection will either share a transformer with a section of the wind farm or may be tied to a separate transformer within the substation, but this will only be determined in the detailed design.
- **Heating ventilation air conditioning** (HVAC) – the HVAC would maintain the batteries at a suitable temperature to optimise their lifetime, performance and to ensure safe operation. This could include small package units, large chillers or a liquid cooling system
- **Fire protection** – where required active gas-based fire protection systems would be installed within the BESS enclosure and thermal sensors and smoke/gas detectors would be installed and connected to a fire control panel.

The final BESS design would be assessed by a Fire Safety Study and other risk assessments post approval (and submitted for DPIE approval prior to construction). As a conservative assessment, this PHA has considered the maximum quantities of hazardous materials that would be onsite, as well as the potential for multiple locations.

Table 10-9 identifies the hazardous materials to be stored on and transported to the study area and consideration of the applicable Resilience and Hazards SEPP threshold. None of the Resilience and Hazards SEPP threshold levels would be exceeded during any phase of the project.

Table 10-9: Resilience and Hazards SEPP Risk screening summary – storage and transport

Material/ Usage	Resilience and Hazards SEPP threshold (tonne)	Exceed threshold?
LPG	For above ground storage, the screening threshold is 10 tonnes.	No
Refrigerant	No threshold identified based on Resilience and Hazards SEPP and excluded from risk screening. Class 2.2 are not considered to be potentially hazardous with respect to offsite risk.	No
Gasoline	For quantity up to 5 tonnes, the amount is unlikely to represent a significant risk and therefore is not potentially hazardous.	No
BESS	No threshold identified based on Resilience and Hazards SEPP and excluded from risk screening. Class 9 is not classified as potentially hazardous material as per Resilience and Hazards SEPP.	No

Despite the conclusions of the preliminary risk screening, the SEARs require that a PHA be prepared, demonstrating that the BESS is suitably located and minimises risks to neighbouring land uses. The PHA includes consideration of the potential hazards presented by the BESS and the other materials in **Table 10-9.**

The materials and chemicals used in the BESS infrastructure do not exceed the threshold for the preliminary risk screening (refer to **Table 10-9**), and therefore the BESS infrastructure would not be a potentially hazardous development. **Table 10-11** identifies the management measures to be implemented to further minimise the potential impacts from these materials.

Other hazards and risks

The detailed outcome of the hazard identification process in **Appendix M** presents the consequence rating of the potential hazard events. These ratings are based on the consequence definitions in **Appendix M**.

<u>Likelihood analysis</u>

The detailed outcome of the hazard identification process in **Appendix M** presents the likelihood rating of the potential hazard events. These ratings are based on the consequence definitions in **Appendix M**.

<u>Risk level</u>

A summary of the key hazards and the associated risk levels assessed in **Appendix M** are presented in **Table 10-10**. The highest risk Level associated with the project is medium. Medium level risks can be managed with the measures inherent to the project and the additional measures described in **Table 10-11**.

Table 10-10: Hazard and risk analysis summary

Hazard	Event	Consequence (to People)	Likelihood	Risk
Electrical	Exposure to voltage	Major	Very Unlikely	Medium
Arc flash	Arc flash	Major	Very Unlikely	Medium
EMF	Exposure to EMF	Insignificant	Extremely Unlikely	Low
Fire	Fire – Transformers	Major	Very Unlikely	Medium
	Fire – Switch rooms	Major	Extremely Unlikely	Medium
	Fire – Construction compound	Major	Very Unlikely	Medium
	Bushfire	Moderate	Likely	High
Reaction	Thermal runaway in battery	Major	Very Unlikely	Medium
Chemical	Release of electrolyte from the battery cell (liquid/vented gas) resulting in fire and/or explosion	Major	Very Unlikely	Medium
	Battery coolant leak	Minor	Very Unlikely	Low
	Refrigerant leak (BESS and refrigeration/chiller units)	Minor	Very Unlikely	Low
	Exposure to hazardous material (herbicide/pesticide)	Minor	Very Unlikely	Low
	Release of LPG from storage vessel or filling point resulting in fire and/or explosion	Major	Very Unlikely	Medium
	Release of gasoline from storage tank or filling point resulting in fire	Major	Very Unlikely	Medium
External factors	Water ingress resulting in fire (BESS or Switch rooms)	Major	Extremely Unlikely	Medium
	Vandalism due to unauthorised personnel access	Moderate	Unlikely	Medium
	Lightning strike	Major	Very Unlikely	Medium

10.8 Environmental management and mitigation measures

Proposed measures to manage and/or mitigate hazards and risks impacts from the project are detailed in **Table 10-11**.

Table 10-11: Management and mitigation measures – hazards and risks

ID	Management/mitigation measure	Timing
AV1	UPC\AC will contact the landowners and aerial operators for Coolah Airport (YCAH), Coolah ALA, Ozton Tongy ALA and local aerial agricultural operators and aerial firefighting operators to inform them of the project. Details of the project, including location and height information of wind turbines, WMT and overhead powerlines will be provided to facilitate the flight planning of aerial application operators.	Prior to construction
AV2	UPC\AC will consult with the Department of Defence on any potential impacts of the project on military flying training within Danger Area D538B Surface to 10,000 feet.	Prior to construction
AV3	Consultation will be undertaken with Airservices Australia to assess potential impacts of the project and to address the lowest safe altitude (LSALT) impact of air route W627 which will need to be raised.	Prior to Construction
AV4	All WMTs and wind turbines will be reported to CASA as a hazardous obstacle.	Prior to construction
AV5	UPC\AC will consult with Airservices Australia and provide all relevant project information to allow for publication of wind turbine locations in aeronautical charts and the En Route Supplement Australia (ERSA). This will include 'as constructed' details of wind turbines and WMT coordinates and elevations.	Prior to construction / operation
AV6	The rotor blades, nacelle and the supporting tower of the wind turbines will be painted white.	Detailed design
AV7	The meteorological masts will have aviation marker balls or highly visible flags or sleeves placed on the outside of the guy wires and paint markings will be applied in alternating contrasting bands of colours to at least the top third of the masts. Consideration will be given to MOS 139 Chapter 8 Division 10 Obstacle Markings (as modified by the guidance in NASF Guideline D).	Detailed design
TC1	UPC\AC will consult with NBN, NSW Police Force and Warrumbungle Shire Council regarding the potential interference caused by turbine LV7, MH 47 and MH48 on their point-to-point links crossing the wind farm site.	Prior to construction

ID	Management/mitigation measure	Timing
TC2	UPC\AC will contact the operators of all potentially affected base stations within 60 km of the wind farm site to identify the associated link paths and determine the likelihood of the project causing interference to their services.	During construction
TC3	If interference to point to point or point to multipoint links is experienced by the operators, options to re-route the links, installation of additional towers, or replacing the affected links with alternative communications infrastructure will be explored.	Operation
TC4	Bureau of Meteorology will be consulted, and their feedback sought on whether interference to their services is likely. If it is determined that interference such as signal clutter is expected, Bureau of Meteorology can train their users to take the locations of the wind turbines into account when analysing the data.	Prior to operation
TC5	If interference is experienced at receivers as a result of the project, UPC\AC will work with the resident to achieve an acceptable outcome. This may include replacement of an existing antenna with a higher gain antenna or installation of alternative technology such as satellite television.	Operation
HH1	Substations will be fenced off from public access and clearances from the electrical equipment to the outer fencing will provide a sufficient buffer for EMF exposure.	Operation
HH2	All electrical equipment including the substation, step-up facility and high voltage transmission lines will be designed and installed in accordance with the relevant guidelines for EMF exposure.	Detailed design
BF1	A bushfire emergency management and operations plan (BEMOP) will be prepared and form part of the CEMP and OEMP. The BEMOP will include: • detailed measures to prevent or mitigate fires igniting • 24-hour emergency contact details including alternative telephone contact • inductions for construction personnel on bushfire risk management and other fire related risks that could present at the wind farm site, the project bushfire contingency plan and emergency response procedures • availability of fire-suppression equipment, access, and water including site infrastructure plans and site access and internal road plans • location of hazards (physical, chemical, electrical) that will impact on the firefighting operations and procedures to manage any identified hazards during firefighting • storage and maintenance of fuels and other flammable materials • notification of the local NSW RFS Fire Control Centre for any works that have the potential to ignite surrounding	Prior to construction

ID	Management/mitigation measure	Timing
	vegetation, proposed to be carried out during a bush-fire fire danger period to ensure weather conditions are appropriate • appropriate bush fire emergency management planning • such additional matters as required by the NSW RFS District Office.	
BF2	All plant, vehicles, and machinery will be routinely inspected and cleaned of any accumulated flammable debris.	During construction and operation
BF3	A dedicated static water supply (approximately 50- 80kL) for bush firefighting purposes will be provided at strategic locations within the construction workforce accommodation and each wind farm cluster with respect to essential equipment and accessibility.	Detailed design
BF4	No hot works (e.g., grinders, welders, slashers) will be carried out on Total Fire Ban Days.	During construction
BF5	A minimum 10m asset protection zone (APZ) will be established and maintained for the life of the project for the structures and associated buildings and infrastructure (excluding road access to the site and power or other services to the site and associated fencing). The APZ will be to the standard of an Inner Protection Areas (IPA) as outlined in Appendix 5 of PBP and the NSW RFS document Standard for Asset Protection Zones.	Operation
BF6	Internal access ways will be maintained through the life of the project and will support access for Cat-1 fire vehicles consistent with the NSW RFS Fire Trail Standards.	Operation
BF7	An APZ will be established around all habitable (construction workers accommodation) buildings and any associated buildings within 10m from a habitable building in accordance with PBP Table A1.12.3 Minimum distances for APZs -FFDI 80 areas <29kW/m² @ 1090K (flame temp.)	Construction
BF8	A minimum 11m APZ for all buildings associated with the workforce accommodation component. The APZ must be installed and maintained for the life of the development to the standard of an Inner Protection Areas (IPA) as outlined in Appendix 5 of Planning for Bushfire 2019 (PBP) and the NSW RFS document Standard for asset protection zones.	Construction
BF9	Internal access ways to the construction workers accommodation will be maintained of the life of the project and will support access for Cat-1 fire vehicles consistent with the NSW RFS Fire Trail Standards.	Construction

ID	Management/mitigation measure	Timing
BF10	All habitable buildings in the workers accommodation will be constructed to BAL-29 construction in accordance with Section 7 of AS3959-2018 Construction of Building in Bushfire Prone Areas.	Detailed design
BF11	Non-habitable buildings associated with the construction workers accommodation site will be constructed to BAL 29 AS3959 construction or be located greater than 10m from any habitable building to prevent building to building fire.	Detailed design
BF12	Access to construction workers accommodation will be two-wheel drive, all weather access and in accordance with Appendix 3 of PBP	Construction
BT1	Wind turbine components will be manufactured and certified to current best practice Australian and international (IEC 61400-23) safety standards and are equipped with sensors that can react to any imbalance in the rotor blades and shut down the turbine if necessary.	At all times
BT2	Wind turbines will be subject to stringent safety and security measures including regular maintenance and servicing (within an ISO90001 Quality Assurance system).	At all times
BT3	Contactors certified in the manufacture, delivery, build, inspection, maintenance and repair of turbine components will be employed.	At all times
BS1	The operator will contact Warrumbungle Local Emergency Management Committee (LEMC) to discuss how the site will be considered under the *Warrumbungle Shire Adverse Event Plan* (2022).	Prior to operation
BS2	UPC\AC will prepare a Fire Safety Study (FSS) for the finalised design of the battery energy storage system in consultation with Fire and Rescue NSW as required under the development consent for the project. The FSS would be prepared based on the final design and prior to construction of the battery energy storage system.	Prior to construction
BS3	The principles from NFPA 855, AS 5139, IEC 62897, UL 9540, UL 9540A and the FM Global's *Development of Sprinkler Protection Guidance for Lithium Ion Based Energy Storage Systems* will be considered during final design of the BESS, where they are appropriate for the project and feasible.	During detailed design/ prior to construction

ID	Management/mitigation measure	Timing
BS4	The BESS would be operated and managed in accordance with the safety requirements for the selected battery technology. Safe handling and operation of battery technology will include storage in a cool (preferably below 30°C) and ventilated area; away from moisture, sources of heat, open flames, food and drink. Appropriate personal protective equipment will be used when handling battery technology.	Operation
BS5	The transformer oil would be handled and managed in accordance with the Safety Data Sheet, including use of required personal protective equipment when handling.	Operation
BS6	The refrigerant would be handled and managed in accordance with the Safety Data Sheet, which includes: protection from sunlight and storage in a cool, well-ventilated place; and use of required personal protective equipment when handling.	Operation

11. ABORIGINAL HERITAGE

11.1 Assessment methodology

11.1.1 Assessment approach

An Aboriginal cultural heritage assessment report (ACHAR) has been prepared by OzArk. The report is provided in full in **Appendix N.**

The purpose of the ACHAR is to meet the following objectives:

- undertake background research to formulate a predicative model for site within the survey boundary
- identify and record objects or sites of Aboriginal heritage significance within the survey boundary, as well as any landforms likely to contain further archaeological deposits
- undertake an Aboriginal cultural values assessment in consultation with Registered Aboriginal Parties (RAPs) of tangible and intangible cultural heritage values that have potential to be impacted by the project
- To assess the significance of any recorded Aboriginal sites, objects, or places likely to be impacted by the project, in consultation with RAPs
- assess the likely impacts of the proposed work to Aboriginal cultural heritage and provide management recommendations, in consultation with RAPs.

Aboriginal cultural sites may include:

- Isolated finds – may be indicative of the random loss or deliberate discard of a single artefact, the remnant of now dispersed or disturbed artefact scatter, or an otherwise obscured or sub-surface scatter. They may occur anywhere within the landscape but are more likely to occur in topographies where open artefact scatters typically occur.
- Open artefact scatters - defined as two or more artefacts, not located within a rock shelter, and located no more than 50 metres away from any other constituent artefact. This site type may occur almost anywhere that Aboriginal people have travelled and may be associated with hunting and gathering activities, short- or long-term camps, and the manufacture and maintenance of stone tools. Artefact scatters typically consist of surface scatters or sub-surface distributions of flaked stone discarded during the manufacture of tools but may also include other artefactual rock types such as hearth and anvil stones.
- Aboriginal scarred trees - contain evidence of the removal of bark (and sometimes wood) in the past by Aboriginal people, in the form of a scar. Bark was removed from trees for a wide range of reasons such as manufacturing of various tools, vessels and commodities including string, water containers, roofing for shelters, shields and canoes and removed for food gathering purposes.
- Quarry sites and stone procurement sites - typically consist of exposures of stone material where evidence for human collection, extraction and/or preliminary processing has survived.
- Burials - are generally found in soft sediments such as aeolian sand, alluvial silts and rock shelter deposits. Burials are generally only visible where there has been some disturbance of sub-surface sediments or where some erosional process has exposed them.
- Grinding grooves – are most likely to occur on flat outcrops of course-grained sandstone in the vicinity of water sources, however, grinding grooves have been recorded on fine-grained granite outcrops.
- Rock shelters - refers to rock shelters/rock overhangs that contain evidence such as stone artefacts and/or bones and/or plant remains (from meals eaten at the site) and/or hearths (fireplaces) and were utilised in the past for both habitation and ceremonial purposes.

- Bora/Ceremonial sites - are places which have ceremonial or spiritual connections. Ceremonial sites may comprise of natural landscapes or have archaeological material. Bora sites are ceremonial sites which consist of a cleared area and earthen rings.

11.1.2 Survey area

The area within the wind farm site that has been assessed for the potential impacts to Aboriginal heritage impacts concentrates on the land where all project components would be located with a suitable buffer (approx. 200m corridor where practically possible) to allow some movement of project components if required. The survey area also encompasses land around proposed intersection upgrades.

The survey area is shown in **Figure 11-1** and encompasses approximately 3,370 hectares of land which includes only 13 per cent of the wind farm site. The Archaeological survey undertaken for this assessment is confined to this survey boundary as illustrated in Figure 1-6 of the ACHAR.

A desktop search was conducted on 25 January 2021 to identify any potential previously recorded heritage within the survey boundary. The following databases were included in the search:

- Commonwealth Heritage Listings
- National Native Title Claims Search
- NSW Aboriginal Heritage Information Management System (AHIMS)
- Warrumbungle Shire Council LEP 2013.

The Aboriginal cultural heritage assessment was undertaken in consultation with the Aboriginal stakeholders (RAPs) identified for the project. A summary of the consultation undertaken as part of the Aboriginal cultural heritage assessment is included in **Chapter 5** with details and records of correspondence provided in **Appendix N.**

A field assessment of the survey area was undertaken by a team of OzArk Senior Archaeologists and heritage specialists over a two-week program:

- Week 1: Monday 17 May to 21 May 2021
- Week 2: Monday 24 May to 28 May 2021.

A one-day site inspection was also completed on 31 August 2021 to ground-truth areas added to the project through the project refinement stages, following the initial survey that was completed in May, or where access was not granted at the time of the initial survey.

Additional survey was also undertaken in December 2021, to ground truth and refine the project layout to avoid impacts to a known site at Cainbil Creek.

An additional day of survey was completed on 19 April 2022 to assess areas within the Mount Hope and Leadville clusters that were not previously accessible as well as land surrounding proposed intersection upgrades. The additional survey was completed with the assistance of a representative from Murong Gialinga Aboriginal & Torres Strait Islander Corporation.

The project team comprised Stephanie Rusden and Brendan Fisher in both week 1 and week 2 and Dr Jodie Benton and Harrison Rochford in week 1 only. Representatives from several RAPs were present during the survey including:

- Steven Flick (Murong Gialinga Aboriginal & Torres Strait Islander Corporation)
- Jacob Long (Michael Long)
- Darren Carney (Gilgandra LALC)
- Greg Kennedy (Dubbo LALC)

- Steve Talbott
- Aaron Talbott (AT Gomilaroi Cultural Consultancy)
- Bareki Knox (Bawurra)
- Josh Talbott (Talcon Pty Ltd).

The survey area was assessed by sampling the different landforms using pedestrian survey. The areas sampled by pedestrian survey are shown on Figure 6-1 of **Appendix N.** and included all turbine and ancillary facility locations and areas where the transmission lines or underground reticulation alignments were within landforms with higher archaeological potential. Some large areas that consisted of sloping landforms or undifferentiated flat landforms that were not close to water and were assessed as having low archaeological potential were driven and the landform potential to contain Aboriginal objects in these locations was assessed.

The sampling covered approximately 3,370 hectares in total constituting approximately 13 percent of the wind farm site, however aligned with the area that is determined to be the construction impact footprint with a suitable buffer to allow some small refinements of project components if required.

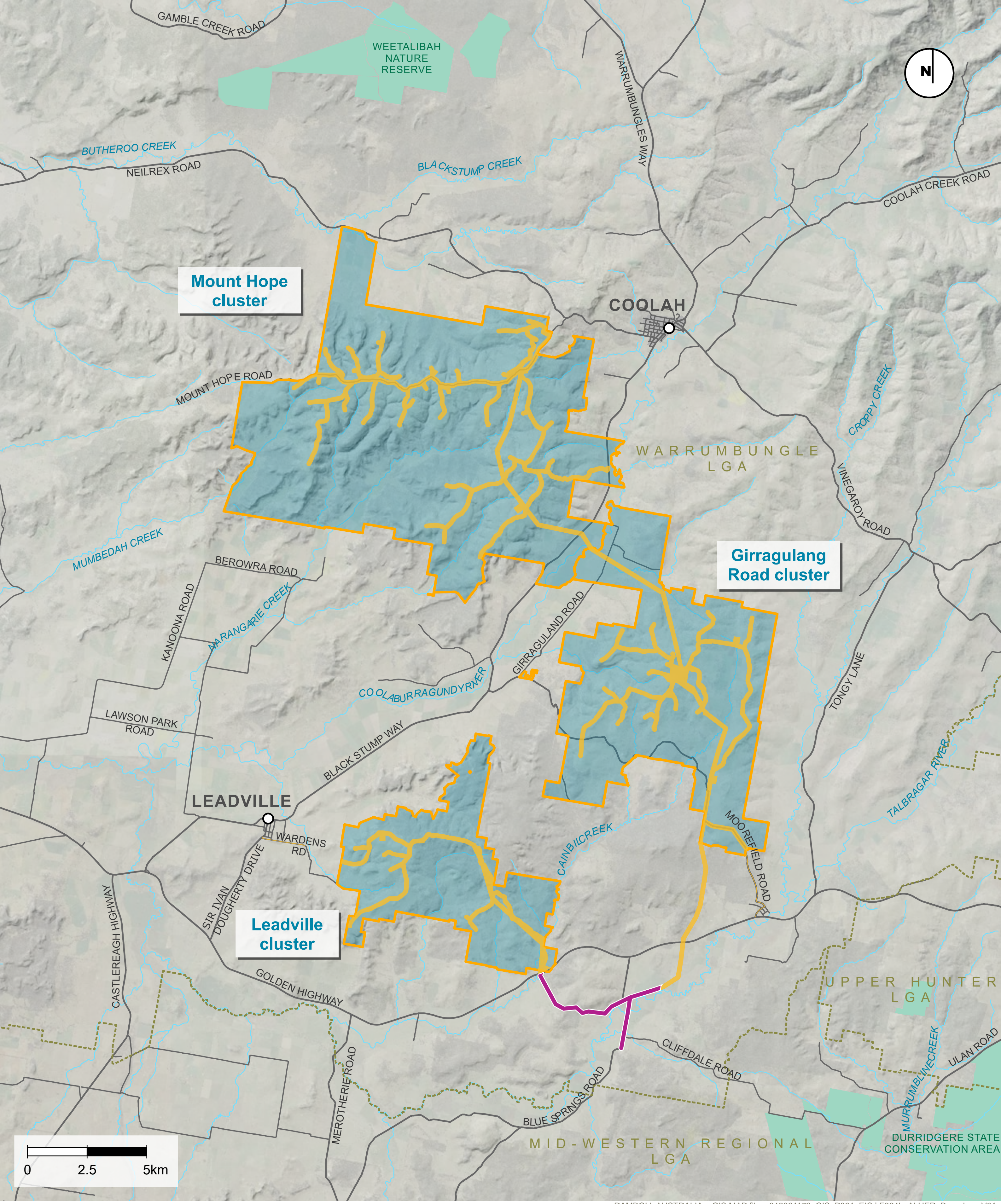
The transmission line connection is subject to finalisation and unsurveyed parts of the transmission line connection will be surveyed following confirmation of the CWO-REZ transmission line strategy. The un-surveyed parts of the site are shown in **Figure 11-1**.

11.1.3 Statutory context, policy and guidelines

The heritage assessment has been undertaken in accordance with the following statutory documents:

- Burra Charter 2013 (Australia International Council on Monuments and Sites (ICOMOS) 2013)
- Part 4 of the EP&A Act
- Part 6 of the NP&W Act
- the EPBC Act by way of the National Heritage List and Commonwealth Heritage List established under the Act
- Heritage Act.

The field survey followed the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (Code of Practice), (DECCW, 2010a) and the ACHAR followed the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH, 2011) and the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (ACHCRs) (DECCW, 2010b).



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Aerial photography from NSW Government Spatial Services

KEY

- Wind farm site
- Access track
- Survey boundary
- Post commitment survey area
- LGA boundaries
- National Parks and Reserves

Figure 11-1 | Aboriginal heritage survey boundary and post commitment survey areas

11.2 Existing environment

11.2.1 Landscape context

An understanding of the environmental contexts of an area is requisite in any archaeological investigation (DECCW 2010a). It is a particularly important consideration in the development and implementation of survey strategies for the of archaeological sites. In addition, detection natural geomorphic processes of erosion and/or deposition, as well as humanly activated landscape processes, influence the degree to which these material culture remains are retained in the landscape as archaeological sites; and the degree to which they are preserved, revealed and/or conserved in present environmental settings.

The topography of the wind farm site is characterised by ridgelines and associated steep slopes with scattered vegetation, rolling hills, and small open flat valleys. The elevated slopes range from gentle to steep gradients and are generally cleared of vegetation and dominated by dense grass cover. Vegetation is present on the steeper terrain where widespread clearing has not been undertaken, although the extent of cover is limited.

The four main landform types within the wind farm site are listed in **Table 11-1** and their extend within the survey boundary is summarised. These landforms are shown in Figure 4-7 Figure 4-9 of the ACAHR.

Table 11-1 Landform types within the study area

Landform type	Description	Area (ha)
Ridgelines and crest landforms	Characterised by a either a single crest (the top of a mountain or hill) or a chain of mountains or hills that form a continuous elevated crest (ridgeline)	1,428
Slope landforms greater than 10 degrees	Landforms with steeper gradients	562
Low gradient/undulating landforms	Characterised by sloping landforms with gentle gradients (less than 10 degrees slope). In the project Boundary, these landforms are elevated and often distant to water.	1,278
Floodplains	Flat, alluvial plains adjacent to major watercourses	152

The survey area is well watered with several named creeks that hold permanent or semi-permanent water. The major waterway within the vicinity of the survey area is Coolaburragundy River, located between the Mount Hope and the Girragulang Road clusters, outside of the impact footprint. In addition, the Talbragar River is located immediately south of the southernmost extent of the survey boundary.

The sloping and elevated terrain of most of the survey area means that obtaining resources in these areas was likely more difficult when compared to other nearby environments, and less favourable to long-term Aboriginal occupation.

The climate of the region is characterised by cold winters and hot, dry summers. If occupation sites exist in the survey boundary, they would tend to be located on landforms with sufficient shelter from the elements, such as areas with significant sandstone outcropping near permanent waterways.

11.2.2 Land use context

The substantial amount of vegetation clearing to obtain open land for agriculture and farming in the modern era has most likely removed many Aboriginal sites such as culturally modified trees and/or dispersed sites such as artefact scatters through the soil loss that followed vegetation clearing.

Disturbed land in the study area also consists of road corridors, farm tracks, farm infrastructure (sheds, cattle yards, dams, fences, etc.), telecommunication aerials, and livestock grazing and trampling. Sites such as artefact scatters, Bora grounds or stone arrangements are likely to have been disturbed through stock trampling. In areas where farming and agriculture is less intensive, such as hills and slopes, Aboriginal objects are likely to be in a secondary context due to slope wash.

11.2.3 Historic context

The survey area is situated within the traditional lands of the Gamilaraay and the Wiradjuri people. To the immediate west lies the Wailwan tribal and linguistic group. The Wiradjuri language group is the biggest in New South Wales and occupied the northern parts of the South Eastern Highlands bioregion in the vicinity of Orange and Bathurst. 'Wiradjuri' means '*people of three rivers*', the three rivers being the Macquarie, Murrumbidgee, and Lachlan Rivers. These rivers represented the Wiradjuri people's livelihood and supplied consistent and abundant resources. The Wiradjuri people generally moved in smaller groups along river flats, open land, and waterways. Early studies by explorers and natural scientists discuss the Gamilaraay social and political organisation, kinship, ritual practices, long distance trade and communication and reveal the area of the Gamilaraay as being rich in both flora and fauna resources with the following listed as having been exploited for food.

There are several broad scale regional archaeological studies which either cover the wind farm site itself or are in general proximity to it, including:

- Aboriginal heritage assessment for a gas pipeline extending from Dubbo to Tamworth via Gunnedah (Jo McDonald Cultural Heritage Management (JMCHM), 1998)
- investigations conducted by NPWS for the Resource and Conservation Assessment Council as part of the regional assessments of western New South Wales (Purcell, 2002)
- Aboriginal heritage assessment for the replacement of Ulindah Bridge over Binnia Creek along Warrumbungle Way, located approximately 6 km south of Binnaway (OzArk, 2009a)
- Aboriginal heritage assessment for a section of Coonabarabran Road crossing Saltwater Creek approximately 40 km east of Coonabarabran (OzArk, 2009b)
- Cobbora Coal Project (EMM 2012)
- Liverpool Range Wind Farm Stage 1 ACHAR (NSW Archaeology, 2014)
- Allison Bridge realignment project Aboriginal Due Diligence Assessment (OzArk, 2016)
- Dunedoo Solar Farm ACHAR (NGH 2020).

Appendix N provides detailed conclusions of these regional archaeological studies. Main findings relevant to the project and survey area include:

- 98 Aboriginal archaeological sites were recorded as part of the JMCHM study, 19 of the sites are within the AHIMS search areas completed for the project assessment, all occurring within the alluvial floodplain associated with Coolaburragundy River.

- Purcell's study located and recorded 1,110 Aboriginal sites with general conclusions that the portions of the study area within the Talbragar – Upper Macquarie Terrace Sands and Gravels landscape unit may have a low archaeological sensitivity.
- The most sensitive archaeological landform (SAL) that has been identified on a landform conducive to Aboriginal occupation is elevated, flat, well drained, with stone outcropping present, and near permanent water.
- most of the Aboriginal sites were recorded in landforms associated with valley floors and watercourses with more sensitive landforms in areas that were associated, or at least near, major watercourses (named rivers and creeks) with flowing tributaries along valley floors.
- Aboriginal sites on slopes are generally in a secondary context having been displaced by erosional processes. The exception is where there is outcropping rock as this feature may have attracted occupation or use.
- the predominant material utilised for artefact manufacture is quartz and there is the potential for artefacts manufactured from volcanics to be present.

11.2.4 Previously recorded sites

A desktop search was conducted on the following databases to identify any potential previously recorded heritage within the survey boundary. The results of this search are summarised in **Table 11-2** and presented in detail in **Appendix N.**

Table 11-2: Aboriginal cultural heritage desktop-database search results

Database	Type of search	Results
Commonwealth Heritage Listings	Warrumbungle LGA	No places listed on either the National or Commonwealth heritage lists are located within the survey boundary or the broader wind farm site.
National Native Title Claims Search	NSW	The survey area includes land currently subject to Native Title Claim by the Gomeroi People (Tribunal File No. NC2011/006, Federal Court No. NSD2308/2011).
Heritage AHIMS	10 km search radius surrounding the project Boundary (GDA Zone 55: Eastings: 733435–766815, Northings: 6443765–6484705)	78 AHIMS sites were returned within the designated search area. Of these, thirteen are located within the wind farm site and two are located within the survey boundary.
Local Environmental Plan (LEP)	Warrumbungle LEP 2013	None of the Aboriginal places noted occur within or near the survey boundary or the broader wind farm site.

As noted in **Table 11-2** the Heritage NSW AHIMS database returned 78 results for Aboriginal sites within a 10 km search radius surrounding the wind farm site. Of the 78 registered sites only thirteen are located within the wind farm site and two are within the survey boundary (36-3-0111 and 36-3-0113). The most frequent site types recorded in the 10km radius of the wind farm site are rock shelter sites with PAD (approximately 20.5%) followed by artefact scatters, scarred trees, and rock shelters with art, each making up 16.7% of the overall site assemblage.

Of the thirteen registered sites within the wind farm site, five are rock shelters with deposit (36-3-0125, 36-3-0126, 36-3-0127, 28-6-0038 and 36-3-0088,), three are axe grinding grooves (36-3-0111 (with stone arrangement and water hole), 36-3-0113, and 28-6-0011) and two are artefact scatters (28-6-0034 and 28-6-0039).

There are also five rock shelters with PAD (28-6-0014, 28-6-0015, 28-6-0016, 28-6-0017 and 28-6-0018) within the site. The distribution of sites conforms to some expected patterns being that all sites are associated with watercourses of varying degrees and the highest densities of sites are located along the two major river systems which intersect the area (the Talbragar and Coolaburragundy Rivers) and the rock shelters are predominately recorded in clusters in the surrounding escarpment.

The survey boundary includes land currently subject to Native Title Claim by the Gomeroi People (Tribunal File No. NC2011/006, Federal Court No. NSD2308/2011). Claim applicants were invited to participate in the Aboriginal community consultation and were involved in the field survey.

11.3 Assessment of potential impacts

11.3.1 Predictive modelling

A model was formulated to broadly predict the type and character of Aboriginal cultural heritage sites likely to exist throughout the survey area and where they are more likely to be located. As numerous archaeological studies suggest, there is a high demonstrated correlation between the permanence of a water source and the permanence and/or complexity of Aboriginal occupation. Site location is also affected by the availability of and/or accessibility to a range of other natural resources including:

- plant and animal foods
- stone and ochre resources and rock shelters
- general proximity to other sites/places of cultural/mythological significance.

Consequently, sites tend to be found along permanent and ephemeral water sources, along access or trade routes or in areas that have good flora/fauna resources and appropriate shelter. Landscapes that provided ideal site locations typically involved crests or terraces that were associated, or within proximity, to a reliable water source such as the Talbragar or Coolaburragundy Rivers.

The predictive model for the study area is based on knowledge of settlement strategies, past land use, previously recorded sites type and patterns and landform modelling that has been described in **Section 11.2**. The predictive model for the site location also utilised the Aboriginal Site Decision Support Tool (ASDST). Based on the model, the following conclusions have been made by OzArk:

- as isolated finds can occur anywhere, particularly within disturbed contexts, it is predicted that this site type could be recorded within the survey area
- artefact scatters are one of the most recorded site types within the surrounding region. A general correlation between different types of watercourses and the nature of the evidence of past Aboriginal occupation is evident. The moderate to steeply sloping landforms within the survey area are unlikely to have been utilised for camping activities that result in artefact scatters. There are few locations of lower topographic areas associated with permanent or semi-permanent watercourses which would have higher archaeological potential for more complex and higher density scatters. It is therefore predicted that large, complex sites will not be present within the survey area.

- as no quarry sites have been recorded in the surrounding landforms, it is unlikely to be a common site type regardless of the presence of basalt and out cropping rock which both lend to suitable material for stone tool manufacture
- multiple grinding grooves have been previously recorded in the surrounding area, so where there is suitable outcropping rock, there is the possibility for there to be grinding grooves
- rock shelters are the most common Aboriginal feature within the surrounding region and have been recorded either in association with PAD or art but as there are limited areas of escarpment landforms within the survey area, rock shelters are not expected to be numerous
- burial sites are deemed unlikely given the topography, nature of the soils and geology and the levels of disturbance.

11.3.2 Sites recorded during the field survey

Five new Aboriginal sites were identified during the field survey. The location of one previously recorded AHIMS site (36-3-0111) was ground-truthed during the inspection. A summary of the Aboriginal cultural heritage sites recorded is provided in **Table 11-3** and **Figure 11-2** shows the location of the sites in relation to the wind farm site. Detailed descriptions of each site as well as photos of the identified sites are included in **Appendix N**.

It should be noted that during the field survey, along a proposed access track in the southeast of the Leadville cluster one of the site officers, Bareki Knox, noted a possible ring tree. The tree has been subject to fire damage and is dead. Mr Knox noted that he did not know whether it was a cultural ring tree as he was aware, they can be created naturally. Given the origin of the tree is unknown, it will not be recorded on the AHIMS data base, however management measures for the tree are included in **Section 11.4**.

Table 11-3: Aboriginal cultural heritage sites recorded during the survey

Site name and number	Feature/s	Landform	No. of artefacts and/or features
Orana OS-1	Artefact scatter with PAD	Elevated and flat	4
Old Farm OS-1	Stone quarry and artefact scatter with PAD	Crest/ ridgeline	10 recorded potential for over 100
Kensington OS-1	Artefact scatter	Drainage line, slope and flats	7
Cainbil Creek OS-1	Artefact scatter with PAD	Drainage line	4
The Rock IF-1	Isolated find	Bench of a slope, within drainage line	N/A

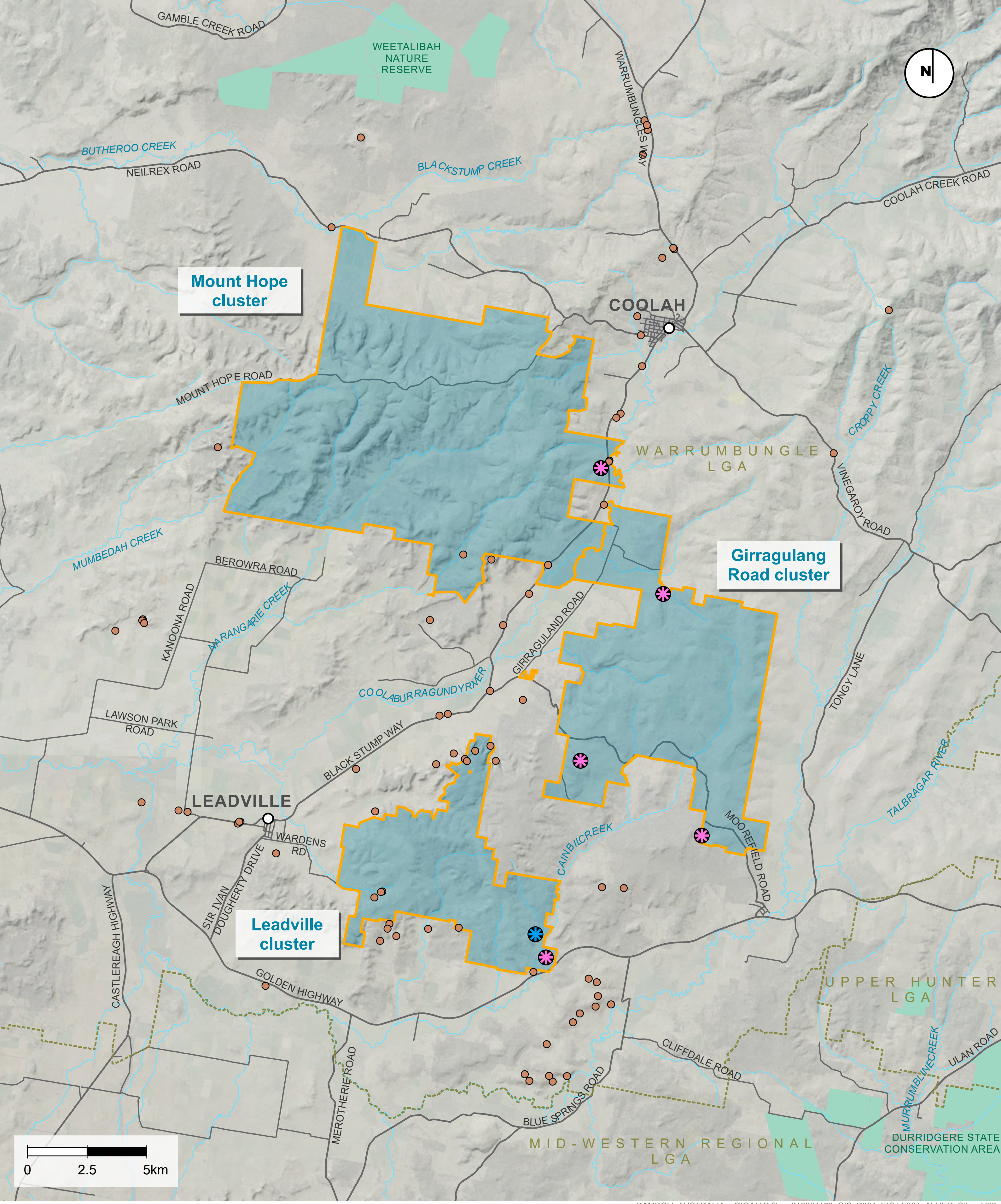
The survey resulted in five new Aboriginal sites being recorded. The sites inside the study area consist of one low-density artefact scatter (Kensington OS-1); two low-density artefact scatters with PAD (Orana OS-1 and Cainbil Creek OS-1), one quarry site incorporating an artefact scatter and PAD (Old Farm OS-1) and one isolated find (The Rock IF-1).

Previously recorded sites were plotted against variables relating to gradient of slope and distance to water. The four new sites have been plotted against the same variables and the following observations have been made:

- all sites were recorded were recorded in lower gradient undulating landforms. The remaining site (Old Farm OS-1) was recorded in the crest/ridgeline landforms.
- the correlation between drainage buffers and recorded sites is a little stronger than was seen with previously recorded sites, but it is still not a clear relationship
- Cainbil Creek OS-1 is on the immediate bank of Cainbil Creek and Orana OS-1 is within 100 m of Spicers Creek. Kensington OS-1 and The Rock IF-1 is within a Drainage 4 buffer, while Old Farm OS-1 plots outside of the drainage buffers.

The location of site 36-3-0111 was ground-truthed during the field survey, however, site 36-3-0113 was unable to be inspected as access had not been granted by the landowner. Ground-truthing the location of previously recorded site #36-3-0113 will be formally surveyed by archaeologists and RAPs following development consent.

Part of the un-surveyed portion of the overhead transmission line that comprises of lower gradient landforms and floodplains adjacent to the Talbragar River have increased potential to contain further Aboriginal objects or landforms with subsurface potential.



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Aerial photography from NSW Government Spatial Services

KEY

Wind farm site
Access track
Aboriginal site (OzArk)
Potential ring tree (OzArk)
AHIMS record (NSW DPIE)
LGA boundaries
National Parks and Reserves

Figure 11-2 | Aboriginal heritage sites

11.3.3 Significance assessment

The appropriate management of cultural heritage items is usually determined based on their assessed significance, as well as the likely impacts of any proposed developments. A significance assessment was undertaken to characterise the social or cultural, archaeological or scientific, aesthetic and/or historic values of the identified sites. The overall cultural heritage values of a site, place or area are resolved through the combination of these elements.

A summary of the significance assessment of Aboriginal cultural heritage sites recorded during the assessment is presented in **Table 11-4**. Further details of each of the assessment criteria are provided in **Appendix N**.

Table 11-4: Aboriginal cultural heritage: significance assessment

Site name	Social or cultural value	Archaeological / Scientific Value	Aesthetic Value	Historic Value
Orana OS-1	High	Low-moderate	Low	Nil
Old Farm OS-1	High	High	Moderate	Nil
Kensington OS-1	High	Low	Low	Nil
Cainbil Creek OS-1	High	Low-moderate	Low	Nil
The Rock IF-1	High	Low	Low	Nil

11.3.4 Impact to identified sites

A summary of potential impacts to Aboriginal cultural heritage associated with the project is presented in **Table 11-5**. All five sites recorded as part of this assessment are located within the survey boundary and therefore are liable to be impacted by the project.

Previously recorded AHIMS site #28-6-0009 is located just outside the project footprint and associated buffer so will not be harmed, however, it is still considered in the management measures proposed for the project.

Table 11-5: Aboriginal cultural heritage: significance assessment

Site name	AHIMS ID	Type of Harm (Direct/ Indirect / None)	Degree of Harm (Total/Partial / None)	Consequence of Harm (Total/Partial/No Loss of Value)	Potential for avoidance
Orana OS-1	28-6-0060	None	Partial	Partial loss of value	No loss of value
Old Farm OS-1	28-6-0061	None	Partial	Partial loss of value	No loss of value
Kensington OS-1	36-3-3805	None	Total	Total loss of value	No loss of value
Cainbil Creek OS-1	36-3-3806	Direct	Partial	Partial loss of value	High
The Rock IF-1	TBC	Direct	Total	Total loss of value	Total loss of value
Argyll No.3	36-3-0011	None	None	No Loss of Value	N/A

Site name	AHIMS ID	Type of Harm (Direct/ Indirect / None)	Degree of Harm (Total/Partial / None)	Consequence of Harm (Total/Partial/No Loss of Value)	Potential for avoidance
Argyll No.1	36-3-0113	None	None	No loss of value	N/A

11.3.5 Unanticipated finds

It is possible further artefact sites would be present inside the study area. Such sites are most likely to include isolated finds located adjacent to waterways in the lower gradient landforms or landforms with subsurface potential which require assessment. Quarry sites, stone procurement sites and burials are not expected to occur within the study area.

An unanticipated finds protocol will be included in the Aboriginal cultural heritage management plan (ACHMP), which will be developed in consultation with the Department. The ACHMP will contain procedures should a new discovery of significant historic artefacts or items be made during construction or operation of the project.

11.3.6 Construction

The five newly recorded sites and two previously recorded AHIMS sites are located within the survey area and therefore are liable to be impacted by construction works.

Cainbil Creek OS-1 is within the location the access track which extends from the Golden Highway leading to the southeast of the Leadville cluster. The site would likely be partially impacted by the construction of the access track. Although the track would follow the alignment of an existing graded road, it is likely that further ground surface disturbance work would be required to allow access across Cainbil Creek. This site cannot be completely avoided by the project, however is considered to have low-moderate archaeological value and low aesthetic value. The social or cultural value of the site is considered high.

The Rock IF-1 is located along a proposed access track which extends from Black Stump Way to the east of the Mount Hope cluster and is unable to be avoided by the project. Surface collection will be undertaken of all surface artefacts within the construction impact area.

