Photomontages

Photomontages have been prepared to illustrate the general appearance of the wind farm following construction. Eleven locations were selected to illustrate the wind farm from view locations in surrounding areas. The locations are shown in Figure 9-5 and listed below:

- W2 – Haymarket Road;
- W14 – Maybole Road;
- W16 – Maybole Road;
- W22 – Ilparran Road;
- W26 – Spring Mountain Road;
- W30 – Gwydir Highway;
- W36 – Ilparran Road;
- W40 – West Furracabad Road;
- W41 – Private Property;
- W42 – Private Property; and
- W43 – Private Property.

The photomontage locations were selected following a review of preliminary ZVI maps, together with a site inspection to identify potential representative viewpoints. The photomontage locations were selected from publically accessible sections of surrounding road corridors as well as areas of private property within the vicinity of residential dwellings and at a range of distances between the viewpoint and wind turbine (between 1.1km and 5.6km) to illustrate the potential influence of distance on visibility. Where possible photomontage locations were selected to provide representative views from single or multiple residential properties located within the vicinity of the photomontage location.

The process used to generate the photomontages is detailed in Appendix 1. An example photomontage is illustrated in Figure 9-6, the entire collection are located in Appendix 1.

Whilst a professional photomontage provides an image that illustrates an accurate representation of a wind turbine, both in relation to its proposed location and its scale relative to the surrounding landscape, the LVIA acknowledges that large scale objects in the landscape can appear smaller in photomontage than in real life, and is partly due to the fact that a flat image does not allow the viewer to perceive any information relating to depth or distance.

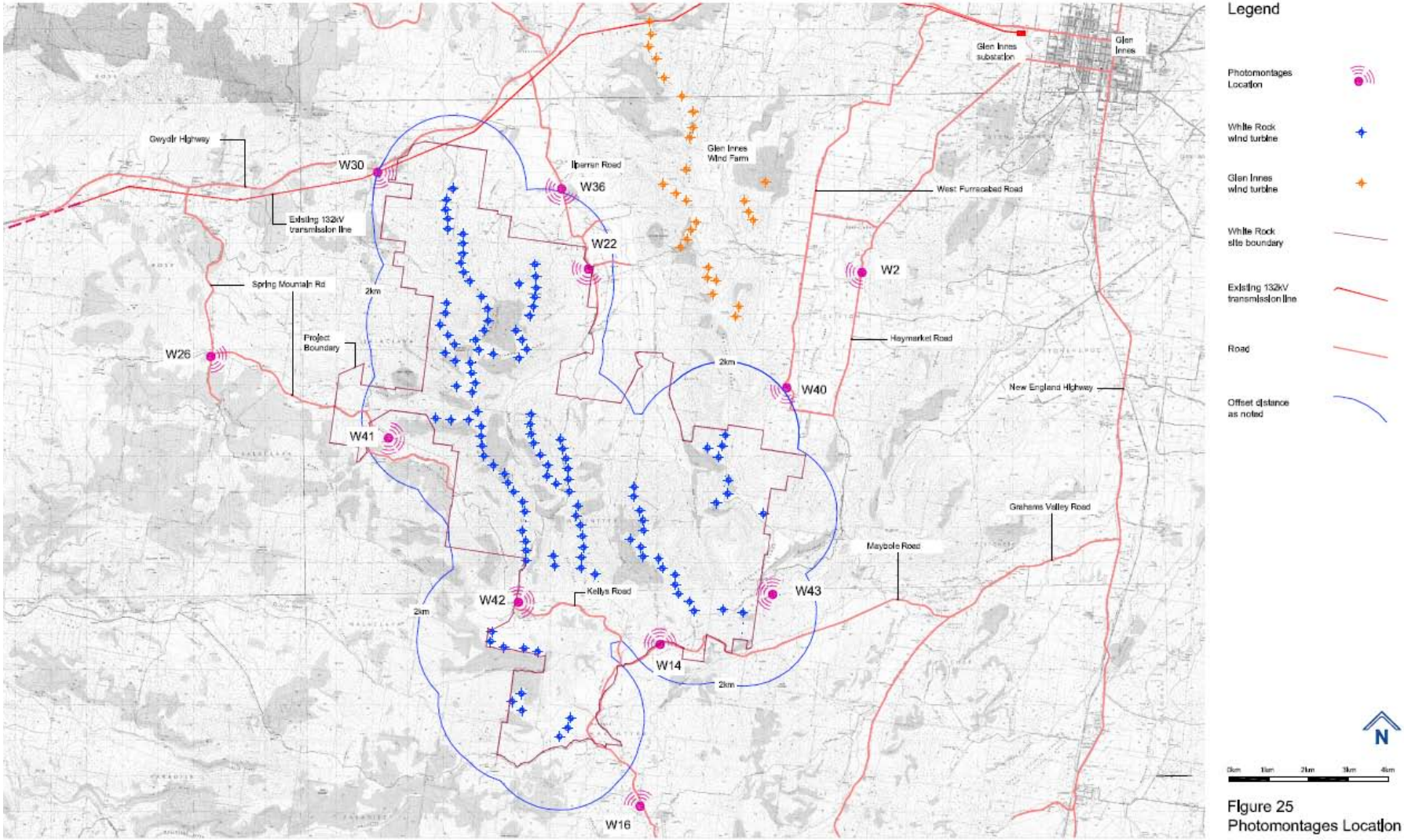

Figure 9-5 Photomontage Locations

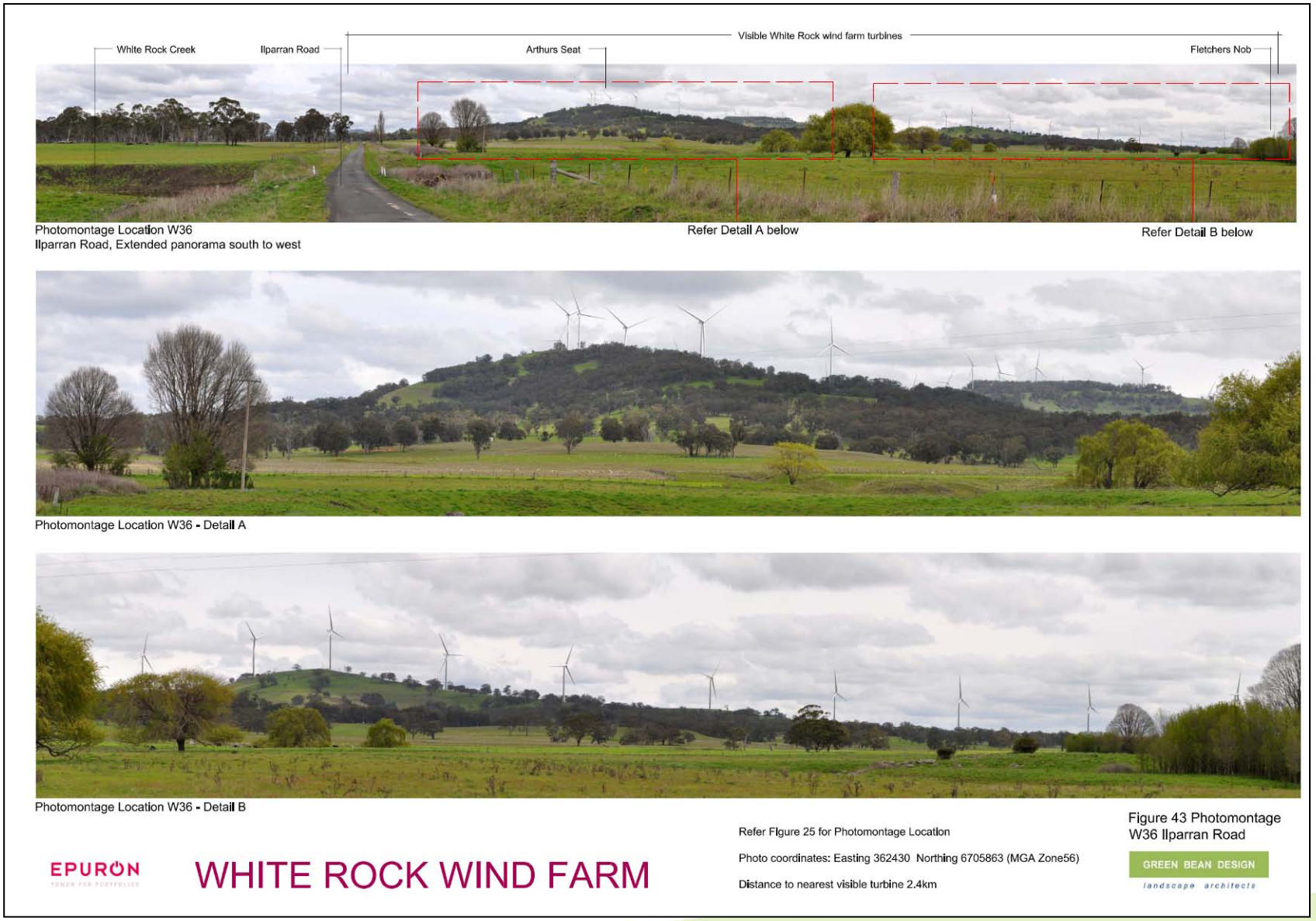

Figure 9-6 Example Photomontage

Night Lighting

The White Rock Wind Farm may require obstacle lighting to be installed and operated during night time and during day time periods of reduced visibility if required to by CASA (see Section 10.1). A small number of existing night time light sources are present in the vicinity of the wind farm, including lights within and surrounding settlements, dispersed homesteads, vehicles travelling along local roads and communication towers. Potential night time light sources from the wind farm could result from:

- operation and maintenance facilities;
- on-site substation;
- obstacle lighting on wind turbines and wind monitoring masts (if required); and
- scheduled or emergency maintenance.

Night time lighting has the potential to be visible from distant view locations, and well beyond the 10km viewshed for the White Rock wind farm, although the level of impact will diminish when viewed from more distant view locations, with a greater probability of night time lighting being screened by landform and/or tree cover.

Pre-Construction and Construction Activities

The key pre-construction and construction activities that may be visible from areas surrounding the proposed wind farm include:

- various civil works to upgrade local roads and access point;
- construction facilities, including portable structures and lay down areas;
- various construction and directional signage;
- mobilisation of rock crushing and concrete batching plant (if required);
- excavation and earthworks; and
- various construction activities including erection of wind turbines, monitoring masts and substation with associated electrical infrastructure works.

The majority of pre-construction and construction activities, some of which would result in physical changes to the landscape, are generally temporary in nature and for the most restricted to various discrete areas within or beyond the immediate wind farm wind farm area. The majority of pre-construction and construction activities would be unlikely to result in an unacceptable level of visual impact for their duration and temporary nature.

The LVIA determined that the wind farm is likely to be an acceptable development within the viewshed, which in a broader context also contains approved wind farm developments and built elements such as roads, agricultural industry, aircraft landing strips, communication and transmitter towers and powerlines.

9.1.3 Results of Visual Impact Assessment

The potential significance of the visual impact resulting from the construction and operation of the White Rock Wind Farm is the result of a combination of the following factors:

- The visibility or extent to which the wind farm structures would be visible from surrounding areas;
- The degree of visual contrast between the wind farm and surrounding landscape, and the ability of the landscape to visually accommodate the wind farm;
- The category and type of situation from which receptors may view the wind farm;
- The distance between receptor and wind farm;
- The duration of time a receptor may view the wind farm from any static or dynamic view location, and
- The visual sensitivity of receptors.

It should be noted that the term 'visual impact' may not necessarily always imply or represent an individual's negative response toward the wind turbines, and that an individual's perception of wind farms can be positive, negative or neutral.

The criteria used to establish visibility and the significance of visual impact are detailed in Appendix 1. Residential and public receptor locations are presented in Figure 20, located in Appendix 1.

Residential viewpoints

The LVIA identified a total of 142 residential viewpoints within 10 km of the wind farm. The LVIA determined that residential receptors beyond 10 km of the wind farm would be unlikely to experience a visual impact greater than Low and would more likely be screened by a combination of undulating landform and tree cover. This was in line with the DGRs, which requested ZVI mapping to be conducted to a distance of at least 10km.

An assessment of each residential receptor location indicated that:

- 8 of the 142 residential viewpoints were determined to have a High visual impact, of which 7 are located on properties associated with the project.
- 29 of the 142 residential viewpoints were determined to have a Moderate visual impact;
- 65 of the 142 residential viewpoints were determined to have a Low visual impact; and
- 40 of the 142 residential viewpoints were determined to have a Nil visual impact.

Public viewpoints

A total of 19 public receptor locations were identified as part of the visual assessment process. An assessment of the visual impact for each potential selected public receptor location indicated that for the White Rock wind farm:

- 0 of the 19 public viewpoints have been determined to have a High visual impact;
- 0 of the 19 public viewpoints have been determined to have a Moderate visual impact;
- 13 of the 19 public viewpoints have been determined to have a Low visual impact; and
- 6 of the 19 public viewpoints have been determined to have a Nil visual impact.

Overall conclusion

Taking into account the mitigation measures outlined in Section 9.1.5 the LVIA concludes that the White Rock Wind Farm would have an overall low visual impact on the majority of non-associated residential view locations as well public view locations, including the New England and Gwydir Highways as well as sections of the local road network identified in the LVIA.

9.1.4 Cumulative Visual Impact Assessment

An assessment of cumulative environmental impacts considers the potential impact of a proposal in the context of existing developments and future developments to ensure that any potential environmental impacts are not considered in isolation.

'Direct' cumulative visual impacts may occur where two or more winds farms have been constructed within the same locality and are simultaneously viewed from the same receptor location.

'Indirect' cumulative visual impacts may also arise as a result of multiple wind farms being observed from the same receptor location, but do not overlap or occur within a single field of view.

'Sequential' cumulative visual impacts may also arise as a result of multiple wind farms being observed at different locations during the course of a journey (e.g. from a vehicle travelling along a highway or from a network of local roads), which may form an impression of greater magnitude within the construct of short term memory.

Existing, approved and proposed wind farms within the regional locality of the White Rock wind farm are identified in the following table:

Table 9-5 Adjacent wind farm developments

Wind Farm	Total number of turbines	Approximate number of turbines within White Rock 10km viewshed	General location of other wind farms relative to the White Rock wind farm	Approximate distance between closest White Rock wind turbine and other wind farm turbine
Glen Innes Wind Farm	27	27	The Glen Innes wind farm extends along the Waterloo Range ridgeline and runs approximately parallel east to north east of the White Rock wind farm.	4.2km
Sapphire Wind Farm	Up to 178	54	The Sapphire wind farm would extend along a series of ridgelines to the north of the Gwydir Highway and north to north west of the White Rock wind farm.	4.5km
Ben Lomond	Up to 100	50	The Ben Lomond wind farm would extend along a series of ridgelines to the south and south east of the White Rock wind farm generally below and to the west of Grahams Valley Road.	5.5km

Following consultation with a number of Local Government Authorities there are no known smaller wind farm developments that have been approved, or are currently being assessed by Glen Innes Severn Council, Guyra Shire Council or Inverell Shire Council.

A number of wind turbines within the Sapphire, Glen Innes and Ben Lomond wind farms would occur within the White Rock wind farm 10km viewshed.

The Glen Innes wind farm extends along the Waterloo Range ridgeline parallel to the east north-east boundary of the White Rock wind farm. There are approximately 27 turbines visible within the White Rock 10km viewshed, with the closest turbine located 4.2km away.

The Sapphire wind farm would extend along a series of ridgelines to the north of the Gwydir Highway to the north nor-west of the White Rock wind farm. Approximately 54 turbines visible within the White Rock 10km viewshed, with the closest turbine located 4.5km away.

The Ben Lomond wind farm would extend along a series of ridgelines to the west of Grahams Valley Road to the south south-east boundary of the White Rock wind farm. Approximately 50 turbines would be visible within the 10km White Rock wind farm viewshed, with the closest turbine located 5.5km away.

It is important to note that the wind turbines may be visible from some areas of the landscape beyond the nominated viewshed, however within the general parameters of normal human vision a wind turbine at a maximum height of 150m to the tip of the rotor blade would occur a relatively small portion of a receptor's field of view from distances in excess of 10km.

Intervisibility with surrounding wind farms

Throughout the White Rock viewshed there will be minimal direct intervisibility with Sapphire wind farm due to tree cover and the land forms surrounding the residential dwellings. The only variations to this occur along the Gwydir Highway and certain local roads. Along the Gwydir Highway a sequential view would occur at both long and short distances. This impact is reduced by the general orientation of the road, being perpendicular to the orientation of the ridgeline. Motorists would travel between the two wind farms briefly rather than adjacent to them for a longer distance. On local roads the majority of the turbines are screened by tree cover and landforms, sequential views would occur for relatively short durations within the White Rock viewshed.

Intervisibility with the Glen Innes wind farm would occur generally for residents north and north east of the White Rock Wind Farm and south to south east of the Glen Innes Wind Farm. Direct views between the two wind farms would be rare due to the relative positions of the residences and the proposed turbines. Indirect views would occur in these same areas, however, the number of visible turbines would be relatively low and hence in addition to the individual impact assessment, the cumulative impact assessment would be low for these residential dwellings. The Gwydir highway would experience a low direct cumulative impact as turbine visibility is limited by local landform and tree cover. Certain local roads would experience sequential views for relatively short durations within the White Rock 10km viewshed.

The Ben Lomond wind farm would have nil or low intervisibility for all residents of the White Rock 10km viewshed due to natural landforms, separation distance and coverage from trees. Certain local roads would experience sequential views for relatively short durations within the White Rock 10km viewshed.

An assessment on the visual impact from each residence with 5 kilometers of a turbine has been conducted in the Landscape and Visual Impact Assessment (Section 9 in Appendix 1).

The LVIA determined that the wind farm is unlikely to result in either any significant ‘direct’, ‘indirect’ or sequential cumulative visual impact (including potential cumulative impact associated with night time obstacle lighting).

9.1.5 Mitigation Measures

It is inevitable that wind turbines of the size proposed for the wind farm will have some degree of visual impact. However, a number of mitigation measures have been incorporated into the design of the wind farm, or form wind farm commitments, with the aim of minimising visual impact. These include:

- Consideration of a matt and/or off-white finish of the structures to reduce visual contrast between turbine structures and the viewing background (this is subject to final turbine selection);
- A commitment to undertake landscape planting at any residence within 3km of a wind turbine.
- A commitment to minimise activities that may require night time lighting and, if necessary, use low intensity lighting designed to be mounted with the light wind farming inwards to the site to minimise glare;
- Substation and other ancillary infrastructure have been sited sympathetically with the nature of the locality and away from major roads and residences where practical to mitigate visual impact;
- The majority of electrical connections within the site (i.e. cables between the turbines) have been designed to be located underground (where practical), in order to further reduce potential visual impacts.

These are outlined in the Statement of Commitments in Section 12.

9.2 Operational and Construction Noise

9.2.1 Background

A noise impact assessment was completed by an independent acoustic consultant for the White Rock Wind Farm. The assessment was undertaken by Sonus Pty Ltd to assess the operational and construction noise and vibration. The complete report can be found in Appendix 2.

A noise impact assessment predicts the noise of the wind farm when operational, measures the existing ambient noise and assesses the predicted noise of construction activities.

The DGRs require a noise impact assessment based on the methodology and criteria from the South Australian Environment Protection Agency, Environmental Noise Guidelines: Wind Farms 2003 (SA EPA, 2003), and this document has been used as the basis for assessing the operational noise from the proposed wind farm. The approach of the assessment was as follows:

- Preliminary predictions of wind farm noise levels were modelled for each receiver (habitable residence) using computer noise modelling software[4]. The results were used together with topographical data to identify receiver locations that would be relevant for assessing the effects of wind farm noise from the development. Sonus selected seven (7) receiver locations around the site for background noise monitoring.
- Background noise monitoring was conducted at each relevant receiver for a 21 day period equivalent to approximately 3000 data points. Monitoring of local weather conditions was undertaken at the same time in order to determine periods of rainfall. Where it was determined that rainfall had occurred, the representative background noise data were excluded from the dataset. Extraneous noise was also excluded from the dataset.
- A regression analysis was performed on measured background noise data, with a best-fit line representing the background noise level at each location across the wind speed range of interest.
- The noise criteria for new wind farm developments, as stipulated by the DGRs, were then applied to the derived background noise levels in the wind speed range of interest in order to determine noise limits at each receiver location.
- Finally, a comparison was made between the predicted wind farm noise levels and the noise limits determined in accordance with the SA EPA Guideline for each receiver in order to establish compliance.

9.2.2 Consultation

There are 30 residences within 2 km of a proposed turbine location (16 involved with the project, 5 uninhabited houses and 9 non involved residences) and 59 residences within 4 km of a turbine location. Representatives from Epuron made contact with all non-involved residents within 4km of the project site and have engaged in either phone or face-to-face meetings, where noise issues were discussed.

Background noise monitoring was conducted primarily at residences that were not associated with the project, to measure the existing ambient noise. A consultant from Sonus was also present at the Open House event in Glen Innes to answer any specific noise related questions.

9.2.3 Assessment

Wind turbines

The noise impact assessment has been undertaken in accordance with the South Australian Environment Protection Authority, *Environmental Noise Guidelines: Wind Farms (2003),* as requested in the Director Generals

[4] Noise predictions were conducted using the propagation model, ISO 9613-2:1996 “Acoustics – Attenuation of sound during propagation outdoors” (ISO 9613).

Requirements. The principal criterion for a wind farm development is that predicted noise levels should not exceed:

- 35 dB(A); or
- the existing background noise level by more than 5 dB(A);

whichever is greater, at all relevant receivers (residences not associated with the project) for each wind speed from cut-in to rated power of the turbine.

For residences that are associated with the project, the World Health Organisation (WHO, 1999) guidelines are adopted, which restrict noise levels to 45dB(A), or background noise levels plus 5dB(A).

The criteria determined for each residence using this approach are as follows:

- Noise loggers are set up at the selected residences and left there for 21 days. During this time the loggers record background noise taking an average reading every ten minutes.
- This data is then analysed to remove recordings during periods of rain and any data that appears erroneous.
- Once plotted on a graph, a curve is then created from the data that describes the existing ambient background noise as a function of wind speed.
- The turbine compliance curve therefore becomes a combination of a base noise level (35dBA for non-involved, and 45dBA for involved properties) and the existing background noise plus 5dBA. An example is given in Figure 9-7.