Inadvertent impacts to five sites may occur during construction of the transmission line. Orana OS-1 is located under the proposed overhead transmission lines which connect Girragulang Road cluster to Mount Hope cluster and Kensington OS-1 is sited within the location of the transmission line south of the Girragulang Road cluster.

Old Farm OS-1 is located to the west of a proposed access track and electrical reticulation associated with turbines GR40 and GR39, which have been moved with the objective to avoid direct impacts to the Old Farm OS-1 site.

The construction impacts of the transmission line including the location of towers and associated access tracks could possibly be avoided through design considerations of the ground works required to support the overhead power lines and the implementation of the mitigation strategies outlined in **Section 12.4** below.

The location of previously recorded AHIMS site 36-3-0113 will be assessed following development consent and its location will be considered for the design of the overhead transmission line to ensure it will not be impacted by the project.

The safeguards outlined in **Section 11.4** below together with the above-mentioned design considerations will minimise the potential for the sites to be directly impacted by ground surface disturbance and retain aesthetic values in the context of the landscape.

11.3.7 Operation

No additional impacts to Aboriginal cultural heritage are anticipated during operation of the project. However, the unanticipated finds procedure would apply to any works involving ground disturbance.

11.3.8 Decommissioning

No additional impacts to Aboriginal cultural heritage are anticipated during decommissioning of the project. However, the unanticipated finds procedure would apply to any works involving ground disturbance.

11.4 Environmental management and mitigation measures

Proposed measures to manage and/or mitigate heritage impacts from the project are detailed in **Table 11-6.**

Table 11-6: Management and mitigation measures – Aboriginal heritage

ID	Management/mitigation measure	Timing
AH1	The unassessed areas within the survey boundary shown in **Figure 11-2** will be formally surveyed by archaeologists and RAPs post approval. The survey will include ground-truthing the location of previously recorded AHIMS location for site 36-3-0113.	Prior to construction
AH2	UPC\AC will develop an ACHMP which is to be agreed to by the RAPs and DPIE. The ACHMP will include an unanticipated finds protocol, unanticipated skeletal remains protocol and long-term management of any artefact.	Prior to construction
AH3	Transport route modifications associated with transporting project components from Newcastle Port along the Golden Highway to the wind farm site will be assessed for impacts to Aboriginal heritage sites.	Prior to construction
AH4	The design of the transmission line will ensure that the areas of PAD associated with Cainbil Creek OS-1 are spanned and that any associated access tracks avoid the areas of PAD.	Detailed design
AH5	Collection of all surface artefacts at Cainbil Creek OS-1 and The Rock IF-1 will be undertaken by an archaeologist. The methodology of the surface artefact collection will be contained in the ACHMP that will be reviewed by RAPs.	Prior to construction
AH6	The remainder of the site extent of Cainbill Creek OS-1 that will not be impacted by the project will be fenced with hi-visibility fencing prior to works commencing in the vicinity of the site. The fencing will remain in place for the duration of construction in the vicinity of the site.	During construction
AH7	Orana OS-1, Old Farm OS-1, Kensington OS-1, site 36-3-0111 and the potential ring tree shown in **Figure 11-2** will be avoided. The site extent of each site will be fenced with hi-visibility fencing prior to works commencing in the vicinity of the site. The fencing will remain in place for the duration of construction in the vicinity of the site.	During construction
AH8	Additional research will take place at Old Farm OS-1. This will involve non-invasive recording, mapping, and photography.	Prior to construction

ID	Management/mitigation measure	Timing
AH9	All land-disturbing activities will be confined to within the survey boundary. Should the parameters of the proposed work extend beyond this, then further archaeological assessment will be required.	During Construction

12. HISTORIC HERITAGE

12.1 Assessment methodology

12.1.1 Assessment approach

A heritage impact statement (HIS) has been prepared by OzArk. The report is provided in full in **Appendix O.**

The purpose of the HIS is to meet the following objectives:

- to identify whether historical heritage items or areas are, or are likely to be, present within the survey boundary
- to assess the significance of any recorded historical heritage items or areas
- determine whether the project is likely to cause harm to recorded historical heritage items or areas
- provide management recommendations and options for mitigating impacts.

A desktop search was conducted on 25 January 2021 to identify any potential previously recorded heritage within the survey boundary. The following databases were included in the search:

- National and Commonwealth Heritage Listings
- SHR
- Historic Heritage Information Management System (HHIMS)
- Warrumbungle Shire Council LEP 2013.

The field assessment of the survey area was undertaken by a team of OzArk Senior Archaeologists and heritage specialists over ten days from 17–21 May and 24–28 May 2021 (two weeks), concurrently with the ACHAR. The project team comprised Stephanie Rusden and Brendan Fisher in both week 1 and week 2 and Dr Jodie Benton and Harrison Rochford in week 1 only.

The survey area was assessed using standard archaeological field survey and recording methods (Burke and Smith 2004).

12.1.2 Statutory context, policy and guidelines

The heritage assessment has been undertaken in accordance with the following statutory documents:

- Burra Charter 2013 (Australia International Council on Monuments and Sites (ICOMOS) 2013)
- Part 4 of the EP&A Act
- The EPBC Act by way of the National Heritage List and Commonwealth Heritage List established under the Act
- Heritage Act.

The historic heritage assessment has been undertaken in accordance with the Heritage Council's *Historical Archaeology Code of Practice* (Heritage Council, 2006).

12.2 Existing environment

12.2.1 Historic context

The wind farm site is situated within the traditional lands of the Kamilaroi (also termed Gamilaraay) and the Wiradjuri people. The region was initially explored by John Oxley in 1817–1818.

Coolah was colonially settled by pastoralists in the 1830s and was a base of the Crown Land Commission and the Border Police from 1839 to 1851, and in 1849 the Coolah Post Office was opened. A railway branch was extended to the town from 1920 to 1975. Early settlement in the region was likely to have been largely unregulated and unlawful.

Leadville is a village located 32 kilometres south of Coolah that was created by private subdivision. In the colonial period, Leadville was settled in 1877 by mine owners and was originally known as "Hobbins' Dam' after Martin Hobbins, one of the early settlers in the area. The town was developed in 1891 to support the local mining industry. Copper, lead, zinc, silver, and gold mineralisation. The town settlement was initially called Slabtown, however, Leadville was chosen during the petition for a post office. A post office, telegraph office, police station, general store, two churches, and a hall were erected in the town and solider settlements developed from the 1920s onwards.

12.2.2 Land use context

Most of the wind farm site has been modified by historical land use practices including vegetation clearing, manual and machine rock-picking, cropping, and livestock grazing. The properties that make up the wind farm site are primarily used for sheep and cattle grazing. Some paddocks are subject to cropping for pasture improvement and cropping is dominant along the lower slopes and floodplains of the Talbragar and Coolaburragundy Rivers.

Due to the sloping and elevated nature of the survey area, if historical sites are present, they are more likely to be vernacular items associated with agriculture/pastoralism. Larger settlements are likely to be associated with flatter, more well-watered landforms outside the survey area, associated with the Talbragar and Coolaburragundy Rivers.

12.2.3 Previously recorded sites

A desktop search was conducted on the following databases to identify any potential previously recorded heritage within the survey area. The results of this search are summarised in **Table 12-1** and presented in detail in **Appendix O**.

Table 12-1: Historic heritage desktop-database search results

Database	Type of search	Results
National and Commonwealth Heritage Listings	NSW	No places listed on either the National or Commonwealth heritage lists are located within the study area
SHR	Warrumbungle LGA	No items on the SHR are located within or near the survey boundary
Section 170 Register	Warrumbungle LGA	No items on the Section 170 Register are located within or near the survey boundary
LEP	Warrumbungle LEP 2013	No items on the Warrumbungle LEP are located within or near the wind farm site

As noted in **Table 12-1**, no records for historical heritage sites are recorded in the survey area. The closest place on the National Heritage List to the project is Item 105696 (The Greater Blue Mountains Area - Additional Values) that is located over 16 kilometres to the southeast.

On the SHR, the Old Police Station & Courthouse at Coolah (Item 00048) and the Dunedoo Railway Station and yard group (Item 01134) are located 790 metres and 27 kilometres from the wind farm site, respectively.

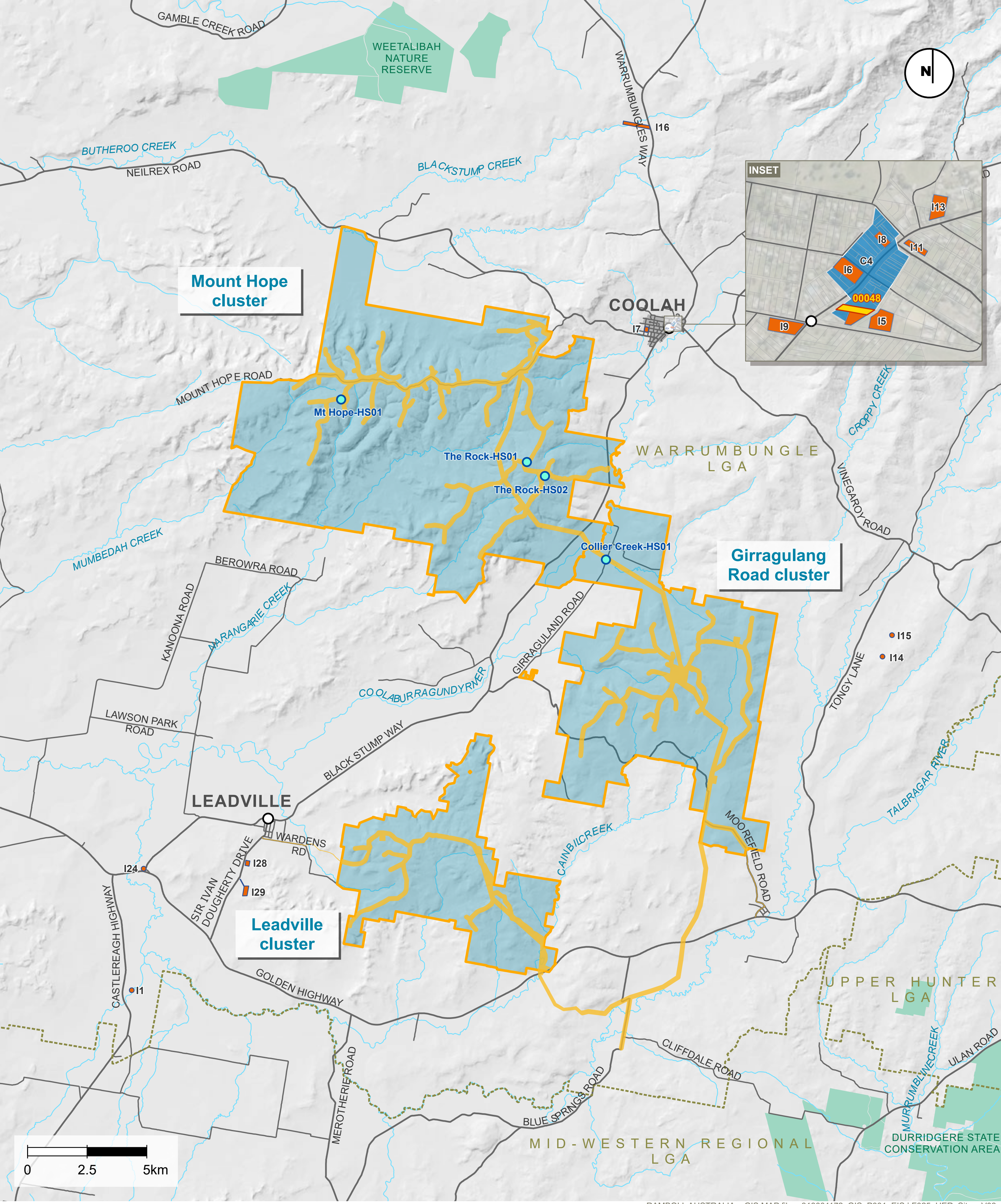
Locally, the closest places listed on the Warrumbungle LEP are the Coolah General Cemetery (Item I7) and the Leadville General Cemetery (Item I28). These items are located 150 metres and 1.2 kilometres from the project.

12.2.4 Sites recorded during the field survey

Four new historic heritage items were identified during the survey. A summary of the historic heritage sites recorded is provided in **Table 12-2**, and **Figure 12-1** shows the location of the sites in relation to the survey area. Detailed descriptions of each site as well as photos of the identified sites are included in **Appendix O**.

Table 12-2: Historic heritage sites recorded during the survey

Site name and number	Type of heritage item	Location
Mount Hope-HS01	Trigonometrical station	Mount Hope Cluster, on the crest along a ridgeline approximately 762m directly south of Mount Hope Road. Less than 50m south of proposed access track and outside of 100m turbine buffer (MH57)
The Rock-HS01	Trigonometrical station	Mount Hope Cluster, on the crest along a ridgeline approximately 3.4 km directly west of Black Stump Way and 4 km directly south of Mount Hope Road. Less than 50m east of proposed access track and approximately 50m north west of underground reticulation and outside of 100m turbine buffer (MH20)
The Rock-HS02	Unknown rural structure	Mount Hope Cluster, on the crest of a ridgeline, approximately 410 m east of Bowenbong Creek, 1.5 km southwest of Paddys Knob, and 4.9 km west of Black Stump Way. Approximately 50m west of proposed underground reticulation and outside of 100m turbine buffer (MH4 and MH5).
Collier Creek-HS01	Rail bridge	Along a disused railway line where it crosses over Collier Creek within Girragulang cluster leading to Mount Hope Cluster and approximately 100m south of the proposed overhead transmission line.



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Aerial photography from NSW Government Spatial Services

KEY

- Wind farm site
- Survey boundary
- Recorded heritage item (OzArk)
- SHR item (Dept. Premier and Cabinet)
- LEP heritage items (DPIE)
  - Item - General
  - Conservation Area - General
- LGA boundaries
- National Parks and Reserves

Figure 12-1 | Identified historical heritage sites

The four identified historic items have been assessed as having no historic heritage significance under the current Heritage NSW guidelines and the Burra Charter as they do not meet the assessment criteria to demonstrate collective, aesthetic, technological and/or natural significance.

12.3 Assessment of potential impacts

All recorded historic heritage items are located within the survey boundary. They will be avoided where feasible, despite being assessed as having no heritage significance.

12.3.1 Unanticipated finds

It is possible further artefact sites would be present inside the survey boundary. However, given the number of previous historic heritage assessments completed for the LGA, the nature of settlement in the district, resulting in agricultural/pastoral land disturbances and very low housing densities there is an overall low level of heritage significance attached to the new recordings.

Regardless, an unanticipated finds protocol will be included in the historical heritage management plan (HHMP), which will be developed in consultation with the Department. The HHMP will contain procedures should a new discovery of significant historic artefacts or items be made during construction or operation of the project.

12.3.2 Construction

Consideration will be given to the following project elements with the objective to avoid impacts to the four recorded sites:

- Mt Hope-HS01: access track immediately north of the item
- The Rock-HS01: access track to the northwest and the underground reticulation to the southeast of the item
- Mt Hope-HS02: underground reticulation to the east of the item
- Collier Creek-HS01: spanning the overhead transmission line over the item and that access tracks are kept away from the bridge.

The safeguards outlined in **Section 12.4** , together with the above-mentioned design considerations would minimise the potential for the sites to be directly impacted by construction of the project. Although this is the case, if any of the items are unable to be avoided, no mitigation measures are required as the items have been determined to have no heritage significance.

12.3.3 Operation

No additional impacts to historic heritage are anticipated during operation of the project. However, the unanticipated finds procedure would apply to any works involving ground disturbance.

12.3.4 Decommissioning

No additional impacts to historic heritage are anticipated during decommissioning of the project. However, the unanticipated finds procedure would apply to any works involving ground disturbance.

12.4 Environmental management and mitigation measures

Proposed measures to manage and/or mitigate heritage impacts from the project are detailed in **Table 12-3**.

Table 12-3: Management and mitigation measures – historic heritage

ID	Management/mitigation measure	Timing
HH1	A historical heritage management plan (HHMP) will be developed in consultation with the Department and will contain procedures should a new discovery of significant historic artefacts or items be made during construction or operation of the project.	Prior to construction
HH2	The location of each item should be considered when finalising the design for the access tracks, the overhead transmission line and the underground reticulation location as outlined in **Section 12.3.2.**	Detailed design
HH3	Mt Hope-HS01 and The Rock-HS01 will be avoided.	Prior to construction
HH4	Areas where access was not permitted during the field survey (Figure 5-2 of the HIS), will be assessed prior to any construction associated with the project taking place.	Prior to construction
HH5	All historic heritage items close to construction works will be temporarily demarcated with a 10m buffer around the item extent.	During construction
HH6	If items of historic heritage significance are uncovered, then an unanticipated finds protocol for historic heritage will be implemented as required. The Unanticipated Finds Protocol for Historic Heritage will be guided by section 6.4 of the HIS (**Appendix O**) and included in the HHMP.	During construction
HH7	To avoid the potential for harm to historic objects on unassessed adjacent landforms, all ground surface disturbing activities will be confined to the impact footprint outlined in this EIS.	During construction

13. WATER AND SOILS

13.1 Assessment methodology

13.1.1 Assessment approach

An assessment of the water and soil (including contamination) environment has been undertaken for the project. The methodology for the water and soil assessment included the following:

- desktop review to define the existing environmental conditions of the wind farm site including:
  - review of rainfall and evaporation data relevant to the wind farm site
  - identification of catchments, watercourses and water sources (surface and groundwater)
  - review of existing water quality data
  - review of relevant soil and geology mapping including soil landscapes and acid sulfate soils (ASS)
- quantification of water demand and water supply arrangements
- identification of any likely impacts to:
  - waterfront land
  - water quality and quantity of surface and groundwater resources
  - other water users
  - soil quality
- identification of water and soil management measures required for the project.

13.1.2 Statutory context, policy and guidelines

The water and soils assessment has been undertaken in accordance with the following statutory documents:

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia (www.waterquality.gov.au/anz-guidelines) (ANZG, 2018)
- Guidelines for Fresh and Marine Water Quality (ANZECC, 2000) (ANZECC Guidelines)
- NSW Water Quality and River Flow Objectives (NSW Environment, Energy and Science, 2006) (Water Quality and River Flow Objectives)
- Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions (Office of Environment and Heritage, 2017)
- Guidelines for Controlled Activities on Waterfront Land (Department of Primary Industries, 2018)
- Guidelines for riparian corridors on waterfront land (NSW Office of Water, 2012)
- Australian Rainfall and Runoff: A Guide to Flood Estimation (Ball J, 2019) (ARR 2019)
- NSW Floodplain Development Manual (Department of Infrastructure, Planning and Natural Resources, 2005)
- Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Department of Primary Industries, 2003)
- Policy & Guidelines for Fish Habitat Conservation & Management (Department of Primary Industries, 2013)
- Managing urban stormwater: soils and construction, vol. 1 (Landcom, 2004)
- Managing Urban Stormwater: Soils and construction, vol. 2 (A, C, D, E) (Department of Environment and Climate Change, 2008).

The Water Quality and River Flow Objectives provide environmental values for NSW waters and the ANZECC 2000 Guidelines provide the technical guidance to assess the water quality needed to protect those values. The criteria used in the Water Quality and River Flow Objectives are based on the ANZECC 2000 Guidelines default values, which can be used where site-specific values are not known.

The ANZECC 2000 Guidelines were revised in 2018 by the online Water Quality Guidelines resource (ANZG, 2018) as part of the broader review of the National Water Quality Management Strategy. However, water quality guidance for primary industries, including livestock drinking water and irrigation water, are still under review and the ANZECC (2000) Guidelines are still utilised in the interim. It is anticipated that there will be no default trigger values in the revised guidelines for 'Basin States' as it is expected that regional water quality targets would be developed for these areas as part of other water planning processes. The Macquarie-Castlereagh catchment (which applies to the wind farm site) is within a 'Basin State' (being the Murray-Darling Basin) identified as water resource area 'SW11'.

The *Macquarie–Castlereagh Water Resource Plan* (2019) (WRP) has been developed for SW11 by the Department of Planning, Industry and Environment and submitted to the Murray-Darling Basin Authority for assessment. The WRP sets water quality targets for SW11 that are aligned with The Basin Plan for the Murray-Darling Basin.

The hydrological assessment was undertaken in accordance with the ARR 2019 and with consideration of the relevant provisions of the NSW Floodplain Development Manual (2005). The mapping within the ARR 2019 is consistent with the NSW Floodplain Development Manual (2005) but provides additional detail and updated recommendations on hazard category thresholds.

13.2 Existing environment

13.2.1 Rainfall and evaporation

The nearest Bureau of Meteorology (BOM) meteorological stations that provides long-term climate statistics are the Dunedoo Post Office (station number 064009) located approximately 16 kilometres west of the wind farm site and the Cassilis (Dalkeith) (station number 062009) located approximately 18 kilometres east of the wind farm site. The Dunedoo Post Office station has data from 1912 to 2021. The Cassilis (Dalkeith) station has data from 1874 to 2021.

A summary of the rainfall statistics is provided in **Table 13-1**.

Table 13-1: Summary of rainfall statistics

Station	Average annual rainfall (mm)	Mean annual number of days of rain	Highest mean rainfall month (mm)	Lowest mean rainfall month (mm)
Dunedoo Post Office	612.9	62.9	January (69.7)	August (39.8)
Cassilis (Dalkeith)	623.9	63.4	January (72.5)	May (39.1)

Source: (Bureau of Meterology, 2021)

The average annual evaporation across the wind farm site is estimated to be between 1,600 and 1,800 millimetres per year (Bureau of Meterology, 2021).

13.2.2 Hydrology

Catchments and water sources

The wind farm site is within the Macquarie-Castlereagh catchment, part of the Murray-Darling Basin. The Macquarie-Castlereagh catchment covers more than 75,000 square kilometres in the central west of NSW (NSW DPIE, 2020). The catchment supports a diverse range of industry including agriculture, agribusiness, tourism, mining and viticulture. Extensive livestock grazing accounts for 70 to 80 percent of the land area in the catchment (Murray-Darling Basin Authority, 2021).

The major water storages in the Macquarie-Castlereagh catchment include:

- **Burrendong Dam (1,190 gigalitres)** – located over 80 kilometres south-west of the wind farm site. As of June 2021, Burrendong Dam was 57.9 percent full and rising (NSW DPIE, 2021)
- **Windamere Dam (353 gigalitres)** – located over 75 kilometres south-east of the wind farm site. As of June 2021, Windamere Dam was 33.9 percent full and steady (NSW DPIE, 2021)
- **Oberon Dam (45 gigalitres)** – located over 180 kilometres south-east of the wind farm site
- **Ben Chifley Dam (31 gigalitres)** – located over 170 kilometres south of the wind farm site
- **Suma Park Reservoir (18 gigalitres)** – located over 140 kilometres south of the wind farm site.

Surface water sharing plans that apply to the wind farm site are shown on **Figure 13-1**. Surface water at the wind farm site is managed under:

- **Water Sharing Plan for the Macquarie Bogan Unregulated and Alluvial Water Sources 2012**:
  - Upper Talbragar Water Source – over the Girragulang Road cluster, Leadville Cluster and along the eastern boundary of the Mount Hope Cluster
  - Lower Talbragar Water Source – over the south-western portion of the Mount Hope Cluster
- **Water Sharing Plan for the Castlereagh Unregulated and Alluvial Water Sources 2011** (Binnaway to Gilgandra Water Source) – over the north-western portion of the Mount Hope Cluster.

Important wetland environments in the catchment include the Macquarie Marshes and the privately owned Wilgara Wetland and Mole Creek which are Ramsar-listed sites. Ramsar-listed wetlands are discussed in more detail in **Chapter 8**.

Watercourses

Coolaburragundy River is the major watercourse in the area and traverses between the Mount Hope cluster and the Girragulang Road cluster (excluded from the wind farm site). It is a perennial stream that is part of the Murray–Darling basin, rising from the south-western slopes of the Liverpool Range, flowing south-west before reaching its mouth at the confluence with the Talbragar River near Leadville. The river is usually dry however an aquifer lies below the Coolaburragundy Valley between Coolah and Dunedoo (Department of Sustainability, Environment, Water, Population and Communities, 2009).

Talbragar River is a major tributary of the Macquarie River. The Macquarie River is one of three major rivers within the Macquarie-Castlereagh catchment, approximately 960 kilometres in length. The Macquarie River rises in the Great Dividing Range near Bathurst and flows north-west through foothills and slopes past Wellington and towards Dubbo. After Dubbo the river crosses alluvial plains, passing Narromine and Warren to meet the Barwon River, upstream of Brewarrina (Murray-Darling Basin Authority, 2021).

Watercourses present in the wind farm site are shown on **Figure 13-1**. Several smaller tributaries cross the wind farm site comprise 1st, 2nd, 3rd and 4th order Strahler streams and ephemeral creeks. The Strahler stream order system, used by DPIE to describe the hierarchy of streams from the top to the bottom of the catchment base, is based on the confluence (joining) of streams of the same order (for example each time two tributaries of the same order join together then the river goes up in order). The main watercourses traversing the wind farm site are listed in **Table 13-2,** including their Strahler Stream Order as mapped by Spatial Services NSW.

Table 13-2: Main watercourses traversing the wind farm site

Watercourse	Strahler Stream Orders	Location
Oliver Creek	1, 2, 3	Mount Hope cluster
Rock Gully	2	Mount Hope cluster
Bowenbong Creek	1, 2, 3, 4	Mount Hope cluster
Miangulliah Creek	1, 2, 3, 4	Mount Hope cluster
Wallambriwang Creek		Mount Hope cluster
Mumbedah Creek	2, 3, 4	Mount Hope cluster
Collier Creek	4	Girragulang Road cluster
Spring Creek	1, 3	Girragulang Road cluster
Deep Creek	2, 3, 4	Girragulang Road cluster
Branch Creek	2, 3, 4	Girragulang Road cluster
Cainbil Creek	2, 3, 4, 5	Girragulang Road cluster / Leadville cluster
Moretonbay Creek	2, 3, 4	Leadville cluster
Hobbins Gully	2, 3	Leadville cluster
Back Creek	1, 2, 3	Leadville cluster
Pine Creek	2, 3	Leadville cluster

The Coolaburragundy Creek and Talbragar River are Key Fish Habitat (KFH) for Eel-tailed Catfish and Purple Spotted Gudgeon. There are numerous named and unnamed drainages across the study area that are KFH for Purple-spotted Gudgeon only. KFH in relation to the project is further assessed in **Chapter 8.**

Water quality

The investigations were unable to identify any routine water quality monitoring that has been undertaken within or in the area immediately surrounding the wind farm site that provide site-specific values. As site-specific data is not available for the project, a review of regional water quality has been undertaken.

The Basin Plan – Water quality technical report for Macquarie Castlereagh surface water resource plan area (SW11) (NSW Department of Planning, Industry and Environment, 2020) provides water quality data for the Macquarie-Castlereagh catchment. Water quality data is provided for 2007 to 2015. The report found that water quality in the catchment varies from poor to excellent.

The Talabraga at Elong Elong (site ID 421042) is the closest surface water monitoring site to the wind farm site. It receives water from the Coolaburragundy River which traverses between the Mount Hope cluster and the Girragulang Road cluster. It is located about 50 kilometres downstream of the wind farm site west of Dunedoo. Water quality at the Talabraga at Elong Elong site scored as 'poor' on the water quality index score (NSW Department of Planning, Industry and Environment, 2020), however monitoring at this location ceased in 2012. The major water quality issues include:

- harmful algal blooms
- dissolved oxygen less than normal ranges
- increased nutrients and turbidity
- toxicants and pesticides (there is no current monitoring data on the presence of toxicants, pesticides and agricultural chemical residues in the Macquarie-Castlereagh catchment, but the area has a long history of gold mining and agriculture, and it is assumed that there is a risk toxicants and pesticides are present in waterways in some areas)
- thermal pollution
- disruption to organic cycling.

Table 13-3 provides a comparison of:

- the water quality targets set in Schedule H to the WRP (currently under assessment by the Murray-Basin Authority)
- the water quality criteria outlined in the Water Quality and River Flow Objectives and ANZECC 2000 Guidelines (set to be replaced by the WRP as a Basin State)
- water quality data for the Talabraga at Elong Elong (site ID 421042) monitoring site from 2007 to 2015 (latest reported data available).

The latest data indicates that the Talabraga at Elong Elong site regularly exceeds the criteria for most water quality indicators (with the exception of dissolved oxygen and pH).

Table 13-3: Water quality criteria and comparison to data for the Talabraga at Elong Elong monitoring site

Indicator	Units	WRP criteria[1]	Water Quality and River Flow Objectives & ANZECC 2000 criteria[2]	Water quality summary statistics for the Talabraga at Elong Elong site (2007-2015)		
				Mean	Min	Max
Turbidity	NTU	20	2-25	89.8	5.2	509
Total phosphorus	µg/L	35	20	231	62	754
Total nitrogen	µg/L	600	250	1020	240	2700
Dissolved oxygen	mg/L	>8	-	-	-	-
	% saturation	90-110	90–110	75.4	48.8	106
pH	pH units	7.0-8.0	6.5–8.0	7.7	7.1	8.3
Salinity	µS/cm	-	30–350	896	244	1774

Notes:

[1]The WRP criteria listed is for zone B3 (upland zone) which applies to the wind farm site.

[2]The Water Quality and River Flow Objectives & ANZECC 2000 criteria listed is for upland uncontrolled streams within the Macquarie-Bogan catchment which applies to the wind farm site.

- Indicates where data or criteria is not available.

13.2.3 Flooding

The highest order (Strahler) waterway within the wind farm site is the Coolaburragundy River, located between the Mount Hope and the Girragulang Road clusters. The Talbragar River is located immediately south east of the Girragulang Road cluster, where the project transmission line is proposed. Named creeks within the wind farm site are included **Table 13-2**. Many of these creeks are ephemeral and only flow after significant rainfall.

Flood mapping included in the Warrumbungle Shire LEP indicates areas of flood prone land in the township of Coolah but not across the wind farm site. Additional flood mapping information was not available for the LGA.

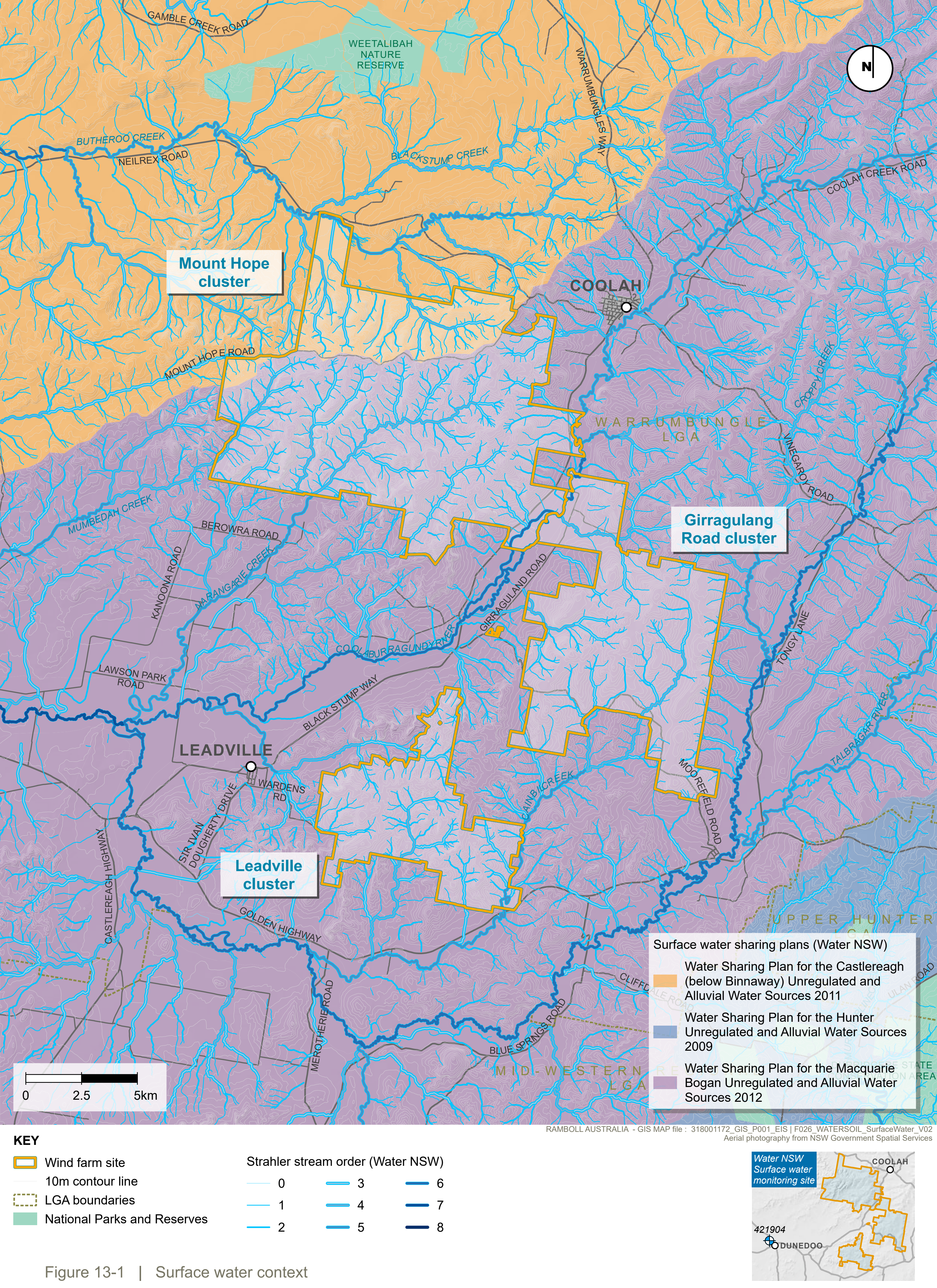


Figure 13-1 | Surface water context

13.2.4 Groundwater

Groundwater sources

Groundwater at the wind farm site is managed under:

- ***Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2020*** (Liverpool Ranges Basalt MDB Groundwater Source (LRBMDB)) – over the majority of the Girragulang Road cluster area and the Mount Hope cluster
- ***Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2020:***
  - Sydney Basin MDB Groundwater Source – over the remainder of the Girragulang Road cluster area and the majority of the Leadville cluster
  - Gunnedah-Oxley Basin MDB Groundwater Source – over a small portion of the Mount Hope cluster in the north-west
  - Lachlan Fold Belt MDB Groundwater Source – over the remainder of the Leadville cluster.

The LRBMDB includes rules for protecting the environment, extractions, managing licence holders' water accounts, and water trading in the plan area. Groundwater extraction is not proposed for the project.

The LRBMDB covers an area of 286,000 hectares. The Liverpool Ranges volcanic lava-field province comprises alkali basalt formed 70 to 30 million years ago. The ranges start from the volcanic plateau of Barrington Tops and runs for approximately 100 km westwards, forming the northern boundary of the Hunter Valley district. Parts of the Liverpool Range from the watershed between the coastal and inland drainage of New South Wales and thus form a component of the Great Dividing Range. The western end of the Liverpool Range merges into the Warrumbungle Range

The Sydney Basin MDB Groundwater Source (which comprises the portion on the eastern side of the MDB extending southward along the MDB border to nearly Bathurst). This covers an outcrop area of 212,000 hectares and a subcrop area of 62,200 hectares. It is a sedimentary structurally controlled sub-basin of the larger Sydney-Bowen Basin extending from Durras, just north of Batemans Bay, to Port Stephens and inland to Lithgow. The western and southern boundary is the unconformity with the Lachlan Fold Belt. The north east boundary is defined by the Hunter Thrust, with the Hunter Valley Dome being included. The northwest boundary remains in dispute but is considered to be along the Mount Coricudgy Anticline. The southeast extent of the basin borders the Pacific Ocean.

Registered groundwater bores

Registered groundwater bores from the BOM Groundwater Explorer (Beauru of Meterology, 2021) within five kilometres of the wind farm site. For the purposes of the bore search five kilometres was assumed from the outer edge of a circle which encompassed all project clusters.

The wells are shown on **Figure 13-2**. A list of the functioning bores within five kilometres of the wind farm site is provided in **Table 13-4**, along with the bore depth, drilled date, purpose and salinity where available.

Table 13-4: Functioning groundwater bores within 5 kilometres of the wind farm site

Bore ID	Bore Depth (m)	Drilled Date	Purpose	Salinity (μS/cm)
GW016265.1.1	15.2	1928-02-01	Stock and Domestic	
GW044138.1.1	9.1	Unknown	Stock and Domestic	356
GW033594.1.1	38.4	1971-01-01	Unknown	
GW804998.1.1	90	2013-01-08	Water Supply	
GW017594.1.1	6.1	1959-01-01	Unknown	
GW806022.1.1	17	2018-07-26	Stock and Domestic	
GW038042.1.1	21.3	1975-04-01	Water Supply	1420
GW016267.1.1	19.8	1954-10-01	Unknown	
GW016269.1.1	21.3	1938-01-01	Stock and Domestic	
GW802302.1.1	15.5	2004-05-03	Stock and Domestic	
GW804074.1.1	6.2	2009-11-27	Monitoring	
GW022191.1.1	73.2	1964-01-01	Water Supply	
GW805611.1.1	120	2014-10-01	Stock and Domestic	
GW060368.1.1	18	1986-09-01	Water Supply	1540
GW805875.1.1	42	2018-04-18	Stock and Domestic	
GW032161.1.1	7	Unknown	Unknown	
GW803055.1.1	64	2006-02-22	Stock and Domestic	
GW803525.1.1	54	2007-11-27	Stock and Domestic	
GW805906.1.1	78	2017-02-28	Stock and Domestic	
GW805906.1.0	78	2017-02-28	Stock and Domestic	
GW055137.1.1	8	Unknown	Unknown	
GW013344.1.1	45.7	1956-01-01	Water Supply	
GW009327.1.1	29	Unknown	Water Supply	
GW010685.1.1	60.3	1953-03-01	Water Supply	
GW050339.1.1	24	Unknown	Unknown	1760
GW039559.1.1	20	1995-09-20	Irrigation	768
GW017593.1.1	4.3	1959-01-01	Unknown	
GW014945.1.1	96	1964-01-01	Water Supply	1900[1]
GW038923.1.1	158.4	Unknown	Water Supply	
GW801461.1.1	49	1998-06-15	Commercial and Industrial	1056
GW027128.1.1	12.2	1910-01-01	Water Supply	
GW806034.1.1	17	2018-07-10	Stock and Domestic	

Bore ID	Bore Depth (m)	Drilled Date	Purpose	Salinity (µS/cm)
GW804395.1.1	10	2010-03-29	Water Supply	
GW800618.1.1	122	1968-01-01	Water Supply	
GW026376.1.1	85.3	1967-01-01	Stock and Domestic	
GW805241.1.1	54	2013-12-10	Stock and Domestic	
GW800619.1.1	34	1970-01-01	Stock and Domestic	
GW059610.1.1	25	1983-02-01	Stock and Domestic	
GW015864.1.1	17	1900-01-01	Water Supply	
GW055775.1.1	36	1982-05-01	Water Supply	
GW805085.1.1	6	2012-11-14	Monitoring	
GW804161.1.1	24	2010-01-12	Water Supply	
GW801508.1.1	17.68	2001-12-12	Water Supply	
GW049325.1.1	8.5	1979-02-01	Water Supply	
GW022999.1.1	27.4	1965-10-01	Stock and Domestic	3745[1]
GW019294.1.1	27.4	1961-07-01	Stock and Domestic	
GW050375.1.1	60.9	Unknown	Unknown	
GW016268.1.1	12.2	1938-03-01	Unknown	
GW027185.1.1	24.4	1952-01-01	Stock and Domestic	
GW024403.1.1	33.5	1965-01-01	Unknown	
GW049198.1.1	12.2	1970-01-01	Water Supply	
GW007030.1.1	34.7	1945-04-01	Irrigation	
GW054503.1.1	16.5	1981-04-01	Water Supply	
GW065203.1.1	97.5	1988-03-10	Water Supply	
GW033595.1.1	11	1971-01-01	Unknown	
GW805984.1.1	127	2017-07-17	Water Supply	
GW017592.1.1	6.1	1959-01-01	Unknown	
GW803894.1.1	66	2006-10-19	Water Supply	
GW803441.1.1	86	2007-10-07	Water Supply	
GW002142.1.1	12.1	1927-08-01	Stock and Domestic	
GW802770.1.1	65	1997-09-30	Stock and Domestic	
GW805455.1.1	59.5	2014-09-25	Water Supply	
GW016273.1.1	26.8	1923-01-01	Water Supply	
GW805638.1.1	102	2015-06-17	Water Supply	
GW805433.1.1	19.5	2014-07-01	Water Supply	

Bore ID	Bore Depth (m)	Drilled Date	Purpose	Salinity (µS/cm)
GW805086.1.1	6	2012-11-14	Monitoring	
GW049481.1.1	6.1	1929-01-01	Unknown	
GW015863.1.1	27.4	1919-01-01	Stock and Domestic	
GW805090.1.1	60	2013-07-06	Stock and Domestic	
GW801190.1.1	54	1999-07-24	Stock and Domestic	800
GW014927.1.1	33.5	1963-08-01	Water Supply	
GW014935.1.1	121.9	1963-10-01	Water Supply	1111[1]
GW024404.1.1	16.5	1965-01-01	Unknown	
GW801013.1.1	48	1996-01-30	Other	
GW804437.1.1	50	2007-01-31	Water Supply	
GW803247.1.1	120	2006-06-20	Water Supply	
GW805170.1.1	84	2013-02-15	Water Supply	1500
GW805829.1.1	102	2015-06-17	Stock and Domestic	
GW803655.1.1	50	2008-03-27	Water Supply	
GW805423.1.1	45	2014-05-15	Water Supply	
GW044137.1.1	96	Unknown	Stock and Domestic	2320
GW023331.1.1	39.6	1965-10-01	Stock and Domestic	5553
GW801295.1.1	49	1995-07-13	Other	
GW044139.1.1	48.7	Unknown	Stock and Domestic	
GW803063.1.1	15	2006-02-23	Stock and Domestic	
GW805409.1.1	61	2014-03-15	Stock and Domestic	
GW801128.1.1	3.23	Unknown	Irrigation	
GW022099.1.1	4.4	1963-10-01	Irrigation	
GW022216.1.1	5.5	1914-01-01	Water Supply	1000
GW805908.1.0	84	2017-02-09	Stock and Domestic	
GW805908.1.1	84	2017-02-09	Stock and Domestic	
GW803535.1.1	65	2007-04-01	Water Supply	
GW012558.1.1	22.6	1956-01-01	Stock and Domestic	
GW009322.1.1	30.8	Unknown	Stock and Domestic	
GW801471.1.1	70	2000-01-15	Water Supply	
GW803615.1.1	42	2008-05-06	Water Supply	
GW803062.1.1	21	2006-02-27	Stock and Domestic	
GW016264.1.1	10.9	1933-01-01	Stock and Domestic	

Bore ID	Bore Depth (m)	Drilled Date	Purpose	Salinity (µS/cm)
GW016271.1.1	16.4	1927-01-01	Stock and Domestic	
GW804073.1.1	5.7	2009-11-27	Monitoring	
GW802440.1.1	150	2005-09-08	Stock and Domestic	
GW007761.1.1	20.7	1949-06-01	Other	
GW054986.1.1	12.2	Unknown	Stock and Domestic	
GW016272.1.1	7.6	1928-01-01	Stock and Domestic	
GW801001.1.1	30.5	1994-09-16	Water Supply	
GW015294.1.1	27.4	Unknown	Unknown	3070
GW805084.1.1	6	2012-11-14	Monitoring	
GW050539.1.1	9	Unknown	Unknown	
GW050157.1.1	15.2	1925-01-01	Unknown	
GW805627.1.1	120	2015-04-10	Water Supply	
GW805901.1.0	70	2016-09-13	Stock and Domestic	
GW805901.1.1	70	2016-09-13	Stock and Domestic	
GW015856.1.1	2.7	Unknown	Water Supply	
GW016270.1.1	22.5	1938-01-01	Water Supply	
GW800847.1.1	61	1999-05-21	Stock and Domestic	1200
GW048983.1.1	109.7	1930-01-01	Stock and Domestic	2300
GW803988.1.1	40	2007-03-19	Monitoring	
GW016266.1.1	71.3	1934-01-01	Stock and Domestic	
GW016399.1.1	73.2	1957-01-01	Unknown	
GW023351.1.1	41.5	1965-10-01	Stock and Domestic	
GW802845.1.1	106	1998-01-17	Water Supply	
GW017591.1.1	18.3	1959-01-01	Unknown	
GW803829.1.1	161	2009-01-14	Water Supply	
GW803490.1.1	156	2007-09-24	Water Supply	
GW804072.1.1	7.5	2009-11-27	Monitoring	
GW016263.1.1	38.4	1941-01-01	Stock and Domestic	
GW801557.1.1	136	2002-04-18	Irrigation	
GW049473.1.1	15.2	1978-11-01	Unknown	

[1] Average used where multiple readings are available.

Standing water levels have not been recorded for the identified functioning bores. Where the standing water level has not been recorded, the groundwater bore depth can be used as an indication of the depth of the water bearing zone as it demonstrates the depth of drilling required to establish a water supply.

A preliminary review of well total depths in the wind farm site (assumed to be depths of groundwater bearing zones) has indicated that approximately 75% are deeper than 20 m and 98% are deeper than 10 m below ground level, and the proposed construction is unlikely to penetrate the water table.

The Murray-Darling Basin is a naturally saline landscape. Salinity has been recorded in 17 monitoring bores in the 1990s as listed in **Table 13-4**. Recorded salinity ranges from 356 microseimens per centimetre (μS/cm) to a maximum 37451 μS/cm, with an average salinity of 5424 μS/cm. Salinities of 2500 – 10,000 μS/cm are considered to be brackish – saline and not suitable for human consumption, and of limited use for stock watering or irrigation.

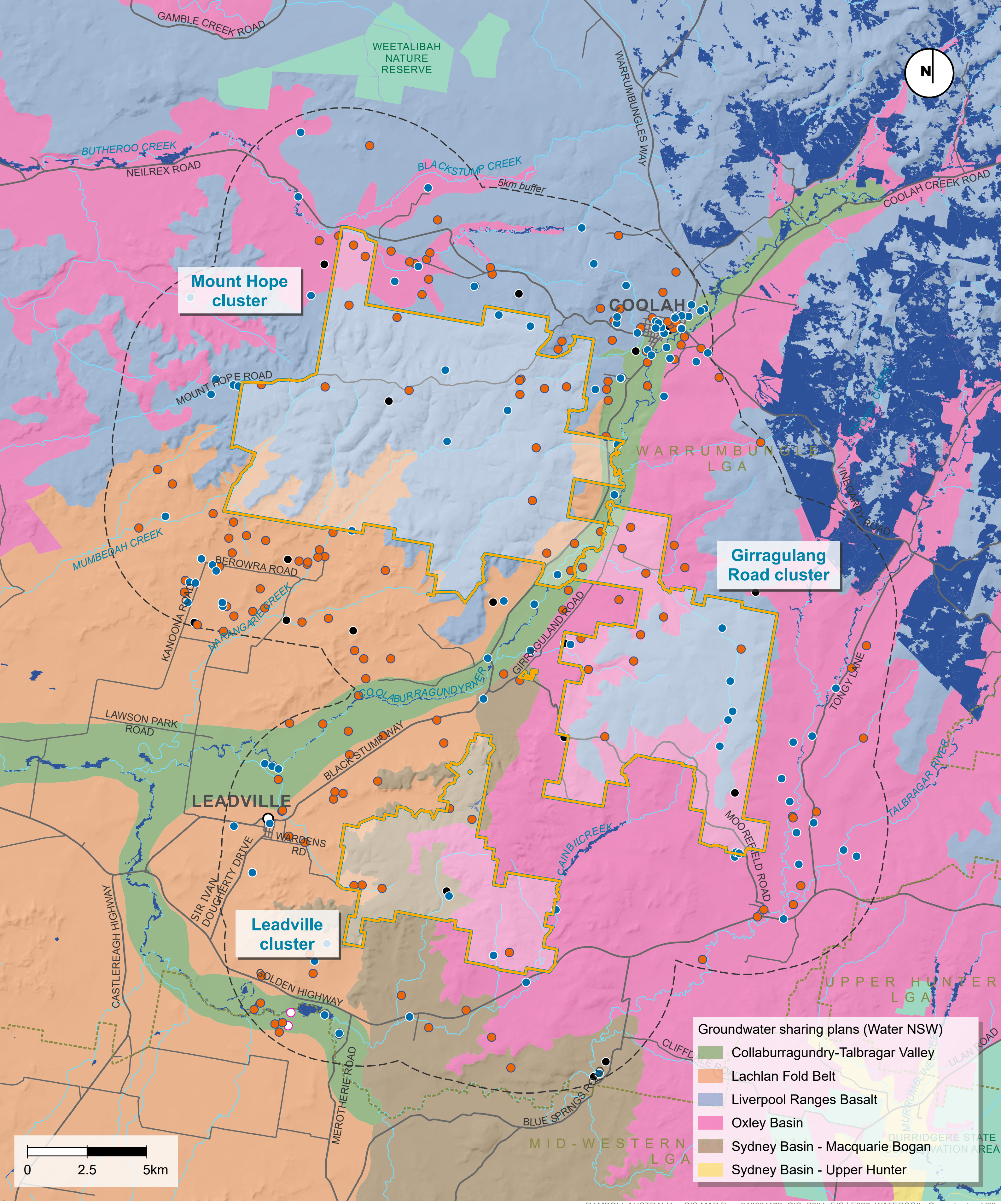
Groundwater dependent ecosystems

Groundwater-dependent ecosystems (GDEs) are ecosystems that require access to groundwater to meet all or some of the water requirements necessary to maintain their plant and animal communities and ecological processes.

GDEs generally do not have a significant presence within the wind farm site, however minor terrestrial GDEs are shown in **Figure 13-2,** and occur:

- within the northern area of the Leadville cluster from a tributary of Hobbins Gully Stream
- on Cainbill Creek approximately 3km downstream of the Girrgulang Road cluster (outside the wind farm site)
- on the northern margin of the Girrgulang Road cluster
- on the eastern margins of Mount Hope cluster.

All noted occurrences of GDEs are outside of the construction and operational impact footprints.



KEY

- Wind farm site
- 5km buffer area
- LGA boundaries
- National Parks and Reserves

Groundwater bores (BoM)

- Functioning
- Unknown
- Proposed
- Abandoned/non-functional/removed

- Groundwater dependent ecosystem (DPIE)

Figure 13-2 | Groundwater context

13.2.5 Water demand and supply

Water demands for construction of the project are described in **Section 4.12.1.**

In recent years the Warrumbungle Shire has experienced significant drought, wildfires and a reduction in surface and ground water allocations for agricultural use resulting from the introduction of the Murray Darling Basin Plan (Warrumbungle Shire Council, 2019).

Water required for construction would be preferentially sourced from:

- commercial suppliers of treated wastewater in the nearby region
- opportunistically sourced from farm dams located within the wind farm site
- sourced from town water.

Water sources would be determined in consultation with suppliers and landholders and be subject to availability. During drought conditions, it is likely that most of the water will be sourced from commercial suppliers or treated wastewater.

Owners or occupiers of land can collect a proportion of the rainfall run-off from their property in one or more dams on non-permanent, mapped minor streams, or unmapped streams, without a water licence, water supply work approval or water use approval under harvestable use rights. Up to 10 per cent of average annual regional rainfall run-off can be captured in the Central and Eastern Divisions of NSW where the project is located. Any runoff harvested from the development footprint would be within the volume permitted under harvestable rights.

There is no sewer access at the site. Therefore, amenity facilities would be pumped out via tanker and delivered to the Coolah and Dunedoo sewage treatment facilities (whichever is closest to the cluster), or as agreed with Warrumbungle Shire Council during construction. UPC\AC or its contractors would consult with Warrumbungle Shire Council prior to commencement of construction to reach an agreement.

13.2.6 Geology

The surface geology of the wind farm site is represented by the Gulgong 1:100,000 Geological Map (Watkins J.J., 2000) and the Gilgandra 1:250,000 Geological Map (A.C, 1968). Geology of the wind farm site is shown in **Figure 13-3**.

The area generally comprises landscapes derived from extensive Tertiary and Quaternary-aged basalt flows and underlying Jurassic/Triassic quartz sandstones and consequently has variable soil and vegetation depending on the local rock type or sediment source. On the lower slopes the topography is more subdued, partly buried in alluvial debris and largely eroded to rolling plains.

Stream courses of Quaternary age occur in the long, alluvial sediments channels and clay plains, generally outside of the wind farm site.

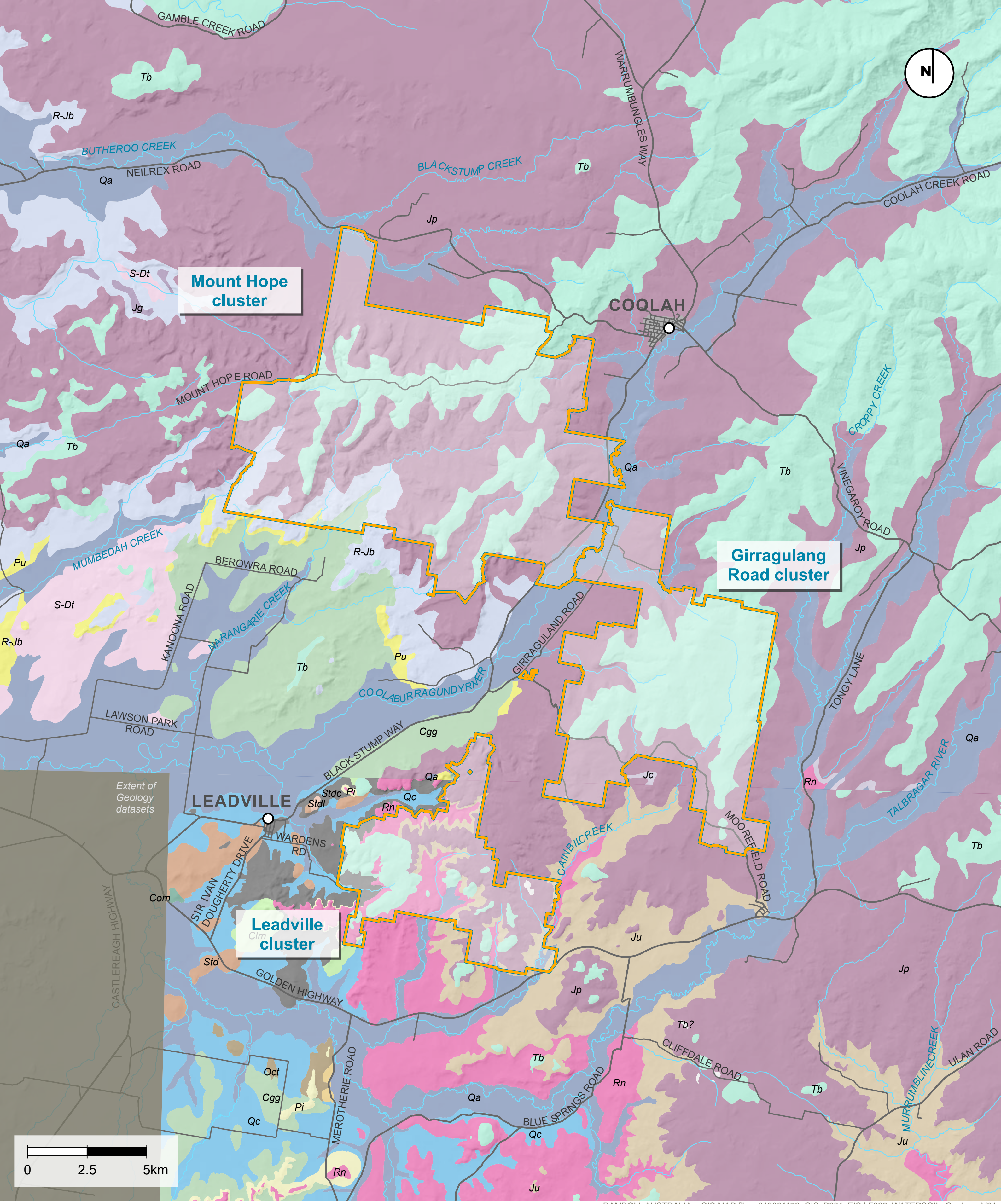
The wind turbines are located on ridges of either Tertiary-aged basalts and intrusive dolerites or the underlying Permo-Triassic sandstones.

Specifically, the geological units of the wind farm site comprise:

- Leadville Cluster:
    - Northwest Section
        - Dungaree Volcanics – Shale
        - Dolerites of the Tertiary-aged Liverpool West basalts
        - Sandstones of the Bankswall Sandstone (Permo-Triassic-aged)

- Southeast Section
  - Sandstones of the Permo-Triassic-aged Purlawaugh Formation and Pilliga Sandstone
- Fingers of Quaternary-aged alluvium extend through the southeast of the cluster.

- Mount Hope Cluster:
  - Dolerites of the Tertiary-aged Liverpool eastern range intrusives with alluvial gravels on the lower slopes
  - Sandstones of the Permo-Triassic-aged Pilliga Sandstones
  - A finger of Quaternary-aged alluvium extends through the southeastern area of the cluster.
- Girragulang Road Cluster:
  - Dolerites of the Tertiary-aged Liverpool west Basalts
  - Sandstones of the Permo-Triassic-aged Pilliga and Purlawaugh Formation Sandstones



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Aerial photography from NSW Government Spatial Services

KEY

Wind farm site

Gulgong 1:100,000 Geological Map (Watkins J.J., 2000) and the Gilgandra 1:250,000 Geological Map (A.C, 1968) - sourced from DIGS

Cgg	Jg	Pi	Qc	Std	Tb
Clm	Jp	Pr	R-Jb	Stdc	Tb?
Com	Ju	Pu	Rn	Stdl	
Jc	Oct	Qa	S-Dt	Stds	

Figure 13-3 | Geology

13.2.7 Mitchell Landscapes

Mitchell Landscapes are defined ecosystem units based upon geologic, geomorphic and pedologic factors (Mitchell, 2002). Seven Mitchell Landscapes intersect the wind farm site, summarised as percentage areas in each cluster in **Table 13-5** and within impact areas in **Table 13-6**.

These landscape types include:

Mount Hope Cluster:

- **Liverpool Range Valleys and Footslopes (Liv)** - Multiple Tertiary basalt flows with intervening sediments and ash fall material, overlying Jurassic quartz sandstones and shale. Long slopes below the Liverpool Tops ecosystem, general elevation 450 to 1000 metres, local relief to 400 metres. Shallow stony clay soils on steep slopes grading to deep black earths on lower slopes.
- **Cassilis Slopes (Cas)** - Undulating hills with dendritic drainage on sub-horizontal Jurassic and Triassic quartz sandstone, siltstone and shale. General elevation 400 to 600 metres, local relief 100 metres. Topographically below the Liverpool Range basalts but partly influenced by them on some valley floors.
- **Merrygoen Hills and Slopes (Meh)** - Low hills and ranges on Triassic/Jurassic conglomerate, quartz sandstone and claystone with exposures of undifferentiated Palaeozoic schist, phyllite and slate in valleys. General elevation 400 to 550 metres, local relief 50 metres. Shallow stony yellow earths with sandstone outcrop on ridgelines merging to yellow harsh texture-contrast soils in shallow valleys.
- **Talbragar – Upper Macquarie Terrace Sands and Gravels (Tab)** - Sandy Quaternary alluvial sediments on the floodplains and terraces of the Talbragar River, general elevation 350 to 500m, local relief 30 to 40m. Red-brown and red-yellow earthy sands with some yellow texture-contrast soils on the valley margins.
- **Trinkey Plateau (Trp)** - Undulating plains and low hills on sub-horizontal Jurassic quartz sandstone, general elevation 500 to 670 metres, local relief 50m. Yellow harsh texture-contrast soils, earthy sands and red earths.
- **Upper Castlereagh Alluvial Plains (Ucp)** - Northern Outwash Tertiary and Quaternary alluvial fans and stream terraces. Sloping plains with alluvial fans that are coarser and steeper than the Gwydir Fans downstream General elevation 420 to 580m, local relief 5 to 30m. Red loams and heavy brown clays.

Girragulang Road Cluster:

- **Liverpool Range Valleys and Footslopes (Liv)** -Multiple Tertiary basalt flows with intervening sediments and ash fall material, overlying Jurassic quartz sandstones and shale. Long slopes below the Liverpool Tops ecosystem, general elevation 450 to 1000 metres, local relief to 400 metres. Shallow stony clay soils on steep slopes grading to deep black earths on lower slopes.
- **Cassilis Slopes (Cas)** - Undulating hills with dendritic drainage on sub-horizontal Jurassic and Triassic quartz sandstone, siltstone and shale. General elevation 400 to 600 metres, local relief 100 metres. Topographically below the Liverpool Range basalts but partly influenced by them on some valley floors.
- **Talbragar – Upper Macquarie Terrace Sands and Gravels (Tab)** - Sandy Quaternary alluvial sediments on the floodplains and terraces of the Talbragar River, general elevation 350 to 500m, local relief 30 to 40m. Red-brown and red-yellow earthy sands with some yellow texture-contrast soils on the valley margins.

Leadville Cluster:

- **Liverpool Range Valleys and Footslopes (Liv)** - Multiple Tertiary basalt flows with intervening sediments and ash fall material, overlying Jurassic quartz sandstones and shale. Long slopes below the Liverpool Tops ecosystem, general elevation 450 to 1000 metres, local relief to 400 metres. Shallow stony clay soils on steep slopes grading to deep black earths on lower slopes.

- **Cassilis Slopes (Cas)** - Undulating hills with dendritic drainage on sub-horizontal Jurassic and Triassic quartz sandstone, siltstone and shale. General elevation 400 to 600 metres, local relief 100 metres. Topographically below the Liverpool Range basalts but partly influenced by them on some valley floors.
- **Cope Hills Granite (Cop)** - Undulating and rolling hills on Carboniferous-aged granite and granodiorite, general elevation 500 to 740 metres, local relief 150 metres.

The following tables present the spatial extent of each landscape type for the three project clusters and as a percentage of the operational/constructional impact areas.

Table 13-5: Mitchell Landscapes within the Wind farm site

Cluster/Landscape Type	Area (ha)	% of Total Area
Girragulang Road		
Cassilis Slopes	3227	42%
Liverpool Range Valleys and Footslopes	3978	52%
Talbragar - Upper Macquarie Terrace Sands and Gravels	453	6%
Total Area	*7657*	
Leadville		
Cassilis Slopes	3138	73%
Cope Hills Granite	301	7%
Liverpool Range Valleys and Footslopes	720	17%
Talbragar - Upper Macquarie Terrace Sands and Gravels	160	4%
Total Area	*4320*	
Mount Hope		
Cassilis Slopes	7781	56%
Cope Hills Granite	132	1%
Liverpool Range Valleys and Footslopes	3576	26%
Merrygoen Hills and Slopes	1327	10%
Talbragar - Upper Macquarie Terrace Sands and Gravels	362	3%
Trinkey Plateau	458	3%
Upper Castlereagh Alluvial Plains	277	2%
Total Area	*13913*	

Table 13-6: Mitchell Landscapes within the Impact Areas

Landscape Type	Area (ha)	% of Area
Operational footprint	549	
Cassilis Slopes	216	39%
Cope Hills Granite	6	1%
Liverpool Range Valleys and Footslopes	271	49%
Talbragar - Upper Macquarie Terrace Sands and Gravels	57	10%
Construction footprint	1318	
Cassilis Slopes	330	25%

Landscape Type	Area (ha)	% of Area
Cope Hills Granite	15	1%
Liverpool Range Valleys and Footslopes	914	69%
Talbragar - Upper Macquarie Terrace Sands and Gravels	59	5%

Each cluster mostly comprises Liverpool Range Valleys and Footslops and Cassilis Slopes landscape types with undulating hills on volcanic and sandstone/siltstone bedrock.

Approximately half of the proposed site compound area for the Leadville Cluster (located in the south-east of the Cluster) is situated on the Talbragar alluvial sediments.

13.2.8 Soils

Australian soil classification

The Australian Soil Classification is the classification system currently used to describe and classify soils in Australia. Soil classifications within the wind farm site are shown in **Figure 13-4** and include:

- Dermosols - high agricultural potential with good structure and moderate to high fertility and water-holding capacity.
- Sodosols - low agricultural potential with high sodicity that leads to high erodibility, poor structure and low permeability. These soils have low to moderate fertility and can be associated with salinity.
- Ferrosols - high agricultural potential because of good structure and moderate to high fertility and water-holding capacity. These soils do have potential for structural decline.
- Kurosols - generally low agricultural potential with high acidity and low fertility. These soils commonly have low water-holding capacity and often sodic (easily erodible).
- Kurosols (natric) - Kurosol subsoil type. Generally sodic (easily erodible) in the top 200 mm of the subsoil horizon.
- Rudosols - low agricultural potential with strong acidity and low water-holding capacity.

Land and soil capability

The Land and Soil Assessment Capability Scheme (NSW OEH, 2012) has been developed for NSW, and outlines eight land and soil capability (LSC) classes. The LSC class provides an indication of the land management practices that can be applied to a piece of land without resulting in degradation to the land and soil within the wind farm site and to the environment offsite (NSW OEH, 2012). Unsuitable land use can lead to a decline in natural ecosystem values, agricultural productivity and infrastructure functionality. As land capability decreases, the management of land requires more attention to mitigate impacts.

The LSC classes outlined in the Land and Soil Assessment Capability Scheme range from class 1 (extremely high capability land which has no limitations and requires no special land management practices), to class 8 (extremely low capability land with limitations that are so severe that the land is incapable of sustaining any land use aside from natural conservation).

The wind farm site includes land mapped between class 2 and class 7 (refer to **Figure 13-5**) (NSW DPIE, 2020). **Table 13-7** includes a definition of the LSC classes within the wind farm site.

Table 13-8 shows the area/percentage within each of the project cluster areas and **Table 13-9** within the proposed construction and operational impact areas.

Table 13-7: Land and soil capability classes within the wind farm site

LSC Class	General definition[1]
1	**Extremely high capability land**: Land has no limitations. No special land management practices required. Land capable of all rural land uses and land management practices.
2	**Very high capability land**: Land has slight limitations. These can be managed by readily available, easily implemented management practices. Land is capable of most land uses and land management practices, including intensive cropping with cultivation.
3	**High capability land**: Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.
4	**Moderate capability land**: Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.
5	**Moderate–low capability land**: Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
6	**Low capability land**: Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation.
7	**Very low capability land**: Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation.
8	**Extremely low capability land**: Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation.

Source: [1] (Office of Environment and Heritage, 2012)

Table 13-8: Land and Soil Capability Classes for Each Cluster

Cluster	Area (ha)	% of Cluster Area
Girragulang Road	7657	
2	304	4%
3	1356	18%
4	3927	51%
5	653	9%
6	1418	19%
Leadville	4320	
2	30	1%
4	6	0%
5	3530	82%
6	694	16%
7	60	1%
Mount Hope	13913	
2	560	4%
3	1654	12%
4	3384	24%
5	2300	17%
6	4126	30%
7	1888	14%

Table 13-9: Land and Soil Capability Classes for Proposed Impact Areas

Land Capability	Area (ha)	% of Area
Operational footprint	549	
2	59	11%
3	144	26%
4	154	28%
5	136	25%
6	55	10%
7	2	0.3%
Construction footprint	1318	
2	60	5%
3	453	34%
4	398	30%
5	214	16%
6	192	15%
7	2	0.2%

In summary:

- the Girragulang Road cluster is mostly classified as moderate and high capability land with some low capability land. The land of the Girragulang Road cluster could be used for grazing, and is suitable for pasture improvement, however acidification can be a problem.
- The Mount Hope cluster is mostly classified as moderate to low capability land.

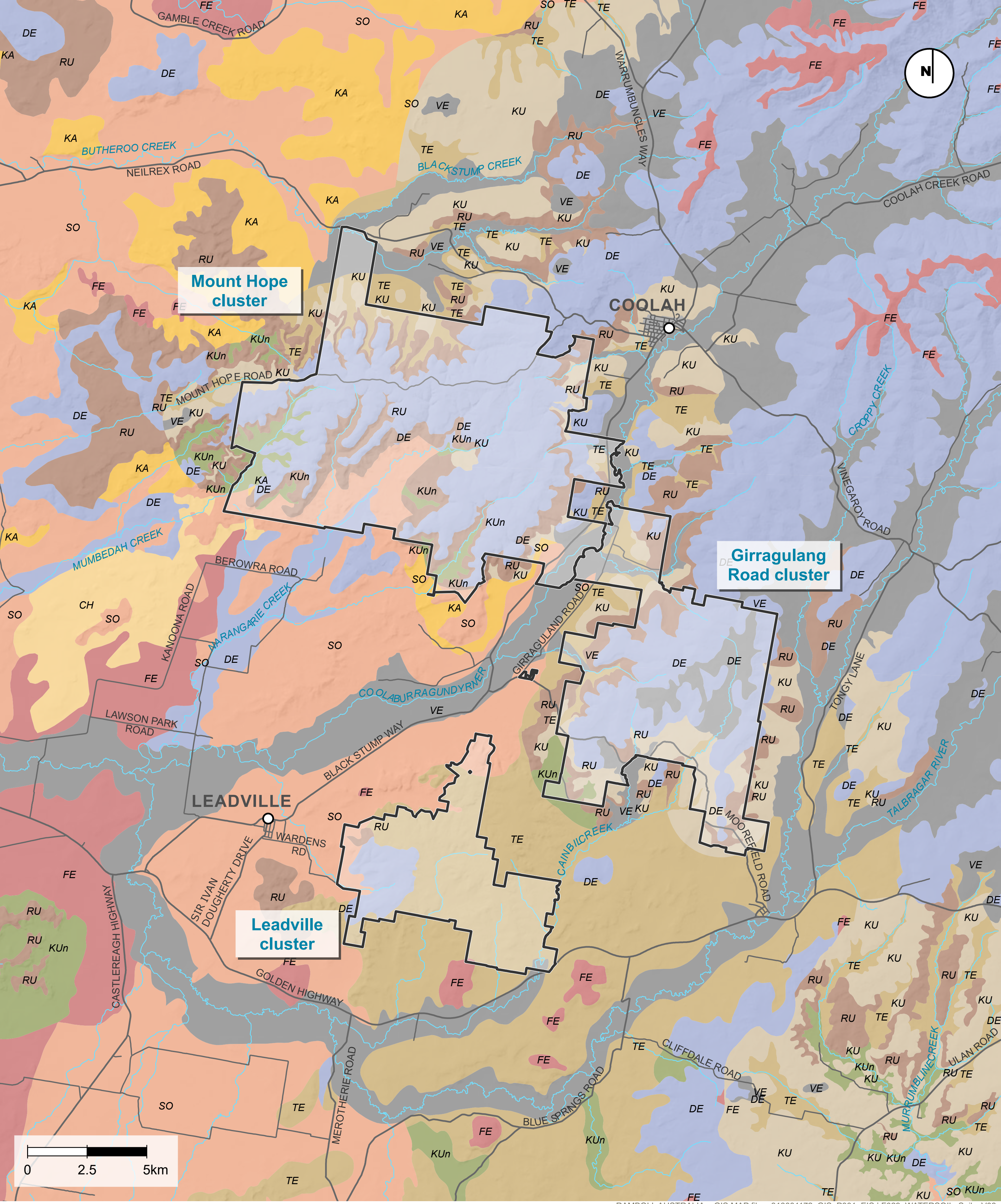
- the majority of land within the Leadville cluster falls within the moderate to low and low capability land classification meaning that the use of the is limited for high impact land management uses such as cropping, and is not capable of supporting regular cultivation.

Salinity

Some landscapes associated with the Sydney Basin bedrock geology have a higher potential for discharge of saline groundwater. A review of NSW Department of Planning, Industry and Environment soil profile and soil map information website 'eSPADE' indicates the soil within the Leadville Cluster has moderate to high likelihood of saline soil occurrence, whilst the Girragulang Road and Mount Hope Clusters have low to high likelihood of saline soil occurrence. Highly saline soils are expected to occur on colluvial slopes and in colluvial material on flanks of hills and in broad colluvial plains in valleys. Construction and operation of the site is not expected to effect changes that will alter the occurrence of soil salinity.

Acid sulfate soils

A review of NSW Department of Planning, Industry and Environment soil profile and soil map information website, 'eSPADE', indicates there is a very low probability for the presence of acid sulfate soils in the area. Soil in all Cluster areas is considered to be naturally acidic.



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Aerial photography from NSW Government Spatial Services

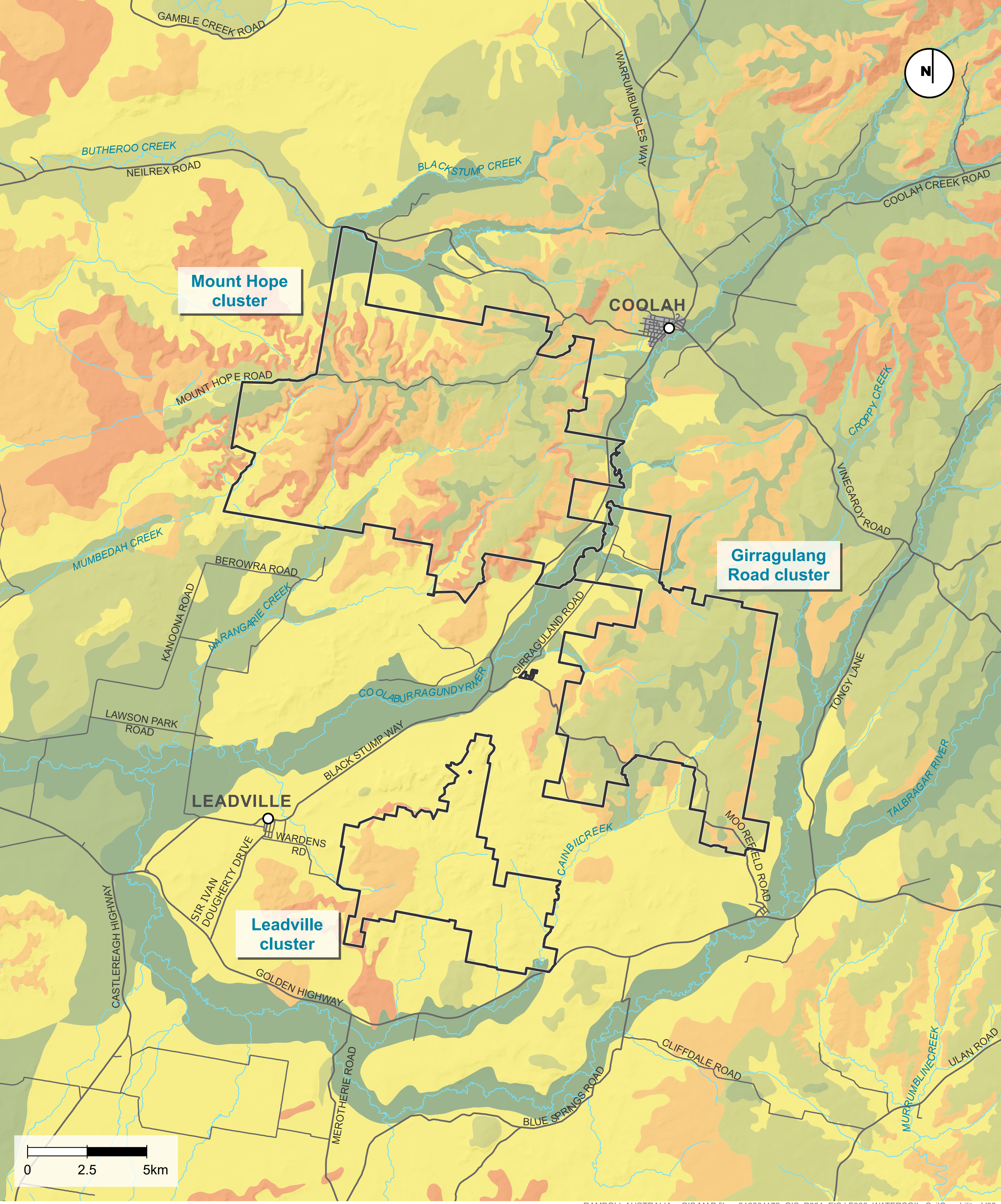
KEY

Wind farm site

Australian Soil Classification (DPIE)

- Chromosols (CH)
- Dermosols (DE)
- Ferrosols (FE)
- Kandosols (KA)
- Kurosols (KU)
- Kurosols - natric (KUn)
- Rudosols (RU)
- Sodosols (SO)
- Tenosols (TE)
- Vertosols (VE)

Figure 13-4 | Australian Soil Classification



KEY

Wind farm site

Land and soil capability (DPIE)

- 2 - Slight but significant limitations
- 3 - Moderate limitations
- 4 - Moderate to severe limitations
- 5 - Severe limitations
- 6 - Very severe limitations
- 7 - Extremely severe limitations

Figure 13-5 | Land and soil capability

13.2.9 Contaminated land

A search of the EPA's contaminated land public record of notice and list of sites notified to the EPA under Section 60 of the CLM Act in July 2021 did not return any information on reported contamination or any regulatory notices issued for the land within the wind farm site (NSW Environmental Protection Authority, 2021).

The contaminated land planning guidelines, Managing Land Contamination Planning Guidelines: SEPP 55 – Remediation of Land (Department of Urban Affairs and Planning, 1998), identify agricultural and horticultural activities as activities which can potentially cause contamination. The wind farm site is located on land that is zoned Primary Production (RU1) under the under the Warrumbungle LEP and is currently used for agricultural purposes including grazing of cattle. The primary chemicals of concern associated with these historic land uses include organochlorine pesticides and arsenic.

13.3 Assessment of potential impacts

13.3.1 Hydrology

Hydrological flows

While there may be some increase to the impervious fraction of the wind farm site through the creation of roads, turbine footings and some small operational buildings this increase is minor (approximately 2%) when compared to the wind farm site as a whole. Given there is no significant increase to impervious areas within the wind farm site, changes to hydrological flows are expected to be negligible.

Water quality

The project will not involve any controlled discharges to the surrounding watercourses. All wastewater will be removed from the site via truck.

Runoff water quality changes would most likely be affected during construction with limited operational impact. Construction of the project would disturb soils which have the potential to lead to sediments or pollutants mobilising in runoff and entering local waterways. These activities include ground disturbing works such as:

- civil works for access tracks
- construction of temporary construction facilities including potential workers accommodation and quarry locations
- construction of the WTGs
- construction of electrical infrastructure including the overhead transmission lines
- construction of permanent onsite ancillary infrastructure.

Additionally, water pollution risks from the project are associated with the following activities:

- hydrocarbon spill risk from use and re-fuelling of construction vehicles and machinery
- onsite concreting for building and equipment foundations, through inappropriate washing of concreting equipment
- storage and use of paints, cleaning solvents and other chemicals such as pesticides and herbicides
- fertilisers used for revegetation
- runoff from waste materials stored onsite.

The project is not anticipated to have negative water quality impacts provided the measures set out in **Table 13-11** are implemented.

Water quality monitoring is proposed, including baseline water quality testing prior to construction and ongoing monitoring through construction and operation. Water quality testing will be undertaken in accordance with best practice guidelines and ANZG (2018)/ANZECC 2000 Guidelines and/or local objectives.

Waterfront land

No artificial structures are planned to be installed within 40 metres of any watercourses within the wind farm site. The waterway road and cable crossings would be designed and constructed in compliance with the Department of Primary Industries Guidelines for Controlled Activities on Waterfront Land (2018) series, including Department of Primary Industries (Office of Water) Guidelines for riparian corridors on waterfront land (2012) and Guidelines for watercourse crossings on waterfront land (2012).

As the project is classified as SSD, a water management work approval under section 90, or a controlled activity approval for certain activities which are carried out on waterfront land under section 91 of the WM Act is not required where the development consent for the SSD authorises the carrying out of those works (refer to discussion in **Chapter 3**)

13.3.2 Flooding

Changes to flooding behaviours has the potential to increase erosion across an area. Key contributing factors associated with developments relate to an increase in impervious surfaces resulting in an increase to flow velocities resulting in erosion risk. During construction whilst soils are exposed this can result in the loss of soil resources and increased turbidity and sedimentation in waterways. During operation, the longer term changes to floodwater behaviour can result in the same impacts albeit over a long period of time.

As discussed in **Section 13.2.3**, available flooding data for the wind farm site is limited to the Warrumbungle Shire LEP land mapping however there are areas within the wind farm site which are mapped as recent-aged alluvial sediments. No significant elements of project infrastructure are located within areas expected to be subject to flooding based on available information. A minor exception is in the western half of the Leadville site compound which is located on the alluvial sediments.

The increase in hardstand area associated with the introduction of project components to the landscape would have some effect on overland flows and velocity immediately surrounding the components. A significant increase would not be expected more broadly because of the relatively small percentage of increased hardstand across the wind farm site and the surrounding ground cover.

Some soils across the wind farm site have high erosion potential as discussed in **Section 13.2.8** and as noted by landholders during consultation. Specific management measures have been included in **Section 13.4** to address areas of high erosion potential during both construction and operational phases of the project.

13.3.3 Groundwater

Changes to groundwater quality and quantity could result from changes to the local hydrology including modification to the landscape affecting:

- groundwater recharge
- groundwater extraction
- interception of groundwater during excavation activities.

Direct impact to groundwater recharge is not considered likely based on the relatively small footprint of the construction and operational areas. Extraction of groundwater is not proposed for the project.

Given the depth to groundwater (expected to be 10 metres below ground level or greater) impact on groundwater levels, quantity or quality from the project is expected to be negligible. The significant differences between existing groundwater levels and proposed infrastructure implies that construction of deep foundations could occur with minimal impact on groundwater. Comprehensive geotechnical investigations will be undertaken during detailed design to further inform the groundwater levels across the wind farm site and identify any specific management measures.

During construction, suitable steps will be taken to ensure construction run-off and other contaminants e.g., spills or leaks of oil from construction machinery, does not contaminate local groundwater/groundwater recharge. Local groundwater is not proposed as a water supply source for the project.

Impacts to groundwater dependent ecosystems would not occur as a result of the project as there are none identified within the vicinity of the construction and operational impact footprints.

13.3.4 Water management

Water demand and supply

A summary of the estimated water requirements for construction is provided in **Table 13-10**.

Table 13-10: Estimated water demands for the project

Water requirement	Water use assumptions	Total estimated volume
Dust suppression (incl. concrete batching plant)	Assume 45km track length at once, 8m application width application rate 2.5L/m^2/day, 78 weeks duration = 900 kilolitres per day	421,200 kilolitres
Pavements	Access tracks, wind turbine hardstands, internal substation benches, O&M facilities, concrete batching plant, construction compounds	647,464 kilolitres
Wind turbine foundations	Concrete and binding	27,612 kilolitres
Amenities (potable water)	Assume 400 persons workforce, 40L/day/person, 78 weeks duration	7,488 kilolitres
Potential workers accommodation facility (potable water)	Assume 400 persons workforce, 40L/day/person, 78 weeks duration	7,488 kilolitres
Total construction	**-**	**1,111,252 kilolitres**

As described in **Section 13.2.5**, water required for construction would be preferentially sourced from:

- commercial suppliers of treated wastewater in the nearby region
- opportunistically sourced from farm dams located within the wind farm site
- sourced from town water.

Groundwater will not be used during the construction phase of the Project.

The details of water supply requirements and options, including identification of appropriate water suppliers, will be further considered by UPC\AC and/or its appointed lead contractor during post-approval works as part of ongoing project design and planning work.

Water use during the operational phase of the Project would be negligible and sourced from suitable and appropriately licenced water sources. Water required for staff amenities would be in the order of 10,400 litres per annum and would be sourced from onsite rainwater tanks or delivered to site as potable water. Groundwater will not be used during the operational phase of the Project.

Wastewater management is discussed in **Chapter14.** Amenity facilities would be pumped out via tanker and delivered to the most appropriate sewage treatment facility, or as agreed with Warrumbungle Shire Council during construction. It is likely that a septic system would be installed for the operational amenities. This would be constructed and managed in accordance with the relevant Warrumbungle Shire Council requirements.

13.3.5 Soils

Erosion And Sediment Control

Construction earthworks would be undertaken in areas that require resurfacing activities for temporary construction activities as part of initial site preparation (including vegetation clearance, establishment of laydown areas, construction compounds, carparking areas and access roads) along with permanent operational infrastructure. Minor earthworks would also be required to prepare the arrays including grading or levelling where required.

The extent of excavations required would depend on the geotechnical conditions and final locations of infrastructure, however heavy earthworks such as grading/levelling and compaction would be minimised as much as practicable.

It is anticipated that construction activities may include the following:

- installing access roads, onsite buildings and other associated infrastructure
- modification of the landscape with earthworks and minor vegetation clearing
- vegetation clearing
- grading/levelling
- access road upgrades
- possible trenching for powerlines
- disturbance from vehicle traffic and heavy machinery traffic
- excavation for wind turbine foundations

Controls to mitigate potential sediment runoff and erosion during earthworks and construction activities will be documented in an Erosion and Sediment Control Plan (ESCP) and implemented in accordance with Managing Urban Stormwater: Soils and Construction (Landcom 2004). All earthworks will be undertaken in compliance with the CEMP, prepared and approved prior to construction.

The continued operation of the site infrastructure will also be undertaken in accordance with the OEMP.

13.3.6 Contamination

Earthworks required for the project would be limited to locations requiring resurfacing activities for temporary construction facilities, and permanent operational infrastructure such as the wind turbine footings, access tracks, substation, potential BESS and ancillary infrastructure. Minor earthworks would also be required to prepare the array areas including grading or levelling, and the need for heavy earthworks would be minimised as much as practicable. The level of surface disturbance, and likelihood of exposing unknown contaminated land is therefore likely to be minimal.

13.4 Environmental Management and Mitigation Measures

Proposed measures to manage and/or mitigate water and soils impacts from the project are detailed in **Table 13-11**.

Table 13-11: Management and mitigation measures – water and soils

ID	Management/mitigation measure	Timing
SW1	All waterway crossings will be designed and constructed in compliance with the Department of Primary Industries, Office of Water, Guidelines for riparian corridors on waterfront land and Guidelines for watercourse crossings on waterfront land.	Detailed design
SW2	Concrete wash from concrete batching plants will be appropriately contained and disposed of. Bunded areas of the batching plant will be designed to contain peak rainfall events and will be remediated after the completion of the construction phase. All waste will be collected and reused or removed from site by an appropriately licenced contractor.	Detailed design
SW3	Additional investigation and planning will be undertaken during the detailed design to manage erosion risk associated with stormwater. Measures such as inclusion of culverts and rock armouring would be included to address the potential for erosion impact specifically during flood events.	Detailed design
SW4	Infrastructure, including turbines, substations, control buildings, stockpiles, and site compounds and turnaround areas, will not be sited within 20 metres of a major drainage lines or water course.	Detailed design
SW5	A construction soil and water management plan (CSWMP) will be prepared to outline measures to manage soil and water impacts associated with the construction works, including contaminated land. The CSWMP will provide: • measures to minimise/manage erosion and sediment transport both within the construction footprint and offsite including	Prior to construction

Valley of the Winds

ID	Management/mitigation measure	Timing

	requirements for the preparation of erosion and sediment control plans (ESCP) for all progressive stages of construction. The plans will incorporate the principles of the existing guidelines, Managing urban stormwater: soils and construction, vol. 1 (Landcom 2004) and vol. 2 (A. Installation of services; C. Unsealed roads; D. Main Roads; E. Mines and quarries) (DECC 2008).
	• measures to manage waste including the classification and handling of spoil
	• procedures to manage unexpected contamination, including:
	    ○ acid sulfate soils
	    ○ salinity in soils
	• measures to manage stockpiles including locations, separation of waste types, sediment controls and stabilisation
	• measures to manage accidental spills including the requirement to maintain materials such as spill kits
	• dewatering protocol if groundwater in intercepted
	• controls for receiving waterways which may include:
	    ○ designation of 'no go' zones for construction plant and equipment
	    ○ creation of catch/diversion drains and sediment fences at the downstream boundary of construction activities where practicable to support containment of sediment-laden runoff	

SW6	Exposed or cleared areas will be stabilised as soon as possible to minimise erosion and sedimentation that has the potential to pollute watercourses in the area.	Prior to construction
SW7	Soil testing for clay content, cation-exchange capacity and electrical conductivity will be conducted as part of geotechnical investigations to inform detailed design. Where sodic soils are identified within an area where trenching is required, soil amendment with gypsum at an appropriate rate will be included within the CSWMP.	Prior to construction
SW8	The CSWMP will include a section on unexpected finds, in the event of exposing previously unknown contaminated land during construction and as part of ongoing operation of the infrastructure. All such finds will be investigated and quantified in terms of potential pollution risks. Where appropriate action will be undertaken to comply with the requirements of section 120 of the POEO Act (prohibition of pollution of waters) and the CLM Act.	Prior to construction /Construction

ID	Management/mitigation measure	Timing
SW9	All vehicles onsite will be required to follow the access track network during construction and operation.	Construction and operation
SW10	The use of any farms dams during construction will be agreed with the landholder and the estimated maximum harvestable right dam capacity will not be exceeded.	Construction
SW11	Where possible, access routes and tracks will be constructed in already disturbed areas and personnel will keep to established tracks wherever possible.	Construction
SW12	If groundwater is intercepted and dewatering is required during construction of the turbine footings, dewatering will be managed in accordance with the CSWMP.	Construction
SW13	Following construction all disturbed land will be rehabilitated to an appropriate state as agreed with the landowner. Topsoil will be stockpiled and reused in the rehabilitation.	Post-construction

14. WASTE AND RESOURCES

14.1 Assessment methodology

14.1.1 Assessment approach

The project will produce several waste streams during the construction and decommissioning phases. Minor quantities of waste will also continue to be generated by the day-to-day operation of the project.