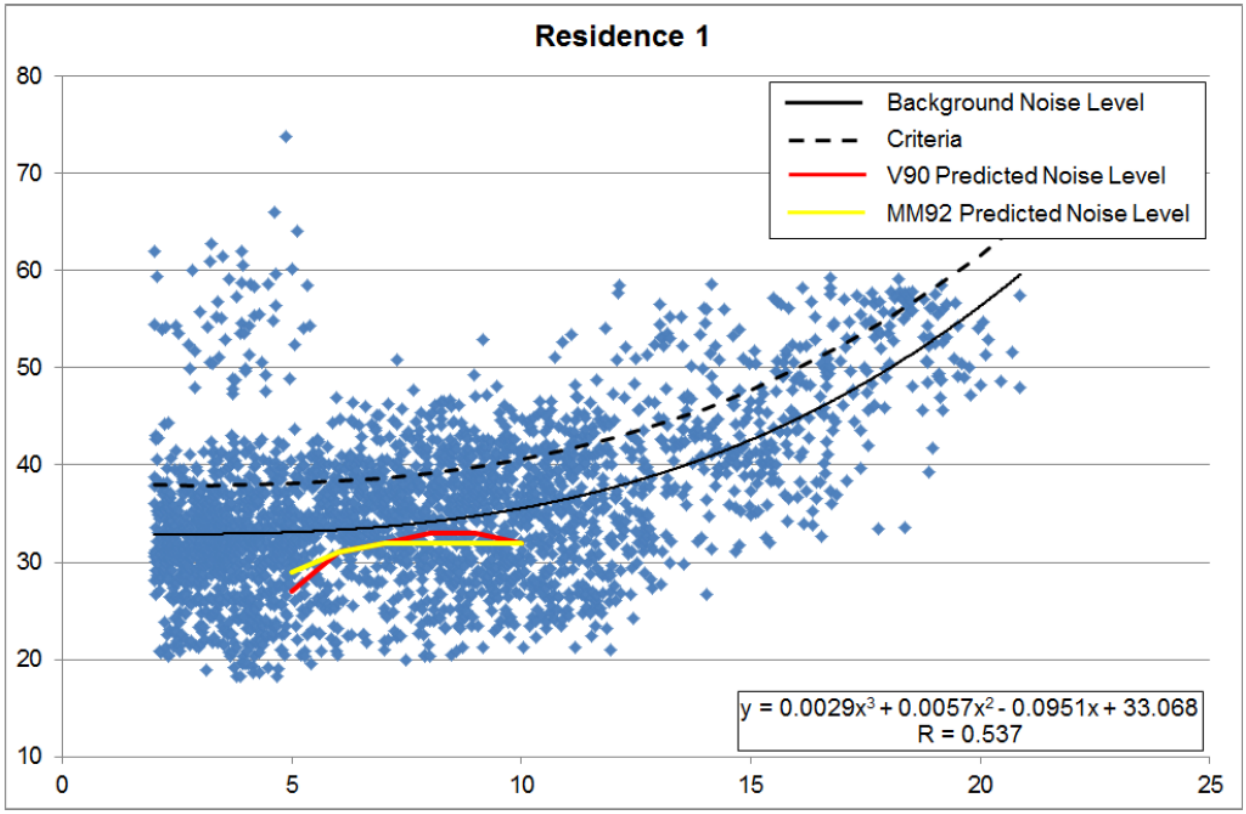

Figure 9-7 Example of a compliance curve

Two turbine types were considered in the modelling of predicted noise levels at relevant receivers. A representative turbine (REpower MM92 2.05MW) and a worst case turbine (Vestas V90 3MW) were modelled to show that compliance can be achieved with the proposed layout under the SA EPA guidelines 2003. The REpower turbine demonstrated full compliance in its normal operating mode, while the Vestas V90 would require two

turbines to operate in a 'low noise mode' at certain wind speeds. The two turbines have been highlighted in Figure 9-10 for the Vestas V90 layout.

Based on the above, the proposed layout can achieve the stringent requirements of the SA EPA guidelines. Figure 9-8 and Figure 9-9 illustrate the predicted noise levels at for the MM92 and V90 respectively. Refer to the complete report in Appendix 2 for a list of residence names and codes along with predicted noise levels at each receiver location.

Substations

There are two proposed substation locations on site, and both have been assessed for their operational noise. It is anticipated that 2 x 100-120 MVA transformers would be required to convert the electricity produced from 33kV to 132 kV at the substation. Noise levels at the nearest residence from the proposed substation location predict levels of 21dB(A), which is 14dB(A) below the base level of the SA EPA Guidelines and as such will not adversely impact on the amenity of residences in the locality of the wind farm.

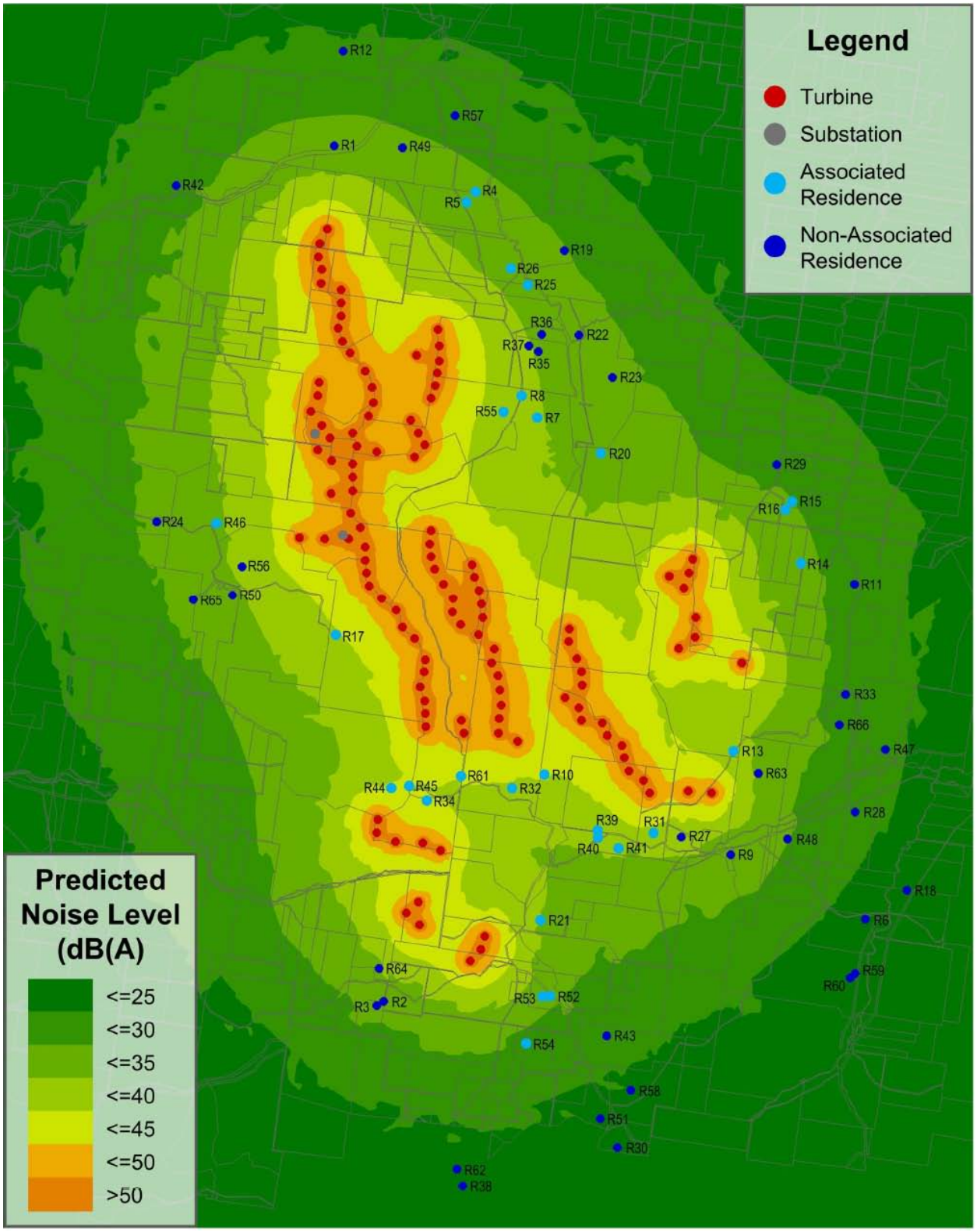

Figure 9-8 Predicted noise levels for the REpower MM92

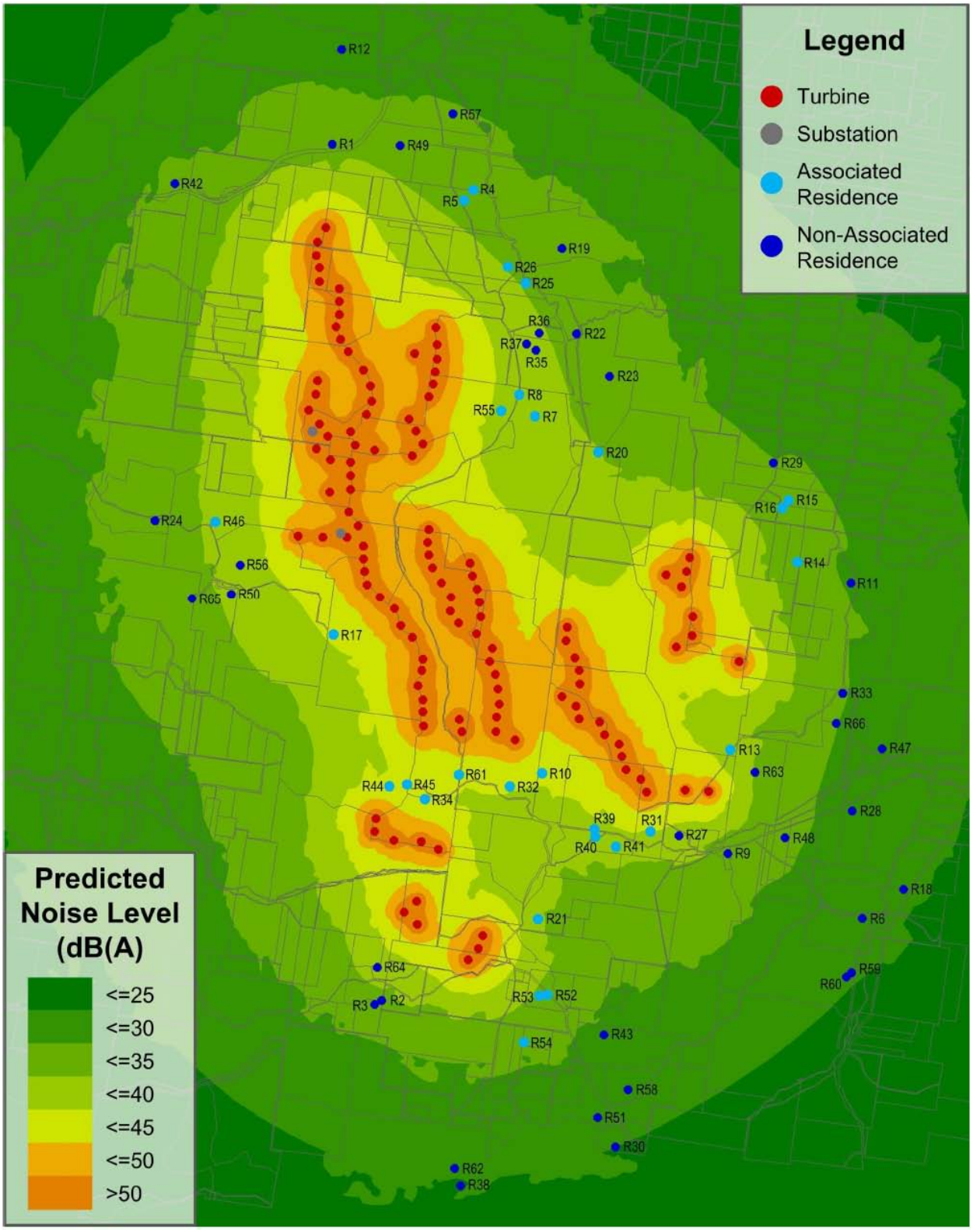

Figure 9-9 Predicted noise levels for the Vestas V90

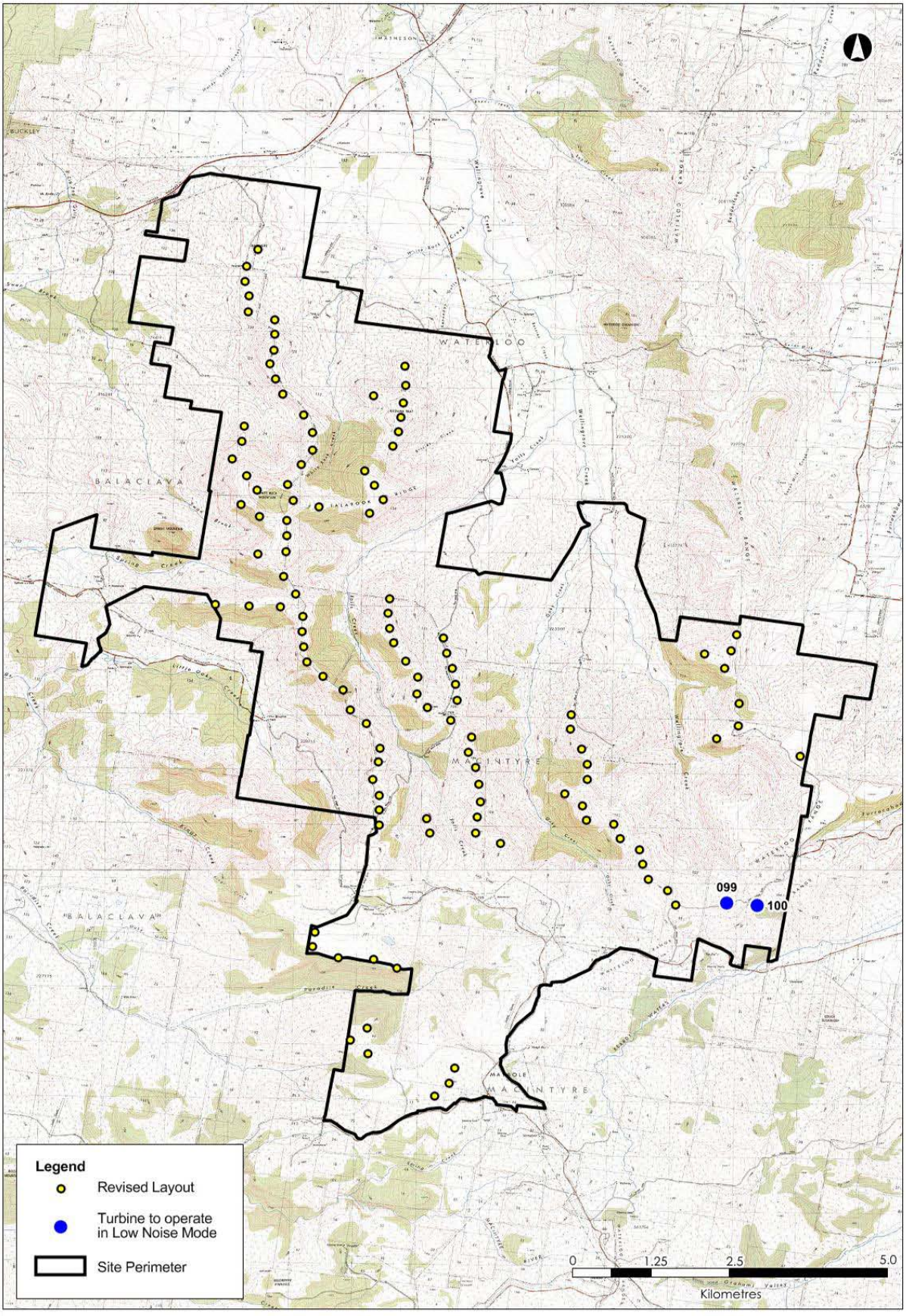

Figure 9-10 Turbine layout for the Vestas V90 with sound management controls

Construction

The construction of a wind farm comprises activities such as road construction, civil works, excavation and foundation construction, electrical infrastructure works and turbine erection requiring processes such as heavy vehicle movements, crushing and screening, concrete batching, and, subject to local conditions, possibly blasting. A worst case approach to the assessment was adopted whereby it was assumed that all equipment was present and operating simultaneously.

To assess construction noise in accordance with the DGRs, the Department of Environment & Climate Change, Interim Construction Noise Guideline 2009 (the ICN Guideline), is referenced.

Based on the predicted noise levels, it is expected that construction noise will be greater than 10 dB(A) above the Rating Background Level (RBL) and less than 75 dB(LAeq) at a distance of 1000m. In accordance with the ICN Guideline it is expected that a dwelling 1000m from construction activity may be "noise affected" but not "highly noise affected". Therefore, the Proponent should apply all feasible and reasonable work practices to meet the noise affected level, and should inform any impacted residents of the proposed construction work (DECC, 2009a).

Traffic Noise

In accordance with the DGRs, traffic noise associated with the construction of the wind farm is to be assessed against the NSW Environment Protection Authority, Environmental Criteria for Road Traffic Noise (ECRTN).

Traffic noise criteria are provided for a range of scenarios. The most appropriate classification for the White Rock wind farm construction site and its associated traffic is considered to be "land use developments with the potential to create additional traffic on local roads". However, it should be noted that this criteria applies to an ongoing operation, as distinct to a temporary construction process.

The daytime criterion provided by the ECRTN is an equivalent (LAeq, 1hour) noise level of 55 dB(A) during any given hour. It is predicted that a distance of 10m from the road side the criterion can be achieved for 10 passenger vehicle movements and 3 heavy vehicle movements in one hour. The number of vehicle movements can double for every doubling of distance from the roadside and continue to achieve the 55 dB(A) criterion. That is, 20 passenger vehicles and 6 heavy vehicle movements could be accommodated in an hour at a dwelling that is 20m from the roadside (NSW EPA, 1999).

Blasting

The DGRs specify that blasting should be assessed against the Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration (ANZEC, 1990) (the Blasting Guidelines).

It is understood that blasting is unlikely to occur during construction of the White Rock Wind Farm. Notwithstanding, the separation distances between the potential blasting activity and the nearest dwellings are of the order of magnitude for which ground vibration and air blast levels have been adequately controlled at other sites.

Given the range of factors associated with both the generation and control of blasting, in the event of blasting occurring, a monitoring regime will be implemented to ensure compliance with the Blasting Guidelines.

Construction Vibration

To assess construction vibration levels in accordance with the DGRs, the DECC document "Assessing Vibration: A Technical Guideline", February 2006 (the Technical Guideline) is referenced.

It is expected that the main sources of vibration will be the drilling rigs where required, rock trenching equipment and roller operation during the road and hard stand construction. The level of vibration at a distance will be subject to the energy input of the equipment and the local ground conditions. Typically, the distances required to achieve the construction vibration criteria provided in the Technical Guidelines are in the order of 20m to 100m. The 100m is a conservative estimate, with vibration from these activities unlikely to be detectable to humans at such a distance (DEC, 2006).

Based on the separation distances between the construction activities and the nearest dwellings being well in excess of the conservative distance of 100m, vibration levels are expected to easily achieve the criteria.

Cumulative

The SA EPA Guidelines explicitly state that "*The noise generated by existing WTGs from another wind farm should not be considered as part of the background noise in determining criteria for subsequent development." Accordingly, the SA EPA Guidelines* do not require the predicted noise to be added together to ensure that the cumulative impacts do not exceed the criteria.

The SA EPA Guidelines include the following references to cumulative impacts and describes the stringency of the base level and how it accounts for cumulative impacts:

> *The base noise level is typically 5 dB(A) lower than the level considered to reflect the amenity of the receiving environment. Designing new developments at a lower level accounts for the cumulative effect of noise from other similar developments and for the increased sensitivity of receivers to a new noise source.*
>
> *Separate wind farm developments in close proximity to each other may impact on the same relevant receiver.*
>
> *Therefore, as for staged development, any additional wind farm that may impact on the same relevant receiver as an existing wind farm should meet the criteria using the background noise levels as they existed before the original wind farm site development. The noise generated by existing WTGs from another wind farm should not be considered as part of the background noise in determining criteria for subsequent development.*

Due to their stringency, the SA EPA Guidelines 2003 implicitly account for the cumulative effect of other wind farms in the vicinity provided the background noise levels used in the assessment are collected prior to the establishment of those wind farms (Section 2.5 of the SA EPA Guidelines). The background noise levels measured in the vicinity of the White Rock Wind Farm do not include the influence of any other wind farm and therefore comply with the cumulative noise requirements of the SA EPA Guidelines.

Prior to construction, the Proponent would submit to the DoP an updated predicted noise assessment including the cumulative noise impact from any adjacent wind farms to demonstrate that the predicted cumulative noise would still comply with the criteria developed in this noise assessment. The updated assessment would be based on the final turbine models and final turbine layouts for the White Rock Wind Farm and any adjacent wind farms.

9.2.4 Mitigation Measures

Operational

- Ensure that the final turbine selection and turbine layout meets the criteria established in this EA (compliance curves), in accordance with the SA EPA Guidelines, for all residential receivers.
- Develop and implement an operational compliance testing program to be included in the OEMP
- If operational noise monitoring identifies an exceedance, consider providing mechanical ventilation (to limit the need to open windows) building acoustic treatments (glazing windows, or using turbine control features to manage excessive noise under particular conditions.

Scheduling

Construction works, including heavy vehicle movements into and out of the site, to be restricted to between 7am and 6pm Monday to Friday, and between 8am and 1pm on Saturdays. Works carried out outside of the hours will only entail:

- works that do not cause noise emissions to be audible at any nearby residences not located on the site; or
- the delivery of materials as requested by Police or other authorities for safety reasons; or
- emergency work to avoid the loss of lives, property, and/or to prevent environmental harm.

If any other works are required outside of the specified hours, they will only be carried out with the prior consent of the New South Wales Department of Planning.

Location of Fixed Noise Sources

Locate fixed noise sources such as crushing and screening plant, concrete batching plant, percussion drilling rigs and generators and compressors at the maximum practicable distance to the nearest dwellings, and where possible, use existing landforms to block line of sight between the equipment and the dwelling

Provide Acoustic Screens around Fixed Noise Sources

Provide appropriate acoustic screens or mounding for fixed crushing and screening plant, concrete batching plant and percussion drilling rigs wherever these noise sources are located within 1000m of a non-associated dwelling and do not have direct line of sight blocked to that dwelling.

Site Management

- Select and locate centralised site activities and material stores as far from noise-sensitive receivers as possible;
- Care should be taken not to drop materials such as rock, to cause peak noise events, including materials from a height into a truck. Site personnel should be directed as part of an off-site training regime to place material rather than drop it;
- Plant known to emit noise strongly in one direction, such as the exhaust outlet of an attenuated generator set, shall be orientated so that the noise is directed away from noise sensitive areas if practicable;
- Machines that are used intermittently shall be shut down in the intervening periods between works or throttled down to a minimum.

Equipment and Vehicle Management

- Ensure equipment is well maintained and fitted with adequately maintained silencers which meet the OEM design specifications. This inspection should be part of a monitoring regime;
- Ensure silencers and enclosures are intact, rotating parts are balanced, loose bolts are tightened, frictional noise is reduced through lubrication and cutting noise reduced by keeping equipment sharp.

Community Consultation

Implement the following noise and vibration elements into the overall community consultation process to ensure adequate community awareness and notice of expected construction noise:

- Regular Community Information newsletters, providing details of the construction plan and duration of the construction phases;
- A site notice board in a community location providing copies of the newsletters, updated construction program details, and contact details of relevant project team members and an ability to register for email updates of the newsletter;
- A feedback mechanism for the community to submit questions to the construction team, and for the construction team to respond;
- Regular updates on the construction activities to Local Council and the local Police to assist in complaint management if necessary;
- Contact details of the project manager and / or site “Environmental Representative”.

In addition, prior to any blasting activity, construction activity occurring within 1000m of a non-associated dwelling or significant construction traffic periods or impacts on local road conditions:

- Contact the local community potentially affected by the proposed works and inform them by letter of the proposed work, the location of the work, the day(s) and date(s) of the work and the hours involved
- This contact shall be made a reasonable time before the proposed commencement of the work; and

- The letter should provide the contact details of the project manager and / or site "Environmental Representative".

The above measures should be incorporated and implemented through a Construction Noise Management Plan for the site.

9.3 Ecology

9.3.1 Background

An Ecology Assessment was conducted by RPS for the proposed White Rock Wind Farm. The purpose of this assessment report is to:

- identify and document the known and potential ecological impacts of the project;
- enable planning, land management and development decisions to be based on sound scientific information and advice; and
- enable compliance with applicable assessment requirements contained within the EPA Act, TSC Act, FM Act, EPBC Act, and any other relevant state, regional and local environmental planning instruments.

The assessment was undertaken in a number of stages and is appended in full in Appendix 3. The stages in the assessment were conducted as follows:

Preliminary assessment

A desktop review of the region and study area was conducted to identify dominant vegetation types and habitat features as well as species and communities that might be present in the area. This was done with the use of aerial imagery and spatial data supplied by Epuron. District scale habitat features, such as movement corridors were also identified in this process.

Field Surveys

Comprehensive field surveys were undertaken using specialist ecology teams covering the development envelope. The development envelope approach assesses a general area that may contain infrastructure, for example, along a ridgeline, as opposed to focusing on each specific turbine location. This approach allows for fine-scale development planning to occur based on the findings and subsequent mapping of the survey effort.