Assessment of waste and resourcing impacts was undertaken using a desktop assessment to understand the likely and potential waste and resourcing issues for the project. This includes:

- identifying the key resources required throughout the construction, operation and decommissioning phases of the project and their availability
- defining the statutory context for waste management
- identifying the waste streams that would be produced over the project lifecycle and their waste classification in accordance with relevant legislation
- identifying the existing waste management facilities in the vicinity and their capacity to accept different waste streams
- estimating quantities for key waste streams that would be produced.

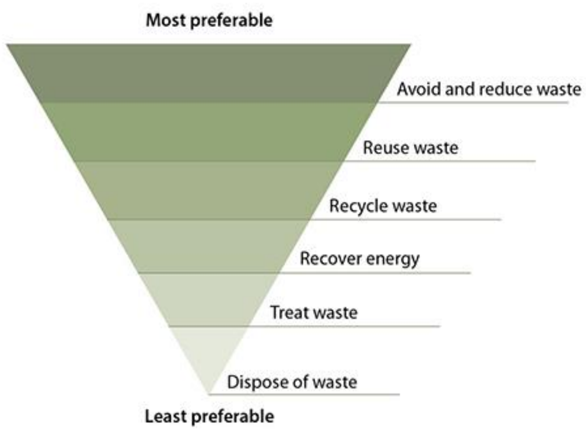
A detailed summary of the waste types, classification, proposed management methods, and estimated annual quantities of wastes produced during the construction and ongoing operation of the project will not be available until detailed design and an EPC contractor has been selected. These will be included in the project's detailed waste management plan prior to construction and will be prepared in consultation with Warrumbungle Shire Council.

14.1.2 Statutory context, policy and guidelines

The management of wastes is primarily regulated under the POEO Act, the *Protection of the Environment Operations (Waste) Regulation 2014* (Waste Regulation) and the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act). Unlawful transportation and deposition of waste is an offence under Section 143 of the POEO Act. Littering is an offence under Section 145 of the POEO Act.

The WARR Act includes resource management hierarchy principles to encourage the most efficient use of resources and to reduce environmental harm (**Figure 14-1**). This includes:

- avoidance of unnecessary resource consumption
- resource recovery (including reuse, reprocessing, recycling and energy recovery)
- disposal.



Source: (NSW Environment Protection Authority, 2017)

Figure 14-1: Waste hierarchy

The classifications that apply to waste in NSW and the descriptions of each are provided by the POEO Act, the Waste Regulation and supporting guidelines, including the *Waste Classification Guidelines* (Environment Protection Agency, 2014). Many waste types are pre-classified under Schedule 1 of the POEO Act and do not require testing. Pre-classified wastes include:

- general solid waste (non-putrescible) e.g. glass, plastic, rubber, bricks, concrete, metal, paper, cardboard and other domestic waste
- general solid waste (putrescible) e.g. food waste, organics and animal wastes
- hazardous wastes e.g. contaminated soils
- liquid wastes e.g. wastewater effluent and fuels and lubricants
- restricted solid wastes
- special wastes e.g. asbestos, waste tyres, clinical wastes.

14.2 Existing environment

14.2.1 Resources

The majority of resources would be used during the construction of the project. Indicative information on the key resources required for the project is provided in **Table 14-1**. The resource quantities would be refined following detailed design. Resources would be sourced locally where practicable subject to availability and cost.

Table 14-1: Indicative resources required for the project

Resource	Description	Indicative quantity	Potential source/s
Sand	Bedding for cable trenches	40,775 m^3	Offsite quarries including: • Dubbo Sands: 22L Rawsonville Rd, Rawsonville NSW 2830 • Holcim Quarry Dubbo: Sheraton Rd, Dubbo NSW 2830 • Boral Quarries: LOT 29 Spring Ridge Rd, Gulgong NSW 2852 • Regional Group Quarries: 20

Resource	Description	Indicative quantity	Potential source/s
			Sheraton Rd, Dubbo NSW 2830 • Dubbo Hard Rock Quarries: 10R Lagoon Creek Rd, Minore NSW 2830 • Tallawonga Pit: 218 Tallawonga Road, Elong Elong, NSW 2831 (Privately owned Quarry)
Concrete	Foundations, general building construction	161,700 m^3	Quarries as listed above
Road base	Pavement for access tracks, hardstands, batching plant and construction compound	308,316 m^3	Sourced from onsite quarry
Steel	Turbine foundation reinforcement	7505 ton	Imported or locally sourced steel (subject to price of IO / Supply Chain conditions)
Water - Dust suppression (incl. concrete batching plant)	Assume 45km track length at once, 8m application width application rate 2.5L/m^2/day, 78 weeks duration = 900 kilolitres per day	421,200 kilolitres	Dust suppression water to be sourced onsite for as much as possible
Water - Pavements	Access tracks, wind turbine hardstands, internal substation benches, O&M facilities, concrete batching plant, construction compounds	647,464 kilolitres	5-10% supply from recycled water from within batching plant Remainder to be sourced from external supplier
Water -Wind turbine foundations	Concrete and binding	27,612 kilolitres	
Water - Amenities (potable water)	Assume 400 persons workforce, 40L/day/person, 78 weeks duration	7,488 kilolitres	
Water - Potential workers accommodation facility (potable water)	Assume 400 persons workforce, 40L/day/person, 78 weeks duration	7,488 kilolitres	

14.2.2 Waste types and classifications

Indicative information on the wastes likely to be generated by the project is provided in **Table 14-2**. All wastes would be transported and disposed of in accordance with the *Waste Classification Guidelines* (Environment Protection Agency, 2014) and the POEO Act.

The management details provided in **Table 14-2** are indicative only and would be detailed in a waste management plan for the project. This would be developed in consultation with Warrumbungle Shire Council and local waste facilities. Waste generated from the project is predicated to be minimal and will be confined to the construction and decommissioning stages. During the operational stage, there will be very limited waste generated.

Table 14-2: Potential waste types, classification, quantities and management details

Waste type	Description	Classification	Indicative quantity[1]			Management details
			C	O	D	
Paper and cardboard	Packaging materials, general office wastes	General Solid Waste (non-putrescible)	Negligible	N/A	Negligible	Separated for recycling
Wood	Pallets and cable drums, timber offcuts	General Solid Waste (non-putrescible)	Negligible	N/A	Negligible	Separated for reuse or recycling
Plastic	Packaging materials, ties, straps and excess building materials such as safety fencing and barriers	General Solid Waste (non-putrescible)	Negligible	N/A	Negligible	Disposed to landfill
Green waste	Vegetation waste from clearing activities	General Solid Waste (non-putrescible)	All material expected to be reused	N/A	N/A	Beneficial onsite or offsite reuse or disposal to a green waste facility or landfill Weeds will be separated, sprayed and bagged to avoid proliferation Non-weedy vegetation will be mulched for reuse onsite where possible
Soil	Surplus spoil from excavations and earthworks	General Solid Waste (non-putrescible)	All material expected to be reused (subject to classicisation)	N/A	N/A	Onsite reuse or offsite reuse or disposal at a licenced facility Any contaminated soils (if encountered) would be tested and treated onsite and/or disposed of to a suitably licensed facility

Waste type	Description	Classification	Indicative quantity[1]			Management details
			C	O	D	
Hydrocarbons	Used lubricants, oils and fuels, contaminated water from equipment washing	Liquid waste	Negligible	N/A	Negligible	Collection in tanks and transported to an offsite licensed facility
Sewage	Biological wastes from onsite septic systems	Liquid waste and General Solid Waste (non-putrescible)	80,000 litres per day[2]	Negligible	80,000 litres per day[2]	Collection by a contractor and disposed of to a suitably licensed facility
General domestic	Food scraps, aluminium cans, glass bottles, plastic and paper containers	General Solid Waste (putrescible and non-putrescible)	2,352 tonnes over 24 month period[3]	4,410 tonnes over a 30 year period[3]	2,352 tonnes over 24 month period[3]	Collection by a waste management contractor and disposed of to a suitably licensed facility
Commercial waste	Oily rags, filters and fuel / lubricant storage containers and empty drums (non-volatile),. Herbicides and pesticide storage containers	General Solid Waste (non-putrescible)	Negligible	Negligible	Negligible	Collection by a contractor and disposed of to a suitably licensed facility
Wind turbines	Mix of resin, fibreglass, metals and electrical components	General Solid Waste (non-putrescible)	0	0	To be determined at detailed design	Blades will be cut to a size suitable for handling and transportation and disposed of at a suitably licensed facility during decommissioning. Metal structures such as the WTG towers and nacelles will be disassembled and sold as scrap metal where possible or disposed of to a suitably licensed facility

Waste type	Description	Classification	Indicative quantity[1]			Management details
			C	O	D	
						Electrical components will be separated from the towers and nacelles where possible and sent to a suitably licensed facility for recycling
Foundations	Reinforced concrete	General Solid Waste (non-putrescible)	0	0	Approximately 800m3 of concrete for each wind turbine	Foundations will remain in situ where it is determined to be more environmentally disruptive to remove the foundation.
Transmission and reticulation line poles		General Solid Waste (non-putrescible)	0	0	Negligible	Metal components will be disassembled and sold as scrap metal where possible or disposed of to a suitably licensed facility
Cable reels		General Solid Waste (non-putrescible)	0	N/A	0	All cable reels would be stored on site and returned to the manufacturer
Chemical / dangerous goods	Lithium-ion cell and batteries	Hazardous waste	0	0	To be determined at detailed design	Special provisions, including packaging instructions for lithium-ion batteries transported for disposal or recycling in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code).

[1] C – construction; O – operation D – decommissioning

[2]Projected waste water quantity is based on NSW Department of Health's general allowance of 200 litres of water per person per day and a peak work force of 400 for construction and decommissioning and 50 employees for operation.

[3]Projected general waste quantity based the *National Waste Report 2020* (Department of Agriculture, Water and Environment, 2020) allowance of 2.94 tonnes per person per year for 2018-19 and a peak work force of 400 for construction and decommissioning and 50 employees for operation.

[4] Negligible – Refers to a quantity of waste that is small or unimportant to the point where it is not worth considering. In the context of this project, it is considered to be less than 50,000 megalitres in total.

14.2.3 Waste management facilities

There are several licensed waste management facilities in the area available for disposal or management of wastes generated by the project. These include:

- Gulgong Waste Facility located at 62 Mineshaft Lane, Gulgong (approximately 50 kilometres by road from the project, within Mid-Western Regional LGA)
- Coonabarabran Landfill located at Baradine Rd, Coonabarabran (approximately 140 kilometres by road from the project within Warrumbungle LGA)
- Gilgandra Waste Management Facility, located at Collision Drive, Gilgandra (approximately 90 kilometres by road from the project, within Gilgandra Shire LGA)
- Mudgee Waste Facility located at 31 Blain Road, Caerleon (approximately 78 kilometres by road from the project, within Mid-Western Regional LGA)
- Whylandra Waste and Recycling Centre, Dubbo (approximately 100 kilometres by road from the project, within Dubbo Regional LGA).

Waste transfer stations are located nearby to the project in Coolah and Dunedoo.

Mudgee Waste Facility can accept 27,000 tonnes per annum of waste and has an estimated remaining lifespan of 60 years (Impact Environmental, 2018). The Coonabarabran Landfill can accept 2,550 tonnes per annum of waste and has an estimated remaining lifespan of 30 years and Whylandra Waste and Recycling Centre can accept 60,000 tonnes per annum of waste and has an estimated lifespan of 200 more years (Impact Environmental, 2018).

Sewerage and wastewater treatment plants are located in Coonabarabran, Baradine, Coolah and Dunedoo. Discussions with Warrumbungle Shire Council regarding waste disposal options for the project site (and construction workers accommodation) have commenced, and further discussions will be engaged prior to construction.

14.3 Assessment of potential impacts

14.3.1 Resource use and availability

The majority of the required resources would be used during the construction of the project. Resources required during operations would be minimal and generally associated with maintenance activities, domestic resources for site personnel (such as water and office materials), and replacement materials for project infrastructure.

The materials required for the project are not currently limited or restricted. In the volumes required, the project is unlikely to place significant pressure on the availability of local or regional resources.

14.3.2 Waste management

Potential impacts from poor management of waste include pollution of land and water, human and animal health impacts, and decreased amenity.

In accordance with definitions in the POEO Act and associated waste classification guidelines, most waste generated by the project would be classified as general solid waste (non-putrescible). Ancillary facilities in the site compound would also produce sanitary wastes classified as general solid waste (putrescible).

During construction, the main waste streams are anticipated to be from packaging materials such as timber pallets, ties, straps and excess building materials. With the exception of some metal and plastic items, most general solid waste (non-putrescible) is capable of being reused or recycled. It is proposed that all waste will be segregated in accordance with the construction waste management plan, which will be developed in consultation with Warrumbungle Shire Council.

Skip bins will be made available onsite to enable waste separation for recycling (e.g. separate skip bins for cardboard recycling and timber collection). General waste bins will be provided for disposal of materials that cannot be cost-effectively recycled.

Operational waste quantities would be very low given the low maintenance requirements of the project. Operational waste would include a small amount of domestic waste including food scraps, aluminium cans, glass bottles, plastic and paper containers and putrescible waste generated by site personnel. Additionally, any components removed during maintenance or upgrade of equipment, machinery and vehicles would also require disposal. These activities would occur infrequently and there would be a high potential for recycling or reuse of any waste.

During decommissioning, all above ground infrastructure and materials would be removed from the site and recycled or otherwise disposed of at approved facilities. Underground cables buried at 1000 millimetres deep and greater would likely remain in situ.

Most project components are recyclable and mitigation measures are in place to maximise reuse and recycling in accordance with resource management hierarchy principles. Any items that cannot be recycled or reused would be disposed of in accordance with applicable regulations and to appropriate facilities.

There are currently no economically feasible methods to recycle retired wind turbines in Australia due to the complex dismantling process that is required to separate the materials (Clean Energy Council, 2020). This is a global issue in a range of industries, not just the wind energy sector. UPC\AC will consider reasonable and feasible alternative disposal methods based on the industry standards at the time of decommissioning. New technologies have recently been announced overseas that would work towards making a whole wind turbines fully recyclable by 2040. The process involves separating the glass or carbon fibre within the turbines, from the resin and then further separating the resin into base materials. These separate materials can then be used for construction of new blades.

14.4 Environmental management and mitigation measures

Proposed measures to manage and/or mitigate waste impacts from the project are detailed in **Table 14-3**.

Table 14-3: Management and mitigation measures – waste and resources

ID	Management/mitigation measure	Timing
WR1	A construction waste management plan will be prepared in consultation with Warrumbungle Shire Council. The waste management plan will include: • details of the quantities of each waste type and the proposed reuse, recycling and disposal locations • details on how the waste will be transported to disposal locations during construction and decommissioning • details on measures to reduce the types and volumes of waste • measures to maximise reuse and recycling.	Prior to construction

ID	Management/mitigation measure	Timing
WR2	UPC\AC will continue to consult with Warrumbungle Shire Council around specific details of the waste management strategy throughout the life of the project.	At all times
WR3	All waste generated from the project will be assessed, classified and managed in accordance with the *Waste Classification Guidelines* (EPA, 2014).	At all times
WR4	Management of wastes will follow the resource management hierarchy principles in accordance with the WARR Act (i.e. avoid > reduce > reuse > recycle > recover > disposal).	At all times
WR5	Skip bins will be made available onsite to enable waste separation for recycling (e.g. separate skip bins for cardboard recycling, plastics and timber collection). General waste bins will be provided for disposal of materials that cannot be cost-effectively recycled.	At all times
WR6	Wastes will be disposed of at suitable facilities permitted to accept the waste.	At all times
WR7	All trucks transporting waste from the site will have covered loads to prevent spillage and other nuisances.	At all times
WR8	The site septic system will be installed and operated in accordance with Warrumbungle Shire Council regulations.	At all times
WR9	UPC\AC will consider reasonable and feasible alternative disposal methods for the wind turbine components based on the industry standards at the time of decommissioning.	Decommissioning

15. SOCIAL

15.1 Assessment methodology

15.1.1 Assessment approach

A social impact assessment has been prepared by AAP Consulting and is included in **Appendix P**.

The objectives adopted for this social impact assessment include:

- providing a clear, consistent, and rigorous framework for identifying, predicting, evaluating, and responding to the social impacts of state significant infrastructure, as part of the overall Environmental Impact Statement process
- facilitating improved project planning and design through earlier identification of potential social impacts
- promoting better development outcomes through a focus on enhancing positive social impacts and minimising negative social impacts
- supporting informed decision-making by strengthening the quality and relevance of information and analysis provided to the consent authority
- facilitating meaningful, respectful, and effective community and stakeholder engagement on social impacts across each Environmental Impact Statement phase, from scoping to post-approval
- ensuring that the potential social impacts of approved projects are managed in a transparent and accountable way over the project life cycle through conditions of consent and monitoring and reporting requirements.

The approach to the social impact assessment included:

- defining the social locality
- identifying and scoping impacts:
  - gaining an understanding of the project's social locality through engagement with the local community and stakeholders, research and analysis of the area surrounding the project, technical assessments and review of comparative projects.
  - considering the characteristic of the communities within the social locality. This is described as the social baseline
  - identifying likely social impacts for different groups in the social locality
- assessing likely and perceived, unmitigated and mitigated positive and negative social impacts
- describing and proposing social impact enhancement, mitigation and residual impacts
- proposing strategies for monitoring of social impacts.

Social locality definition

There is no prescribed meaning or fixed, predefined geographic boundary to a social locality; rather, the social locality should be construed depending on the nature of the project and its impacts. Defining the social locality begins with understanding how positive and negative impacts may be reasonably perceived or experienced by different people. Social impacts in and beyond the wind farm boundaries, both positive and negative have been considered. The scoped social locality includes:

- the Warrumbungle Shire LGA
- the rural township of Coolah (the closest to the project site)
- Leadville (of which the Leadville cluster of the project is named after)
- Uarbry (south of the Girragulang Road cluster and east of the Leadville cluster)
- the rural township of Dunedoo (closest to the Leadville cluster of the project).

Social baseline data collection

A key component in the development of the social baseline was the collation and interpretation of relevant demographic data. To provide statistical analysis, the primary areas of interest for the purpose of this assessment and as defined by the ABS (2016) are shown in **Table 15-1**. The study also uses the state of NSW for comparative purposes.

Table 15-1: Statistical area of analysis

Analysis Area	Geographical boundaries including ABS area code
Host Landholders / Neighbours / Community	The state suburbs of: Coolah (11024) Leadville (12290) Uarbry (13999) Dunedoo (11316)
Region	Warrumbungle Shire Local Government Area (18020)

A wide range of social indicators were considered prior to conducting this statistical analysis as well as in the development of the existing social baseline. The selection of social indicators was primarily informed by the key theme contained in the NSW Department of Planning Infrastructure and Environment Central West and Orana Regional Plan 2036.

The baseline also uses the Socio-Economic Indexes for Areas (SEIFA). This is an ABS measure that ranks areas in Australia according to relative socio-economic advantage and disadvantage. There are four different SEIFA measures, however, this report utilises the Index of Relative Socio-Economic Disadvantage (IRSD) as it considers vulnerability. Higher IRSD scores reflect lower levels of disadvantage. The IRSD scores included in the social impact assessment are for geographical areas at the LGA level. The score is standardised against a mean of 1,000, with a standard deviation of 100.

Finally, the baseline also considers existing social infrastructure. Social infrastructure refers to facilities and services that enhance the social capacity of communities and may include infrastructure related to health, housing, youth, aged care, leisure, community safety facilities and road safety (Franks, 2012).

An online desktop search was the method used to determine the existing social infrastructure associated with the project. Data was sourced from a range of websites including

- Warrumbungle Shire website
- NSW Department of Education
- NSW Health
- NSW National Parks and Wildlife Service

This assessment includes the most current data sources at the time of writing. It is important to note that while the ABS Census 2021 was undertaken in August 2021, the results are released from June 2022 and therefore have not been included in this assessment.

15.1.2 Statutory context, policy and guidelines

The social and economic assessment has been undertaken in accordance with the following:

- Social Impact Assessment Guideline 2021
- Community Engagement Guidelines for the Australian Wind Industry
- Best Practice Charter for Renewable Energy Developments
- A Guide to Community Benefit Sharing for Renewable Energy Projects.

Warrumbungle Shire Economic Development and Tourism Strategy

The *Warrumbungle Shire Economic Development and Tourism Strategy* (Warrumbungle Shire Council, 2019) (Warrumbungle ED&T Strategy) was developed to provide direction and a framework to encourage, support and facilitate economic development within Warrumbungle Shire. The Warrumbungle ED&T Strategy recognises the need for Warrumbungle Shire to diversify its economy to reduce its dependence on agriculture. One of the key macro-trends and drivers with the potential to influence economic growth within the Shire identified in the Strategy is Eco Efficiency and Sustainability. This includes the transition to a more sustainable and resource efficient economy moving towards a 'closed-loop' economy whereby all outputs become either inputs for other activities or are returned to natural systems as benign emissions rather than pollutants. To address this trend, the Strategy identifies the opportunity to shift to investment in renewable energy and demand for land and/or materials for alternative energy production (Warrumbungle Shire Council, 2019).

15.2 Existing environment

15.2.1 Social locality demographics

A brief overview the characteristics of the community is provided below, with additional context and supporting data provided in **Appendix P**. Key characteristics include:

- rural community with an ageing population
- this aging population is reflected in employment, with only 47 percent of the population reported as participating in the labour force
- strong reliance on rural based industries
- strong social ties with higher-than-average volunteer rates
- substantial difference in digital inclusion and access to mobile networks when compared to urban areas
- strong connection to country, with Aboriginal persons accounting for approximately 10% of the population
- limited public transport options which flows on to lower accessibility to community and health services, often located in the larger regional centres of Dubbo and Tamworth, or Newcastle and Sydney.

15.2.2 Social impact assessment engagement outcomes

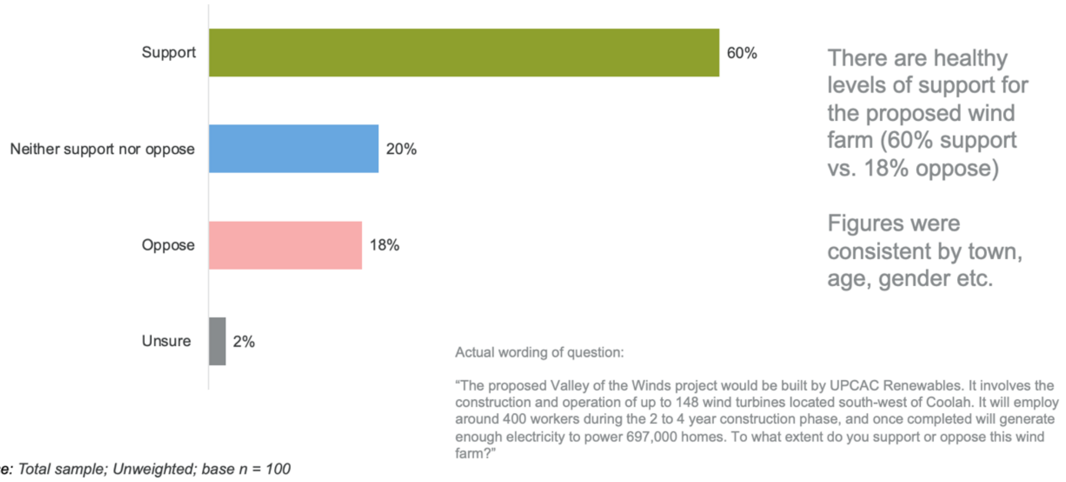
As described in **Chapter 5** impartial and participatory engagement was undertaken independently of the project EIS engagement activities to further inform the social impact assessment. The tools used to achieve the desired social impact assessment consultation outcomes included:

- opt-out survey (random)
- semi-structured interviews
- online survey

Opt-out survey

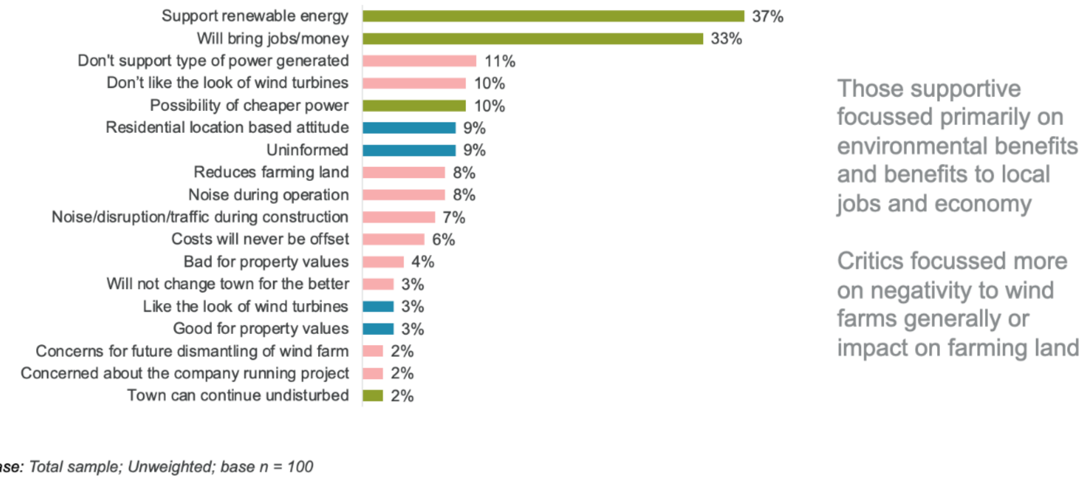
The random survey was undertaken during January 2022 by an experienced, independent research company. The research centred around the towns of Coolah and Dunedoo, seeking a sample size of n=100 adult residents in total. Key findings are presented in **Figure 15.1** and **Figure 15.2** and included:

- 50% of respondents supported (in general) wind farms being built in their region, against 25% opposed (and the balance unsure or neutral). Of four energy infrastructure options offered, only solar farms were more popular (at 58% support) - compared to 27% support for large-scale batteries, and 18% for a gas-fired power station.
- After being informed of the Valley of the Winds wind farm, 60% of residents supported the proposed wind farm (Coolah 61%, Dunedoo 59%), against 18% opposed (Coolah 23%, Dunedoo 15%), with the balance neutral or unsure.
- In terms of their major concerns, 15% (unprompted) were worried about the visual aesthetic of wind turbines, 14% concerned about noise and traffic during construction, and 10% worried about noise during operation. The only other concerns of note were impact on farming land, and the reliability/life cycle/disposal options for wind turbines (at 5% each).
- 63% supported a worker camp accommodation being used (against 22% opposed and the balance neutral or unsure).



Source: Taverner Research

Figure 15.1: Support of the proposal



Source: Taverner Research

Figure 15.2: Reasons for support or opposition

Semi-structured interviews

Between December 2021 and February 2022, a number of targeted interviews were carried out by AAP Consulting Pty Ltd to inform the social impact assessment. The breakdown of interviews by stakeholder group is provided in **Table 15-2**.

Table 15-2: Number of interviews by stakeholder group

Stakeholder group	Respondents
Host landholders	12
Nearby neighbours	12
Special interest groups including local community groups, health, emergency services and community representatives	8
Local business and employment industry	9
Wider community including representative from a comparative project	9
Aboriginal groups	1
Total respondents	51

Key themes emerging from consultation are shown in **Figure 15.3** and **Figure 15.4** (unprompted). The themes are broken down into stakeholder groups by frequency of feedback. It should be noted that stakeholders were able to raise multiple issues or concerns. By stakeholder group, the most frequently raised issues include:

- **Host landholders**: Community investment, leading to improved sustainability and enhancing resilience. Distributive equity of benefits – the investment should stay in the towns most impacted by the project. Decommissioning and how turbines will be pulled down and disposed of.
- **Nearby neighbours**: Changes to the visual landscape and how they experience their surroundings and the potential negative impact on property values.
- **Community groups**: Community investment. Concerns around distributive equity and how the community funds will be administered.

- **Local business and industry**: Economic contributions and sustainability. Including employment and training opportunities, and economic benefits to local businesses and suppliers.
- **Wider community**: Community investment, employment and job opportunities. Concerns around distributive equity and how the community funds will be administered.

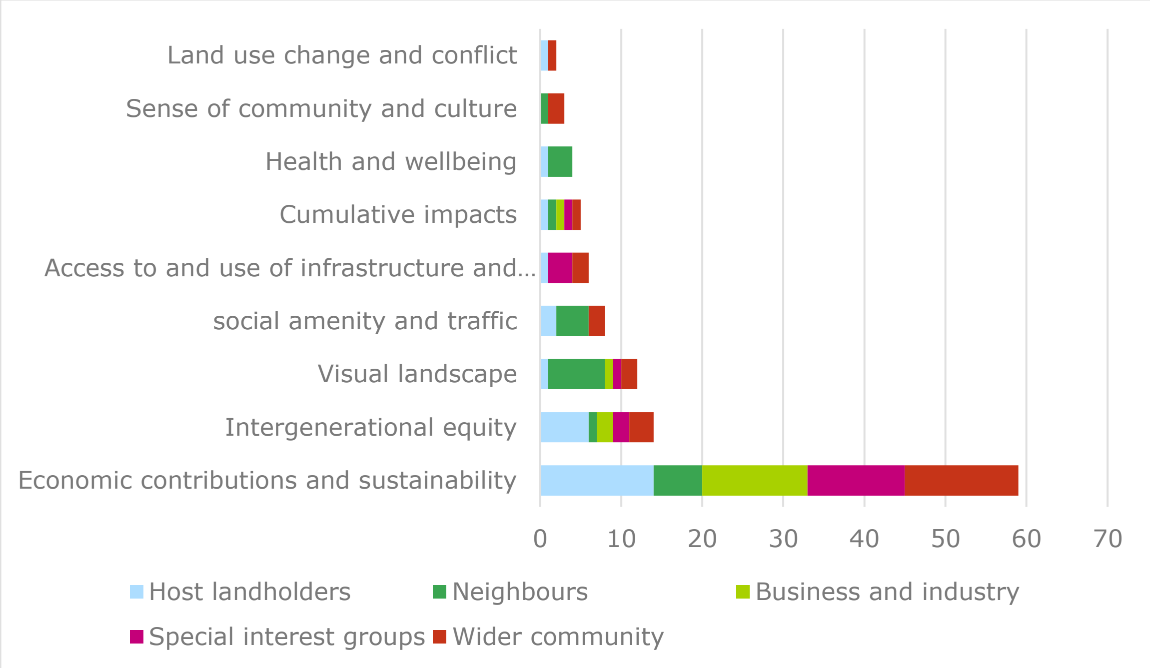


Figure 15.3: Impact themes during targeted engagement (unprompted)

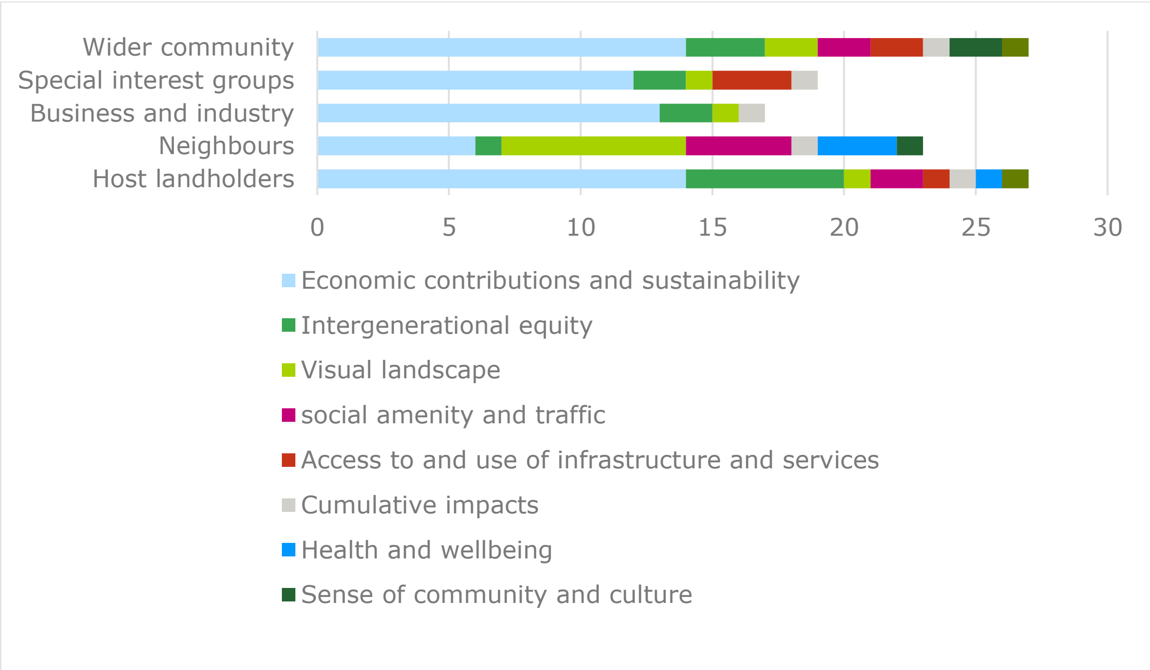


Figure 15.4: Impact themes by stakeholder group (unprompted)

Online survey

An online survey was administered in September 2021 to help further inform the scoped impacts and provide further direction for this assessment. The survey was advertised in local papers, included in direct mail outs and emails to nearby neighbours and host landholders and accessible via the project website. The survey included a series of open-ended and choice questions and received a total of 84 responses, which full completion rate of 25% (21 completed responses). The key themes from the online survey included:

- the positive impact on livelihoods, including the additional income to landholders and the injection of revenue into the broader community. This included increased employment opportunities, increasing local spending for businesses within the surrounding towns, and improving resilience to drought and other natural disasters experienced by rural communities.
- distributive equity of income
- visual impacts
- concerns that during the construction phase, the temporary accommodation needs of workers would increase rental prices and impact the lower-income earners within the community. As a result, they could no longer afford housing and may be forced to relocate, negatively impacting their standard of living.

The outcomes of consultation informed the assessment of perceived social impacts which is discussed in **Section 15.3.1.**

15.2.3 Social baseline summary

This baseline presents some of the strengths and challenges facing communities in the locality and it has been used as a basis, where possible, to assess the social impacts of the project. From a review of the baseline, it is possible to identify a number of key issues and opportunities for the Warrumbungle area, as listed below:

- developing more and diverse employment, education and training services/opportunities for local people
- protecting key community values including local communities; rural lifestyle
- social/community and recreation facilities and events; traditional community and family values
- job growth and economic diversification (including creative economy, small business, tourism, agriculture, renewable energy, retail, health services)
- access to education and community service provision
- access to quality health services
- conservation of heritage and environment.

Inherent within the social impact assessment process is the need to identify and empower vulnerable groups. "Although vulnerability is context dependent and can include a very wide range of groups, typically the concept includes Indigenous peoples, ethnic minorities, migrants, disabled people, the homeless, the poor, those struggling with substance abuse, and isolated elderly people" (Vanclay, 2015).

From the social profile analysis undertaken for the project, it is possible to assess key areas of community resilience and risk in the Warrumbungle LGA. The key findings are summarised in **Table 15-3** which identifies several population groups as potentially having vulnerability to the social or economic changes that the project, and the cumulative effects of other developments across the region, may bring. These include:

- low income earners, the elderly and youth
- property owners within the social locality
- services providers, including those providing short term accommodation options within the social locality for the purpose of tourism
- local job seekers

- Aboriginal and First Nations people
- regular users of short-stay accommodation and tenants within the private rental market

Table 15-3: Social baseline summary

Strengths	Vulnerabilities	Potential implications for vulnerable groups
Abundant and diverse natural capital, including diversity of natural resources, heritage items, agricultural lands, and national parks and reserves.	Competing land uses in the region and managing community perceptions.	Ongoing potential for conflict between different and similar industries utilising the natural capital of the area, particularly property owners who use the land for agricultural production and those who provide accommodation for tourism and short-term stays.
Stable population mobility and strong community support, showing strong ties to community connections, leading to community strength and resilience.	Population decline, ageing population and skills shortage. New production technologies and changing skill requirements. Technology gap between regional and metropolitan NSW – include access to internet.	Those with low education qualifications have reduced resilience to changes in employment due to unforeseen circumstances. Reduced access to support networks.
A broad range of cultural, sporting and recreational activities with schools and health services and opportunities for tourism	Increasing costs of services, facilities and maintenance of assets, and the number of short-term accommodation and longer-term rentals options. Attracting GPs and other professionals to smaller communities. Access to quality education opportunities and limited public transport options	Potential further restrictions to access to services for vulnerable groups due to influx of workers from major works. Opportunity to improve access to services for marginalised and vulnerable groups
Improving renewable energy services to the area, including the Central-West Orana Renewable Energy Zone.	Temporary reduction in social amenity during construction Impact on livelihoods and existing industry due to changes in land ownership.	Potential further restrictions to access to services for vulnerable groups due to influx of workers from major works and competing land use priorities.
Strong housing market for homeowners and investment properties.	Limited housing stock in both the rental and buying markets.	Higher rental and property prices, or limited availability of housing for those most vulnerable.
Strong rural based industries	Lack of economic diversity and job opportunities for vulnerable communities including youth, those needing assistance and aboriginal communities.	Employment and training opportunities, and opportunities to strengthen community resilience to natural disasters such as drought, fires and floods.

15.3 Assessment of potential impacts

15.3.1 Likely and perceived positive and negative impacts

Perceived impacts identified by research participants cover a range of social impact categories and reflect the fears and aspirations of the stakeholders consulted. **Table 15-4** defines the social impact themes that fall within each of the 2021 Guideline social impact categories and demonstrates the interrelationships that exist between the social impacts raised.

Table 15-4: Likely and perceived social impacts

Social impact theme	ID	Impact on people (unmitigated)	Project aspect	Social impact category (Guideline)
Visual Landscape	S01	Changes to the visual landscape affecting how people experience their rural surroundings	Construction and operations	Surroundings
Social amenity	S02	Decline in social amenity or way of life due to construction impacts such as dust and noise	Construction	Way of life
	S03	Increased traffic causing increased road safety risks for road user and further decline in quality of roads	Construction	Way of life, health and wellbeing
	S04	Operational noise generated by wind turbines, causing a decline in social amenity and how people experience their rural surroundings	Operations	Way of life
Sense of community and culture	S05	Changes to local population causing a decline in the composition and character of the community	Construction and operations	Community
	S06	Changes to community composition potentially leading to increase in community resilience and changes to the way the community functions	Construction and operations	Community
	S07	Changes to land use resulting in a sense of loss of Aboriginal cultural heritage values	Construction and operations	Culture
Land use change and conflict	S08	Changes to the existing land use resulting in potential loss of native flora and fauna, changing how people experience their environment	Operations	Livelihoods, surroundings

Social impact theme	ID	Impact on people (unmitigated)	Project aspect	Social impact category (Guideline)
	S09	Changes to land use affecting the availability of land for agricultural purposes	Operations	Livelihoods, surroundings
Access to and use of infrastructure and services	S10	Decline in access to affordable housing, accommodation and community services due to temporary increase in population	Construction	Accessibility
Economic contributions and sustainability	S11	Enhanced wellbeing from job opportunities and training, including increased opportunities for vulnerable groups	Construction and operations	Livelihoods, community
	S12	Community investment initiatives leading to improved sustainability and enhancing resilience	Construction and operations	Livelihoods, community
	S13	Fear that the presence of the project will devalue properties	Construction and operations	Livelihoods
	S14	Distributive equity and decision-making systems	Construction and operations	Decision making systems, community, livelihoods
Intergenerational equity	S15	The effectiveness of wind farms as an alternate energy source and the associated carbon costs.	Operations and policy	Surroundings Decision making systems
	S16	Future land use and rehabilitation	Policy	Decision making systems, surroundings
	S17	Changes to existing land use generating an alternate revenue stream for host landholders leading to improved resilience through income diversification	Decommissioning	Surroundings
Cumulative impacts	S18	Multiple concurrent and nearby major projects leading to reduced levels of social cohesion, creation of skills shortages or a shortfall in supplies	Operations	Surroundings, community, livelihoods

Social impact theme	ID	Impact on people (unmitigated)	Project aspect	Social impact category (Guideline)
	S19	Multiple concurrent projects leading to impacts on the road network and a decrease in road safety	Construction	Community, way of life
	S20	Increased pressure on community services during construction should multiple concurrent projects occur	Construction	Accessibility
	S21	Level of trust in decision making systems and lack of national strategic direction around renewable energy	Policy	Community, accessibility
	S22	Multiple renewable energy projects and changes to the regional visual landscape affecting and how people experience their rural surroundings	Construction and operations	Surroundings
	S23	Changes to land use affecting the availability of land for agricultural purposes, negatively impacting agricultural resources and production and affecting rural landscapes	Operations	Decision making systems
Health and wellbeing	S24	Potential negative health impacts because of the transmission lines and other infrastructure, anxiety around the permanent change to surroundings	Operations	Livelihoods

15.3.2 Cumulative impacts

During engagement, a number of cumulative impacts were raised relating to the project in combination with other relevant planned future projects. Primarily these related to the rate of change across the Central West and Orana region, due to the growing number of proposed and active development projects combined with the REZ and the associated cumulative changes caused by these activities.

The cumulative impact concerns primarily related to the potential for multiple concurrent and nearby major projects leading to reduced levels of social cohesion, creation of a skills shortages or a shortfall in supplies, increased pressure on community services and the impact on the road network.

In terms of the impact on the road network, there was a specific concern that the increased construction traffic from concurrent projects would cause greater road safety risks for other road users, increase commuter travel times, and decrease the quality of the road network.

There was also a lack of trust in the decision-making systems and concerns that there was a lack of national strategic direction around renewable energy and that the community was both fatigued and overwhelmed by the number of projects proposed in the area. A community representative expressed a desire for UPC\AC and other proponents of renewable energy projects in the region to exercise "thought leadership" and to advocate for strategic thinking in facilitating the local community's ability to participate in the energy transition.

There has also been concern expressed regarding the loss of important agricultural land in the Central West, with the NSW Energy and Environment Minister making a commitment to balancing the land-use in the region to ensure renewable energy projects aren't being built on prime agricultural land.

15.3.3 Summary of mitigated impacts

The following table provides a summary of the predicted socioeconomic impacts in relation to the Project. It considers the outcomes of the assessment including enhancement, mitigation, and residual impacts at a holistic level.