Constraints mapping and impact assessment

The results of the field surveys were documented and mapped using aerial imagery to create a vegetation map. An assessment of the potential impact from the wind farm infrastructure was also made. The vegetation map was used to aid the relocation of turbines within the development envelope where the impact to native vegetation was considered unacceptable.

9.3.2 Methodology

Assessment Criteria

In accordance with the DGRs, the ecology report has been structured and conducted to fulfil the requirements of the *Environmental Planning and Assessment Act 1979* (EPA Act), the *Threatened Species Conservation Act 1995* and the *Fisheries Management Act 1994* (FM Act). Assessment of the proposal under the requirements of *State Environmental Planning Policy No. 44 (SEPP 44) – 'Koala Habitat Protection*' is also included. Consideration of the proposal has been undertaken in relation to the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*.

The DGRs also identify certain requirements that must be incorporated into the flora and fauna assessment aspect of the project. These include consideration of the *Wind Farms and Birds: Interim Standards for Risk Assessment* (AusWEA, 2005) and having regard to the Department of Environment and Heritage's (DEH) *Wind Farm Collision Risk for Birds - Cumulative Risk for Threatened and Migratory Species* (DEH 2006). These requirements (and the requirements of other relevant documentation such as EPBC Act Policy Statements) have been considered and are referred to throughout this assessment where appropriate.

Survey Effort

Ecological field investigations were undertaken within the study area in spring from 25 September 2010 to 1 October 2010.

Consideration has been given to the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004) and the addendum *Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians* (DECC, 2009b).

With regards to the current proposal, the majority of survey effort was given to bird and bat surveys (identification of species at risk of collisions), vegetation mapping (e.g. presence of endangered ecological communities), and habitat assessment (e.g. identification of key habitats, potential movement corridors). Such an approach is consistent with the relevant requirements of DEH (2005), DEC (2004), Auswind (2005), Auswind (2006) and Planning NSW (2002).

Table 9-6 Survey Dates, Types and Prevailing Weather

DATE	WEATHER					
	Temp (min. – max.)	*Rain (24 hrs to 9:00am)*	Max Wind Speed/Direction	Cloud Cover	*Sun*	
					Rise	*Set*
25/09/2010	11.3°C-17.0°C	1.6 mm	31km/h - NW	8 eighths	06:09	18:20
26/09/2010	10.0°C -20.0°C	0.4 mm	15 km/h - NNW	6 eighths	06:08	18:21
27/09/2010	9.5°C -19.0°C	0 mm	35 km/h - SW	4 eighths	06:07	18:22
28/09/2010	10.0°C -21.0°C	0.2 mm	54 km/h - WNW	8 eighths	06:06	18:22
29/09/2010	5.5°C -17.0°C	1.0 mm	50 km/h - W	0 eighths	06:04	18:22
30/09/2010	6.0°C -16.0°C	0 mm	30 km/h - E	4 eighths	06:03	18:23
01/10/2010	5.0°C -13.5°C	0 mm	33 km/h - E	7 eighths	06:02	18:24

Source: (BOM, 2010)

Flora surveys

Species of plants in the study area were assessed and recorded utilising a combination of both 20 m x 20 m quadrats and the random meander technique (Cropper, 1993). Sixteen quadrats were placed throughout the study area. These were placed in some turbine locations and within areas of significant vegetation adjoining turbine sites. The random meander technique involves walking in a random manner throughout the study area and recording all species seen. The time spent in each vegetation community was generally proportional to the size of the community and its species richness.

Fauna Survey

Fauna species present in the study area were recorded through observation methods such as point census bird surveys, incidental sightings, spotlighting, identifying bird and frog calls, searches for ground-dwelling reptile species under logs and leaf litter, and by sighting indirect evidence of species presence such as fauna scats, feathers, tracks and hair. No terrestrial or arboreal mammal trapping was undertaken, given that few impacts were expected to terrestrial and arboreal mammal species.

Bat detectors (ANABAT II with CF ZCAIM) were used to record the echolocations calls of microchiropteran bats within the study area. A total of 21 sites were sampled overnight using stationary bat detectors. Survey locations were selected proximate to proposed wind turbine location groups and sampled the range of habitat types and topographic locations of the proposed turbine locations.

Nocturnal animals were surveyed using call playback, whereby recordings of the vocalisations of animals are broadcast to elicit a response, either vocal or behavioural. Species calls used included Barking Owl, Masked Owl and Powerful Owl. At each site there was an initial 10 minute listening period followed by a four minute call broadcast and then a two minute listening and spotlighting period. For each additional species the four and two

minute periods were repeated. Calls were broadcast using a portable MP3 player and amplified through a megaphone.

Spotlighting was undertaken from the vehicle using handheld 100w spotlights, with the approximate speed of survey being 5 km per hour. In addition, the area surrounding each call playback site was spotlighted on foot by two people for around 30 minutes.

9.3.3 Existing Environment

The study area is typical of the wider bioregion and all properties within it are managed as active grazing properties. Flora and fauna habitats primarily consist of four broad habitat types: woodland, creek lines, farm dams, and cleared areas with and without scattered trees.

Many of the native flora and fauna species recorded or considered likely to occur on the site are those tolerant of the variegated landscape. A number of other species that have specific habitat requirements (including many threatened species) are no longer present within the locality. The most suitable habitat for native species occurs within the larger remnant forest patches.

Potential habitat for terrestrial, arboreal, and flying mammals also exists, including nesting / roosting habitat in the form of tree hollows. Caves that provide roosting habitat for cave-dwelling microchiropteran bats are also known to occur in the broader site perimeter, although do not occur within the study area itself.

Elsewhere, isolated paddock trees or small remnant patches of less than 1ha occur in otherwise cleared areas. Whilst larger remnants provide most ecological attributes, scattered trees are also considered to play an important role in ecosystem functioning and productivity, and have been shown to be an important habitat feature for fauna, including foraging insectivorous bats (Lumsden & Bennett, 2000).

Historical clearing and selective tree lopping have substantially reduced the density of tree hollows throughout forested areas. It is likely that the demand for hollows is likely to exceed that which is currently available and the availability of hollows is likely to be a limiting factor for the size and distribution of hollow dependent fauna populations.

The numerous small farm dams throughout the area provide habitat for wetland / water birds and frogs. Creek lines are generally degraded through clearing, erosion, sedimentation, and cattle and sheep impacts such as trampling of riparian vegetation and contributing to bank erosion. The upper reaches of Falls Creek provide the most intact areas of freshwater habitat including for small freshwater fish and crustaceans.

Ongoing patterns of degradation from weeds, erosion, grazing, and feral animals continue to impact upon the above mentioned habitat attributes such that the current biological diversity of the study area has been significantly reduced.

Feral and domestic animals including foxes, goats, rabbits, European hares, cattle and sheep impact on habitat attributes in a number of ways, including reduction in native fauna populations, simplification of understorey and pollution of water bodies. Grazing in particular has lead to a depletion of the understorey, decline of native grass and species richness, and inhibits the regeneration of trees.

Individual proposed turbine sites were typically characterised by treeless pasture areas either close to existing woodland remnants or within larger treeless pasture areas. Areas between proposed turbines and along proposed access paths often contained areas of remnant woodland vegetation.

Vegetation communities

Three predominant vegetation communities occur within the wind farm study area and include:

1. Ribbon Gum – Mountain Gum Woodland (EEC – Ribbon Gum – Mountain Gum – Snow Gum Grassy Forest/Woodland of the New England Tableland Region);
2. Yellow Box Woodland (EEC White Box Yellow Box Blakely's Red Gum Woodland); and
3. Cleared Pasture with Scattered Trees.

The general condition of the vegetation within the study area and wider locality is substantially degraded from over 100 years of European settlement and associated land management practices. Ongoing degradation regimes

from cattle and sheep grazing, timber felling, weeds, erosion and feral animals continue to impact upon the native vegetation.

Flora and Fauna in the study area

A total of 87 flora species were identified during the survey period over the White Rock study area within the quadrats and random meander surveys. This included 55 native species and 32 exotic species. A complete list of the flora species identified is provided in the full version of this report, found in Appendix 3.

No rare or threatened flora species were recorded on-site during the current surveys.

A total of 70 vertebrate fauna species were recorded during formal and opportunistic surveys, comprising 51 bird species, 7 mammals, 1 reptile and 6 amphibians. The species recorded, and those that have the potential to occur (see Appendix 3 Table 6-1) are considered to be typical of the habitats present in the site and in the wider locality.

Three threatened fauna species were recorded during field surveys namely, the Eastern Bentwing-bat (Miniopterus schreibersii), Little Pied Bat (Chalinolobus picatus) and Varied Sittella (Daphoenositta chrysoptera). All three species are listed as 'Vulnerable' under the TSC Act.

Description of maps

Detailed maps are included in the Ecology Assessment and contain the following information:

- Flora and Fauna survey effort
- Ecological communities identified
- Recorded fauna sites
- Ecology constraints

Refer to the Ecology Assessment in Appendix 3 (Figure 2-2 Figure 3-1 and Figures 4-1 to 4-4) for these map sets.

9.3.4 Assessment

Threatened species

An assessment of the potential impacts to threatened species was carried out to characterise the significance of the impacts in accordance with the NSW and Commonwealth legislation.

An Assessment of the potential level of impact on EECs and threatened flora species listed under the TSC Act identified one (1) EEC and four (4) threatened flora species as potentially impacted by the project, and are outlined in Table 9-7.

No threatened flora species listed under the TSC Act were identified within the study area during the field surveys. Potential habitat within the study area was identified for three threatened species identified during database searches.

For EECs and flora species the positioning of wind turbines in areas to avoid forest/woodland vegetation resulted in the proposed power line easements and access roads as requiring most woodland/forest vegetation removal. The relatively small area of vegetation that would be removed for the wind farm in relation to much larger amount available in the immediate area resulted in a finding of no significant impact on EECs or threatened flora species listed under the TSC Act. Refer to Section 6.2.1 of the Ecology Assessment (Appendix 3) for a detailed assessment on the potential impact to each individual species.

Assessment of the potential level of impact on threatened fauna species under the TSC Act identified seven threatened fauna species as potentially impacted by the project. Of the seven species that were identified, two were observed on site during the survey fieldwork. An assessment of these species (Eastern Bent-wing Bat and Little Pied Bat) has been summarised below in Operational Impacts. The species that were not recorded on site have all been assessed as unlikely to be impacted by the project as infrastructure has been proposed in areas not suitable for habitats or foraging environments for these species. Any potential impacts from blade strike would therefore be in very small numbers. Mitigation measures have been proposed to further reduce the impact of the project to native fauna. For a detailed assessment on the potential impact to each individual species refer to section 6.2.3 of the Ecology Assessment (Appendix 3).

Table 9-7 Listed species with potential for impact

Scientific name	Common name	Listing	Identified on Site
FLORA			
Bothriochloa biloba	Lobed Bluegrass	(V*)	No
Dichanthium setosum	Bluegrass	(V)	No
Digitaria porrecta	Finger Panic Grass	(E, E*)	No
Thesium australe	Austral Toadflax	(V, V*)	No
ECOLOGICAL COMMUNITIES			
Ribbon Gum, Mountain Gum, Snow Gum Grassy Forest/Woodland of the New England Tableland Bioregion		EEC	Yes
FAUNA			
Neophema pulchella	Turquoise Parrot	(V)	No
Pteropus poliocephalus	Grey-headed Flying-fox	(V, V*)	No
Chalinolobus picatus	Little Pied Bat	(V)	Yes
Miniopterus schreibersii	Eastern Bentwing-bat	(V)	Yes
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	(V)	No
Scoteanax rueppellii	Greater Broad-nosed bat	(V)	No
Nyctophilus timoriensis	Greater Long-eared bat	(V)	No

The Key Thresholds Assessment indicated that no significant impacts to threatened species or endangered ecological communities are likely as a consequence of the project.

Habitat removal

The construction of the White Rock Wind Farm will cause some disturbance to native vegetation through construction of access tracks, cabling and construction of foundations and other associated infrastructure. Soil disturbance and the construction of access tracks may also facilitate the spread of weeds and cause localised erosion / sedimentation or waterway pollution.

The Proponent will seek to minimise these impacts through effective weed-control and careful construction methods avoiding erosion and waterway pollution.

While the project would result in the removal of some areas of remnant vegetation, principally for power line easements and access roads, the areas removed are unlikely to significantly impact on any key habitat areas or mapped corridors within the study area, particularly given the narrow, linear form of the required infrastructure.

Within the study area there are approximately 312 ha of native vegetation, the Ribbon Gum – Mountain Gum (EEC). This EEC is the dominant vegetation community throughout the study area. Approximately 22 ha (7%) of the mapped EEC within the study area will be required to be removed/modified as part of the project. The majority of

this community is degraded by grazing with incursions of pasture weeds and a simplified structure. Given that the majority of this EEC (93%) will be not be impacted upon by the project and larger intact stands occur immediately adjacent along the steeper slopes, it is considered highly unlikely this EEC will be significantly impacted upon by the project. Therefore it is unlikely that the project will have a significant impact upon this EEC.

Impact Area Calculations

Impact area estimations were undertaken to calculate the footprint of the development, within the development envelope, and attribute areas of direct impact to the vegetation types they would occur in. As the development envelope assessment aims to ensure flexibility, the calculation of impact areas must be undertaken on a 'worst case scenario' basis, in order to ensure that impacts are not underestimated.

Underground cabling will be used to connect wind turbines together and trenches for these cables will be situated adjacent to the constructed access tracks. For the purpose of impact area calculations the underground cabling has been incorporated into the access track figures. Vegetation within overhead power line easements will require maintenance and a worst case approach has been taken by considering the entire easement width in the impact area calculations. This area has been described as habitat modification as opposed to permanent habitat loss.

Figure 9-11 Ribbon Gum – Mountain Gum Woodland

Table 9-8 Impact Area Calculations

PROJECT COMPONENTS	Typical Dimensions	Quantity	Total Area (ha)	Impacted Area (ha)
Permanent Infrastructure:				
Footing and Hardstand#	25 x 60 m	119	17.85	0.34
Access and spur roads (length m)*#	10m	68.79 km	68.79	4.69
Underground powerlines onsite**	1 m	53.05 km	5.305	-
Overhead reticulation cabling / easement^	25 m	8.18 km	20.45	4.54
132kV power line^	40 m	7.88 km	31.52	12.15
Substation and control building	100 x 100m	1	1	0
Switchyard	100 x 100m	1	1	0
Operations and Maintenance facilities	100 x 100m	1	1	0
Permanent habitat loss				**5.03**
Habitat modification				**16.69**
Temporary Infrastructure:				
Concrete batch plant	50 x 100m	1	0.5	0
Construction compound, staging and storage	100 x 100m	1	1	0

* Access tracks around the site are anticipated to be 5 metres in width, however, a 10 metre width has been used to assess the likely impact due to cut and fill operations in order to achieve the required slope.

**The impact area associated with underground cables has been incorporated into the figures for access tracks.

Habitat permanently removed

^ Habitat would be modified for transmission and power line maintenance. This would include clearing vegetation for each power pole and maintaining clearance from electrical conductors between poles.

Given the size and scale of the project, the ecological impacts of the project are expected to be comparatively minimal. This is due to the following factors:

- The area is predominantly cleared of native vegetation with the majority of properties used for cattle, sheep and horse grazing.
- The design phase ensured turbines and associated infrastructure were located away from vegetated areas.
- Turbine locations have been adjusted to minimise the removal of trees and impacts to remnant native vegetation.
- The area does not occur as part of any significant habitat resource for threatened fauna species. Where significant flora species or vegetation was identified, turbines have been sympathetically located.
- Implementation of a number of mitigation measures, as specified in the following section.

Operational impacts - Birds

Research undertaken both overseas and in Australia has demonstrated two types of impacts to birds: 1) direct mortality from collisions, and 2) indirect impacts from avoidance, habitat disruption and displacement (NWCC, 2004; AusWEA, 2005).

As the project will remove a relatively small area of remnant vegetation in comparison to the remaining remnant vegetation, the main potential impacts to birds are likely to be as a result of collisions with turbines and/or avoidance behaviour.

From the results obtained during field surveys, including flight activity and behaviour monitoring, and the collation of available literature, it was possible to assess the collision potential of birds seen or expected to occur within the study area. This information is outlined in Table 4-1 of Appendix 3.

Generally, the results indicated that the non-passerines, (swans, ducks, hawks, kites, eagles, falcons, cockatoos, parrots and lorikeets) have greater risk potentials, than the passerines (wrens, warblers, fantails, honeyeaters, whistlers, finches and swallows). The non-passerines generally have flight characteristics that make them more prone to collisions with wind turbines. They are usually larger and less mobile than the passerines and many occur in flocks and in more open areas. Furthermore, most passerine species are small species, which are potential prey for larger bird species and therefore tend to keep lower to the ground where they remain in close proximity to the shelter of vegetation.

With specific regard to the species noted within the study area, it is considered that raptors, wetland / waterbirds, and other common local resident birds (e.g. Yellow-faced Honeyeaters, Magpie, Crimson Rosella and Raven) would be most likely to be prone to turbine collisions. Some minor changes to the local distribution and abundance of these species may be expected as a consequence of the ongoing operation of the turbines, although these impacts are not expected to be significant.

The threatened Varied Sittella was observed within the study area. This species forages within the tree canopy and as such is unlikely to be impacted by rotor blades or turbulence. The Varied Sittella inhabits woodland vegetation and therefore, the minimal removal of woodland vegetation for construction activities is unlikely to significantly impact on this species.

This information suggests that impacts are likely to be mainly restricted to localised indirect effects on common farmland birds, as has been noted elsewhere within Australia (AusWEA, 2004). In consideration of the above-mentioned factors, potential impacts to birds are expected to be relatively minimal and in line with stated Auswind (2006) and Barclay et al. (2007) collision rates of around one to two birds per turbine per year.

Sufficient baseline data has been collected and presented herein, from which a post construction monitoring program can be established to further assess the impacts of the project on bird species and populations.

By maximising the distance of the wind turbines from forested vegetation, the site selection and design process has significantly reduced the potential for bird collisions. While the potential impact of blade strike is important, the protection of likely breeding and foraging habitat is considered to be more important.

Operational impact - Bats

A low number of microchiropteran bat species were recorded within the study area including the Eastern Bent-wing Bat, Little Pied Bat, Gould's Wattled Bat, Chocolate Wattled Bat and White-striped Freetail Bat. These species occur in a variety of habitats including woodlands and open grasslands (Churchill, 1998). No known maternity caves are located with 50km of the site. The closest known roosts for Bent-wing Bats are located at:

- Maternity roost at Riverton approximately 80km north of the site
- Roost site at Tingha approximately 30km west of the site
- Roost sites at Emmaville/Torrington approximately 30km north of the site

Both direct and indirect impacts on bats may occur as a result of the project. Potential direct impacts are associated with mortality resulting from collision with rotors and monopoles and barotrauma. Barotrauma can occur when a bat is suddenly passing through a low air pressure region surrounding the turbine blade tips, resulting in death through lung or other tissue damage (Baerwald et al., 2008). Potential indirect impacts on bats may include disruption of foraging behaviour and breeding activities resulting from alterations in landscapes. The

key potential impacts to bats include the loss of a small number of hollow-bearing trees and mortality resulting from collisions with turbines and/or turbine avoidance behaviour.

The project may remove a small number of hollow-bearing trees that may be used by hollow-roosting species such as Gould's Wattled Bat and the Chocolate Wattled Bat. However, turbines and infrastructure have been located away from these key habitat features as far as practicable. Wind turbines have been located as far as practicable away from the remnant patches. Species at highest risk from rotor strike are highflying species such as the White-striped Freetail Bat and potentially the Eastern Bent-wing Bat.

The White-striped Freetail Bat was recorded from two passes at two sites within the study area during current investigations. This species is a fast-flying, high altitude forager, taking prey 50m or more above the ground. They are not overly manoeuvrable and rely on speed to capture prey items. Based on these traits it is of particular concern in relation to wind farms. A study by Hoye (2005) for a proposal at Crookwell identified that turbines situated in open pasture away from forest remnants are likely to suffer relatively low levels of bat strike although the bat species stated as being of most risk was the White-Striped Freetail Bat. Hoye (2005) indicated that activity levels of this species were proportionately higher in pasture as against forest remnants when compared to other species and that Hall & Richards (1972) had identified this species as being known to suffer mortality from "Dunlite" wind generators.

The Eastern Bent-wing Bat was the most commonly recorded species within the study area during the survey period. It forages many times above the tree canopy, although whether this includes up to rotor height is uncertain. It will also fly close to the ground when in open areas. These traits suggest that this species is less likely to be impacted by turbine operation. This species is a cave-dwelling species and as such does not rely on tree hollows for roosting. It is considered that, while these species occurs in the study area, they would also be very common in the immediate vicinity of the study area, and are common throughout the locality and region.

Relevant studies of wind farms in Australia and their corresponding impacts on species such as the White-striped Freetail Bat are few. It is considered appropriate that ongoing monitoring of the turbines occurs to ensure that assumptions made during the assessment process are not flawed due to a lack of available scientific literature. Such monitoring would inform and provide rigorous scientific information that could assist in determining and implementing appropriate contingency plans for this project, while also assisting in assessing the impacts of future projects in other areas.

Although the threatened Grey-headed Flying-fox (Pteropus poliocephalus) is likely to occasionally occur during the flowering of eucalypts in the region, no NPWS Atlas of NSW Wildlife records exist within the area, suggesting the locality is not significant to the species, and accordingly few or no impacts are expected. No camps are known to be located in close proximity to the study area. It is expected that, were fatalities do occur as a result of impacts with the turbines, these would be minor in relation to deaths occurring via other permitted activities such as culling near fruit farms. Regular monitoring would ensure that this is the case and where required, contingency plans are in place (as likely to be identified in the recommended EMP).

Whilst it is acknowledged that there may be a potential loss of a very low number of individuals due to turbine strikes or barotrauma, it is considered unlikely that this will place any local population(s) of these species at risk of extinction given that the key habitat features including forested remnants and caves will remain relatively unaffected. The loss of hollow-bearing trees will be minimised by micro-siting turbines and infrastructure. It is considered that the number of bats likely to be affected by the Proposal is not significant.

By maximising the distance of the wind turbines from forested vegetation, the site selection and design process has significantly reduced the potential for bat collisions. While the potential impact of blade strike is important, the protection of likely breeding and foraging habitat is considered to be more important.

A post-construction monitoring program will be established to further assess the known and potential impacts to bat populations.

Some minor impacts to birds and bats may occur due to turbine collisions. Some minor changes to the local distribution and abundance of locally occurring common species may also be expected as a consequence of the ongoing operation of the turbines. However, these impacts are not expected to be significant with few or no impacts on population(s) sizes or surrounding habitats.

Cumulative

A cumulative risk of increasing numbers of wind farms has been identified as being of concern for particular species of birds and bats in Australia by the Department of Sustainability, Environment, Water, Population and Communities. This aspect of concern in relation to wind farms has been investigated by Biosis for SEWPAC, with the results contained in a report entitled *Wind Farm Collision Risk for Birds – Cumulative Risks for Threatened and Migratory Species* (DEH, 2006). The report is a collation of six individual reports.

Of most relevance to the White Rock Wind Farm is the overview of the modelling of cumulative risks posed by multiple wind farms and the risk level investigation of select species at Gippsland. The Swift Parrot report has also been considered, although there are no known records in the locality of this species.

The closest other known proposals are located at:

- Glen Innes Wind Farm, approximately 5km east, 27 turbines, approved;
- Sapphire Wind Farm, adjoining current study area to the north, up to 178 turbines, proposed; and
- Ben Lomond Wind Farm, approximately 8km south-east, 98 turbines, proposed.