Table 15-5: Summary of mitigated impacts

ID	Impact on people (unmitigated)	Project aspect	Extent of impact	Perceived impact (unmitigated)	Project refinements and mitigation measures	Residual impact significance
Social impact theme: Visual landscape						
S01	Changes to the visual landscape affecting and how people experience their rural surroundings	Construction and operations	Host landholders	Medium	• Reduced number of turbines and refinement of turbine locations • Landscape Management Plan • Individual property agreements (host landholder and neighbouring properties	Low (C1 possible/minimal)
			Nearby neighbours	High		Medium (C2 possible/minor)
			Wider community	Medium		Low (D1 unlikely/minimal)
S02	Multiple renewable energy projects and changes to the regional visual landscape affecting and how people experience their rural surroundings	Construction and operations	Wider community	Low	• Reduced number of turbines and refinement of turbine locations • Landscape Management Plan	Low (D1 unlikely/minimal)
Social impact theme: Social amenity and traffic						
S03	Decline in social amenity or way of life due to construction impacts such as dust and noise	Construction	Host landholders	Medium	• Noise and vibration management plan • Compliance monitoring • Social Performance and Communications Plan • Complaints management procedure	Medium (C2 possible/minor)
			Nearby neighbours	Low		Medium (C2 possible/minor)

ID	Impact on people (unmitigated)	Project aspect	Extent of impact	Perceived impact (unmitigated)	Project refinements and mitigation measures	Residual impact significance
					• Addressing social risks in the Construction Environment Management Plan and Construction Traffic Management Plan to ensure project integration	
S04	Operational noise generated by wind turbines, causing a decline in social amenity and how people experience their rural surroundings	Operations	Host landholders / nearby neighbours	Medium	• Refinement of turbine locations • Targeted and tailored consultation on a case by case basis. • Noise and vibration management plan, including details of testing procedures, reporting time frames and compliance monitoring. • Provision of monitoring results to the community	Low (D2 unlikely/minor)
			Wider community	Low		no residual impact
S05	Increased traffic causing increased road safety risks for road user and further decline in quality of roads	Construction	Host landholders	Medium	• Construction Traffic Management Plan developed in consultation with Transport for NSW, Council, bus services and directly affected stakeholders (including the village of Uarbry) • Dilapidation survey of roads • Adaptive monitoring and management strategy that	Low (D2 unlikely/minor)
			Nearby neighbours	Medium		Low (D2 unlikely/minor)
			Wider community / road users	Medium		Low (D2 unlikely/minor)

ID	Impact on people (unmitigated)	Project aspect	Extent of impact	Perceived impact (unmitigated)	Project refinements and mitigation measures	Residual impact significance
					responds to any unforeseen matters that may arise • Timely and clear community information that is accessible to all community members, including those people with disabilities, including visual, auditory, physical, speech, cognitive, language, learning, and neurological disabilities and youth including those young Learner and Provisional drivers on the road network.	
S06	Multiple concurrent projects leading to impacts on the road network and a decrease in road safety	Construction and operations	Wider community	Low	• As above • Temporary workforce accommodation.	Low (C1 possible/minimal)
Social impact theme: Sense of community and culture						
S07	Changes to local population causing a decline in the composition and character of the community	Construction and operations	Wider community	low	• Workplace strategies that encourage the integration of incoming populations with local communities including work place behaviours policies, employee inductions and	Low (C1 possible/minimal)

ID	Impact on people (unmitigated)	Project aspect	Extent of impact	Perceived impact (unmitigated)	Project refinements and mitigation measures	Residual impact significance
S08	Changes to community composition potentially leading to increase in community resilience and changes to the way the community functions.	Construction and operations	Wider community	Low (positive)	toolboxes and opportunities for workforce participation in community events and initiatives. • Local Participation Plan and Aboriginal Participation Plan that maximises local hire where possible • Full time, local based resources prior to and during construction • Community benefit scheme and community grants	Medium (positive) C3 (possible/moderate)
S09	Changes to land use resulting in a sense of loss of Aboriginal cultural heritage values	Construction and operations	Aboriginal people	low	• Project refinement to avoid impacts • Aboriginal Cultural Heritage Management Plan • Aboriginal Participation Plan	Low (C1 possible/minimal)
Social impact theme: Landuse change and conflict						
S10	Changes to the existing land use resulting in potential loss of native flora and fauna, changing how people experience their environment	Operations	Wider community	low	• Project refinements to avoid, minimise and mitigate impacts to biodiversity values • Biodiversity Management Plan • Bird and Bat Adaptive Management Plan • Biodiversity offsets	Low (C1 possible/minimal)

ID	Impact on people (unmitigated)	Project aspect	Extent of impact	Perceived impact (unmitigated)	Project refinements and mitigation measures	Residual impact significance
S11	Changes to land use affecting the availability of land for agricultural purposes	Operations	Wider community	low	• Project refinement to minimise land required for wind farm development • Individual property agreements (host landholder and neighbouring properties	Low (C1 possible/minimal)
S12	Cumulative impact of multiple nearby projects affecting the availability of land for agricultural, negatively impacting regional agricultural resources and production and affecting rural landscapes	Operations	Region	Low	• As above • Co-existence of wind farming with grazing activities • Rehabilitation of land upon project decommissioning	Low (D1 unlikely/minimal)
Social impact theme: Access to and use of infrastructure and services						
S13	Decline in access to affordable housing and accommodation, and community services due to temporary increase in population	Construction	Wider community	High	• Temporary workforce accommodation • Community benefit sharing or investment – specifically, exploring initiatives that are linked to outcomes that meet community priorities identified	Medium (positive) C3 (possible/moderate)

ID	Impact on people (unmitigated)	Project aspect	Extent of impact	Perceived impact (unmitigated)	Project refinements and mitigation measures	Residual impact significance
S14	Increased pressure on community services during construction should multiple concurrent projects occur	Construction	Wider community	Low	in this SIA and through engagement, such as community transport and connectivity, improvements or maintenance of social infrastructure and initiatives that retain the younger generation with Coolah and surrounds. • Workplace strategies that encourage the integration of incoming populations with local communities and promote positive workforce behaviours • Early investment in partnerships that build local business development and capacity • Prioritising opportunities for Indigenous economic participation in the project • Advocating with industry bodies such as EnergyCo. for a strategic approach to understanding and managing the cumulative impacts on the REZ on regional communities	Low (D2 unlikely/minor)

ID	Impact on people (unmitigated)	Project aspect	Extent of impact	Perceived impact (unmitigated)	Project refinements and mitigation measures	Residual impact significance
					in regard to access to and use of infrastructure and service.	
Social impact theme: Construction workforce accommodation						
S25	A decrease in economic benefit to local business and services due to drive-in drive-out nature of workers camps and decline in community character due to potential for antisocial behaviour	Construction	Local business and suppliers including aboriginal service providers	Medium	• Ongoing and targeted consultation. • Encourage the integration of incoming populations with local communities including work place behaviours policies, employee inductions and toolboxes and opportunities for workforce participation in community events and initiatives. • Local Participation Plan and Aboriginal Participation Plan that maximises local hire where possible	Low (C1 possible/minimal)
Social impact theme: Economic contributions and sustainability						
S15	Enhanced wellbeing from job opportunities and training, including increased	Construction and operations	Community	High (positive)	• Early investment in partnerships that provide job-readiness, training and education outcomes to benefit	High (positive) (B4, likely/major)
			Youth	High (positive)		High (positive) (B4, likely/major)

ID	Impact on people (unmitigated)	Project aspect	Extent of impact	Perceived impact (unmitigated)	Project refinements and mitigation measures	Residual impact significance
	opportunities for vulnerable groups		Aboriginal people	High (positive)	the region, and not just the proposed Valley of the Winds project • Local Participation Plan and Aboriginal Participation Plan that commits to procurement, employment and investment in job readiness targets for UPC\AC and its contracting partners.	High (positive) (B4, likely/major)
S16	Community investment initiatives leading to improved sustainability and enhancing resilience	Construction and operations	Community	High (positive)	• Community benefits framework • Exploring initiatives that are linked to outcomes that meet community priorities identified in the SIA. For example, education and training outcomes for youth, community transport and connectivity, small business and enterprise capacity building, various community grants and scholarships in arts, sporting and culture. • Community grants • Implementing an adaptive management and monitoring framework that defines how UPC\AC will track, measure,	High (positive) (B4, likely/major)

ID	Impact on people (unmitigated)	Project aspect	Extent of impact	Perceived impact (unmitigated)	Project refinements and mitigation measures	Residual impact significance
					respond and report on social performance commitments and making parts of this accessible to the public to further increase levels of trust and awareness. • Individual property agreements (host landholder and neighbouring properties	
S17	Fear that the presence of the project will devalue properties	Construction and operations	Nearby neighbours	Medium	• UPC will advocate to industry groups such as EnergyCo and Re-Alliance to commission research in response to ongoing community concerns about the potential of wind farms to devalue properties. This research should be made publicly available for all communities impacts by the REZs. • Individual property agreements (host landholder and neighbouring properties	Low (C1 possible/minimal)
S18	Distributive equity and decision-making systems	Construction and operations	Community	High	• UPC\AC is discussing the opportunity with Council to split the VPA into three portions to help promote distributive equity and the	Medium (negative) C3 (possible/moderate)

ID	Impact on people (unmitigated)	Project aspect	Extent of impact	Perceived impact (unmitigated)	Project refinements and mitigation measures	Residual impact significance
					channelling of the funds back into the immediately affected community. It would also provide the community with a greater voice in the distribution of the funds. • Community benefits framework that includes community grants • Individual property agreements (host landholder and neighbouring properties • Adaptive management and monitoring framework to assess social performance.	
S19	Multiple concurrent and nearby major projects leading to reduced levels of social cohesion, creation of skills shortages or a shortfall in supplies	Construction	Wider community	Low	• As per S15-S18	Low (C1 possible/minimal)
Social impact theme: Intergenerational equity						
S20	Wind farms as an alternative energy source, including	Operations and policy	Community	Low	• Rehabilitation and decommissioning plan	Low (C1 possible/minimal)

ID	Impact on people (unmitigated)	Project aspect	Extent of impact	Perceived impact (unmitigated)	Project refinements and mitigation measures	Residual impact significance
	associated carbon costs				• Recycling all decommissions infrastructure and equipment, where possible • Improved communications and information around carbon costs associated with wind farms and the recycling of components to build trust and transparency with the community.	
S21	Future land use and rehabilitation	Decommissioning	Host landholders	Medium		Low (D1 unlikely/minimal)
			Nearby neighbours	Low		Low (D1 unlikely/minimal)
			Wider community	Low		Low (D1 unlikely/minimal)
S22	Changes to existing land use generating an alternate revenue stream for host landholders leading to improved resilience through income diversification	Operations	Host landholders	High (positive)	• Individual property agreements (host landholder and neighbouring properties	High (positive) (B3, likely/moderate)
			Nearby neighbours	Low (positive)		Medium (positive) C3 (possible/moderate)
S23	Level of trust in decision making systems and lack of national strategic direction around renewable energy	Policy	Wider community	Low	• Industry advocacy	Low (D2 unlikely/minor)

ID	Impact on people (unmitigated)	Project aspect	Extent of impact	Perceived impact (unmitigated)	Project refinements and mitigation measures	Residual impact significance
Social impact theme: Health and wellbeing						
S24	Potential negative health impacts because of the transmission lines and other infrastructure, anxiety around the permanent change to surroundings	Planning, construction and operations	Host landholders Nearby neighbours	Low	• Maintaining transparent, open and timely communications with the community, including nearby neighbours and host landholders, • Social Performance and communications Plan • Community benefits framework	Physical health: Low D2 (unlikely/minor) Mental ill-health: Medium C2 (possible/minor)

15.4 Environmental management and mitigation measures

Proposed measures to manage and/or mitigate social impacts from the project are detailed in **Table 15-6**.

Table 15-6: Management and mitigation measures – social and economic

ID	Management/mitigation measure	Timing
S1	UPC\AC will enter into a Voluntary Planning Agreement (VPA) with Warrumbungle Shire Council. The VPA is currently under discussion with Council. In direct response to community feedback, UPC\AC is discussing the opportunity with Council to split the fund into three portions, being: • a portion administered by Council, • a portion administered through a Section 355 Committee • a portion administered through a community representative committee. The purpose of this is to help promote distributive equity and the channelling of the funds back into the immediately affected community.	Prior to construction
S2	A Community Benefit Scheme Framework will be developed to consolidate the various community benefit initiatives, including: • VPA • Neighbouring property benefits scheme • Community grants This framework will provide a framework for distribution of benefit and mechanisms to track and monitor the effectiveness of community benefits. The framework will include targets to enhance the community benefit sharing scheme by linking to outcomes that meet community priorities identified in the social impact assessment. For example, education and training outcomes for youth, community transport and connectivity, small business and enterprise capacity building, various community grants and scholarships in arts, sporting and culture.	Prior to construction
S3	A Neighbouring Property Benefit Scheme has been setup so the eligible properties neighbouring the wind farm site see a direct benefit from the project. This scheme, amongst others, will have an indirect benefit for the local economy and community more broadly for the life of the project. The Neighbouring Property Benefit Scheme framework was setup as a direct response to the issues raised regarding equality and fair distribution of benefits.	Prior to construction
S4	During the development phase of the project UPC\AC has been assisting with community grants to support various initiatives and programs within the local community including education, arts,	Prior to construction

ID	Management/mitigation measure	Timing
	sporting and culture sectors. This support will continue throughout construction, operation and decommissioning.	
S5	The construction environmental management plan and Construction Traffic Management Plan would include development of relevant measures in response to social impacts including: • amenity related impacts such as noise and dust • traffic impacts, including potential impacts to public transport providers including the coach service that operates as part of Transport for NSW TrainLink and the school bus service operated by Grace Coaches • an adaptive monitoring and management strategy that responds to any unforeseen matters that may arise • cumulative impacts due to other major projects in the locality.	Prior to construction
S6	Workplace strategies will be implemented that encourage the integration of incoming populations with local communities including, but not limited to: • workplace behaviours policies • employee inductions and toolboxes and opportunities for workforce participation in community events and initiatives.	During construction
S7	UPC\AC will appoint a full time, locally based resource prior to and during construction with experience in community relations and workforce engagement. This resource will be responsible for: • community and workforce engagement and communications (including media) • responding to community enquiries and complaints • event planning and participation • community benefit sharing implementation • local participation plan implementation	Prior to and during construction
S8	A robust and supportive social performance and communications plan will be prepared to: • facilitate communication between UPC\AC, the Construction Contractor and the community • to outline an adaptive management and monitoring framework that defines how UPC\AC will track, measure and respond and report on social performance • the objectives of this plan would be in line with the DPIE's Community Participation Plan (DPIE, 2019) and seek to ensure that UPC\AC's engagement is open and inclusive, easy to access, relevant, timely and meaningful. This plan would: • consider all phases of the project, from detailed design to operation • outline a process that ensures communication materials are accessible to all community members, including the culturally and linguistically diverse community and those people with disabilities, including visual, auditory, physical, speech, cognitive, language, learning, and neurological disabilities	Prior to construction

ID	Management/mitigation measure	Timing
	• have measurable targets, performance indicators and means by which performance can be measured • have clearly defined roles and responsibilities for the delivery of activities • include a timetable of actions and events • identified the resourced needed to implement the plan. • key components of the plan, including outcomes of social performance monitoring, would be made accessible to the public to further increase levels of trust and awareness.	
S9	The social performance and communications plan will include a complaints management procedure which will outline a grievance process for the community to raise comments, questions and complaints will be established prior to construction commencing. The grievance process will be made publicly available and include a feedback process through which the complainant is provided with information relating to how their concern has been assessed, considered, and where feasible, addressed.	Prior to construction
S10	UPC\AC will, in consultation with Council, continue to investigate the benefits of inclusion of a construction workers accommodation to address the issue of increased pressure on housing and accommodation due to the construction workforce raised by community members as an area of concern.	Prior to construction
S11	A plan of management will be developed for the construction workers accommodation should it go ahead. The primary purpose of this plan is to: • outline how the proposed construction workers accommodation will maintain a high level of amenity for neighbouring properties and for the workforce • strategies to encourage the integration of the workers camp with local communities to ensure that the economic benefits associated with the presence of a workforce are received by local businesses and service providers • policies and guidelines around expectations for workforce behaviours • consider appropriate safety and security measures • the plan would be developed in consultation with relevant stakeholders including community representatives, council and emergency services.	Prior to construction
S12	A Local Participation Plan and Aboriginal Participation Plan will be developed that prioritises participation and commits to procurement, employment and job readiness investment targets for UPC/AC and its contracting partners. The plans would be supported through procurement and employment systems that: • are embedded into construction contracts, management and assurance	Prior to construction

ID	Management/mitigation measure	Timing
	• tenders are reviewed prior to release to extract smaller packages of work where there is known local and Indigenous business capability • tender evaluation criteria and weightings are built into procurement processes • identification of priority roles to be filled by local and Indigenous candidates • candidate assessment criteria and weightings • initiatives to enhance the retention of local and Indigenous employees • initiatives to promote the transition from training to long term employment The plan will be strategic in terms of labour hire and relevant contractual conditions to ensure that issues around career path progression for youth and the equitable distribution of job opportunities are considered.	
S13	UPC\AC will advocate with industry bodies such as EnergyCo for a strategic approach to understanding and managing the cumulative impacts on the REZ on regional communities regarding access, accommodation and housing and the use of infrastructure and service. UPC will advocate to industry groups such as EnergyCo and Re-Alliance to commission research in response to ongoing community concerns about the potential of wind farms to devalue properties. This research should be made publicly available for all communities impacts by the REZs.	Ongoing

16. ECONOMIC

16.1 Assessment methodology

16.1.1 Assessment approach

An economic assessment has been prepared for the project and is provided in full in **Appendix Q**.

The preparation of the economic assessment included the following methodology:

- describe the existing regional economy
- assesses the regional and State economic activity associated with construction and operation of the project including foregone agriculture and impacts to land values using an input-output analysis
- provide measures to mitigate and manage economic impacts.

Input-output analysis essentially involves two steps:

1. construction of an appropriate input-output table (regional transaction table) that can be used to identify the economic structure of the region and multipliers for each existing sector of the economy
2. identification of the impact or stimulus of the project (construction/operation of the project and reduced potential agricultural activity) in a form that is compatible with the IO equations so that the input-output multipliers and flow-on effects for the impacts or stimulus of the project can then be estimated (West, 1993).

Input-output analysis identifies the economic activity of a project on the economy in terms of four main indicators:

- Gross regional output – the gross value of business turnover.
- Value-added – the difference between the gross value of business turnover and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output. These costs exclude income costs.
- Income – the wages paid to employees including imputed wages for self-employed and business owners.
- Employment – the number of people employed (including self-employed, full-time, and part-time).

16.1.2 Statutory context, policy and guidelines

The Economic Assessment was prepared in accordance with the requirements of the SEARs as listed in **Table 1-1** and include an assessment of the economic impacts and benefits of the project for the region and the State as a whole. There are no economic assessment guidelines for wind farms.

16.2 Existing environment

The wind farm is in the Warrumbungle Shire LGA. Consistent with the Social Impact Assessment, the region for analysis is identified as the Warrumbungle Shire LGA.

16.2.1 Characterisation of the region

Table 16-1 provides some characteristics of the usual residents of Warrumbungle Shire LGA based on the 2016 ABS Census of Population and Housing. In 2016, the regional economy had a population of 9,384 and a labour force of 3,620. In 2016, there were 285 people unemployed.

The main occupations of usual residents were Managers (which includes farm managers), followed by Labourers and Professionals.

Table 16-1: Characterisation of usual residents

	Warrumbungle Shire	
Demographics		
Population	9,384	
Median Age	49	
In labour force	3,620	38.6%
Unemployed	285	7.9%
Median household weekly income	$878	
Unoccupied private dwellings %	761	17.8%
Median rent	160	
Occupations	**No.**	**%**
Managers	890	26.7
Labourers	476	14.3
Professionals	469	14.1
Community and Personal Service Workers	373	11.2
Technicians and Trades Workers	341	10.2
Clerical and Administrative Workers	280	8.4
Machinery Operators and Drivers	218	6.5
Sales Workers	216	6.5

Source: Australian Bureau of Statistics, 2016 Census of Population and Housing, Community Profiles

The main industry sectors in which usual residents were employed in 2016 is provided in **Table 16-2**. *Beef Cattle Farming (Specialised)* is the main sector of employment for usual residents followed by *Local Government Administration*, *Hospitals (except Psychiatric Hospitals)*, *Primary Education* and *Sheep Farming (Specialised)*. 11.6% of employed usual residents work outside the Warrumbungle Shire LGA, mainly in Mid-Western Regional LGA and Western Plains Regional LGA.

Table 16-2: Top five industry sectors of employment for usual residents

Warrumbungles Shire	No.	%
Beef Cattle Farming (Specialised)	346	10.7
Local Government Administration	178	5.5
Hospitals (except Psychiatric Hospitals)	121	3.8
Primary Education	110	3.4
Sheep Farming (Specialised)	106	3.3

Source: Australian Bureau of Statistics, 2016 Census of Population and Housing, Community Profiles

An indication of the health of an economy can be gained from population changes. Trends in regional economies of NSW because of globalisation and associated structural adjustment include:

- loss of significant industries such as abattoirs and timber mills from many rural areas
- increased mechanisation of agriculture and aggregation of properties, resulting in loss of employment opportunities in this industry
- growth of regional centres, at the expense of smaller towns
- preference of Australians for coastal living, particularly for retirement
- preference of many of today's fastest growing industries for locating in large cities (Collits 2000).

The result is that there has been declining population in many rural LGAs that are in non-coastal areas in NSW. There has also been a decline in the population of smaller towns even in regions where the population has been growing.

Against this backdrop, it is evident that the population of the region has declined by 4.32% since 2006, while the population of NSW has grown by 14.20% over the same period (refer to **Table 16-3**).

Table 16-3: Population growth

Location	2006	2011	2016	Growth 2006 - 2011	Growth 2011 - 2016	Growth Rate 2006 - 2016
Warrumbungle Shire LGA	9,808	9,588	9,384	-2.24%	-2.13%	-4.32%
NSW	**6,549,177**	**6,917,658**	**7,480,228**	**5.60%**	**8.10%**	**14.20%**

Source: Australian Bureau of Statistics, 2006, 2011, 2016 Census of Population and Housing, Community Profiles

Population of the Warrumbungle Shire LGA is expected to continue to decline by 2,200 people between 2016 and 2041 (NSW Government, 2019).

16.2.2 Economic Activity in the Region

An indication of the nature of the regional economy can be gained by examining place of work employment by industry data refer to (**Figure 16-1**). This indicates the significance of the *Agriculture* sectors (predominantly Beef Cattle farming and Sheep farming), followed by *Education and Training* sectors, and *Heath Care and Social Assistance* sectors). 97% of people who work in the region also live in the region.

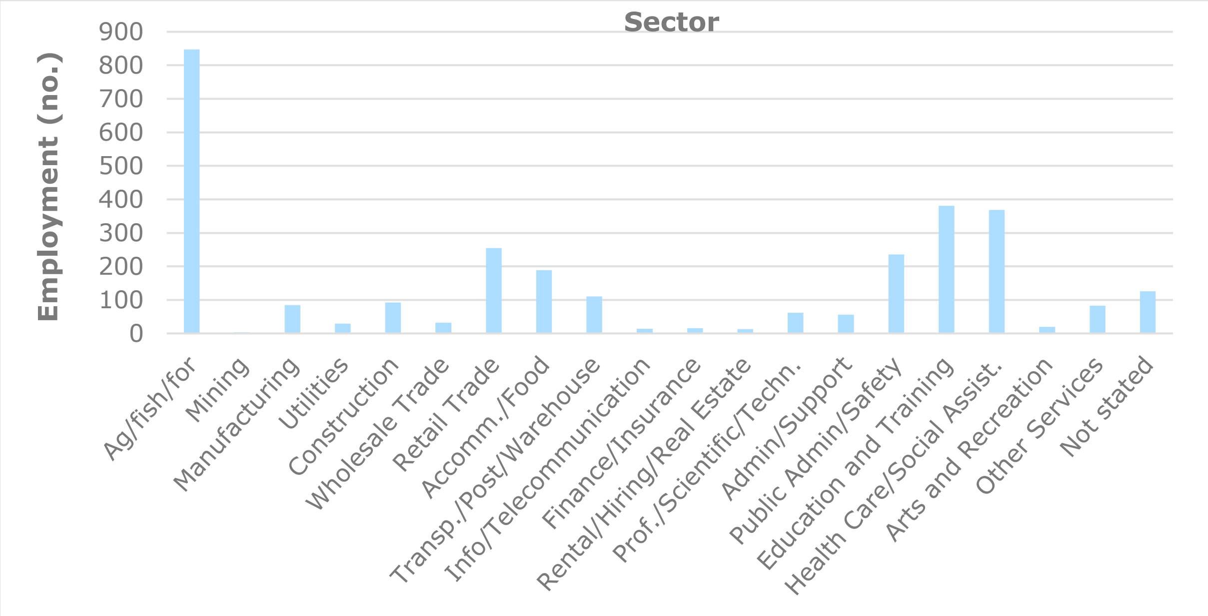


Figure 16-1: Place of work employment by industry

Source: Australian Bureau of Statistics, 2016 Census of Population and Housing, Working Population Profiles

The Gross Regional Product (GRP) of the regional economy was estimated at $491 million for 2020. The region is a net exporter, with exports out of the region of $391.7M million and imports into the region of $279.0 million (REMPLAN, 2022). The largest exporting industries are:

- Agriculture, forestry and fishing ($269.5M)
- Manufacturing ($26.3M)
- Public administration and safety ($23.4M)
- Education and training ($23.0M) (REMPLAN, 2022).

Exporting sectors are based on a region's endowments and competitive advantages, and in regional economic development economics are considered to be the key drivers of the economy.

Conversely, the largest importing industries in the region are:

- Agriculture, forestry and fishing ($110.7M)
- Manufacturing ($28.2M)
- Construction ($21.1M)
- Accommodation and food services ($19.3M) (REMPLAN, 2022).

Gross value-added measures the value of goods and services in produced in a region. **Table 16-4** presents the gross value-add for the five largest industries within the Warrumbungle LGA. It is estimated that *Agriculture, Forestry and Fishing; Rental, Hiring and Real Estate Services; Education and Training; Health Care and Social Assistance;* and *Public Administration and Safety* had the highest value-added in total, equal to approximately 71% of the regional economy and 64% of regional employment.

Table 16-4: Gross Value Added for the five largest industries in the regional economy (ANZSIC One Digit Sectors)

Industry	Gross Value Added ($m)	Proportion of Regional Economy (%)	Proportion of Regional Employment (%)
Agriculture/Forestry/Fishing	120.8	27%	29%
Rental, Hiring and Real Estate Services	77.8	17%	1%
Education and Training	42.1	9%	13%
Health Care and Social Assistance	39.0	9%	13%
Public Administration and Safety	37.5	8%	8%

(REMPLAN, 2022)

16.3 Assessment of potential impacts

The project would provide economic activity to the regional economy during both the construction and operation phase. It would also result in some reduction in potential regional economic activity from foregone potential agricultural activity within the disturbance footprint.

16.3.1 Construction phase

Construction is estimated to occur over a 4-year period at a total cost of around $1.8B (Muller Partnership Quantity Surveyors, 2021). Turbine and other component costs are estimated to comprise 76% of construction costs and imported from overseas. The remainder (24%) is associated with civil works and associated salaries (Muller Partnership Quantity Surveyors, 2021).

The direct and indirect regional economic impact of this level of expenditure in the regional and NSW economy is reported in **Table 16-5** and **Table 16-6**. For the purpose of the EIS and to avoid over stating the local economic benefits of the construction phase of the project, an analysis has been included that considers an estimate of 30% local hires and 70% of hires sourced from outside the region.

Consequently, the final two columns in **Table 16-5** adjusts Total Effects to only include 30% and 70% of consumption-induced flow-ons. For NSW all the construction workforce is expected to come from NSW and hence no adjustment to consumption induced flow-ons is made.

Table 16-5: Average Annual Economic Impacts of the Construction Workforce on the Regional Economy

	Direct	Production induced	Consumption induced	Total Flow on*	Total effect *	Adjusted total for 30% local workforce	Adjusted total for 70% local workforce
OUTPUT ($M)	192	75	24	99	291	274	284
Type 11A Ratio	1.00	0.39	0.13	0.52	1.52	1.43	1.48
VALUE ADDED ($M)	94	10	15	25	119	109	115
Type 11A Ratio	1.00	0.11	0.16	0.27	1.27	1.16	1.22
INCOME ($M)	34	6	5	11	45	41	43
Type 11A Ratio	1.00	0.17	0.16	0.32	1.32	1.22	1.28
EMPL. (No.)	380	101	125	226	606	518	569
Type 11A Ratio	1.00	0.27	0.33	0.60	1.60	1.36	1.50

Note: Totals may have minor discrepancies due to rounding.

Table 16-6: Average Annual Economic Impacts of the Construction Workforce on the NSW Economy

	Direct	Production induced	Consumption induced	Total Flow on*	Total effect*
OUTPUT ($M)	192	206	199	404	596
Type 11A Ratio	1.00	1.07	1.04	2.11	3.11
VALUE ADDED ($M)	93	66	111	177	271

	Direct	Production induced	Consumption induced	Total Flow on*	Total effect*
Type 11A Ratio	1.00	0.71	1.19	1.90	2.91
INCOME ($M)	33	65	60	125	159
Type 11A Ratio	1.00	1.96	1.79	3.75	4.77
EMPL. (No.)	380	304	618	922	1,302
Type 11A Ratio	1.00	0.80	1.63	2.43	3.43

Note: Totals may have minor discrepancies due to rounding.

In estimating the total regional impacts, it is important to separate the flow-on effects that are associated with firms buying goods and services from each other (production-induced effects) and the flow-on effects that are associated with employing people who subsequently buy goods and services as households (consumption-induced effects). This is because these two effects operate in different ways and have different spatial impacts.

UPC\AC aims to target up to 70% local hires for the construction phase of the project, with the remaining 30% expected to be sourced from outside the region. However, it is understood that due to many factors, the target of 70% local hires may not be achievable. Such factors may include other developments in the area competing for skilled local hires, specialised skills not being readily available locally, or lack of available local workforce.

The average annual construction impacts of the project on the regional economy are estimated at between:

- $274M and $284M in annual direct and indirect output.
- $109M and $115M in annual direct and indirect value-added.
- $41M and $43M in annual direct and indirect household income.
- 518 and 569 direct and indirect jobs.

The average annual construction impacts of the Project on the NSW economy are estimated at up to:

- $596M in annual direct and indirect output.
- $271M in annual direct and indirect value added.
- $159M in annual direct and indirect household income.
- 1,302 direct and indirect jobs.

The impacts are larger for the NSW economy because there is less leakage of direct and indirect expenditure out of the NSW economy compared to the regional economy.

Type 11A ratio multipliers (refer **Appendix Q**) summarise the total impact on all industries in an economy in relation to the initial own sector effect e.g. total income effect from an initial income effect and total employment effect from an initial employment effect, etc.

At the regional level, the adjusted type 11A ratio multipliers for the construction workforce of the project range from 1.16 for value-added up to 1.43 for output when 30% of direct labour is sourced from the region. The multipliers are slightly larger when 70% of direct workforce is sourced from the region.

16.3.2 Operation phase

The total and disaggregated average annual impacts of the project on the regional and NSW economy (in 2021 dollars) is shown in **Table 16-7** and **Table 16-8**, respectively. Direct and indirect Output is not reported for reasons of commercial confidentiality.

Table 16-7: Annual economic impacts of the operation of the project on the regional economy ($2021)

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
VALUE ADDED ($'000)	**123**	**7**	**3**	**10**	**132**
Type 11A Ratio	1.00	0.06	0.02	0.08	1.08
INCOME ($'000)	**4**	**3**	**1**	**4**	**8**
Type 11A Ratio	1.00	0.77	0.24	1.01	2.01
EMPL. (No.)	**50**	**35**	**22**	**56**	**106**
Type 11A Ratio	1.00	0.70	0.43	1.13	2.13

Note: Totals may have minor discrepancies due to rounding.

Table 16-8: Annual economic impacts of the operation of the project on the NSW economy ($2021)

	Direct Effect	Production Induced	Consumption Induced	Total Flow-on	TOTAL EFFECT
VALUE ADDED ($'000)	**123**	**22**	**21**	**43**	**166**
Type 11A Ratio	1.00	0.18	0.17	0.35	1.35
INCOME ($'000)	**4**	**15**	**12**	**27**	**31**
Type 11A Ratio	1.00	4.02	3.01	7.03	8.03
EMPL. (No.)	**50**	**101**	**119**	**220**	**270**
Type 11A Ratio	1.00	2.01	2.38	4.40	5.40

Note: Totals may have minor discrepancies due to rounding.

The project is estimated to make up to the following total annual contribution to the regional economy:

- $132M in annual direct and indirect regional value-added.
- $8M in annual direct and indirect household income.
- 106 direct and indirect jobs.

The project is estimated to make up to the following total annual contribution to the NSW economy:

- $166M in annual direct and indirect regional value-added.
- $31M in annual direct and indirect household income.
- 270 direct and indirect jobs.

The impacts are larger for the NSW economy because there is less leakage of direct and indirect expenditure out of the NSW economy compared to the regional economy.

The Type 11A ratio multipliers for the Project's impact on the regional economy range from 1.08 for value-added up to 2.13 for employment.

16.3.3 Agricultural impacts

For the purpose of the analysis the average revenue per ha i.e. $485 per ha per year, across all types of beef grazing enterprise for which the NSW Department of Primary Industries (DPI) provides gross margin budgets, was used. For cultivation of oats and barley, average revenue per ha of $333/ha was used. This was based on average local value per ha for these activities based on the ABS data on agricultural production for the Central West (ABS 2021a, ABS2021b).

Foregone potential revenue would be in the order of $235,500 per annum. Using revenue, expenditure and employment ratios in the sheep, beef and dairy cattle sector of the regional input-output table, the direct and indirect impact of this level of revenue is summarised in **Table 16-9**.

Table 16-9: Annual Economic Impacts of Foregone Agriculture During Project Operation ($2021)

	Direct	Production induced	Consumption induced	Total Flow on*	TOTAL EFFECT*
OUTPUT ($M)	**0.24**	**0.09**	**0.03**	**0.12**	**0.35**
Type 11A Ratio	1.00	0.36	0.13	0.49	1.49
VALUE ADDED ($M)	**0.09**	**0.04**	**0.02**	**0.06**	**0.15**
Type 11A Ratio	1.00	0.41	0.20	0.61	1.61
INCOME ($M)	**0.03**	**0.02**	**0.01**	**0.02**	**0.06**
Type 11A Ratio	1.00	0.50	0.20	0.70	1.70
EMPL. (No.)	**0.76**	**0.37**	**0.16**	**0.53**	**1.29**
Type 11A Ratio	1.00	0.48	0.20	0.69	1.69

Note: Totals may have minor discrepancies due to rounding.

The agricultural impacts of the project are less than 0.26% of agricultural activity in the region and hence are insignificant.

While there is a loss of potential agricultural activity to the region, this is a private economic decision made by the project landholders for which they are compensated.

16.3.4 Land value impacts

The economic value of private land is determined by the interaction of demand and supply in the market, with the market price for land reflecting the willingness to pay of a potential purchaser. Willingness to pay reflects the discounted future potential returns from the land (whether from agriculture, rural residential uses, mining and extractive industries, recreation uses and potential (real or otherwise) to convert to higher value uses e.g. rural residential, urban, industrial or commercial uses). These potential future returns reflect the structural, access and environmental attributes of the land.

The value of private lands on the urban fringe are potentially determined by both agricultural characteristics of the land (i.e. future potential agricultural returns) and urban influences including access to the urban area (and associated physical and social infrastructure including employment, schools, hospitals etc.) and potential for urban conversion.

Where no potential for urban conversion exists in the next say 20 to 30 years, potential agricultural production and/or access to urban areas (employment and physical and social infrastructure) are likely to be major potential determinants of land values. Given enough distance from an urban area, land parcels are valued for agricultural uses only (Guiling *et al* 2009) and land values increase linearly with size.

A literature review by Urbis (2016) of Australian and international studies found that the majority of published reports conclude that there is no impact or a limited defined impact of wind farms on property values. Those studies which identified a negative impact are based in the northern hemisphere and are associated with countries with higher population densities and a greater number of traditional residential and lifestyle properties affected by wind farms. This is generally contrary to the Australian experience, with most wind farms being located in low population density environments that derive the majority of their value from productive farming purposes (Urbis 2016).

Urbis (2016) undertook an assessment of the impact of wind farms on surrounding land values in NSW and Victoria. It found that there is insufficient sales date to provide a definitive answer utilising statistically robust quantitative analysis techniques. However, from its case study assessments it did not identify any conclusive trends that would indicate that wind farms have negative impacts on property values. Its property resale analysis indicated that all of the properties examined demonstrated capital growth that aligned with the broader property market at the time. Consequently, Urbis (2016, p. 21) concluded:

> ***"In our professional opinion, appropriately located windfarms within rural areas, removed from higher density residential areas, are unlikely to have a measurable negative impact on surrounding land values."***

More recent studies have not been published.

16.4 Environmental management and mitigation measures

Proposed measures to manage and/or mitigate economic impacts from the project are detailed in **Table 16-10**.

Table 16-10: Management and mitigation measures – waste and resources

ID	Management/mitigation measure	Timing
E1	Local residents will be preferentially employed where they have the required skills and experience or are able to be upskilled and can demonstrate a cultural fit with the organisation. UPC\AC would work with Warrumbungle Shire Council to develop an employment strategy to maximise local hires wherever possible.	Prior to construction/ construction
E2	Non-labour inputs to production will be locally sourced where local producers can be cost and quality competitive, to support local industries	Prior to construction/ Construction
E3	UPC\AC will continue and expand its participation, as appropriate, in business group meetings, events or programs in the regional community including (but not limited to) the operation of the CCC and the community benefits fund. For additional information refer to **Chapter 5** and **Section 15.4**	Ongoing

17. OTHER ISSUES

17.1 Land use

17.1.1 Assessment methodology

Assessment approach

The assessment methodology to identify potential impacts on existing and future land use involved:

- desktop review of publicly available information to identify existing land uses and interests within and surrounding the wind farm site including:
  - land use zones
  - agricultural land
  - mining and exploration titles
  - Native title and Aboriginal land claims
  - areas of crown land
  - National Parks and Reserves
  - biosecurity
- consultation with affected landholders, neighbouring properties, community and other relevant stakeholders to identify existing land uses not available via publicly available information, particularly existing agricultural operations within the local area
- site walkover undertaken on 24 February 2020 to verify results of the desktop assessment, identify any other existing land uses and gain an appreciation of the wind farm site and surrounds
- identification of appropriate management and mitigation measures to avoid or minimise impacts to land use resulting from the project.

Study area

As discussed in **Chapter 4** a survey boundary has been developed within the wind farm site boundary to consider the impacts of ground disturbance within the wind farm site.

A survey boundary that provides a 200-metre corridor around access tracks and turbines has been applied to this section as the study area. This corridor ensures the assessment on land use impacts adequately identifies potential disturbance, but also provides flexibility for the proposed layout to be refined within the surveyed area during detailed design.

17.1.2 Statutory context, policy and guidelines

The land use assessment has been undertaken in accordance with the following statutory documents:

- Warrumbungle LEP
- Warrumbungle ED&T Strategy
- Mining SEPP
- *Native Title Act 1993*
- *Local Land Services Act 2013*
- Commonwealth *Biosecurity Act 2015*
- NSW *Biosecurity Act 2015*.

17.1.3 Existing environment

Land uses

Land uses in the study area
As discussed in **Section 3.1.3**, the project is located on land that is zoned RU1 – Primary Production under the Warrumbungle LEP. The objectives of this zone are:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.
- To encourage diversity in primary industry enterprises and systems appropriate for the area.
- To minimise the fragmentation and alienation of resource lands.
- To minimise conflict between land uses within this zone and land uses within adjoining zones.

The study area is privately owned land largely used for cattle grazing. Some cropping of oats or barley for grain currently takes place within the wind farm site.

Land uses in the broader locality
Land uses within the broader locality include:

- **Farming** – predominantly grazing cattle and sheep, with small patches of cropping (cereal and fodder)
- **Rural living** – scattered rural dwellings and sheds present throughout the landscape, with a higher density of dwellings in the townships.

Agriculture is the primary land use within the Warrumbungle Shire LGA, with 565,766 hectares of the LGA (45.7 percent) being agricultural land (Warrumbungle Shire Council, 2019). Cattle and sheep production and cereal cropping being the main activities. Other crops include canola, pulses (chick peas, mung beans, faba beans), cotton and pasture. The Warrumbungle Shire has several piggeries, a large thoroughbred horse stud and several viticultural, horticultural and apiary producers (Warrumbungle Shire Council, 2019). The Warrumbungle ED&T Strategy recognises

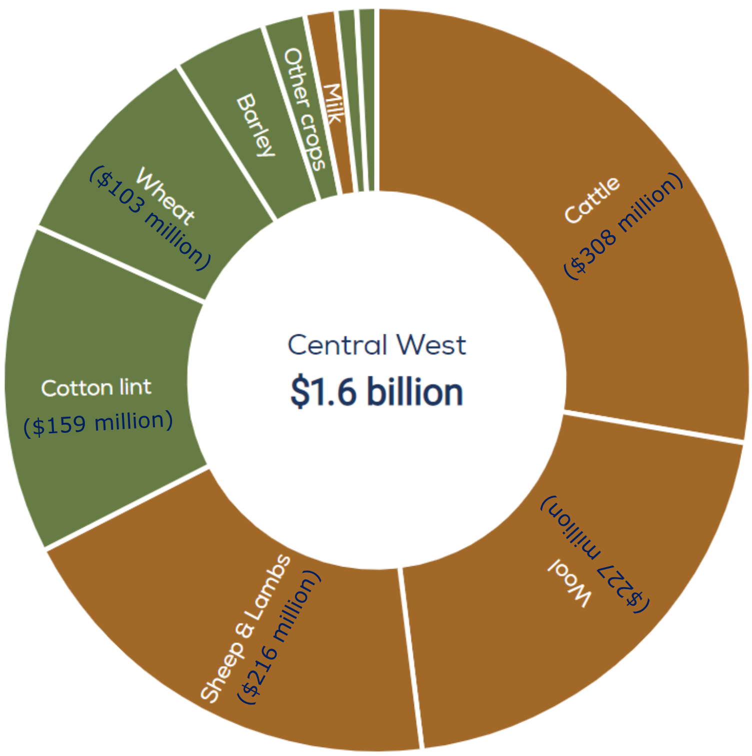
"Warrumbungle Shire needs to diversify its economy to reduce its dependence on agriculture" (Warrumbungle Shire Council, 2019).

Tourism is another significant economic activity within the Warrumbungle Shire LGA, with high profile tourist attractions including the Warrumbungle and Coolah Tops National Parks, Pilliga Forest, Siding Spring Observatory and the Warrumbungle Dark Sky Park (Warrumbungle Shire Council, 2019) (refer to **Figure 1-1**).

Regional land use
A Local Strategic Plan 2016-2021 has been prepared for the Central West (where the study area is located) to assist NSW Local Land Services achieve its vision of resilient communities in productive healthy landscapes (NSW Local Land Services, 2016). The plan was prepared to be consistent with the *Local Land Services Act 2013*, which requires a state strategic plan that sets a vision, priorities and provides an overarching strategy for Local Land Services with a focus on economic, social and environmental outcomes.

The Central West regional economy has historically been based on agriculture, and it remains one of the most productive agricultural areas in Australia. Agricultural land in the Central West region occupies 5,730,000 hectares (81 percent of the region) (Department of Agriculture, Water and the Environment, 2021). Despite the variation in climate and soils, on the whole the region is considered highly productive. Retail, services, mining and tourism also make important contributions to the regional economy (NSW Local Land Services, 2016).

In the 2018 to 2019 reporting period, the gross value of agricultural production in the Central West region was $1.6 billion (refer to **Figure 17-1**) (NSW Department of Primary Industries, 2020). Cattle and calves were the largest contributors ($308 million) representing 12 percent of the total State output, followed by wool ($238 million), and sheep and lambs ($212 million).



Source: Adapted from (NSW Department of Primary Industries, 2020)

Figure 17-1: Central West regional output 2018-2019

Agricultural land

<u>Biophysical strategic agricultural land</u>
BSAL is defined as land that has high quality soil and water resources that are capable of sustaining high levels of productivity. A total of 2.8 million hectares of BSAL have been mapped across the state (NSW Department of Planning, Industry and Environment, 2019).

As discussed in **Section 3.2.1**, BSAL, as mapped under SEPP Mining, occurs within the study area as shown in **Figure 17-2**. This includes the land around Coolaburragundy River between the Mount Hope and Girragulang Road cluster and a small area of BSAL within the Leadville cluster associated with Cainbil Creek. Approximately 1,411 hectares of BSAL are mapped within the wind farm site, of which, 90 hectares are within the survey boundary.

Important agricultural land

Important agricultural land is land that contains a combination of resources that is highly suitable for agricultural industries. It includes existing agricultural land or areas that have future agricultural potential.

The NSW Government has committed to preparing a Regional Agricultural Development Strategy to identify and map important agricultural land, and actions to protect these areas from land use conflict and fragmentation and manage the interface between important agricultural lands and other land uses (NSW Government, 2017). Draft important agricultural land mapping has not yet been released for the Central West Orana region.

The Department of Primary Industries has developed *A guideline to identifying important agricultural lands in NSW* (NSW Department of Primary Industries, 2016) to assist local and state governments to map important agricultural land. The criteria and thresholds to identify important agricultural land within the Central West Orana region are outlined in Table 6 of the plan and have been reproduced in **Table 17-1**.