In terms of barrier effects, the spacing of the turbines (250 – 500m apart) allows for expansive areas for birds and bats to move through the site when moving through the locality. Such spacing is considered to be sufficient for birds and bats to navigate through the locality with only minor disruptions to their existing movement patterns. The most likely movements through the study area would be through Wellingrove Creek valley and through the northern parts of Falls Creek valley. These areas contain a low number of turbines.

To address cumulative ecological impacts, this EA includes mitigation measures to reduce impacts on areas of higher conservation significance and to offset the area to be disturbed by the project. Offsets are considered to be required, where impacts cannot be avoided, in order to achieve a 'maintain or improve' environmental outcome. The approach taken by this assessment is to offset the quantum of habitat loss associated with the project, based on the finalised infrastructure layout. The broader environmental benefits of establishing renewable energy sources have not been considered in the assessment or offset plan. Therefore, coupled with measures to offset habitat loss, the contribution of the project to reducing the adverse environmental impacts of fossil fuel based electricity generation is anticipated to constitute an overall 'improve' outcome.

Ongoing monitoring of operational ecological impacts, such as collisions, would be undertaken on site, as well as other regional wind farms. This commitment addresses the need to build local knowledge of actual impacts of wind farms in the region and address them in a co-ordinated manner. Specific Statements of Commitment are stated in Section 12 of this EA.

Birds

There are currently no operational wind farms within 50km of the study area. Cumulative impacts are expected to occur to a minor degree. However given the likely low fatality rates outlined in this report, such impacts are unlikely to impact significantly upon birds, particularly threatened birds.

No nationally listed threatened bird species were recorded within the study area, however, one nationally listed migratory species, Rainbow Bee-eater (*Merops ornatus*) was recorded during bird surveys. The Rainbow Bee-eater was observed foraging above and within woodland canopies.

Bats

Both direct and indirect impacts on bats may occur as a result of the project. Potential direct impacts are associated with mortality resulting from collision with rotors and monopoles and barotrauma. Barotrauma can occur when a bat is suddenly passing through a low air pressure region surrounding the turbine blade tips, resulting in death through lung or other tissue damage (Baerwald et al., 2008). Potential indirect impacts on bats may include disruption of foraging behaviour and breeding activities resulting from alterations in landscapes. The key potential impacts to bats include the loss of a small number of hollow-bearing trees and mortality resulting from collisions with turbines and/or turbine avoidance behaviour.

Whilst it is acknowledged that there may be a potential loss of a very low number of individuals due to turbine strikes or barotrauma, it is considered unlikely that this will place any local population(s) of these species at risk of

extinction given that the key habitat features including forested remnants and caves will remain relatively unaffected. The loss of hollow-bearing trees will be minimised by micro-siting turbines and infrastructure.

A post-construction monitoring program has been recommended to further assess the known and potential impacts to bat populations.

Offsetting

Measures to avoid, mitigate or compensate impacts on flora and fauna have been considered for this project. Such measures are required to ensure that the project can aim to result in an improved or maintained outcome in accordance with DECCWs vegetation offset principles. Proposed measures such as weed control and native vegetation rehabilitation will be used. An Offset Plan will be developed in consultation with DECCW. Refer to Statement of Commitments No. 21.

The development design process has focused on ensuring that the turbines and associated infrastructure avoid and minimise direct impacts upon existing native vegetation and corresponding habitats. This has been the major consideration provided to flora and fauna in terms of avoidance of impacts as the project has resulted in negligible impacts upon the existing natural habitat on the study area.

Approximately 5 ha of native vegetation would need to be cleared for turbine and access track construction and approximately 17 ha modified for transmission and power line easements. This area would be offset using similar quality vegetation at a ratio of 2 to 1 through a Conservation Agreement with DECCW. There are sufficient areas of this community within the project boundary that are a viable and achievable offset option. The potential impacts on birds and bats attracted to the habitat in the offset area has been considered as part of the assessment of potential impacts assessed and justified for the whole site (Refer Appendix 3 – Ecology Assessment). The proposed offset areas are not considered to be located too close to the turbine locations.

No field surveys have been carried out in the proposed offset areas yet, but based on the surveys of the adjoining study area, the ecology assessment of the site and a review of the aerial photography it has been assessed that the proposed offset areas are likely to contain the Ribbon Gum EEC that would need to be offset. The potential offset areas, which are considered to be in better condition than the areas to be impacted by the wind farm, are shown in Figure 9-12.

Conclusion

No significant impacts are expected to any matters of National Environmental Significance (NES), as listed under the EPBC Act. As a precautionary measure, a referral (EPBC 2011/5834) was submitted to the federal Department of Sustainability, Environment, Water, Population and Communities who confirmed on 8 March 2011 that that the project is not a controlled action..

As a positive environmental consequence, the project addresses (in-part) the key threatening processes of “human-caused climate change” (as listed under the TSC Act), and “loss of climatic habitat caused by anthropogenic emissions of greenhouse gases” (as listed under the EPBC Act).

From the data presented herein, there appears to be no significant ecological constraints to the development of this proposal within this locality of the northern tablelands region. This is based on the premise that appropriate baseline studies are undertaken, potential ecological impacts are minimised through appropriate siting of turbines and associated infrastructure, and further mitigation measures would be implemented in accordance with the Construction and Operational Environmental Management Plans.

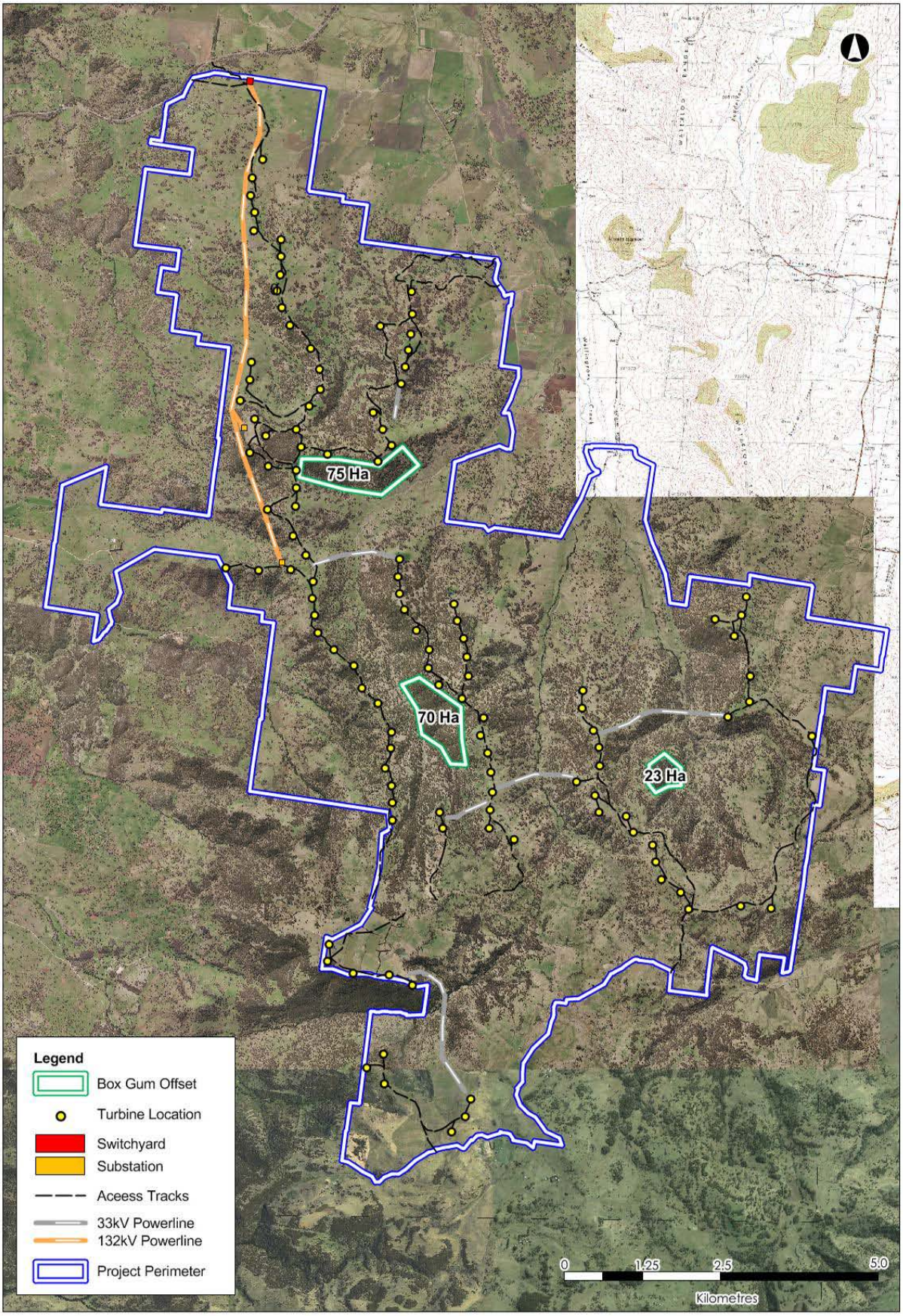

Figure 9-12 Potential offset locations

9.3.5 Mitigation Measures

The following measures would be made to minimise and monitor any likely and potential ecological impacts of the project:

- Constructional and operational phases of the development should be in line with the Best Practice Guidelines for Wind Energy Projects (Auswind, 2006), including the implementation of an Environmental Management Plan (EMP) and a Construction Environmental Management Plan (CEMP).
- All vegetation removal would be restricted to a minimal development footprint. Careful micro-siting of roads and cabling should be undertaken to minimise potential impacts.
- Final turbine locations would be micro-sited, where practical, to avoid or minimise impacts to native vegetation and habitats.
- Access roads and cabling would be aligned along existing tracks wherever possible to minimise vegetation removal and loss of hollow-bearing trees, number of easements, and the spread of weeds.
- Powerlines between turbines have been designed to be constructed underground and along access tracks where practical to minimise potential incidents of avian collisions (including the creation of perching locations in the vicinity of turbines).
- A post-construction bird and bat monitoring program, such as that described by NWCC (1999) and AusWEA (2005) would be established to determine the impacts of the project on bird / bat populations.
- The CEMP would include appropriate weed control protocols such as washing machinery after entering affected areas and spraying road ways to ensure the spread of weeds is restricted during construction and throughout the ongoing operation of the project.

9.4 Aboriginal and European Heritage

RPS Group was engaged to prepare an Aboriginal Heritage Impact Assessment for the proposed wind farm. This section provides a summary of the approach and findings of the assessment. Refer to Appendix 4 for the full report.

9.4.1 Methodology

The assessment was conducted in accordance with the DGRs. The approach to this assessment consisted of: a desktop review of the region to considered the environmental and archaeological context of the study area, the development of a predictive model to help design the survey effort, an archaeological survey of the study area for Aboriginal and non-Indigenous heritage items and finally documentation of the findings.

Aboriginal consultation was also undertaken simultaneously in accordance with the process and timing set out in the *Aboriginal Cultural Heritage Consultations Requirements for Proponents* (DECCW, 2010b), being more onerous than the 2005 guidelines referred to by the DGRs.

Aboriginal groups and individuals who may hold cultural information are identified, notified and invited to register interest in the project. Letters were sent to DECCW EPRG, Glen Innes Local Aboriginal Land Council, the Registrar of Aboriginal Owners, Native Title Services Corporation Limited, Glen Innes Severn Local Council and the Border Rivers - Gwydir Catchment Management Authority on the 31 August 2010 requesting information and contact details for interested local Aboriginal parties, authorities were asked to respond within 14 days.

As a result of the invitation for expression of interest letters and the advertisement published in the Glen Innes Examiner (26/8/2010) a total of five Aboriginal Community Stakeholders registered their interest in the project.

Four of these groups responded to the proposed heritage assessment methodology and strategy for collecting information on cultural heritage significance that was provided by RPS as part of the consultation process.

Due to the size of the development only one stakeholder was able to participate in the survey field work. For more details regarding this consultation process refer to Appendix 4.

A survey of the study area was undertaken by RPS archaeologist, Tessa Boer-Mah and Aboriginal community representative Hilda Connors from the 18th October to the 22nd of October 2010.