Table 17-1: Criteria and thresholds for mapping important agricultural lands in the Central West and Orana region

	Annual horticulture	Perennial horticulture	Meat / coarse wool	Fine wool	Cropping	Cotton
Rural land capability classes	2, 3, 4	2, 3, 4	2, 3, 4, 5	4, 5	2, 3, 4	2, 3, 4
Slope (%)	≤10	≤10	≤20	≤30	≤20	≤10
Rainfall (mm)	N/A	N/A	500 to 1000	>600	>400	N/A
Irrigation	Yes	Yes	Yes	No	Yes	Yes
Elevation (m)	>500	>500	N/A	N/A	N/A	N/A
Other	N/A	East of Newell Highway	N/A	N/A	N/A	West of Newell Highway

The study area exhibits the following characteristics relevant to the criteria and thresholds for agricultural lands in the Central West and Orana region:

- **Rural land capability classes** – contains land mapped between LSC class 2 and class 7 (refer to discussion in **Section 13.2.8** and **Figure 13-5**)
- **Slope** – areas within the development footprint have slopes between 0 and 49 degrees.
- **Rainfall** – average annual rainfall is greater than 600 millimetres.
- **Irrigation** – The Macquarie Regulated River System is the major source of surface water irrigation in the Macquarie Valley. The Talbragar River is one of the major tributaries in the Macquarie system located south of the wind farm site. The wind farm site is watered with several named and unnamed creeks that hold permanent or semi-permanent water.
- **Elevation** - ranges between 626 metres and 757 metres AHD.
- **Other** – the study area is east of the Newell Highway and north of the Golden Highway.

Based on the above, the study area does contain some areas of important agricultural lands.

Rural and residential living

Scattered rural dwellings and sheds are present throughout the landscape, with a higher density of dwellings in the townships. Details on the population centres surrounding the study area are presented in **Table 17-2**.

Table 17-2: Population centres in vicinity of the study area

Township	State suburb population	Urban population	Approximate distance from the study area	Direction from the study area
Coolah	1,290	795	4 km	northeast
Leadville	169	-	3 km	west
Uarbry	49	-	4 km	southeast
Dunedoo	1,221	-	17 km	west
Gulgong	2,521	1,956	33 km	south
Mudgee	10,923	-	58 km	south
Dubbo	38,943	-	94 km	southwest
Coonabarabran	3,290	-	64 km	northwest
Muswellbrook	12,075	-	109 km	southeast

Source: (Australian Bureau of Statistics, 2016)

The minimum lot size that applies to land surrounding the study area is 600 hectares, under the Warrumbungle Shire LEP (refer to discussion in **Section 3.1.3**). This minimum lot size requirement has been established to prevent the fragmentation of rural lands.

Native title and Aboriginal land claims

The National Native Title Tribunal Register of Native Title Claims holds information about all native title claimant applications that have been registered. Applications are registered where they meet certain registration test conditions set out in sections 190B and 190C of the Commonwealth *Native Title Act 1993*.

There are four known claims under the Native Title Act (*NC2011/006; NC2018/002; NC2016/005; NC2013/006)* in proximity to the wind farm site. Land currently subject to Native Title Claim by the Gomeroi People (Tribunal File No. NC2011/006, Federal Court No. NSD2308/2011) includes the land on which the wind farm site is located (refer to **Figure 17-3**). The ACHAR undertaken for the project included consultation with the Gomeroi People.

Crown land

As shown in **Figure 17-4**, the wind farm site contains a total of 296 hectares of Crown Land, of which 64 hectares are within the survey boundary.

National parks and reserves

No National Parks or reserves have been identified near the wind farm site. Natural parks and reserves that characterise the regional context of the site are shown on **Figure 17-2** and include:

- Coolah Tops National Park – approximately 35 kilometres to the northeast
- Warrumbungle National Park – approximately 70 kilometres to the north / northwest
- Goulburn River National Park – approximately 20 kilometres southeast

- Other state conservation areas to the south of the site.

Triangulation stations

Triangulation stations, also known as trigonometrical stations, provide real-time geodetic survey data. In NSW, 'CORSnet-NSW' is the network used to determine coordinates for positioning and guidance solutions across a variety of sectors, such as:

- surveying
- agriculture
- construction
- emergency services
- mining
- scientific research
- asset management.

The service is delivered by a network of permanent Global Navigation Satellite System (GNSS) receivers, known as Continuously Operating Reference Stations (CORS), that are strategically located across NSW (NSW Spatial Services, 2021).

A review of Geoscience Australia (Australian Government, 2021), shows there are 26 trigonometry points within 20 kilometres of the wind farm site. The project is located within the first order and second order triangulation region.

Trigonometry stations within the wind farm site include:

- TS5999 F COOLAH – approximately 257 metres from the nearest turbine (MH25)
- TS5998 F COLLIER - approximately 230 metres from the nearest turbine (GR19)
- TS5554 F MUMBEDAH - approximately 399 metres from the nearest turbine (MH70).

Two operational CORS are located near the project:

- 'Coolah' (SCIMS no. TS 12249) – located 2.87 kilometres northeast of Mount Hope cluster
- 'Dunedoo' (SCIMS no. TS 12197) – located 17.85 kilometres west of the Leadville cluster.

The trigonometry stations are shown in **Figure 17-2.**

Biosecurity

Biosecurity protects the Australian economy, environment and community from the impacts of weeds, pests and disease and is administered under the Commonwealth *Biosecurity Act 2015* and the NSW BSA Act (refer to **Chapter 3**) The Commonwealth Act supports the *Biosecurity Strategy 2013-2021* (NSW Department of Primary Industries, 2013) which shares responsibilities for biosecurity across government, industry and the community. The broad objectives for biosecurity in NSW are to manage pest, disease and weed risks by:

- preventing their entry into NSW
- quickly finding, containing and eradicating any new entries
- effectively minimising the impacts of those pests, diseases and weeds that cannot be eradicated.

<u>Weed management</u>

The BSA Act outlines priority weeds that pose a risk to reducing the diversity of native plant and animal species. The Warrumbungle Shire Council is the Local Control Authority responsible for administering the BSA Act in the region that applies to the study area (refer to discussion in **Chapter 3**).

The *Central West Regional Strategic Weed Management Plan 2017-2022* (NSW Local Land Services, 2017) provides a framework for regional weed management and supports the implementation of the NSW BSA Act at a regional level. The plan outlines four goals relating to weed management:

- **Goal 1**: Responsibility for weed biosecurity is shared by the Central West community
- **Goal 2**: Weed biosecurity supports profitable, productive and sustainable primary industries
- **Goal 3**: Weed biosecurity supports healthy, diverse and connected natural environments
- **Goal 4**: Weed biosecurity is supported by coordinated, collaborative and innovative leadership and partnerships.

The plan identifies a large number of priority high risk weeds and the development of the regional priority weed list for the region. Priority weed species are grouped together under the following categories with an associated regional strategic response:

- **prevention** – comprising weed species that are not found in the state/region, however, pose a significant biodiversity risk and need to be prevented
- **eradication** – comprising weed species that are present in a limited distribution and abundance in NSW, and therefore need to be eliminated
- **containment** – comprising weed species that are widely distributed in areas of the state/region, and the associated risks posed by these species need to be minimised
- **asset protection** – comprising weeds that are widely distributed, and the spread of these weeds therefore needs to be minimised to protect certain assets.

<u>Pest management</u>

The *Central West Regional Strategic Pest Animal Management Plan 2018-2023* (NSW Local Land Services, 2018) outlines a framework to protect the environment, community and economy from the impacts of pest animals and support positive outcomes for biosecurity. The plan is consistent with the NSW *Invasive Species Plan 2017-2021*, which in turn supports the NSW *Biosecurity Strategy 2013-2021*. The plan outlines a number of pest species for the Central West, prioritised based on the level of risk and feasibility of control:

- wild dog
- feral pig
- wild deer
- European red fox
- wild rabbit
- wild horse
- feral cat
- feral goat
- pest bird species (e.g. Indian myna, peafowl, red whiskered bulbul)
- pest fish (e.g. common carp, tilapia).

Management of pest animals is prioritised as follows:

- **prevention/alert** – to prevent the pest animal species arriving and establishing in the region causing adverse impacts on the environment, society and the economy
- **eradication** – to permanently remove the species from the state or region and to develop actions to prevent its re-establishment
- **containment** – to prevent the spread of the pest animal species onto other parts of the state or region
- **asset protection** – to reduce the impact of widespread pest animals on key assets with high economic, environmental and social value

- **limited action** - applies only to species that have a low to negligible risk in the region or for which further investigation is required on effective control techniques and strategies for management.

Mining and exploration

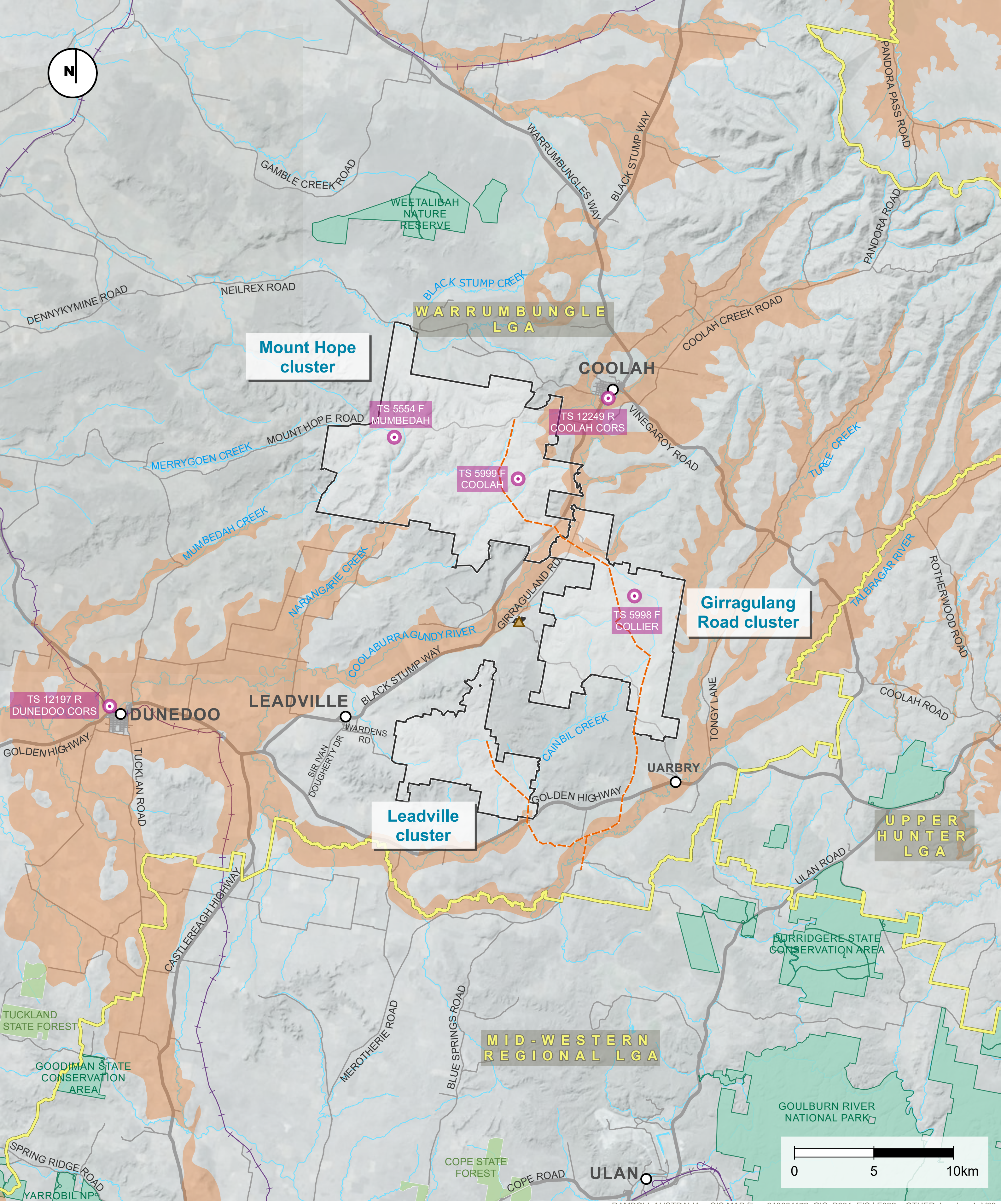
Operational mines

- Coal mining is a major industry within the Mid-Western LGA which is located to the south of the Warrumbungle LGA. Operating mines near the study area are shown on **Figure 1-1** and include:
  - Ulan Coal Mines – located over 30 kilometres southeast of the study area
  - Moolarben Coal Complex – located over 27 kilometres southeast of the study area
  - Wilpinjong Mine – located over 35 kilometres southeast of the study area.

Mining and exploration titles

As discussed in **Chapter 3**, the study area is subject of the following authorities under the Mining Act:

- Exploration Lease (EL) 8665 held by Bacchus Resources Pty Ltd for the purpose of mineral exploration expiring 23 October 2022
- EL 9173 held by Lachlan Cooper Pty Ltd for the purpose of mineral exploration expiring 13 May 2024
- EL 9268 held by Gilmore Metal for the purpose of mineral exploration expiring 23 August 2026.



RAMBOLL AUSTRALIA - GIS MAP file : 318001172_GIS_P001_EIS | F032a_OTHER_Landuse1_V03
Aerial photography from NSW Government Spatial Services

KEY

- Wind farm site
- Overhead transmission line
- Potential construction workforce accommodation
- LGA boundary
- National Parks and Reserves
- State forest
- Trigonometrical station (NSW Spatial Services)
- Biophysical Strategic Agricultural Land (DPIE)

Figure 17-2 | Trigonometrical stations and Biophysical Strategic Agricultural Land

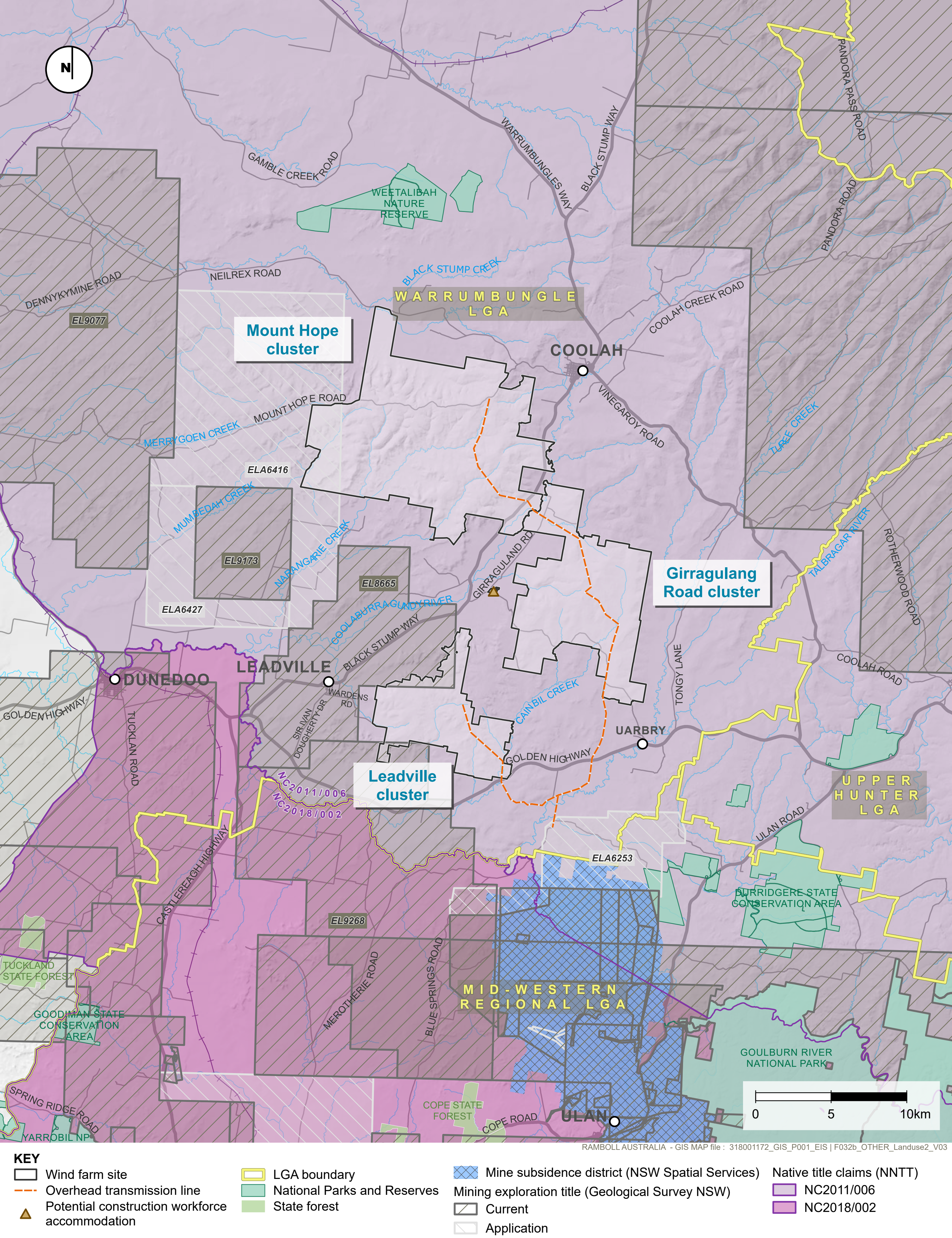
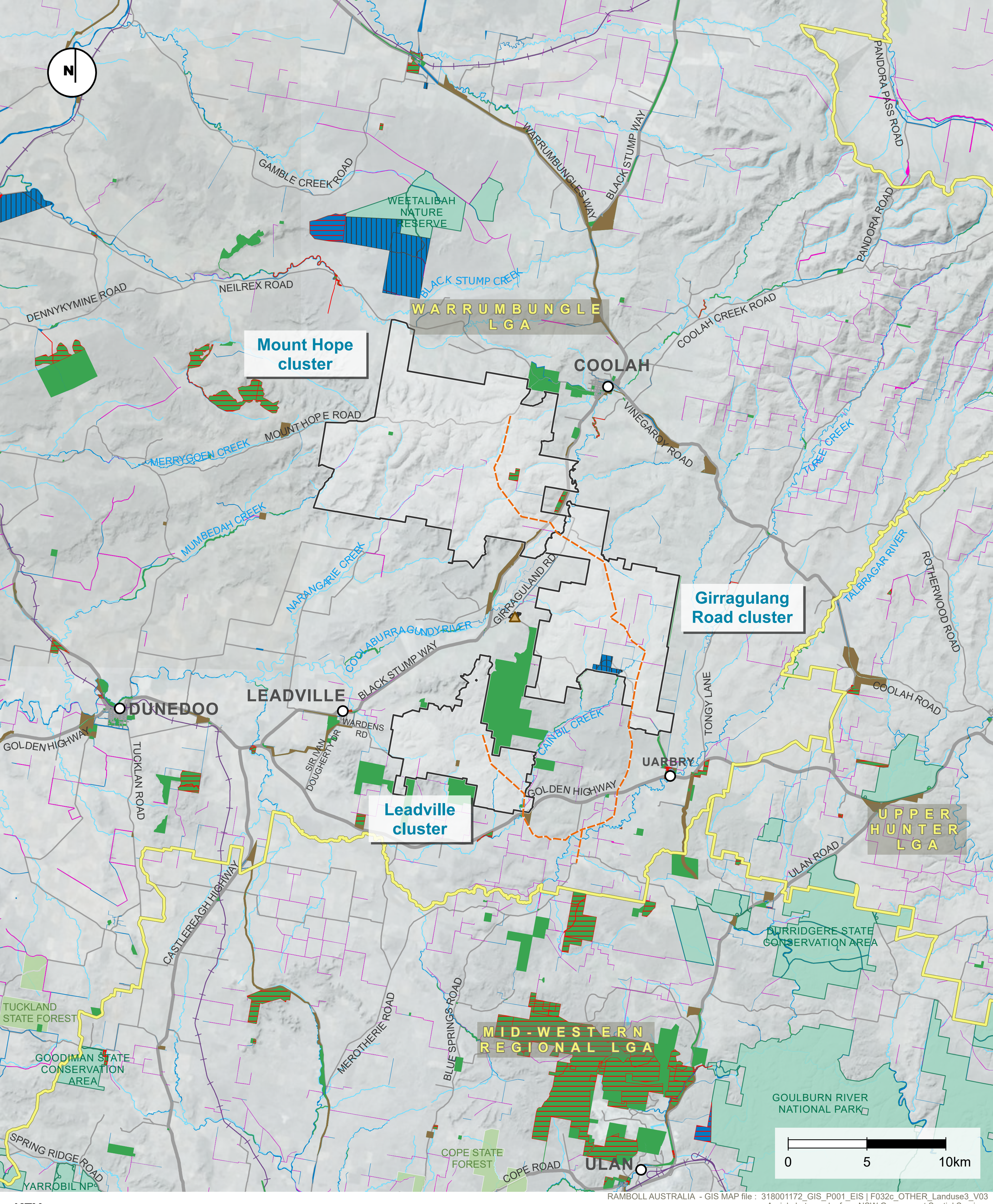


Figure 17-3 | Native title, mine subsidence and mining titles



KEY

- Wind farm site
- Overhead transmission line
- Potential construction workforce accommodation
- LGA boundary
- National Parks and Reserves
- State forest

Crown land (DPIE)

- Travelling stock route
- Crown license
- Crown lease
- Crown enclosure permit
- Crown reserve
- Crown land

Figure 17-4 | Crown land

17.1.4 Assessment of potential impacts

Agriculture

The project would result in a change of the land use in the development footprint from its existing agricultural use to electricity generation. This change would be temporary and the land would be returned to its pre-existing land use or another land use as agreed by the project owner and the landholder at that time. Travelling Stock Reserves (TSR) and the movement of livestock or farm vehicles would not be impeded by the project.

The large separation between the placement of turbines allows the proposal to co-exist with the existing agricultural land use of the survey boundary, with only small portions of land to be occupied by turbine infrastructure and access roads being removed from agricultural production.

The area of agricultural land and BSAL that would be temporarily removed by the project within the context of the Warrumbungle Shire LGA and NSW is provided in **Table 17-3**.

The area of land that would be impacted by the construction footprint and the operational footprint gives an indicative representation of the potential impact of the project on agricultural land over its operational life. During construction, approximately 0.23% of agricultural land within the Warrumbungle Shire LGA would be impacted by the project, and approximately 0.02% of the total agricultural land within NSW. The percentage that would remain impacted by the operational footprint would be approximately 0.097 due to rehabilitation of some areas of the construction footprint.

Table 17-3: Agricultural land removed by the project

<table>
<tr><th rowspan="2">Type</th><th rowspan="2">Geographic range</th><th rowspan="2">Total in geographic area (ha)</th><th rowspan="2">Area of land within survey boundary (ha)</th><th colspan="2">Impact footprint (ha)</th><th rowspan="2">% of agricultural land within geographical area removed</th></tr>
<tr><th>C[1]</th><th>O[1]</th></tr>
<tr><td rowspan="2">Agricultural land</td><td>Warrumbungle Shire LGA</td><td>565,766</td><td rowspan="2">3265.92</td><td rowspan="2">1318.08</td><td rowspan="2">549.33</td><td>0.23</td></tr>
<tr><td>NSW</td><td>64,790,000</td><td>0.02</td></tr>
<tr><td>BSAL</td><td>NSW</td><td>2,800,800</td><td>90.99</td><td>64.88</td><td>60.93</td><td>0.002</td></tr>
</table>

- *Note:*
- 1 C – Construction footprint; O – Operational footprint

It is anticipated that landholders would continue to use remaining portions of their properties (not subject to the landholder agreement) for agricultural activities. Consultation has already commenced with participating and neighbouring landholders to identify potential transport requirements associated with the movement of stock between paddocks and seasonal based agricultural activities and determine appropriate temporary routes/access arrangements or scheduling of vehicle movements to minimise disruption to planned agricultural activities during construction of the project. The economic impacts of the project on agricultural land are discussed in **Chapter 16.**

The survey boundary contains land mapped between LSC class 2 and class 7 (refer to discussion in **Chapter 13**) (NSW DPIE, 2020). Class 2 land is identified as having 'very high' capability and

Class 3 land is identified as having 'high' capability. There is 186.57 hectares of Class 2 and 1,039.95 hectares of class 3 land within the survey boundary. There is no 'extremely high capability land' (class 1) within the survey boundary.

Rural and residential living

The project may result in some temporary impacts to surrounding rural and residential land uses during construction as a result of amenity impacts associated with increases in noise, traffic from an increase in heavy vehicle movements, and reduced air quality. There are no turbines within 2 kilometres of a residential dwelling. Impacts associated with noise, traffic, and air quality are discussed in **Chapter 7**, **Chapter 9**, and **Section 17.2** respectively.

Tourism

The visual impact assessment presented in **Chapter 6** found that there were no tourist attractions within the zone of visual influence of the wind farm site. The project would not become a dominant feature in the landscape when viewed from these locations or the other surrounding high points that prevail in the region such as Salisbury Hill, Bald Hill, Paddys Knob and Dungeon Cave. The character of areas which are valued for their high landscape quality and utilised for recreation and tourism surrounding the project would also remain intact. Regionally, significant landscape features of the locality would remain dominant features of the landscape and it is unlikely the proposal would degrade the scenic value of these landscape features or their attraction.

Native Title and Aboriginal Land Claims

Consultation with the Gomeroi People (Tribunal File No. NC2011/006) has taken place as described in **Chapter 5.** Refer to **Appendix N** for further detail on consultation undertaken with native title claimants and Aboriginal groups.

Crown land

As noted in **Chapter 3**, consultation with NSW Crown Land would be required and an appropriate agreement, lease or licence acquired under Part 5 of the *Crown Land Management Act 2016*.

National parks and reserves

The project is not anticipated to impact on National parks or reserves given the nearest identified National Park is located more than 20 kilometres away from the study area. The visual impacts of the project to from the Coolah Valley Lookout within Coolah National Park has been included in the impact assessment in **Section 6.3**.

Triangulation stations

The project is located generally to the south of the trigonometrical stations and provides for unobstructed views to GPS Satellites from 'Coolah' (SCIMS no. TS 12249) and 'Dunedoo' (SCIMS no. TS 12197)

It is unlikely that the of the 26 trigonometry points within 20 kilometres of the wind farm site host electronic distance measuring devices or other equipment that may be subject to EMI (refer to **Section 10.3**).

There are two trigonometrical stations that are less than 50 metres from proposed access tracks, however detailed design and micro siting of these tracks and nearby turbines would avoid these locations.

Biosecurity
If not adequately managed, the project has the potential to introduce and transport weeds as a result of the increase in vehicle movements to and from the study area during construction. This could lead to the further invasion of weeds to the local area, thereby resulting in changes to vegetation communities over time and associated loss of habitat for native species.

The project may also encourage pest animals to the local area as a result of potential increase in food sources associated with the construction activities and ground disturbance.

Weed and pest management and other biosecurity impacts during construction and operation would be managed appropriately through the implementation of the construction environmental management plan and operational environmental management plan. Weeds that are present within the study area that are listed under the NSW Biosecurity Act 2015 would be managed in accordance with a weed management plan.

Decommissioning and rehabilitation
Near completion of operation of the project, a decommissioning and rehabilitation plan would be prepared that outlines the rehabilitation objectives and strategies to return the study area to its pre-existing condition for agricultural land use (cattle grazing). This would include:

- rehabilitation objectives and strategies
- describing the design criteria of the final land use and landform
- performance indicators to be used to guide the return of the land back to a condition suitable for agricultural production (i.e. cattle grazing)
- expected timeline for the rehabilitation program.

Mining and exploration
The extraction of any resources within the development footprint during construction and operation would not be possible, potentially impacting on exploration licence holders. It is noted that any biodiversity offset areas within these areas may also place a long-term restriction on the exploration/extraction of material.

As the footprint of the project infrastructure represents a small percentage of the total wind farm site, ground-based exploration of minerals could occur concurrently except in the close vicinity of the infrastructure where there may be safety, structural, operational or engineering limitations.

Notification has been provided to relevant licence holders during the project development phase and preparation of the EIS (refer to **Chapter 5**). Given the reversible nature of the project, it is expected that exploration activities could resume following the decommissioning stage of the project.

17.1.5 Environmental management and mitigation measures

Proposed measures to manage and/or mitigate land use impacts from the project are detailed in **Table 17-4**.

Table 17-4: Management and mitigation measures – land use

ID	Management/mitigation measure	Timing
LU1	Consultation will continue to be undertaken with participating landholders to minimise disruption to agricultural activities during construction and operation.	Detailed design / prior to construction

ID	Management/mitigation measure	Timing
LU2	Consultation will continue to be undertaken with mining and exploration title holders as required regarding any planned exploration activities within the vicinity of the project. Final wind turbine locations and details of project infrastructure will be provided to the licence holders prior to construction.	Detailed design / prior to construction
LU3	Biosecurity management will be included in the biodiversity management plan, specifically: • measures to manage the impacts of weeds, disease and pest animals during construction, operation, and decommissioning activities • biosecurity response measures where impacts are identified • contingency measures if existing measures are inadequate in managing the risk/impact.	At all times
LU4	Targeted weed management will be implemented before vegetation clearance and during the construction period as required to minimise the spread of weeds.	During construction
LU5	All machinery will be cleaned prior to entering and exiting the construction site to minimise the transport of weeds to vegetated areas. Weeds that are present within the construction site that are listed under the NSW Biosecurity Act 2015 will be managed in accordance with a weed management plan.	During Construction
LU6	A Decommissioning and Rehabilitation Plan (DRP) will be prepared that outlines the rehabilitation objectives and strategies to rehabilitate the wind farm site to an appropriate standard in consultation with the landholder. This will include but not be limited to: • rehabilitation objectives and strategies • describing the design criteria of the final land use and landform • performance indicators to be used to guide the rehabilitation of the land expected timeline for the rehabilitation program.	Prior to decommissioning

17.2Air quality

17.2.1 Assessment methodology

Assessment approach

An air quality impact assessment (AQIA) has been prepared to address specific SEARs relating to air quality as presented in **Table 1-1**. The report is summarised in the following sections and provided in full in **Appendix R.**

The assessment has been prepared to determine potential air quality impacts from the project on receptors surrounding the wind farm site and formulate mitigation measures to reduce these impacts. Modelling has been included to provide a high-level, worst-case prediction of potential impacts.

<u>Relevant air quality criteria</u>

The Approved Method for the Modelling and Assessment of Air Pollutants in NSW (EPA, 2016) (the Approved Methods) specify particulate concentration assessment criteria, by particle size and averaging period. The air quality criteria applicable to the assessment for the project are presented below in **Table 17-5**.

Table 17-5: Impact assessment criteria for particulates $PM_{2.5}$, PM_{10} and TSP

Pollutant	Unit	24-hour Average	Annual Average
PM2.5	µg/m3	25	8
PM10	µg/m3	50	25
TSP	µg/m3	N/A	90

The above criteria are compared against the 100th percentile prediction. Background air quality should also be considered for a cumulative assessment of impacts.

Level 1 screening dispersion modelling assessment

The Approved Methods specify two levels of impact assessment:

- Level 1 – screening-level dispersion modelling technique using worst-case input data.
- Level 2 – refined dispersion modelling technique using site-specific data.

This air quality impact assessment applies a Level 1 assessment approach.

The screening model AERSCREEN was used to quantify particulate impacts from the construction of the project. AERSCREEN is the US EPA recommended screening-level air quality model based on the AERMOD model. AERSCREEN also interfaces with AERMAP, the terrain pre-processor. This is considered of importance for the project as the terrain of the wind farm site and the region is complex.

The model produces a site-specific matrix of meteorological conditions and predicts concentrations, regardless of the source-receptor-wind direction. Therefore, this model estimates the worst-case impacts.

Receptor distances

The AERSCREEN model provides an estimate of pollutant concentration by distance from the source. The distances between the turbines and the sensitive receptors were determined using GIS data prepared for the project. A summary of the distances (including both associated and non-associated residences) that are presented in **Table 17-6**.

Table 17-6: Assessment distances

Statistic	Distance (m)
Minimum	861
Maximum	61,726
Median	18,811
Average	19,820

Model inputs

The model inputs are summarised in **Table 17-7**. These inputs were applied to AERSCREEN to complete the assessment.

Table 17-7: AERSCREEN model inputs

Parameter	Input
Domain size (km)	40 km x 40 km
Volume source configuration	1 in the approximate centre of the clusters Easting: 751,322 m Northing: 6468,808 m
Release height (m)	1 m AGL
Initial Vertical Dimension	0.5
Length of side	5,714 m (equivalent area as project footprint)
Minimum temperature (º C)	2.1
Maximum temperature (º C)	32.2
Minimum wind speed (m/s)	0.5
Landuse type	Cultivated Land
Albedo	AERMET seasonal tables
Bowen Ratio	AERMET seasonal tables
Surface Roughness (m)	AERMET seasonal tables
Terrain Effects	Y (SRTM1/SRTM3)
Adjust Surface Friction Velocity (ADJ_U*)	Y

To convert the mean hourly concentration predicted by the dispersion model to a 24-hour average, factors that are provided by AERSCREEN have been applied. A factor of 0.60 has been applied to achieve a 24-hour averaging period and a factor of 0.10 has been applied to achieve an annual average.

Source locations

A map of the source location from AERSCREEN is provided in **Figure 17-5**. The source was placed at a lower elevation on a ridgeline to reduce the distance between the source and the ground level in the valleys which would reduce dispersion distance and generate a conservative result.

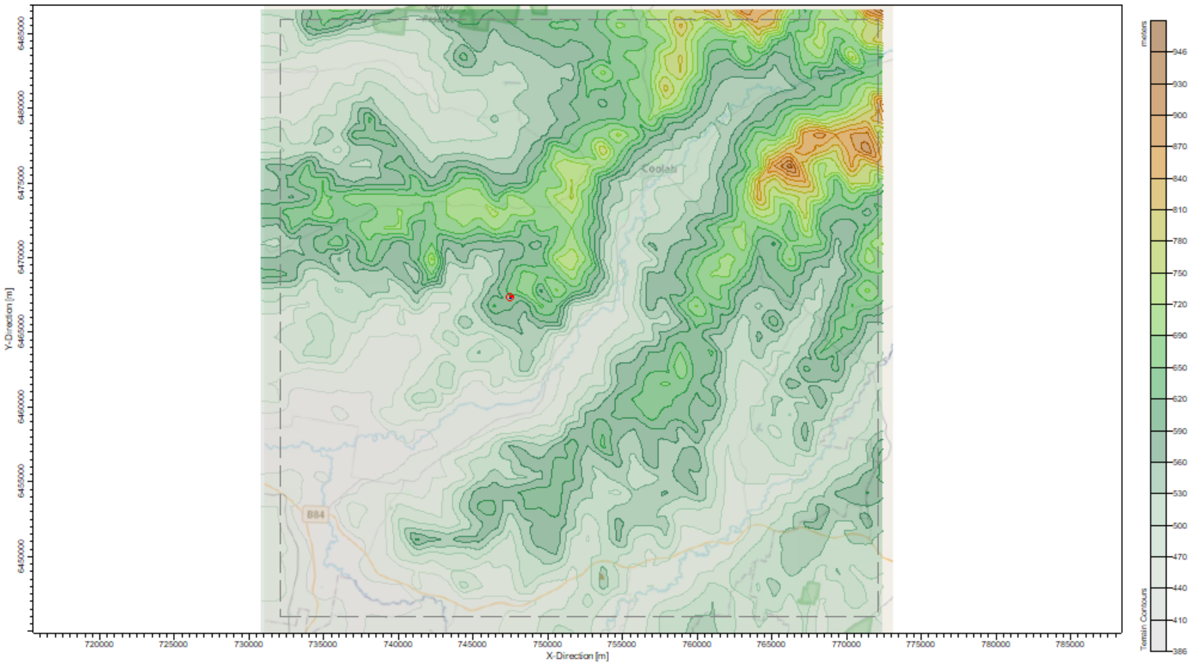


Figure 17-5: Modelled source location in AERSCREEN

17.2.2 Statutory context, policy and guidelines

The air quality assessment has been undertaken in accordance with the following:

- *Protection of the Environment Operations Act 1997*
- *Protection of the Environment Operations (Clean Air) Regulation 2020* (the "Clean Air Regulation").
- Approved Method for the Modelling and Assessment of Air Pollutants in NSW (the Approved Methods)

17.2.3 Existing environment

Terrain

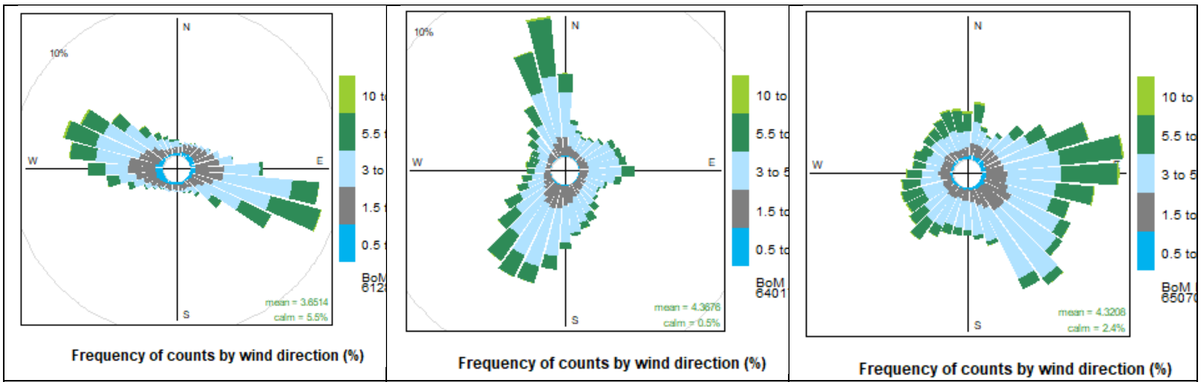
As discussed in previous chapters of this EIS, the terrain within the wind farm site and surrounds is mountainous, with the most significant terrain features being the mountain range in the Coolah Tops National Park to the east and the Warrambungles to the northwest. The topography of the wind farm site is characterised by ridgelines and associated steep slopes and rolling hills and small open flat valleys. The elevated slopes range from gentle to steep.

Meteorology

The BoM maintains automatic weather station's (AWS) in the region surrounding the project. The Merriwa AWS (ID 061287) is located 55 kilometres to the southeast, the Coonabarabran AWS (ID 064017) is located 75 kilometres to the northwest, and the Dubbo AWS (ID 065070) is located 105 kilometres to the southwest. The AWS located in Dunedoo (ID 064009) located approximately 16 kilometres west has not measured wind data since 2010, which is of importance for pollutant transport and dispersion of air pollutants, so has not been considered further for this assessment.

Windroses for data measured at Merriwa, Coonabarabran and Dubbo from 2016 to 2020 are presented in **Figure 17-6**. The three locations show variable wind frequency patterns, which would be influenced by the terrain in the area. Merriwa is located south of the Coolah tops ridgeline, which runs east-west, influencing winds in the area to be predominantly along the east-west axis. Coonabarabran is located to the east of the Warrambungles, which would obstruct winds from the west, with the data showing prevailing winds from the north and south. Dubbo is located on relatively flat terrain, and shows winds from all directions, with a higher frequency of winds from the east.

The mean minimum temperature measured at Dunedoo (Post Office, ID 064009) was 2.1 ºC and the mean maximum was 32.2 ºC (BoM, 2021). These measured values have been applied as model inputs for this assessment.



Merriwa	Coonabarabran	Dubbo

Figure 17-6: Wind roses: Merriwa, Coonabarabran and Dubbo

Sensitive receptors

The closest sensitive receptors to the project are shown in **Figure 17-7**. Note there are additional sensitive receptors located beyond the bounds of the map (mostly to the north), which are not presented for display purposes.

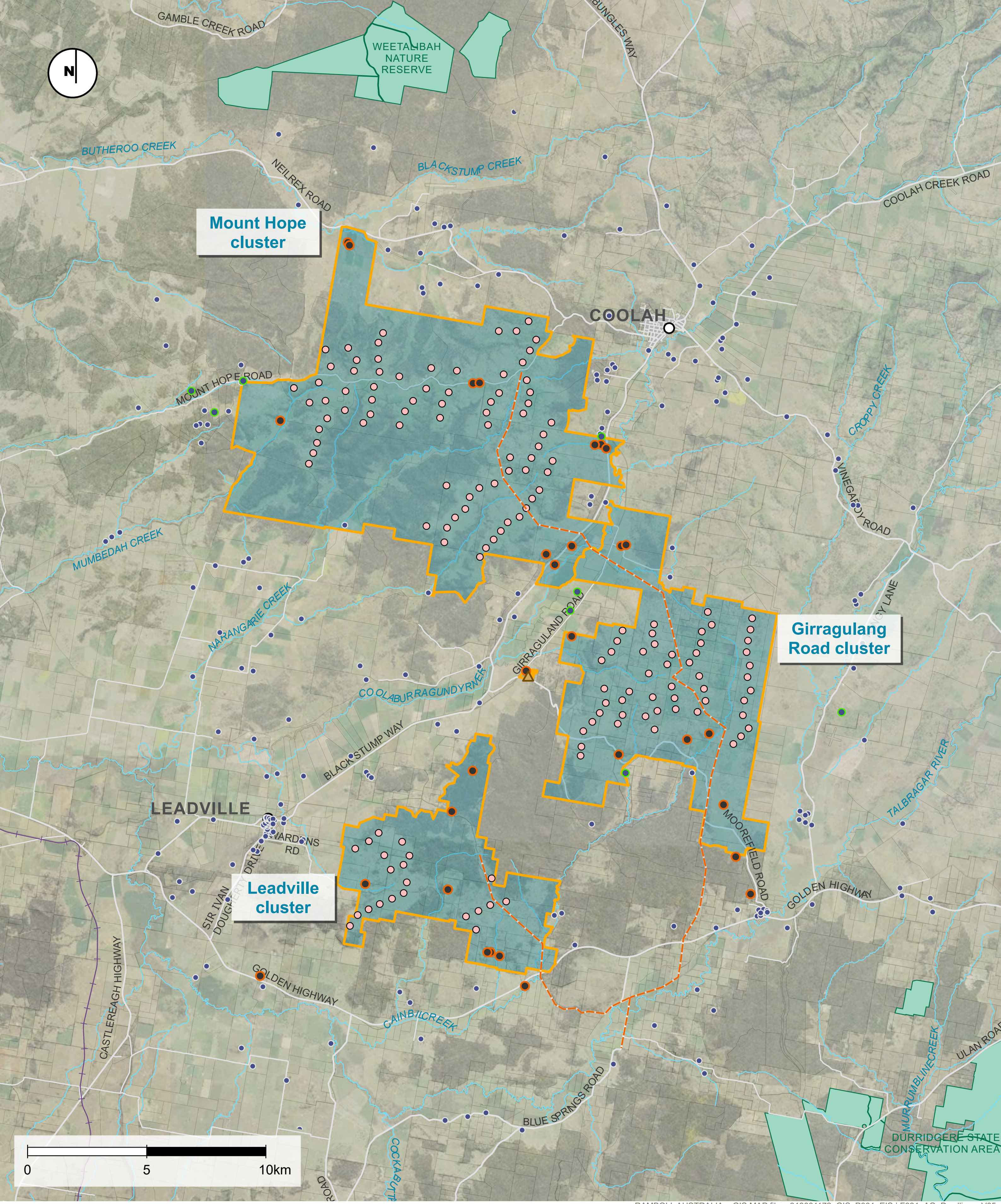
Background air quality

Air quality monitoring stations maintained by the Department of Planning, Industry and Environment in Merriwa were reviewed for particulate matter of less than 2.5 microns aerodynamic diameter ($PM_{2.5}$) and less than 10 microns diameter (PM_{10}). Data was assessed for the period of 1 January to 16 December 2021 to determine average background concentrations of $PM_{2.5}$ and $PM_{10.}$ The average concentration from the measured data is presented below in **Table 17-8**. These values are applied to determine the potential cumulative impact of the project with other background sources in the region.

Table 17-8: Background particulate matter concentrations, Merriwa 2021

Pollutant	Average concentration (µg/m3)
PM2.5	3.1
PM10	15.5

No background air quality monitoring data was available for total suspended particulates (TSP)



KEY

- Wind farm site
- Turbine location
- Overhead transmission line
- Potential construction workforce accommodation
- Host dwelling
- Associated dwelling
- Non-associated dwelling
- National Parks and Reserves

Figure 17-7 | Sensitive receptor locations

17.2.4 Assessment of potential impacts

Construction impacts

Emissions

The emission source details used to determine emission factors for TSP and PM_{10} are provided in **Appendix R**. Civil estimates of quantities (e.g. aggregate, concrete, sand etc) in combination with National Pollutant Inventory (NPI) emission estimation technique manuals (Australian Government Department of the Environment, 2014) were used to estimate emissions for activities proposed for the project. Note that not all TSP and PM_{10} emissions factors were available for all activities, therefore PM_{10}:TSP ratios were calculated for some activities based on emission rates of other activities of similar nature.

Project-only and cumulative impacts

The model outputs a gradient of pollutant concentrations at an increasing distance from the source, beginning at the point of highest concentration. As mentioned in **Section 17.2.1,** terrain was included in the assessment, therefore, the concentration gradient accounts for the undulating landscape.

The results represent the highest 1-hour concentrations over an annual period, during worst-case meteorological conditions for all seasons. Where the maximum ground level concentration was predicted at a greater distance than the nearest sensitive receptor, the maximum result was applied to the nearest sensitive receptor.

The results of the assessment are presented below in **Table 17-9** for project only contribution and **Table 17-10** for a cumulative assessment. There are no predicted exceedances of the air quality criteria for all particulate size fractions, all relevant averaging periods and project-only and cumulative scenarios.

Given that there is no TSP background monitoring data available and therefore TSP was not assessed cumulatively, it can be noted that generally, where PM_{10} and $PM_{2.5}$ criteria are satisfied, there would be expected to be no exceedances for TSP. A screening model approach is intended to be conservative.

Table 17-9: Project only results by distance to sensitive receptors

		1-hour			24-hour			Annual		
Statistic	Distance	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5
Minimum	861	54.5	28.4	4.3	32.7	17.1	2.6	5.5	2.8	0.4
Maximum	61,726	25.5	13.3	2.0	15.3	8.0	1.2	2.5	1.3	0.2
Median	18,811	27.5	14.3	2.1	16.5	8.6	1.3	2.7	1.4	0.2
Average	19,820	25.5	13.3	2.0	15.3	8.0	1.2	2.5	1.3	0.2

Table 17-10: Cumulative results by distance to sensitive receptors

Statistic	Distance (m)	24-hour		Annual	
		PM10	PM2.5	PM10	PM2.5
Minimum	861	32.6	5.7	18.3	3.5
Maximum	61,726	23.5	4.3	16.8	3.3
Median	18,811	24.1	4.4	16.9	3.3
Average	19,820	23.5	4.3	16.8	3.3

Operational impacts

The operational air quality impacts from the project are likely to consist of wind erosion from exposed areas, use of operational equipment, vehicles travelling on unsealed surfaces and maintenance works. These impacts are considered minor, so no modelling has been conducted. The project would be managed to ensure risks to air quality are avoided or minimised through the measure set out in **Section 17.2.5**.

17.2.5 Environmental management and mitigation measures

Proposed measures to manage and/or mitigate air quality impacts from the project are detailed in **Table 17-11**.

Table 17-11: Management and mitigation measures – air quality

ID	Management/mitigation measure	Timing
AQ1	Air quality management measures will be included in the construction environmental management plan for the project. The construction environmental management plan will outline the management measures to control and minimise dust generation from the project.	Prior to construction
AQ2	Water and/or dust suppressants will be applied during high dust generating activities (such as quarrying, batch plant operation, rock crushing and earthworks) and to exposed areas, stockpiles and unsealed roads.	During construction
AQ3	The traffic management plan will include optimisation of vehicle movements onsite reducing wheel generated dust. It will also incorporate speed restrictions for equipment operating on unsealed access tracks and disturbed areas.	At all times
AQ4	Loads will be covered when transporting material off site.	At all times
AQ5	Exposed areas will be rehabilitated and stabilised progressively through vegetation planting as soon as practicable after construction to minimise dust from wind erosion.	During construction
AQ6	Weather will be monitored to limit dust generating activities during unfavourable, high dust-generating conditions such as extended dry periods or when Warrumbungle Regional Council has water restrictions in place.	During construction

17.3 Climate change and greenhouse gas

17.3.1 Assessment methodology

Assessment approach

The SEARs do not require an assessment of the project's potential climate change and greenhouse gas impacts. However, to address concerns raised by the neighbouring landholders, a qualitative assessment of the project's potential climate change and greenhouse gas impacts has been undertaken.

Assessment of climate change and greenhouse gas impacts was undertaken using a desktop assessment to understand the likely and potential issues for the project. This includes:

- identifying the climate change projections for the region
- understanding the strategic context for climate change and greenhouse gas policy in Australia
- undertaking a review of existing research and data for similar projects
- identification of the project activities and components that generate greenhouse gas emissions.

17.3.2 Statutory context, policy and guidelines

There are various State and Commonwealth initiatives aimed to increase the proportion of renewable energy within the Australian electricity market (refer to discussion in **Section 2.1**). These policies are primarily driven by the objectives to diversify the Australian market, ensure security of the network and to decrease greenhouse gas emissions generally associated with non-renewable energy sources to meet climate change agreements and targets such as the Paris Agreement and RET scheme.

17.3.3 Existing environment

Climate change projections

Climate change refers to the warming temperatures and altered climatic conditions associated with the increased concentration of greenhouse gases in the atmosphere. Greenhouse gases include carbon dioxide, methane, nitrous oxide, ozone, water vapour and synthetic gases such as chlorofluorocarbons and hydrofluorocarbons. Climate change impacts can influence the environmental impacts of construction and decommissioning of the project. For example, hot, dry or windy conditions can exacerbate air quality impacts and prolonged rainfall can increase soil compaction impacts or cause flooding.

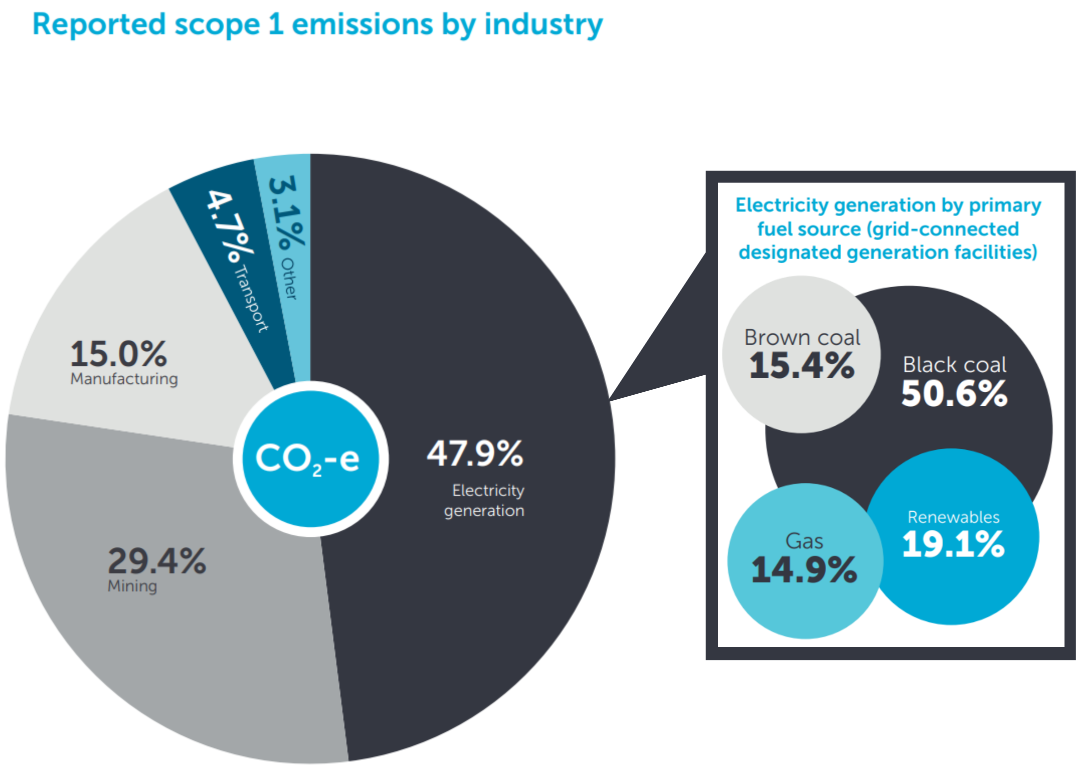
Climate change projections for Australia includes increases in sea and air temperatures, more frequent and hotter hot days and fewer cool extremes, decrease in rainfall across southern Australia and more intense rainfall throughout Australia, and more extreme events such as bushfires, heatwaves and flooding (CSIRO, 2018).

In the past the Warrumbungle Shire has been significantly impacted by natural hazards including bushfires, flooding, drought and heatwaves. In 2013 the Wambelong Fire swept through the Warrumbungle National Park, burning more than 55,000 hectares of land. Following this in 2017 another catastrophic fire known as the 'Sir Ivan Fire' swept through the shire and burnt approximately 55,000 hectares of land (Warrumbungle Shire Council, 2020).

The Warrumbungle Region is expected to experience up to 5 per cent less rainfall in the near future (2020-2039) whilst temperatures are predicted to increase by up to one degree (NSW DPIE, 2014).

Electricity generation and greenhouse gas emissions

Each year, Australian corporations that meet certain thresholds must report their emissions and energy information under the National Greenhouse and Energy Reporting (NGER) scheme. Each reporting year, the electricity sector has been the largest emitting industry in Australia, contributing 47.9 per cent of Australia's scope 1 emissions in the 2019-2020 reporting year (approximately 156,633,000 tCO_2-e) (**Figure 17-8**) (Clean Energy Regulator, 2021). Of this 47.9 per cent, approximately 50.6 per cent is from black coal fuel sources, 15.4 per cent is from brown coal, 14.9 per cent is from gas and 19.1% from renewables (**Figure 17-8**) (Clean Energy Regulator, 2021).



Source: Adapted from (Clean Energy Regulator, 2021)

Figure 17-8: Reported scope 1 emissions by industry in Australia (2019-2020)

In comparison to the 2018-2019 reporting period, emissions in the electricity sector for the 2019-2020 period have decreased by 4.6 percent (7.5 million tonnes). This is largely due to the increased use of renewable energy and the decreased use of black coal (Clean Energy Regulator, 2021).

Figure 17-9 shows the total reported scope 1 and 2 greenhouse gas emissions and average emissions intensities for major fuel types in 2019-2020 (Clean Energy Regulator, 2021). The largest contributors to scope 1 and 2 greenhouse gas emissions in the reporting period were black coal fuel sources (total emissions 104,060,769 tCO_2-e) and brown coal fuel sources (total emissions 39,895,894 tCO_2-e). Wind fuel sources contributed only 37,807 tCO_2-e of scope 1 emissions and 22,630 tCO_2-e of scope 2 emissions in the reporting period (total emissions 60,437 tCO_2-e).

The average emissions intensity calculated for wind fuel sources is significantly lower (around 0.23 tCO_2-e per MWh) in comparison to conventional fuel sources such as black coal (around 0.89 tCO_2-e per MWh), (brown coal around 1.18 tCO_2-e per MWh) and gas (around 0.67 tCO_2-e per MWh).

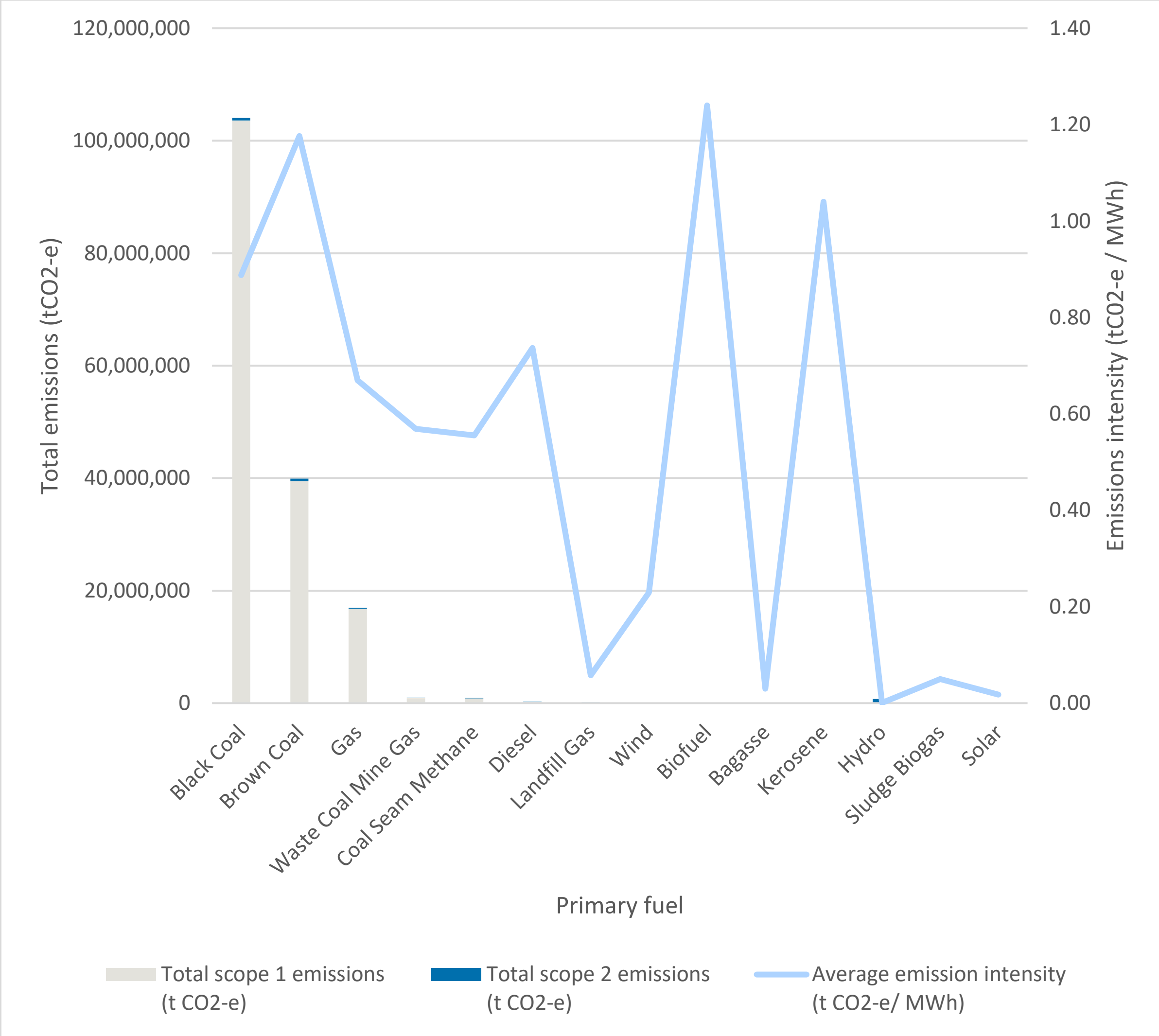


Figure 17-9: Reported greenhouse gas emissions and average emissions intensities for major fuel types (2019-2020)

Lifecycle greenhouse gas emissions and wind projects

Both fossil-fuel and non-fossil-fuel power technologies generate greenhouse gas emissions over their lifecycle due to their energy requirements for:

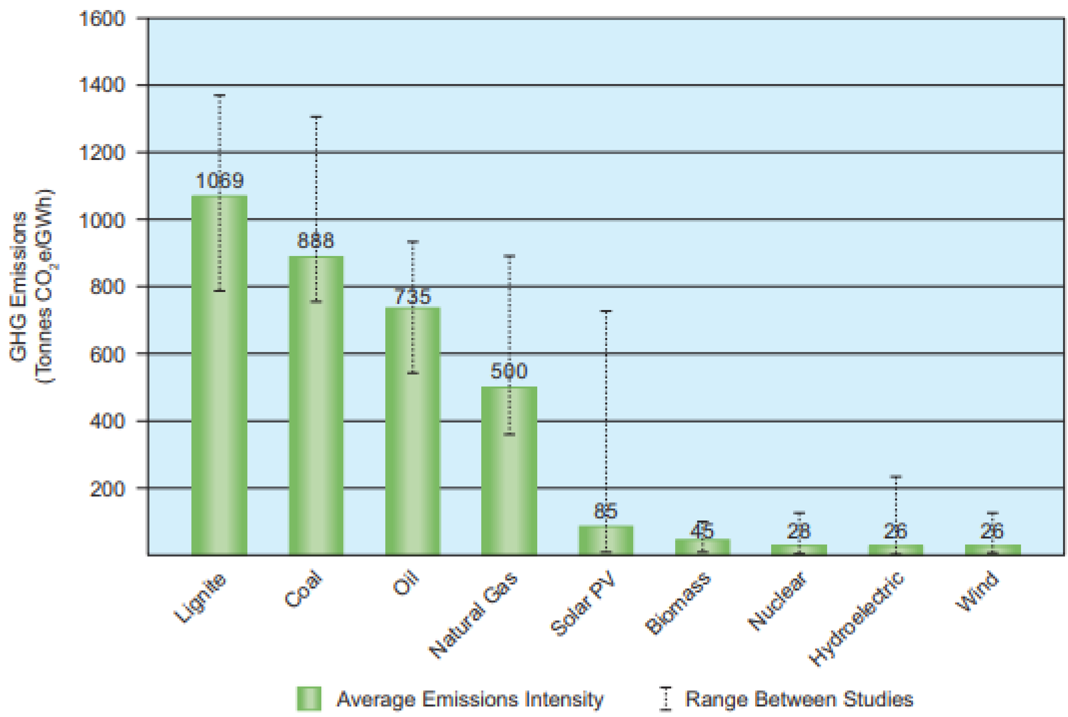
- **upstream processes** – raw material extraction, material production, material transportation to site, and installation and construction
- **operational processes** – power generation and operational maintenance
- **downstream processes** – decommissioning and disposal.

The greenhouse gas emissions produced over a project's lifecycle are categorised into three different scopes:

- **Scope 1 emissions** – all direct emissions from an activity

- **Scope 2 emissions** – indirect emissions from electricity purchase and use
- **Scope 3 emissions** – all other indirect emissions not included in scope 2 due to upstream or downstream activities.

Lifecycle greenhouse gas emissions associated with wind energy projects are significantly lower on average than other conventional electricity generation methods such as lignite (brown coal), coal (black coal), oil and gas (refer to **Figure 17-10**). Wind projects release the majority of their emissions during construction and decommissioning, whereas in comparison, coal fired power plants release the majority of their emissions during operation (World Nuclear Association, 2011).



***Source**:* (World Nuclear Association, 2011)

Figure 17-10: Lifecycle greenhouse gas emissions intensities for electricity generation methods

Energy payback time

The 'Energy Payback Time' refers to the period of time for which a wind turbine needs to be in operation before it has generated as much electricity as it consumes in its lifecycle. The Energy Payback Time for wind turbines is quite small (Pacific Hydro, 2015).

While the Energy Payback Time varies depending on the megawatt rating of the particular turbine, studies suggest it is at most two to three years for turbines ranging between two and five megawatts (refer to **Table 17-12**). The project is expected to use five megawatt turbines and could be up to seven megawatts.

Table 17-12: Energy Payback Time for wind turbines identified in life-cycle assessment studies

Study	Megawatt rating	Energy Payback Time (months)
Guezuraga et al (2012)	2	27.6
Martinez et al (2009)	2	7
Tremac and Meunier (2009)	4.5	20.4
Vestas (2011)	3	8
Weinzettal et al (2009)	5	13

Source: (Pacific Hydro, 2015)

17.3.4 Assessment of potential impacts

Climate change considerations

Wind

Wind generation is sensitive to any reduction in average wind-speed as well as to the frequency and magnitude of destructive gusts. The uncertainty of future climate change impacts means that some areas may experience a decrease in high wind events, affecting wind generation output, plant profitability and design specifications. Conversely, some areas may experience higher winds as a result of climate change that would benefit the generating capacity of wind farms (Australian Energy Market Operation, 2020).

High winds can reduce the capacity and threaten the integrity of transmission lines making it an important consideration for network capacity assessments, design specifications and analysis of failure rates (Australian Energy Market Operation, 2020).

Rainfall

The Warrumbungle Region is expected to experience less rainfall over the next 10 years leading to drought conditions. This would impact on the amount of water that is available for allocation within the region.

Further discussion on the water supply and demand for the project is included in **Section 4.12.1**.

Bushfires

Over the next thirty to forty years (expected lifespan of the project), the climate is projected to change, resulting in more days of higher fire danger than previously experienced, and projected FFDR and GFDR exceeding current levels (Douglas, B in Cool Burn Fire and Ecology, 2021). The planning for long term infrastructure may be impacted by higher fire danger and potentially higher fire frequencies.

Further discussion on the bushfire risk for the project is included in **Chapter 10**.

Greenhouse gas emissions

Upstream greenhouse gas emissions would be generated during the construction phase of the project including:

- embodied scope 3 emissions in the extraction and production of construction materials such as cement, steel for the WTG components and associated infrastructure

- combustion of fuel in construction plant, equipment and vehicles resulting in the release of scope 1 emissions
- emissions from vegetation clearance or construction waste resulting in the release of scope 1 emissions
- electricity consumption for equipment and machinery resulting in the release of scope 2 emissions
- scope 2 emissions from general electricity consumption in construction compounds, administration buildings and for lighting.

Once operational, wind farms generate minimal greenhouse gas emissions in comparison to other conventional electricity generation methods (refer to **Figure 17-9**). Scope 1 emissions would be released from the combustion of fuel in construction plant, equipment and vehicles and from maintenance vegetation clearing activities. Minor scope 2 emissions would be generated during operations by the use of electricity used at in the administration building for domestic purposes (e.g. lighting, computer use, kitchen appliances, security equipment). These emissions are offset by the clean electricity that is generated by the project.

Decommissioning activities would result in scope 1 emissions from the combustion of fuels and electricity consumption in plant, equipment and vehicles used to disassemble, remove and dispose of infrastructure.

Based on the average lifecycle emissions for wind projects (26 tCO_2e/GWh) (World Nuclear Association, 2011) (refer to **Figure 17-10**) the project would generate approximately 2,262 kilotonnes over its lifecycle [Formula used: 26 tCO_2e x (2,900GWh x 30 yrs) = 2,262,000t = 2,262kt]. This is 37,228,594 kilotonnes less than the average lifecycle emissions from conventional brown coal projects and 101,361,016 kilotonnes less than the average lifecycle emissions from black coal projects. This approximation does not take into consideration the specific project activities and components and does not consider the advancement of technology since the publication of the source study in 2011. It does however provide a general comparison of the lifecycle greenhouse gas emissions released from conventional brown and black coal facilities to the project.

Based on recent studies (**Table 17-12**), the Energy Payback Time for the wind turbines would be at most two to three years for turbines ranging between two and five megawatts but could be as short as thirteen months given the megawatt rating of the proposed turbines. Thus, for the 29 subsequent years, the project would power 697,000 households without consuming electricity generated using conventional energy sources

The electricity generated by the project would displace electricity produced using fossil fuel sources (such as coal and gas), thereby reducing greenhouse gas emissions from the stationary electricity sector. Therefore, the project would have a positive impact on greenhouse gas emissions.

17.3.5 Environmental management and mitigation measures

Proposed measures to manage and/or mitigate climate change and greenhouse gas impacts from the project are detailed in **Table 17-13**.

Table 17-13: Management and mitigation measures – climate change and greenhouse gas

ID	Management/mitigation measure	Timing
CC&GHG1	Fuel and energy efficient equipment and vehicles will be selected where available.	Prior to construction
CC&GHG2	Equipment and vehicles will be regularly serviced and maintained to optimise efficiency.	At all times

18. CUMUALTIVE

18.1 Assessment methodology

18.1.1 Assessment approach

Adverse cumulative impacts occur when the infrastructure or activities at the project area exacerbate the impacts of other infrastructure or activities occurring nearby. Cumulative impacts can occur concurrently or sequentially.

Nearby projects with the potential to result in cumulative impacts with or as a result of the project were identified using the following sources:

- DPE Major Projects website
- Google Maps
- Warrumbungle Shire Council development application register
- Transport for NSW current projects register (relative to transport routes).

Projects were selected based on the following screening criteria:

- Location – proximity to areas and activities assessed as part of each staged assessment.
- Timeframe – whether the project occurs in the recent past or present or foreseeable future.
- Scale – potential impacts of a scale that could cause cumulative impacts with each staged assessment.
- Status – the stage of the project at the time of each staged assessment (including forecast timeframes for construction and operation). Stages includes approved projects, proposed projects and local strategic plans.

The cumulative impact assessment is proportionate to the scale of the wind farm, the geographical area of influence of the project and is relevant to the strategic context of the project as discussed in **Section 2.1**. Operational, approved and proposed SSD projects within the region have been considered as part of the cumulative impact assessment. Most of these projects are located within the CWO-REZ and are considered relevant to the potential combined impacts of the project on the environmental character of the area and the regional and national context.

The key issues investigated in this assessment relate to visual, traffic, noise, air quality, social and land use with the key projects investigated including Liverpool Range Wind Farm, Barneys Reef Wind Farm, Wollar Solar Farm, Stubbo Solar Farm, Dunedoo Solar Farm, Tallawong Solar Farm and the Birriwa Solar Farm developments that are all located within the CWO-REZ.

The data available for the cumulative impact assessment includes that which has been made publicly available for the approved projects on the Major Projects website. Given the proximity of the project to Liverpool Range Wind Farm project, the potential cumulative impacts have been considered in detail utilising the most recent data from the modification application (including an increase in the maximum tip height to 250 metres and a decrease in the maximum number of turbines). The Liverpool Range Wind Farm project data has been incorporated into the technical impact assessments including landscape character and visual, noise and vibration and traffic and transport for the purpose of considering potential cumulative impacts between the projects.

Other projects considered for the assessment include large scale mines and other infrastructure projects as outlined in **Section 18.2.1.**

18.2Existing environment

18.2.1 Planned and existing projects

A summary of both planned and existing projects within the immediate region with the potential for cumulative impacts with the project is provided in **Table 18-1** with locations shown on **Figure 18-1**.

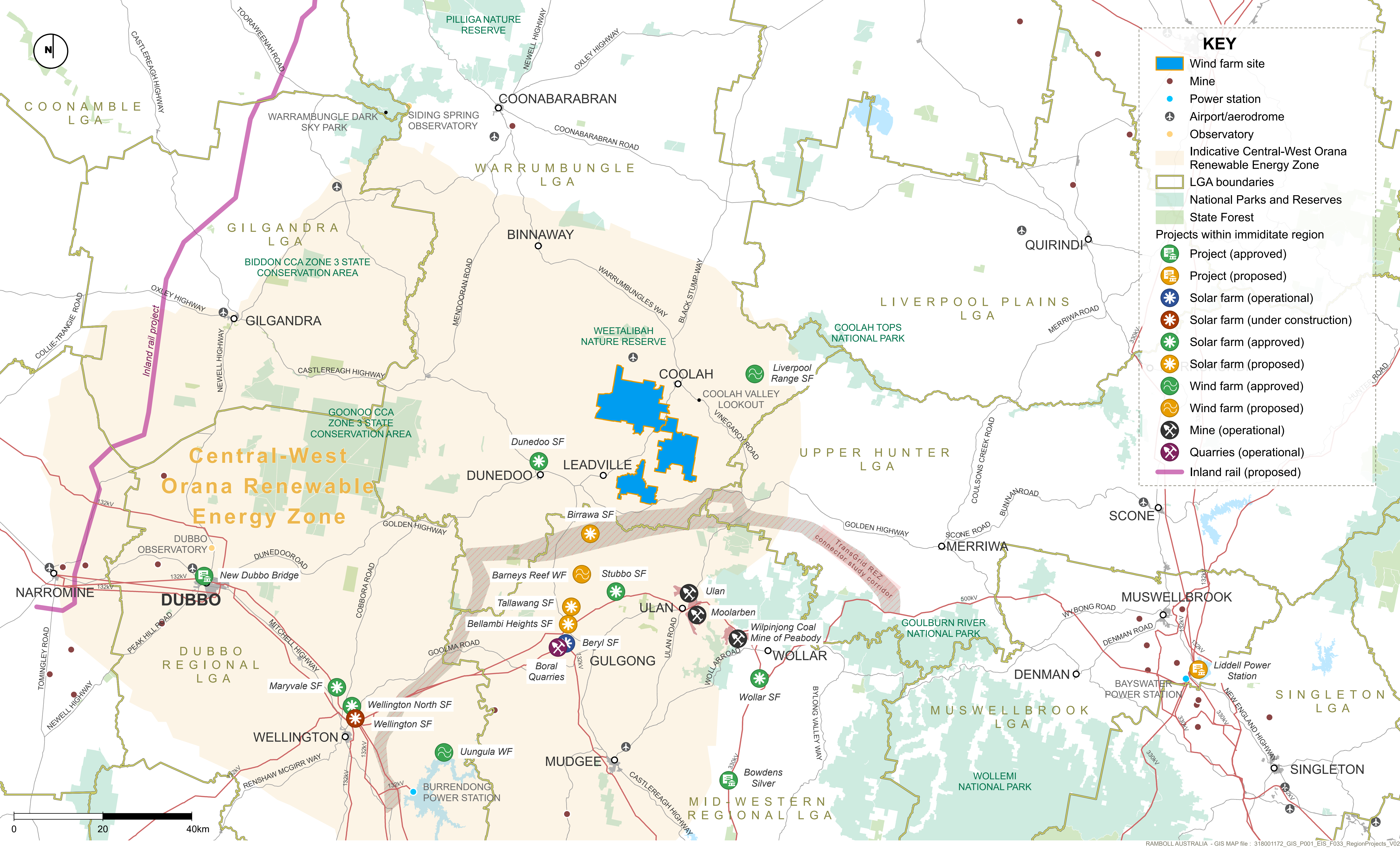
Table 18-1: Planned and existing projects within the immediate region

Project	Status	Proximity and location	Key project details
Beryl Solar Farm[1]	Operational	33 km south-west of study area	• Commenced operations in June 2019 • Capacity of up to 95 MW • 30-year operational project life • Development footprint of 225 ha • Peak workforce of approximately 150 jobs
Boral Quarries Beryl	Operational	33 km south-west of study area	• Construction material mining
Ulan Mine[2]	Operational	30 km south-east of study area	• Open cut and underground mine • Mine life approved to 2033 • Production of up to 20 Mt of run-of-mine coal per annum • Peak workforce of 931 persons
Moolarben Mine[3]	Operational	27 km south-east of wind farm site	• Open cut and underground mine • Mine life approved to 2038 • Production of up to 16 Mt of run-of-mine coal per annum • Peak workforce of 740 persons
Wilpinjong Mine[4]	Operational	35 km south-east of wind farm site	• Open cut mine comprising seven mining areas • Production of up to 16 Mt of run-of-mine coal per annum • Mine life approved to 2033 • Peak workforce of 625 persons
New Dubbo Bridge (Newell Highway)[5]	Approved	92 km south west of wind farm site	• New bridge over the Macquarie River and construction of around 2.2 km of new highway • Construction scheduled 2022 – 2025
Liverpool Range Wind Farm[6]	Approved	10 km north east of wind farm site	• Proposed 267 wind turbines • Maximum tip height 165 metres • Capacity of up to 1000 MW • Peak workforce of approximately 800 jobs
Liverpool Range Wind Farm[6]	Proposed modification	10 km north east of wind farm site	• Maximum tip height to 250 metres • Up to 220 wind turbines • Amendments to infrastructure and the transport route and updated native vegetation clearing limits.

Project	Status	Proximity and location	Key project details
Uungula Wind Farm [7]	Approved	65 km south west of wind farm site	• Proposed 97 wind turbines • Capacity of up to 400 MW • Peak workforce of approximately 250 jobs
Dunedoo Solar Farm[8]	Approved	16 km west of wind farm site	• Construction scheduled to commence 2021 (12-month program) • Capacity of up to 66 MW • 30-year operational project life • Development footprint of 95 ha • Peak workforce of approximately 100 jobs
Bowdens Silver Project[9]	Approved	66 km south-east of wind farm site	• Open cut silver, zinc and lead mine • Extraction of up to 29.9 Mt of run-of-mine ore per annum • Mine life of 23 years
Wollar Solar Farm[10]	Approved	50 km south-east of wind farm site	• Construction scheduled to commence in mid-late 2020 (approximate 22-month construction period) • Capacity of up to 290 MW • 30-year operational project life • Peak workforce of approximately 300 jobs
Maryvale Solar Farm	Approved	80 km south west of the wind farm site	• Capacity of up to 125 MW • 25-year operational project life • Peak workforce of approximately 150 jobs
Wellington Solar Farm	Under construction	80 km south west of the wind farm site	• Capacity of up to 174 MW • 12 month construction period • 30-year operational project life • Peak workforce of approximately 200 jobs
Wellington North Solar Farm	Approved	70km south west of the wind farm site	• Capacity of up to 300 MW • 24 month construction period • 30-year operational project life • Peak workforce of approximately 400 jobs
Stubbo Solar Farm[11]	Approved	20 km south of the wind farm site	• 24-month construction program • Construction anticipated to commence late 2021 • 400 MW solar farm with 200MW battery storage • 30-year operational project life • Peak workforce of approximately 400 jobs
Liddell Power Station[12]	Proposed	143 south-east of wind farm site	• Demolition and rehabilitation works of power station and associated infrastructure

Project	Status	Proximity and location	Key project details
			• Closure and demolition over approximately 10 years • Ongoing maintenance and rehabilitation to continue for approximately 10 years • Closure commencing in 2022 • Peak workforce of approximately 75 - 100 jobs
Tallawang Solar Farm[13]	Proposed	30 km south west of wind farm site	• 34-month construction program • Capacity of up to 500 MW • 35-year operational project life • Peak workforce of approximately 430 jobs
Barneys Reef Wind Farm[14]	Proposed	11 km south of wind farm site	• Proposed 63 wind turbines • Capacity of up to 441 MW • Peak workforce of approximately 340 jobs
Birriwa Solar Farm[15]	Proposed	14 km south west of wind farm site	• 36-month construction program • Capacity of up to 600 MW • 30-year operational project life • Peak workforce of approximately 500 jobs
Melbourne to Brisbane Inland Rail (specifically the Narromine to Narrabri section)	Proposed	97 km west of wind farm site	• Four year construction period • Construction anticipated to commence late 2021 • 306 km of new single-track within a new rail corridor with a minimum width o 40m • Peak workforce of approximately 2,000 jobs
Bellambi Heights Solar Farm	Proposed	40 km south of the wind farm site	• 200 MW solar farm and 200 MW BESS
Energy Co Wollar Substation[16]	Proposed	70 km south of wind farm site	• Upgrade/expansion of the existing Wollar Substation
Energy Co Transmission line	Planning	13 km south of the wind farm site	• Construction of high voltage transmission line to service the CWO-REZ

Sources: [1] (Ngh Environmental; First Solar, April 2017); [2] (Glencore, March 2020); [3] (Yancoal, April 2020); [4] (Peabody Energy, 2016); [5] (RMS, May 2019) [6] (Epuron, May 2017) and (NSW Government, 2022) ; [7] (NSW DPIE, May 2021); [8] (Ngh Environmental, March 2020); [9] (R.W. Corkery & CO. Pty. Limited, June 2020); [10] (Wollar Solar Development Pty Ltd, 2019); [11] (Ramboll, 2020); [12] (GHD, July 2021); [13] (Umwelt, July 2021); [14] (Umwelt, July 2021); [15] (EMM, October 2021); [16] (AECOM, 2021)



Information presented in this figure is approximate only and should not be relied upon as accurate

Figure 18-1 | Planned and existing projects within the immediate region

18.2.2 Strategic Plans

The Central West and Orana Regional Plan identifies Orana, where the project is located, to accommodate some of the most productive agricultural areas in NSW. **Chapter 16** and **Section 17.1** discuss the capability of the wind farm site in terms of agricultural capability and value of the land impacted by the project. Given the surrounding lands are identified a regionally important, the Central West and Orana Regional Plan identifies a range of road and rail freight link improvements that will strengthen the supply chain for agricultural resources.

Such infrastructure projects include road and rail upgrades as well as construction of key strategic regional corridors including Golden Highway upgrade, Newell Highway upgrade and the Melbourne to Brisbane Inland Rail which commenced construction in 2018 with an estimated completion date of 2027. The Narromine to Narrabri section of the Melbourne to Brisbane Inland Rail project is the longest section of track and is approximately 97 kilometres west of the site. The first phase of construction is anticipated to start in late 2021 and is expected to take about four years to complete. The proposal is expected to be operational, as part of Inland Rail as a whole, once all 13 sections are complete.

18.3 Assessment of potential impacts

Cumulative impacts may relate to:

- traffic volumes and movements
- noise and vibration emissions
- air emissions including dust and vehicle emissions
- changes to the landscape character and visual amenity
- social impacts including workforce accommodation and availability
- resource use and availability including construction materials and labour force availability
- changes to land use.

There may be cumulative impacts from the concurrent construction of the project and the Liverpool Range Wind Farm, Barneys Reef Wind Farm, Wollar Solar Farm, Stubbo Solar Farm, Dunedoo Solar Farm and the Birriwa Solar Farm developments due to the proximity, size of the construction workforce and subsequent demand for short-term accommodation, local infrastructure and services and associated vehicle movements on the regional road network. These impacts would be dependent on the final timing and duration of construction activities associated with the nearby proposed developments and the project. The Narromine to Narrabri section of inland rail is also expected to have completed construction by 2025, prior to the construction of the project.

The assessment of potential cumulative impacts has informed design refinements throughout the project development as outlined in **Section 2.4** and shown in **Figure 2-4**. The project specific mitigation measures have been developed in consideration of cumulative impacts and are considered appropriate to satisfactorily address the potential combined effects of other surrounding developments.

18.3.1 Traffic volumes and movements

The construction access routes for the Liverpool Range Wind Farm, Barneys Reef Wind farm, Stubbo Solar Farm, Wollar Wind Farm and Birriwa Solar Farm that overlap with the project include the New England Highway and the Golden Highway.

The Golden Highway is also a key access route for Duneedoo Solar Farm. **Chapter 9** and **Appendix H** discuss that the combined projected traffic volume based on construction movements occurring at the same period would see a traffic increase of 693 vehicles along the Golden highway, on top of the existing daily traffic volume of 2,185 vehicles per day.

The cumulative impact of the project when considering surrounding developments is anticipated to be negligible due to the low traffic volumes that still satisfy the Austroads roadway design standards for rural highways. In addition, the MRV/HRV and AV/B-double types of vehicles generated by the projects will avoid peak hours for delivery and utilise approved B-double access roads. The traffic mitigation measures outlined in **Section 9.4** will reduce the cumulative traffic impacts of the project.

18.3.2 Noise and vibration emissions

The cumulative noise impacts of the project and Liverpool Range wind farm have been discussed in **Chapter 6.** The predicted cumulative noise levels presented are for the wind speeds which give rise to the highest noise emissions from each project respectively.

In most instances where cumulative noise is considered, a noise sensitive receiver cannot be simultaneously downwind of all wind turbines of adjoining projects. The predictions are therefore conservative for the purpose of considering cumulative noise levels.

Regardless, the assessment found that the contribution of the Liverpool Range Wind Farm does not result in a change of compliance outcome with respect to the 35 dB L_{Aeq} base criterion which applies to each wind farm. At one receiver (Receiver 5), using the GE 6.0-164 turbine model, the influence of the Liverpool Range Wind Farm is predicted to increase the marginal excess at 10 m/s over the applicable criterion from 0.2 dB to 0.3 dB.

18.3.3 Air emissions

Cumulative impacts with neighbouring mining operations may include the generation of dust or noise emissions during construction activities and additional traffic impacts on the regional road network. These impacts are anticipated to be minimal due to the distance between the operations and the project and the stringent management measures and monitoring requirements inherent to mining operations.

18.3.4 Changes to landscape character and visual amenity

Despite there being opportunity to view both the project and the Liverpool Range Wind Farm from some public locations across the landscape (refer to **Section 6.3.7)**, it is anticipated viewers would identify the project as one entity when viewed simultaneously given the consistent turbine height of the both the projects (250 metres). Further, opportunity for such as view would be limited because of the undulating topography surrounding the viewpoints and the project. Detailed assessment of the cumulative impact on landscape character can be seen in **Appendix D.**

18.3.5 Social and accommodation availability

The site is accessible from townships Coolah, Gulgong, and Mudgee, as travel time to the central site location is less than 1 hour for each. There are expected to be some pressures on existing short-term accommodation, local infrastructure and services if all projects proceed to construction within a similar timeframe due to the size of the construction workforce anticipated for each project. An accommodation and employment management strategy prepared would assist in alleviating these pressures.

The project includes a potential construction workforce accommodation in direct response to community concern raised around the pressures of the project on availability of short term accommodation.

18.3.6 Changes to land use

Once the project has reached the end of its operational life, all project infrastructure would be decommissioned and removed, with the exception of underground cabling deeper than 1000 millimetres, which would remain in-situ following decommissioning. The land within the study area would then be returned to its pre-existing land use, suitable for grazing of sheep and/or cattle, or another land use as agreed by the project owner and the landholder at that time. As a result, cumulative impacts to agricultural land capability are not anticipated following decommissioning of the project.

18.4 Environmental management and mitigation measures

Proposed measures to manage and/or mitigate cumulative impacts from the project are detailed in **Table 18-2**.

Table 18-2: Management and mitigation measures – cumulative

ID	Management/mitigation measure	Timing
CU1	A community and stakeholder engagement plan that includes ongoing consultation with neighbouring operations to manage and cumulative impacts will be developed and implemented.	Prior to construction
CU2	Ongoing consultation with TfNSW in the development of the Traffic Management Plan (TMP) to coordinate management of turbine delivery programs across the projects should they occur in parallel.	Prior to construction
CU3	The Accommodation and Employment Strategy (described in **Section 14**) will be developed and implemented for the project in consultation with Warrumbungle Shire Council to manage work force accommodation across the projects should they occur in parallel.	Prior to construction
CU4	UPC\AC will continue discussions with the proponent of Liverpool Range Wind Farm and other relevant projects to align management plans and consider construction traffic management along the New England Highway and the Golden Highway.	Prior to construction

19. ENVIRONMENTAL MANAGEMENT AND MITIGATION MEASURES

19.1 Environmental management strategy

UPC\AC and its contractors will manage its environmental responsibilities and environmental performance through the implementation of an environmental management strategy and will ensure the commitments made in this EIS, as well as any conditions of approval or legal requirements, are fulfilled. The management of environmental impact during construction and operation will be documented in the construction environmental management plan (CEMP) and the operational environmental management plan (OEMP), which form part of the environmental management strategy.

The environmental management measures set out in **Table 19-1** will be monitored during construction and operation of the project to confirm their effectiveness, and whether any additional measures are required.

The CEMP provides the system to manage and control the environmental aspects of the project during pre-construction and construction. It also provides the overall framework for the system and procedures to ensure environmental impact is minimised and legislative requirements are fulfilled. This includes the preparation of environmental sub-plans, which detail how potential environmental issues are managed through construction.

The OEMP documents the management and control of environmental aspects during the operating lifecycle of the project. The iterative design and environmental assessment process allow impacts on the environment to be avoided or minimised where possible. Where environmental controls are incorporated as part of the design development, there will be a program of monitoring and review to ensure the controls comply with stated objectives.

19.2 Construction and operation environmental management plans

The CEMP and the OEMP will provide a structured approach to the management of environmental issues identified in this EIS during construction and operation of the project. Implementing the CEMP and the OEMP will effectively ensure that the project meets regulatory and policy requirements in a systematic manner and continually improves its performance. The strategies defined in the CEMP and the OEMP will be developed with consideration of the project approval requirements, and mitigation measures presented in this EIS.

The management plans will:

- assign responsibilities for planning, implementing, maintaining and monitoring environmental controls including the responsibilities of sub-contractors
- provide specific mitigation measures and controls that can be applied to avoid or minimise negative environmental impact
- provide specific mechanisms for compliance with applicable policies, approvals, licences, permits, consultation agreements and legislation
- state objectives and targets for issues that are important to the environmental performance of the project
- outline monitoring regimes to check the adequacy of controls as they are implemented during construction and operation. This includes monitoring to validate the impact predicted for the project, to measure the effectiveness of environmental controls and implementation of the CEMP and the OEMP, and to address approval requirements. Where

non-conformances are detected, further analysis will be carried out to identify and implement corrective actions to rectify and notify the non-conformance as required
- include the requirements of regular inspections to evaluate the effectiveness of controls and compliance with the CEMP, the OEMP and sub-plans. Any maintenance or deficiencies in controls will be recorded and provided to the contractor for corrective action
- provide details of communications within the project team and with government authorities and the community. This includes the requirement to prepare and implement a community communications strategy and a complaints and enquiries procedure
- include copies of approvals, licenses and permits
- include the provision of environmental sub-plans which detail how construction and operation activities will be managed to avoid or minimise impact including the type, location and timing of environmental controls.
- provide an emergency response procedure for mitigating environmental damage and procedures for planning restoration activities
- provide details of training and awareness programs for personnel working on the project. This includes a compulsory site induction that outlines the requirements of the CEMP and legislative requirements, regular toolbox talks on specific environmental issues, and daily pre-start meetings during construction
- provide for an environmental auditing program to verify compliance with the CEMP, the OEMP and sub-plans, conditions of approval, and relevant legislation.
- provide a mechanism for regular evaluation of environmental performance and continual improvement.

19.2.1 Sub-plans

Environmental management sub-plans support the CEMP and the OEMP. These documents will be prepared to identify requirements and processes applicable to specific impacts described in the EIS. They will address requirements of conditions of approval and other measures identified in the EIS to the satisfaction of the Secretary. The construction related sub-plans that will be prepared for the project are outlined in **Table 19-1** and include:

- biodiversity management plan, including a bird and bat adaptive management plan
- traffic management plan
- A bushfire emergency management and operations plan
- cultural heritage management plan (including Aboriginal and non-Aboriginal heritage)
- soil and water management plan including:
    - erosion and sediment control plan
    - flood response plan.
- noise and vibration management plan
- air quality management plan
- waste and resource management plan.

19.2.2 Non-conformance and corrective action

If a non-conformance is identified, a corrective/preventative action (or actions) will be implemented. In addition, environmental management improvement opportunities can be initiated following incidents or emergencies, monitoring and measurement, audit findings or other reviews. Improvement opportunities may also result in the implementation of corrective/preventative actions.

Corrective/preventative actions and improvement opportunities will be entered into the contractor's quality system database and include detail of the issue, action required and timing and responsibilities. The records will be updated with date of close out and any necessary notes. The database will be reviewed regularly to ensure actions are closed out as required.

Non-conforming activities would be stopped, by personnel outlined in the CEMP. The work will not start until a corrective/preventative action was closed out.

Procedures for rectifying and where required, notifying any non-compliance identified during environmental auditing, review of compliance or incident management are also documented in a compliance tracking program. A compliance tracking program will be established to track compliance against the following for pre-construction and construction phases of the project:

- conditions of approval
- management measures identified in the EIS and the response to submissions report
- legislative requirements
- licensing conditions
- contract specifications relating to environmental matters.

19.3 Decommissioning and rehabilitation management plan

Near completion of the projects operating life, a Decommissioning and Rehabilitation Plan (DRP) will be prepared that outlines the rehabilitation objectives and strategies to return the study area to its pre-existing condition for agricultural land use. This will include:

- rehabilitation objectives and strategies
- describing the design criteria of the final land use and landform
- performance indicators to be used to guide the return of the land back to a condition suitable for agricultural production
- expected timeline for the rehabilitation program.

19.4 Summary of management measures

A summary of the environmental management measures that will be implemented during the construction and operation of the project is presented in **Table 19-1**.

Table 19-1: Summary of management and mitigation measures

ID	Management/mitigation measure	Timing
	Landscape character and visual	
LCV1	The turbines selected for the project will be finished with a low reflectivity surface treatment in accordance with the requirements of The Bulletin. The blades, nacelle and tower will use consistent colouring.	Detailed design
LCV2	The wind farm site will not include unnecessary lighting, signage or logos.	Detailed design
LCV3	Access tracks: • where possible existing roads, trails or tracks will be used as access tracks to reduce the need for new roads • new roads will minimise cut and fill where feasible and avoid the need for vegetation clearing where possible • local materials will be used in the construction of access tracks where possible and practical.	Detailed design
LCV4	Transmission lines: • where possible underground cabling will be used for electrical reticulation • the route for any proposed overhead transmission lines should be chosen to reduce visibility from surrounding areas. • routes for overhead transmission lines will be planned to minimise vegetation loss	Detailed design
LCV5	Visual screening planting for dwellings will be undertaken in consultation with the landowners of residences identified as requiring mitigation measures in **Table 6-3** and **Table 6-4**.	During construction
	Noise and vibration	
NV1	The predicted operational wind turbine noise levels will be updated with final layout and sound power levels of the final turbine technology selected, to verify compliance with the criteria in accordance with the NSW Assessment Bulletin.	Detailed design
NV2	The predicted operational related infrastructure noise levels will be updated with the final design and sound power levels of the final equipment selection to verify compliance with the criteria in accordance with the NPfI.	Detailed design
NV3	The procurement contract for the supply of turbines to the site will typically include specifications concerning the allowable total noise emissions from the turbine, and the permissible characteristics of	Detailed design

ID	Management/mitigation measure	Timing
	the turbine. In the event that turbine emissions are found to exceed the contracted values, the supplier will be required to implement measures to reduce the noise to the contracted value. This can include measures to rectify manufacturing defects or appropriate control settings.	
NV4	A noise management plan will be prepared which identifies how compliance with the wind farm's operational noise limits will be demonstrated, including details of testing procedures and reporting time frames following commencing of operation of the wind farm.	Prior to construction
NV5	Construction noise and vibration management measures will be implemented consistent with recommendations contained within the ICNG as relevant to the project.	Construction
NV6	Compliance monitoring will be conducted to satisfy the NSW Noise Assessment Bulletin including evaluation of special noise characteristics.	Operation
	Biodiversity	
B1	Measures proposed to mitigate and manage prescribed biodiversity impacts at the development site will be documented in a biodiversity management plan, that includes an approved bird and bat adaptive management plan (BBAMP). The BBAMP is to include: • up to 12 months of bird utilisation studies at the 33 designated sites described in this report, across four (4) seasons, to provide more accurate risk data • carcass monitoring during the first 2 years of the operation of the wind farm, to estimate the number of birds and bats struck by turbine blades • scavenger assessment, to allow adjustment of carcass search data for carcasses removed prior to surveys. • bird Utilisation Studies at a subset of the 33 sites, to measure the ongoing impacts of the wind farm on bird populations locally • monitoring of bats across four seasons, to measure the ongoing impacts of the wind farm on microbat populations locally. • a strategy and notification protocol in the event that the wind farm significantly impacts protected or threatened species. The BBAMP will be implemented for the first 5 years of operation of the project.	Prior to construction / during operation
B2	Pre-clearance surveys will be undertaken prior to tree clearing. A qualified ecologist/licenced wildlife handler will supervise tree removal in accordance with best practise methods.	Prior to construction / construction

ID	Management/mitigation measure	Timing
B3	Active breeding or nesting identified during pre-clearance surveys will be avoided in August, September and October which is the breeding/nesting period for most fauna species.	Prior to construction / construction
B4	A procedure will be developed for the relocation of habitat features (e.g. fallen timber, hollow logs) to adjacent retained habitat.	Prior to construction
B5	Clearing protocols will be developed that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance (e.g. removal of native vegetation by chainsaw instead of heavy machinery where only partial clearing is proposed). Fencing (or other barriers as required) and signage will be placed around those areas of vegetation to be maintained to prevent any accidental construction damage and provide a permanent barrier between the development footprint and retained areas. The type of fencing during construction may be of a temporary nature and scale that is robust enough to withstand damage during this stage of work.	Prior to construction / construction
B6	All waterway crossings will be designed and constructed in accordance with *Policy and Guidelines for Fish Friendly Waterway Crossing* (DPI, n.d.) where appropriate.	Detailed design
B7	Appropriate controls will be implemented to manage exposed soil surfaces and stockpiles to prevent sediment discharge into waterways. All works within proximity to the drainage lines will have adequate sediment and erosion controls (e.g. sediment barriers, sedimentation ponds). Revegetation will also commence as soon as is practicable to minimise risks of erosion. Suitable species will be used as ground cover species in any revegetation areas.	Prior to construction / construction
B8	Construction works will predominately be undertaken during daylight hours. Occasionally night lights will be used during concrete pours. Lights associated with operation will be directional to avoid unnecessarily shining light into adjacent retained vegetation where possible. Noise impacts around batch plants and compounds to be managed where they impact on residents.	Construction
B9	Suitable species will be used as ground cover species in any revegetation areas.	Construction
B10	Temporary fencing will be installed when works are within 100m of any threatened flora that provides a 10m exclusion zone around known locations. Temporary fencing will also be used to demarcate the exact easement of the transmission line during construction.	Construction

ID	Management/mitigation measure	Timing
B11	All machinery will be cleaned prior to entering and exiting the construction site to minimise the transport of weeds to vegetated areas to be retained. Weeds that are present within the study area that are listed under the NSW Biosecurity Act 2015 will be managed in accordance with a weed management plan.	Construction
B12	All personnel working on the project will undertake an environmental induction as part of their site familiarisation. This will include: • site environmental procedures (vegetation management, sediment and erosion control, exclusion fencing and noxious weeds) • what to do in case of environmental emergency (e.g. chemical spills, fire, injured fauna) • key contacts in the case of an environmental emergency.	Construction
	Traffic and transport	

TT1	A construction traffic management plan (CTMP) will be prepared in consultation with Transport for NSW and Warrumbungle Shire Council.
	The plan will include the following (with consideration given to potential cumulative impacts of the project with other developments where relevant):
	• details of the transport routes to be used for all project-related traffic
	• details of any road upgrade works required by the Development Consent
	• a protocol for undertaking independent dilapidation surveys to assess the existing condition of the proposed construction routes prior to and post-construction, and post-decommissioning
	• a protocol for the repair of the construction routes if dilapidation surveys identify these roads to be damaged during construction, operation or decommissioning works
	• details of the measures that will be implemented to minimise traffic impacts during construction, operation and decommissioning works, including:
	  • traffic control plans, including detours and signage
	  • notifying the local community about project-related traffic impacts
	  • procedures for receiving and addressing complaints from the community about project-related traffic
	  • minimising potential for conflict with coach and school bus services, other road users during peak hours as far as practicable (measures also required during operation of the project) including consultation with service providers
	  • minimising dirt tracked onto the public road network from project-related traffic
	  • scheduling of haulage vehicle movements to minimise convoy length or platoons
		Prior to construction

ID	Management/mitigation measure	Timing
	• responding to local climate conditions that may affect road safety, such as fog, dust and wet weather • responding to any emergency repair or maintenance requirements • a traffic management system for managing OSOM movements. • a program to ensure drivers associated with the project receive suitable training on the Driver Code of Conduct and any other relevant obligations under the CTMP • a flood response plan detailing procedures and options for safe access to and from the site in the event of flooding • controls for transport and use of dangerous goods in accordance with State Environmental Planning Policy No. 33 – Hazardous and Offensive Development, Australian Dangerous Goods Code and Australian Standard 4452 Storage and Handling of Toxic Substances.	
TT2	An engineered detailed design based on full 3D swept path analysis for the OSOM access intersections and proposed road upgrades will be developed in consultation with the relevant road authority. The design will be developed to the standard and satisfaction of Warrumbungle Shire Council and referred to TfNSW under Section 138 of the *Roads Act 1993* as appropriate.	Prior to construction
TT3	Parking requirements for the project construction and operation workforce will be provided onsite and parking will not be provided on public roads adjacent to the worksites.	Prior to construction
TT4	UPC\AC will undertake consultation with landholders affected where proposed upgrades impact on land outside of the road reserve.	At all times
	Hazards and risks	
AV1	UPC\AC will contact the landowners and aerial operators for Coolah Airport (YCAH), Coolah ALA, Ozton Tongy ALA and local aerial agricultural operators and aerial firefighting operators to inform them of the project. Details of the project, including location and height information of wind turbines, WMT and overhead powerlines will be provided to facilitate the flight planning of aerial application operators.	Prior to construction
AV2	UPC\AC will consult with the Department of Defence on any potential impacts of the project on military flying training within Danger Area D538B Surface to 10,000 feet.	Prior to construction
AV3	Consultation will be undertaken with Airservices Australia to assess potential impacts of the project and to address the lowest safe altitude (LSALT) impact of air route W627 which will need to be raised.	Prior to Construction

ID	Management/mitigation measure	Timing
AV4	All WMTs and wind turbines will be reported to CASA as a hazardous obstacle.	Prior to construction
AV5	UPC\AC will consult with Airservices Australia and provide all relevant project information to allow for publication of wind turbine locations in aeronautical charts and the En Route Supplement Australia (ERSA). This will include 'as constructed' details of wind turbines and WMT coordinates and elevations.	Prior to construction / operation
AV6	The rotor blades, nacelle and the supporting tower of the wind turbines will be painted white.	Detailed design
AV7	The meteorological masts will have aviation marker balls or highly visible flags or sleeves placed on the outside of the guy wires and paint markings will be applied in alternating contrasting bands of colours to at least the top third of the masts. Consideration will be given to MOS 139 Chapter 8 Division 10 Obstacle Markings (as modified by the guidance in NASF Guideline D).	Detailed design
TC1	UPC\AC will consult with NBN, NSW Police Force and Warrumbungle Shire Council regarding the potential interference caused by turbine LV7, MH 47 and MH48 on their point-to-point links crossing the wind farm site.	Prior to construction
TC2	UPC\AC will contact the operators of all potentially affected base stations within 60 km of the wind farm site to identify the associated link paths and determine the likelihood of the project causing interference to their services.	During construction
TC3	If interference to point-to-point or point-to-multipoint links is experienced by the operators, options to re-route the links, installation of additional towers, or replacing the affected links with alternative communications infrastructure will be explored.	Operation
TC4	Bureau of Meteorology will be consulted, and their feedback sought on whether interference to their services is likely. If it is determined that interference such as signal clutter is expected, Bureau of Meteorology can train their users to take the locations of the wind turbines into account when analysing the data.	Prior to operation
TC5	If interference is experienced at receivers as a result of the project, UPC\AC will work with the resident to achieve an acceptable outcome. This may include replacement of an existing antenna with a higher gain antenna or installation of alternative technology such as satellite television.	Operation

ID	Management/mitigation measure	Timing
HH1	Substations will be fenced off from public access and clearances from the electrical equipment to the outer fencing will provide a sufficient buffer for EMF exposure.	Operation
HH2	All electrical equipment including the substation, step-up facility and high voltage transmission lines will be designed and installed in accordance with the relevant guidelines for EMF exposure.	Detailed design
BF1	A bushfire emergency management and operations plan (BEMOP) will be prepared and form part of the CEMP and OEMP. The BEMOP will include: • detailed measures to prevent or mitigate fires igniting • 24-hour emergency contact details including alternative telephone contact • inductions for construction personnel on bushfire risk management and other fire related risks that could present at the wind farm site, the project bushfire contingency plan and emergency response procedures • availability of fire-suppression equipment, access, and water including site infrastructure plans and site access and internal road plans • location of hazards (physical, chemical, electrical) that will impact on the firefighting operations and procedures to manage any identified hazards during firefighting • storage and maintenance of fuels and other flammable materials • notification of the local NSW RFS Fire Control Centre for any works that have the potential to ignite surrounding vegetation, proposed to be carried out during a bush-fire fire danger period to ensure weather conditions are appropriate • appropriate bush fire emergency management planning • such additional matters as required by the NSW RFS District Office.	Prior to construction
BF2	All plant, vehicles, and machinery will be routinely inspected and cleaned of any accumulated flammable debris.	During construction and operation
BF3	A dedicated static water supply (approximately 50- 80kL) for bush firefighting purposes will be provided at strategic locations within the construction workforce accommodation and each wind farm cluster with respect to essential equipment and accessibility.	Detailed design
BF4	No hot works (e.g., grinders, welders, slashers) will be carried out on Total Fire Ban Days.	During construction
BF5	A minimum 10m asset protection zone (APZ) will be established and maintained for the life of the project for the structures and associated buildings and infrastructure (excluding road access to the site and power or other services to the site and associated fencing). The APZ will be to the standard of an Inner	Operation

ID	Management/mitigation measure	Timing
	Protection Areas (IPA) as outlined in Appendix 5 of Planning for Bushfire Protection 2019 and the NSW RFS document Standard for Asset Protection Zones.	
BF6	Internal access ways will be maintained through the life of the project and will support access for Cat-1 fire vehicles consistent with the NSW RFS Fire Trail Standards.	Operation
BF7	An APZ will be established around all habitable (construction workers accommodation) buildings and any associated buildings within 10m from a habitable building in accordance with PBP Table A1.12.3 Minimum distances for APZs -FFDI 80 areas <29kW/m² @ 1090K (flame temp.)	Construction
BF8	A minimum 11m APZ for all buildings associated with the workforce accommodation component. The APZ must be installed and maintained for the life of the development to the standard of an Inner Protection Areas (IPA) as outlined in Appendix 5 of PBP and the NSW RFS document Standard for asset protection zones.	Construction
BF9	Internal access ways to the construction workers accommodation will be maintained of the life of the project and will support access for Cat-1 fire vehicles consistent with the NSW RFS Fire Trail Standards.	Construction
BF10	All habitable buildings in the workers accommodation will be constructed to BAL-29 construction in accordance with Section 7 of AS3959-2018 Construction of Building in Bushfire Prone Areas.	Detailed design
BF11	Non-habitable buildings associated with the construction workers accommodation site will be constructed to BAL 29 AS3959 construction or be located greater than 10m from any habitable building to prevent building to building fire.	Detailed design
BF12	Access to construction workers accommodation will be two-wheel drive, all weather access and in accordance with Appendix 3 of PBP	Construction
BT1	Wind turbine components will be manufactured and certified to current best practice Australian and international (IEC 61400-23) safety standards and are equipped with sensors that can react to any imbalance in the rotor blades and shut down the turbine if necessary.	At all times
BT2	Wind turbines will be subject to stringent safety and security measures including regular maintenance and servicing (within an ISO90001 Quality Assurance system).	At all times
BT3	Contactors certified in the manufacture, delivery, build, inspection, maintenance and repair of turbine components will be employed.	At all times

ID	Management/mitigation measure	Timing
BS1	The BESS would be operated and managed in accordance with the safety requirements for the selected battery technology. Safe handling and operation of battery technology will include storage in a cool (preferably below 30°C) and ventilated area; away from moisture, sources of heat, open flames, food and drink. Appropriate personal protective equipment will be used when handling battery technology.	Operation
BS2	Transformer oil would be handled and managed in accordance with the safety data sheet, including use of required personal protective equipment when handling.	Operation
BS3	Refrigerant would be handled and managed in accordance with the safety data sheet, which includes protection from sunlight and storage in a cool, well-ventilated place. Appropriate personal protective equipment will be used when handling refrigerant.	Operation
	Aboriginal heritage	
AH1	The unassessed areas within the survey boundary shown in **Figure 11-2** will be formally surveyed by archaeologists and RAPs post approval. The survey will include ground-truthing the location of previously recorded AHIMS location for site 36-3-0113.	Prior to construction
AH2	UPC\AC will develop an Aboriginal Cultural Heritage Management Plan (ACHMP) which is to be agreed to by the RAPs and DPIE. The ACHMP will include an unanticipated finds protocol, unanticipated skeletal remains protocol and long-term management of any artefacts.	Prior to construction
AH3	Transport route modifications associated with transporting project components from Newcastle Port along the Golden Highway to the wind farm site will be assessed for impacts to Aboriginal heritage sites	Prior to construction
AH4	The design of the transmission line will ensure that the areas of PAD associated with Cainbil Creek OS-1 are spanned and that any associated access tracks avoid the areas of PAD	Detailed design
AH5	Collection of all surface artefacts at Cainbil Creek OS-1 and The Rock IF-1 will be undertaken by an archaeologist. The methodology of the surface artefact collection will be contained in the ACHMP that will be reviewed by RAPs.	Prior to construction
AH6	The remainder of the site extent of Cainbill Creek OS-1 that will not be impacted by the project will be fenced with hi-visibility fencing prior to works commencing in the vicinity of the site. The fencing will remain in place for the duration of construction in the vicinity of the site.	During construction
AH7	Orana OS-1, Old Farm OS-1, Kensington OS-1, site 36-3-0111 and the potential ring tree shown in **Figure 11-2** will be avoided. The site extent of each site will be fenced with hi-visibility fencing prior to	During construction

ID	Management/mitigation measure	Timing
	works commencing in the vicinity of the site. The fencing will remain in place for the duration of construction in the vicinity of the site.	
AH8	Additional research will take place at Old Farm OS-1. This will involve non-invasive recording, mapping, and photography.	Prior to construction
AH9	All land-disturbing activities will be confined to within the survey boundary. Should the parameters of the proposed work extend beyond this, then further archaeological assessment will be required.	During Construction
	Historic heritage	
HH1	A historical heritage management plan (HHMP) will be developed in consultation with the Department and will contain procedures should a new discovery of significant historic artefacts or items be made during construction or operation of the project.	Prior to construction
HH2	The location of each item should be considered when finalising the design for the access tracks, the overhead transmission line and the underground reticulation location as outlined in **Section 12.3.2.**	Detailed design
HH3	Mt Hope-HS01 and The Rock-HS01 will be avoided.	Prior to construction
HH4	Areas where access was not permitted during the field survey (Figure 5-2 of the HIS), will be assessed prior to any construction associated with the project taking place.	Prior to construction
HH5	All historic heritage items close to construction works will be temporarily demarcated with a 10m buffer around the item extent.	During construction
HH6	If items of historic heritage significance are uncovered during, then an unanticipated finds protocol for historic heritage will be implemented. The Unanticipated Finds Protocol for Historic Heritage will be guided by section 6.4 of the HIS (**Appendix O**) and included in the HHMP.	During construction
HH7	To avoid the potential for harm to historic objects on unassessed adjacent landforms, all ground surface disturbing activities will be confined to the impact footprint outlined in this EIS.	During construction
	Water and soils	
SW1	All waterway crossings will be designed and constructed in compliance with the Department of Primary Industries, Office of Water, Guidelines for riparian corridors on waterfront land and Guidelines for watercourse crossings on waterfront land.	Detailed design
SW2	Concrete wash from concrete batching plants will be appropriately contained and disposed of. Bunded areas of the batching plant will be designed to contain peak rainfall events and will be remediated after	Detailed design

ID	Management/mitigation measure	Timing
	the completion of the construction phase. All waste will be collected and reused or removed from site by an appropriately licenced contractor.	
SW3	Additional investigation and planning will be undertaken during the detailed design to manage erosion risk associated with stormwater. Measures such as inclusion of culverts and rock armouring would be included to address the potential for erosion impact specifically during flood events.	Detailed design
SW4	Infrastructure, including turbines, substations, control buildings, stockpiles, and site compounds and turnaround areas, will not be sited within 20 metres of a major drainage lines or water course.	Detailed design

SW5	A construction soil and water management plan (CSWMP) will be prepared to outline measures to manage soil and water impacts associated with the construction works, including contaminated land. The CSWMP will provide:
	• measures to minimise/manage erosion and sediment transport both within the construction footprint and offsite including requirements for the preparation of erosion and sediment control plans (ESCP) for all progressive stages of construction. The plans will incorporate the principles of the existing guidelines, Managing urban stormwater: soils and construction, vol. 1 (Landcom 2004) and vol. 2 (A. Installation of services; C. Unsealed roads; D. Main Roads; E. Mines and quarries) (DECC 2008).
	• measures to manage waste including the classification and handling of spoil
	• procedures to manage unexpected contamination, including:
	  ○ acid sulfate soils
	  ○ salinity in soils
	• measures to manage stockpiles including locations, separation of waste types, sediment controls and stabilisation
	• measures to manage accidental spills including the requirement to maintain materials such as spill kits
	• dewatering protocol if groundwater in intercepted
	• controls for receiving waterways which may include:
	  ○ designation of 'no go' zones for construction plant and equipment
	creation of catch/diversion drains and sediment fences at the downstream boundary of construction activities where practicable to support containment of sediment-laden runoff
		Prior to construction

SW6	Exposed or cleared areas will be stabilised as soon as possible to minimise erosion and sedimentation that has the potential to pollute watercourses in the area.	Prior to construction

ID	Management/mitigation measure	Timing
SW7	Soil testing for clay content, cation-exchange capacity and electrical conductivity will be conducted as part of geotechnical investigations to inform detailed design. Where sodic soils are identified within an area where trenching is required, soil amendment with gypsum at an appropriate rate will be included within the CSWMP.	Prior to construction
SW8	The CSWMP will include a section on unexpected finds, in the event of exposing previously unknown contaminated land during construction and as part of ongoing operation of the infrastructure. All such finds will be investigated and quantified in terms of potential pollution risks. Where appropriate, action will be undertaken to comply with the requirements of section 120 of the POEO Act (prohibition of pollution of waters) and the CLM Act.	Prior to construction /Construction
SW9	All vehicles onsite will be required to follow the access track network during construction and operation.	Construction and operation
SW10	The use of any farms dams during construction will be agreed with the landholder and the estimated maximum harvestable right dam capacity will not be exceeded.	Construction
SW11	Where possible, access routes and tracks will be constructed in already disturbed areas and personnel will keep to established tracks wherever possible.	Construction
SW12	If groundwater is intercepted and dewatering is required during construction of the turbine footings, dewatering will be managed in accordance with the CSWMP.	Construction
SW13	Following construction all disturbed land will be rehabilitated to an appropriate state as agreed with the landowner. Topsoil will be stockpiled and reused in the rehabilitation.	Post-construction
	Waste and resources	
WR1	A construction waste management plan will be prepared in consultation with Warrumbungle Shire Council. The waste management plan will include: • details of the quantities of each waste type and the proposed reuse, recycling and disposal locations • details on how the waste will be transported to disposal locations during construction and decommissioning • details on measures to reduce the types and volumes of waste • measures to maximise reuse and recycling.	Prior to construction
WR2	UPC\AC will continue to consult with Warrumbungle Shire Council around specific details of the waste management strategy throughout the life of the project.	At all times

ID	Management/mitigation measure	Timing
WR3	All waste generated from the project will be assessed, classified and managed in accordance with the *Waste Classification Guidelines* (EPA, 2014).	At all times
WR4	Management of wastes will follow the resource management hierarchy principles in accordance with the WARR Act (i.e. avoid > reduce > reuse > recycle > recover > disposal).	At all times
WR5	Skip bins will be made available onsite to enable waste separation for recycling (e.g. separate skip bins for cardboard recycling, plastics and timber collection). General waste bins will be provided for disposal of materials that cannot be cost-effectively recycled.	At all times
WR6	Waste will be disposed of at suitable facilities permitted to accept the waste.	At all times
WR7	All trucks transporting waste from the site will have covered loads to prevent spillage and other nuisances.	At all times
WR8	The site septic system will be installed and operated in accordance with Warrumbungle Shire Council regulations.	At all times
WR9	UPC\AC will consider reasonable and feasible alternative disposal methods for the wind turbine components based on the industry standards at the time of decommissioning.	Decommissioning
	Social	
S1	UPC\AC will enter into a Voluntary Planning Agreement (VPA) with Warrumbungle Shire Council. The VPA is currently under discussion with Council. In direct response to community feedback, UPC\AC is discussing the opportunity with Council to split the fund into three portions, being: • a portion administered by Council, • a portion administered through a Section 355 Committee • a portion administered through a community representative committee. The purpose of this is to help promote distributive equity and the channelling of the funds back into the immediately affected community.	Prior to construction
S2	A Community Benefit Scheme Framework will be developed to consolidate the various community benefit initiatives, including: • VPA • Neighbouring property benefits scheme • Community grants	Prior to construction

ID	Management/mitigation measure	Timing
	This framework will provide a framework for distribution of benefit and mechanisms to track and monitor the effectiveness of community benefits. The framework will include targets to enhance the community benefit sharing scheme by linking to outcomes that meet community priorities identified in the social impact assessment. For example, education and training outcomes for youth, community transport and connectivity, small business and enterprise capacity building, various community grants and scholarships in arts, sporting and culture.	
S3	A Neighbouring Property Benefit Scheme has been setup so the eligible properties neighbouring the wind farm site see a direct benefit from the project. This scheme, amongst others, will have an indirect benefit for the local economy and community more broadly for the life of the project. The Neighbouring Property Benefit Scheme framework was setup as a direct response to the issues raised regarding equality and fair distribution of benefits.	Prior to construction
S4	During the development phase of the project UPC\AC has been assisting with community grants to support various initiatives and programs within the local community including education, arts, sporting and culture sectors. This support will continue throughout construction, operation and decommissioning.	Prior to construction
S5	The construction environmental management plan and Construction Traffic Management Plan would include development of relevant measures in response to social impacts including: • amenity related impacts such as noise and dust • traffic impacts, including potential impacts to public transport providers including the coach service that operates as part of Transport for NSW TrainLink and the school bus service operated by Grace Coaches • an adaptive monitoring and management strategy that responds to any unforeseen matters that may arise cumulative impacts due to other major projects in the locality.	Prior to construction
S6	Workplace strategies will be implemented that encourage the integration of incoming populations with local communities including, but not limited to: • workplace behaviours policies employee inductions and toolboxes and opportunities for workforce participation in community events and initiatives.	During construction
S7	UPC\AC will appoint a full time, locally based resource prior to and during construction with experience in community relations and workforce engagement. This resource will be responsible for: • community and workforce engagement and communications (including media)	Prior to and during construction

ID	Management/mitigation measure	Timing
	• responding to community enquiries and complaints • event planning and participation • community benefit sharing implementation local participation plan implementation	
S8	A robust and supportive social performance and communications plan will be prepared to: • facilitate communication between UPC\AC, the Construction Contractor and the community • to outline an adaptive management and monitoring framework that defines how UPC\AC will track, measure and respond and report on social performance • the objectives of this plan would be in line with the DPE's Community Participation Plan (DPIE, 2019) and seek to ensure that UPC\AC's engagement is open and inclusive, easy to access, relevant, timely and meaningful. This plan would: • consider all phases of the project, from detailed design to operation • outline a process that ensures communication materials are accessible to all community members, including the culturally and linguistically diverse community and those people with disabilities, including visual, auditory, physical, speech, cognitive, language, learning, and neurological disabilities • have measurable targets, performance indicators and means by which performance can be measured • have clearly defined roles and responsibilities for the delivery of activities • include a timetable of actions and events • identified the resourced needed to implement the plan. • key components of the plan, including outcomes of social performance monitoring, would be made accessible to the public to further increase levels of trust and awareness.	Prior to construction
S9	The social performance and communications plan will include a complaints management procedure which will outline a grievance process for the community to raise comments, questions and complaints will be established prior to construction commencing. The grievance process will be made publicly available and include a feedback process through which the complainant is provided with information relating to how their concern has been assessed, considered, and where feasible, addressed.	Prior to construction
S10	UPC\AC will, in consultation with Council, continue to investigate the benefits of inclusion of a construction workers accommodation to address the issue of increased pressure on housing and accommodation due to the construction workforce raised by community members as an area of concern.	Prior to construction
S11	A plan of management will be developed for the construction workers accommodation should it go ahead. The primary purpose of this plan is to:	Prior to construction

ID	Management/mitigation measure	Timing
	• outline how the proposed construction workers accommodation will maintain a high level of amenity for neighbouring properties and for the workforce • strategies to encourage the integration of the workers camp with local communities to ensure that the economic benefits associated with the presence of a workforce are received by local businesses and service providers • policies and guidelines around expectations for workforce behaviours • consider appropriate safety and security measures the plan would be developed in consultation with relevant stakeholders including community representatives, council and emergency services.	
S12	A Local Participation Plan and Aboriginal Participation Plan will be developed that prioritises participation and commits to procurement, employment and job readiness investment targets for UPC/AC and its contracting partners. The plans would be supported through procurement and employment systems that: • are embedded into construction contracts, management and assurance • tenders are reviewed prior to release to extract smaller packages of work where there is known local and Indigenous business capability • tender evaluation criteria and weightings are built into procurement processes • identification of priority roles to be filled by local and Indigenous candidates • candidate assessment criteria and weightings • initiatives to enhance the retention of local and Indigenous employees • initiatives to promote the transition from training to long term employment The plan will be strategic in terms of labour hire and relevant contractual conditions to ensure that issues around career path progression for youth and the equitable distribution of job opportunities are considered.	Prior to construction
S13	UPC\AC will advocate with industry bodies such as EnergyCo for a strategic approach to understanding and managing the cumulative impacts on the REZ on regional communities regarding access, accommodation and housing and the use of infrastructure and service. UPC will advocate to industry groups such as EnergyCo and Re-Alliance to commission research in response to ongoing community concerns about the potential of wind farms to devalue properties. This research should be made publicly available for all communities impacts by the REZs.	Ongoing

ID	Management/mitigation measure	Timing
	Economic	
E1	Local residents will be preferentially employed where they have the required skills and experience or are able to be upskilled and can demonstrate a cultural fit with the organisation. UPC\AC would work with Warrumbungle Shire Council to develop an employment strategy to maximise local hires wherever possible.	Prior to construction/ construction
E2	Non-labour inputs to production will be locally sourced where local producers can be cost and quality competitive, to support local industries	Prior to construction/ Construction
E3	UPC\AC will continue and expand its participation, as appropriate, in business group meetings, events or programs in the regional community including (but not limited to) the operation of the CCC and the community benefits fund. For additional information refer to **Chapter 5** and **Section 15.4**	Ongoing
	Land use	
LU1	Consultation will continue to be undertaken with participating landholders to minimise disruption to agricultural activities during construction and operation.	Detailed design / prior to construction
LU2	Consultation will continue to be undertaken with mining and exploration title holders as required regarding any planned exploration activities within the vicinity of the project. Final wind turbine locations and details of project infrastructure will be provided to the licence holders prior to construction.	Detailed design / prior to construction
LU3	Biosecurity management will include: • measures to manage the impacts of weeds, disease and pest animals during construction, operation, and decommissioning activities • biosecurity response measures where impacts are identified • contingency measures if existing measures are inadequate in managing the risk/impact.	At all times
LU4	Targeted weed management will be implemented before vegetation clearance and during the construction period as required to minimise the spread of weeds.	During construction
LU5	All machinery will be cleaned prior to entering and exiting the construction site to minimise the transport of weeds to vegetated areas. Weeds that are present within the construction site that are listed under the NSW Biosecurity Act 2015 will be managed in accordance with a weed management plan.	During Construction
LU6	A decommissioning and rehabilitation plan will be prepared that outlines the rehabilitation objectives and strategies to rehabilitate the wind farm site to an appropriate standard in consultation with the landholder. This will include but not be limited to: • rehabilitation objectives and strategies	Prior to decommissioning

ID	Management/mitigation measure	Timing
	• describing the design criteria of the final land use and landform • performance indicators to be used to guide the rehabilitation of the land • expected timeline for the rehabilitation program.	
	Air quality	
AQ1	Air quality management measures will be included in the construction environmental management plan for the project. The construction environmental management plan will outline the management measures to control and minimise dust generation from the project.	Prior to construction
AQ2	Water and/or dust suppressants will be applied during high dust generating activities (such as quarrying, batch plant operation, rock crushing and earthworks) and to exposed areas, stockpiles and unsealed roads.	During construction
AQ3	The traffic management plan will include optimisation of vehicle movements onsite reducing wheel generated dust. It will also incorporate speed restrictions for equipment operating on unsealed access tracks and disturbed areas.	At all times
AQ4	Loads will be covered when transporting material off site.	At all times
AQ5	Exposed areas will be rehabilitated and stabilised progressively through vegetation planting as soon as practicable after construction to minimise dust from wind erosion.	During construction
AQ6	Weather will be monitored to limit dust generating activities during unfavourable, high dust-generating conditions such as extended dry periods or when Warrumbungle Regional Council has water restrictions in place.	During construction
	Climate change and greenhouse gas	
CC&GHG1	Fuel and energy efficient equipment and vehicles will be selected where available.	Prior to construction
CC&GHG2	Equipment and vehicles will be regularly serviced and maintained to optimise efficiency.	At all times
	Cumulative	
CU1	A community and stakeholder engagement plan that includes ongoing consultation with neighbouring operations to manage and cumulative impacts will be developed and implemented.	Prior to construction
CU2	Ongoing consultation with TfNSW in the development of the Traffic Management Plan (TMP) to coordinate management of turbine delivery programs across the projects should they occur in parallel.	Prior to construction

ID	Management/mitigation measure	Timing
CU3	The Accommodation and Employment Strategy (described in **Section 14**) will be developed and implemented for the project in consultation with Warrumbungle Shire Council to manage work force accommodation across the projects should they occur in parallel.	Prior to construction
CU4	UPC\AC will continue discussions with the proponent of Liverpool Range Wind Farm and other relevant projects to align management plans and consider construction traffic management along the New England Highway and the Golden Highway.	Prior to construction

20. PROJECT JUSTIFICATION AND CONCLUSION

20.1 Project justification

The project would result in a number of benefits including:

- supporting and contributing to Commonwealth and State climate change commitments such as the Paris Agreement, RET Scheme, 2020 ISP, NSW *Net Zero Plan Stage 1: 2020-2030*, and NSW *Renewable Energy Action Plan 2013*
- supplying over 800 megawatts to the NEM and contributing towards the targeted 3,000 megawatts for the CWO REZ as identified in the NES
- enhancing reliability and security of electricity supply
- contributing to capacity gaps in the electricity market following the closure of major coal-fired power generators within the State by 2035 including Vales Power Station, Eraring Power Station, Bayswater Power Station and Mount Piper Power Station
- creation of local job opportunities
- supporting the diversification of the local economy.

The site, technology, layout and size of the project have been developed in consideration of several alternatives to ensure the project would result in maximum benefits for the locality and region in the long term, whilst minimising impacts to the environment. The project is justified and in the public interest because:

- it is suitably located in a region with ideal climatic and physical conditions for large-scale wind energy generation
- it is close to the proposed CWO-REZ transmission line providing a connection to dispatch electricity to the NEM
- it is situated adjacent to agricultural land uses that are compatible with large-scale wind energy generation
- it would not result in significant biophysical, social or economic impacts
- it would create employment opportunities and benefits to the local and regional economy.

The project specific mitigation measures have been developed in consideration of cumulative impacts and are considered appropriate to satisfactorily address the potential combined effects of other surrounding developments. This includes coordinated management plans for construction, operation and decommissioning of the project and ongoing engagement with the proponents of relevant nearby projects.

UPC\AC is committed to the long-term environmental management of the land within the development footprint. At the end of the project's investment and operational life, the wind farm site would be returned to an appropriate condition in consultation with the landowners.

The consequences of not proceeding with the project would include:

- loss of opportunity to reduce greenhouse gas emissions and move towards cleaner electricity generation
- loss of a renewable energy supply that would assist in reaching the RET
- loss of additional electricity generation and supply into the NEM
- loss of social and economic benefits created through the provision of direct and indirect employment opportunities during the construction and operation of the project, as well as flow on social and economic benefits.

20.2Ecologically sustainable development

Ecologically sustainable development (ESD) involves the effective integration of social, economic and environmental considerations in decision-making processes. In NSW, the principals of ESD have been incorporated into legislation including the EP&A Act and the EP&A Regulation. The principles used to define ESD are outlined in the Intergovernmental Agreement on the Environment (1992) and the NSW *Protection of the Environment Administration Act 1991* (NSW). These principles are presented in **Table 20-1** along with a description of how the project and this EIS have considered each principle.

Table 20-1: Principles of ESD and how they have been considered in the project and this EIS

Principle	Considerations
Precautionary Principle	
a) The precautionary principle, namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by: i. careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and ii. an assessment of the risk-weighted consequences of various options.	The precautionary principle has been adopted in the assessment of environmental impacts (**Chapter 6** to **Chapter 18**). All potential impacts have been considered and management and mitigation measures have been included where a risk is present. These measures are summarised in **Chapter 19**. As described in Section 2.3, UPC\AC has considered a range of options in developing the project to avoid environmental constraints.
Inter-generational Equity Principle	
b) Inter-generational equity, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.	The project would contribute to the sustainable transition of electricity generation in NSW to a more reliable, more affordable and cleaner energy future. As the wind farm approaches the end of its operational lifespan, it may be upgraded and maintained to continue operating viably, or the land within the wind farm site can be rehabilitated to its current use if required thereby allowing for either continuation of renewable energy generation or a return to agricultural use, both of which would provide benefits for future generations.
Biodiversity Principle	
c) Conservation of biological diversity and ecological integrity, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration.	The impact of the project on biodiversity values has been assessed in the BDAR in **Appendix G** and are summarised in **Chapter 8**. The project has been designed to avoid areas of higher conservation value. This has included selecting the location of the study area with consideration of limiting the amount of intact vegetation to be removed. Management and mitigation measures have been prescribed to minimise and manage residual impacts (refer to Chapter 19).

Principle	Considerations
Valuation Principle	
d) Improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as: i. polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement, ii. the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste, iii. environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.	There is currently limited recent evidence or detailed academic studies in an Australian setting (e.g. quantitative research or economic assessments) that considers whether an increase in large-scale wind developments in an area is associated with a decline or increase in surrounding property values. However, it is generally considered that impacts relating to visual amenity are the more driving concerns of loss of property value for neighbouring residential properties. A visual amenity impact assessment has been undertaken for the project (**Appendix D**). The assessment concluded that project could be undertaken whilst maintaining the core landscape character of the area and would have a minimal visual impact on the surrounding visual landscape. It is therefore unlikely that a decline in neighbouring property values would occur as a result of the project.

20.3 Objectives of the Environmental Planning and Assessment Act 1979

The relevant objectives of the EP&A Act, under which the project is being assessed are:

(a) to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources,
(b) to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment,
(c) to promote the orderly and economic use and development of land,
(e) to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats,
(f) to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage),
(g) to promote good design and amenity of the built environment,
(j) to provide increased opportunity for community participation in environmental planning and assessment.

The objects of the EP&A Act have been considered throughout this environmental assessment including consideration of socio-economic impacts (**Chapter 15 and Chapter 16**), natural resources and competing land uses (**Chapter 14 and Chapter 17**), conservation of threatened and other species and their habitats (**Chapter 8**), management of built and cultural heritage (**Chapter 11** and **Chapter 12**), and amenity impacts (**Chapter 6**). Considerable consultation has also been undertaken with the local community to release community values and incorporate these into the project design (**Chapter 5**).

The project aims to promote the orderly and economic use of the land through the provision of utility services (power generation). The project has been designed and located to avoid native vegetation and other sensitive environments (i.e. waterways) as much as possible and minimise the use of natural and artificial resources while considering the social and economic welfare of the local community.

For these reasons it is considered that the project is consistent with the objects of the EP&A Act.

20.4 UPC\AC project commitments

As a signatory to the Clean Energy Council's *Best Practice Charter for Renewable Energy Developments*, UPC\AC has demonstrated their intention to:

- where unavoidable, minimise any environmental impacts related to the project
- engage respectfully with the communities in which they plan and operate projects
- be sensitive to environmental and cultural values
- make a positive contribution to the regions in which they operate.

Stakeholder engagement on the project has been comprehensive to date and reflects the importance UPC\AC places on this aspect of its business. UPC\AC will continue to work with all stakeholders as the approval process for the project progresses and detailed design and approval schedule for the project is better defined. This commitment is highlighted by the significant investment in the community to date in the attempt to build strong, trusted, meaningful and long-lasting relationships which will endure into the future.

The environmental management strategy will govern the avoidance, minimisation and management of impacts during the construction and ongoing operation of the project and will be set out to ensure the responsibilities and accountabilities for environmental performance are clear.

Throughout community engagement as part of the preparation of the EIS, UPC\AC has also demonstrated their intention to establish a positive, long-term connection with the local community.

20.5 Conclusion

The proposed wind farm assessed in this EIS has been developed to provide a balance between technological, energy and environmental aspects, while retaining the flexibility required in the final design stage. The environmental assessment undertaken for the project has determined that it would not result in significant impacts to environmental, cultural, social and economic values and residual impacts can be managed through implementing the mitigation measures summarised in **Chapter 19**. Furthermore, the project is consistent with the principles of ESD, and the objectives of the EP&A Act and therefore should be approved under the EP&A Act.

Throughout the project refinement process, UPC\AC has made considerable effort to avoid potential environmental impacts, where at all possible. In those instances where potential impacts cannot be avoided, UPC\AC's design principles have sought to minimise environmental impacts and/or implement mitigation measures to manage the extent and severity of any residual environmental impacts. During detailed design and prior to the commencement of construction, the placement of infrastructure and extent of construction activities would be further refined to ensure avoidance and minimisation objectives are met.

The project forms an important part of Australia's transition to renewable energy generation and would positively contribute to meeting Commonwealth and State targets. The project would enhance the reliability and security of electricity supply by contributing to the anticipated capacity gaps in the electricity market following the closure of major coal-fired power generators within NSW.

Should the project not proceed, it will be more difficult for the Commonwealth and NSW Government to achieve their respective renewable energy and greenhouse gas emission reduction targets, whilst the potential project benefits region and state described within the EIS would not be realised.

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