9.4.2 Existing Environment

The development footprint is predominantly contained to the tops of ridgelines where tree coverage is cleared and sparse. The survey area encompassed a larger region than the development footprint as the predictive model indicated a higher chance of artefacts in areas other than those proposed for development. Recorded sites have been illustrated in Figure 9-14 and Figure 9-15.

Scarred Trees

Due to previous land clearance and the pastoral nature of the Glen Innes district, scarred trees are a rare site type, thus, two recorded sites (RPS WR01A and RPS WR01B) have been assessed has having high local and regional significance. These two sites were recorded within the project boundary, although not within the development footprint of the proposed infrastructure. Both scars have likely been created for bark shields and are very representative of this site type. These sites have been assessed as having high local and regional significance for representativeness.

RPS WR01A occurs on a dead tree and has been subject to damage, it has therefore been assessed as having moderate integrity on a local and regional scale. RPS WR01B occurs on a living tree and therefore has been assessed as having high significance in terms of integrity on a local and regional scale. RPS WR01A and RPS WR01B are 25 metres apart and therefore demonstrate connectivity between sites; both have been assessed as having high significance for connectedness on both a local and regional scale. Both scars are well executed and bark removal of this type is a complex and slow process, relying on the strategic placement of wedges to lift bark away from the heartwood and in some areas bark removal can only take place in certain seasons.

Both sites have been assessed as having high significance for connectivity. The majority of the heartwood of RPS WR01A has been removed, exposing the underside of the scar and allowing observation of the nature of re-growth which is not often observable; thus this site has been assessed as having high research potential on a local and regional scale. RPS WR01B occurs on a living tree and thus does not allow the opportunity for the observation of the nature of internal re-growth; it has been assessed as having moderate research potential on a local and regional scale.

Overall, both scarred tree sites RPS WR01A and RPS WR01B have been assessed as having high local and regional significance, but do not meet the criteria for state significance.

RPS WR04 is representative within the local region and therefore has been assessed as having high local significance, in a regional context, however the young age of the tree is not as representative on a regional scale and therefore has been assessed as having moderate regional representativeness. The site is located within the project boundary, however, it is well outside the development footprint proposed by the project.

This scar is in good condition and therefore has been assessed as having high significance for integrity on a local and regional scale. RPS WR04 occurs as an isolated site, not having nearby associated sites and therefore has been assessed as having low significance for connectedness on a local and regional scale. This scar is symmetrical and well executed; it has therefore been assessed as having high significance for complexity on a local scale, but moderate complexity on a regional scale. This site has been assessed as having high research potential on a local scale and moderate potential on a regional scale. Overall, RPS WR04 has been assessed as having high local significance and moderate regional significance.

Figure 9-13 A scarred tree (RPS WR01A)

Artefact Scatters

Artefact scatters have previously been identified in the local and regional landscape; thus both artefact locations identified during field studies (RPS WR02 and RPS WR03) have been assessed has having moderate significance on a local and regional scale. The raw materials and types of artefacts identified at these sites are representative of materials in the local landscape, but do not display the range of materials identified at other sites in the region, both these sites have been assessed as having high significance for representativeness on a local scale, but moderate representativeness on a regional scale.

It is likely that both sites have integrity and potential archaeological deposit present; they have been assessed as having high significance on a local scale, but moderate significance on regional scale, as there are likely other sites in the region with greater archaeological integrity. Both sites are located with 100m of each other and therefore

are likely to be connected; they have thus been assessed as having high local significance for connectedness and moderate significance on a regional scale. The raw materials and artefact types are moderately complex and therefore have been assessed as having moderate significance on a local and regional scale.

Both sites are likely to have sub-surface material present and therefore have been assessed as having high local significance for research potential, but are of moderate significance on a regional scale.

Overall, RPS WR02 and RPS WR03 have been assessed as having high local significance and moderate regional significance.

European Heritage

No non - indigenous heritage items were identified during heritage register searches, nor during the field survey; thus there are no identified non-indigenous heritage constraints relating to the proposed works.

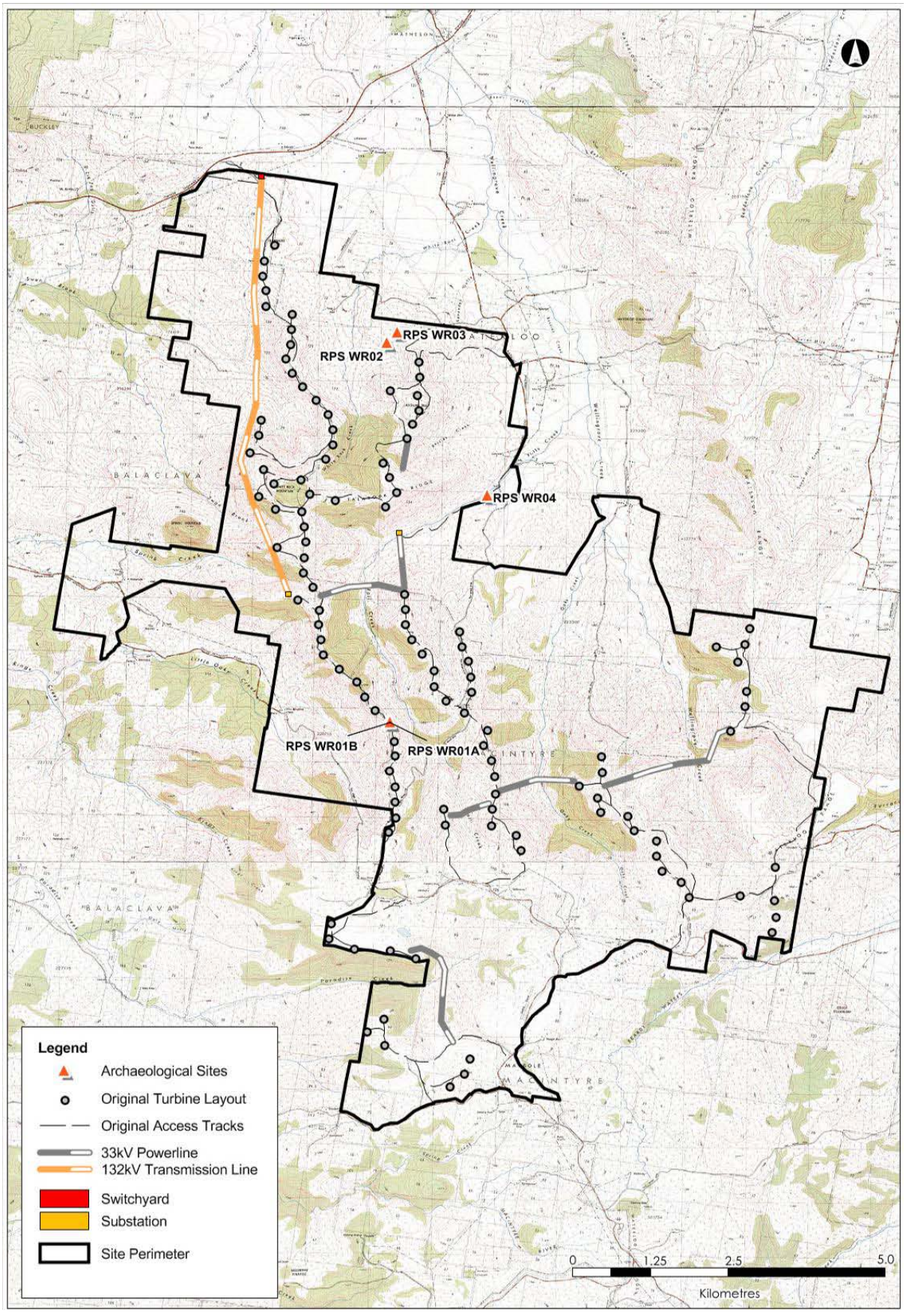

Figure 9-14 Heritage artifact locations

Figure 9-15 Heritage sites WR01A and WR01B

9.4.3 Assessment

Five Aboriginal sites in total were identified during the survey. All Aboriginal sites identified during the survey occur outside the development footprint and thus are not likely to be impacted. Two scarred tree sites (RPS WR01A and RPS WR01B) have been identified in close proximity to the development footprint. Appropriate mitigation measures should be taken In order to conserve these sites and protect from accidental impact.

RPS WR02 and RPW WR03 are located 800 metres beyond the impact zone and therefore no potential impacts have been identified.

All five sites have been registered with DECCW's AHIMS and AHIMS numbers have assigned. Refer to Section 6.2.2 of Appendix 4.

The management recommendations in the following section have been formulated with consideration of the significance of Aboriginal heritage, as well as, potential impacts and have been prepared in accordance with the relevant legislation.

Table 9-9 Summary of potential impacts, risks to heritage and mitigation options

Potential Impact	Risk to Heritage	Mitigation
Construction of Access Tracks and Plant/vehicle impact	Disturbance/damage to Scarred trees (RPS WR01A, RPS WR01B and RPS WR04)	A 30m buffer should be placed around these sites and during construction works this buffer zone should be demarcated by temporary fencing

9.4.4 Mitigation Measures

The mitigation measures for the management of identified heritage sites within the study area are:

1. A 30m buffer zone would be maintained around scarred tree sites and demarcated by temporary fencing during construction and associated plant movement.
2. The locations of the other sites identified should be outlined within Epuron's environmental management system to ensure their conservation
3. All relevant staff and contractors should be made aware of their statutory obligations for heritage under NSW NPW Act (1974) and the NSW Heritage Act (1977), which may be implemented as a heritage induction.
4. If additional Aboriginal site/s or non-Indigenous heritage items are identified in the study area pre-construction or during, then all works in the area should cease, the area cordoned off and contact made with a suitably qualified archaeologist and the relevant Aboriginal stakeholders, so that it can be adequately assessed and managed.
5. In the unlikely event that skeletal remains are identified, work must cease immediately in the vicinity of the remains and the area cordoned off. The proponent will need to contact the NSW Police Coroner to determine if the material is of Aboriginal origin. If determined to be Aboriginal, the proponent, must contact a suitably qualified archaeologist and representatives of the local Aboriginal Community Stakeholders to determine an action plan for the management of the skeletal remains, formulate management recommendations and to ascertain when work can recommence.

10 Health, Safety & Additional Issues

10.1 Aviation

10.1.1 Background

The proposed development of the White Rock Wind Farm would involve the construction of wind turbines with a maximum height of up to 150 meters to the blade tip. Due to the height of the wind turbines, potential impacts to the safety of aviation activities have been assessed. This includes:

- Identifying nearby aerodromes and landing strips;
- Consultation with aviation authorities and associations; and
- Assessing the risk to aerial agricultural activities.

10.1.2 Existing Environment

Aerodromes

The closest aerodromes to the proposed wind farm site are Glen Innes, Inverell and Armidale airports. The wind farm site is approximately 24km to the south west of Glen Innes airport which does not use instrument landings. The wind farm is approximately 40km to the east of Inverell airport and 75km to the north of Armidale airport. The Civil Aviation Safety Authority (CASA) has advised that there are no regulated aerodromes closer to the proposed wind farm site than these airports.

CASA uses a term called Obstacle Limitation Surfaces (OLS) to manage the area around an aerodrome. An OLS is a series of surfaces that define the limits to which objects may project into the airspace, and above which, become obstacles to aircraft operations and must be reported to CASA. CASA has advised that OLS extend out to a distance of 15km from an aerodrome and as such the project is outside the OLS of any CASA regulated aerodrome. The location of these airports in relation to the project is presented in Figure 10-1.

Landing Strips

Six private landing strips (known as Aircraft Landing Areas or ALAs) have been identified on private properties within 5km of the project, which have historically been used for aerial agriculture. The majority of these landing strips are on properties associated with the project. ALAs are not registered or regulated by CASA. Locations of the landing strips are shown in Table 10-1 and Figure 10-2.

Table 10-1 Location of existing landing strips

Ref	Location		Distance from wind farm	Orientation
	Easting	Northing		
15	360538	6705685	1.2 km	NNE
14	363442	6703037	1.7 km	N
13	369349	6699030	2.3 km	NNE
4	356401	6689763	4.6 km	NNE
9	363573	6691787	1.1 km	NNE
22	368110	6695120	1.1 km	NNE

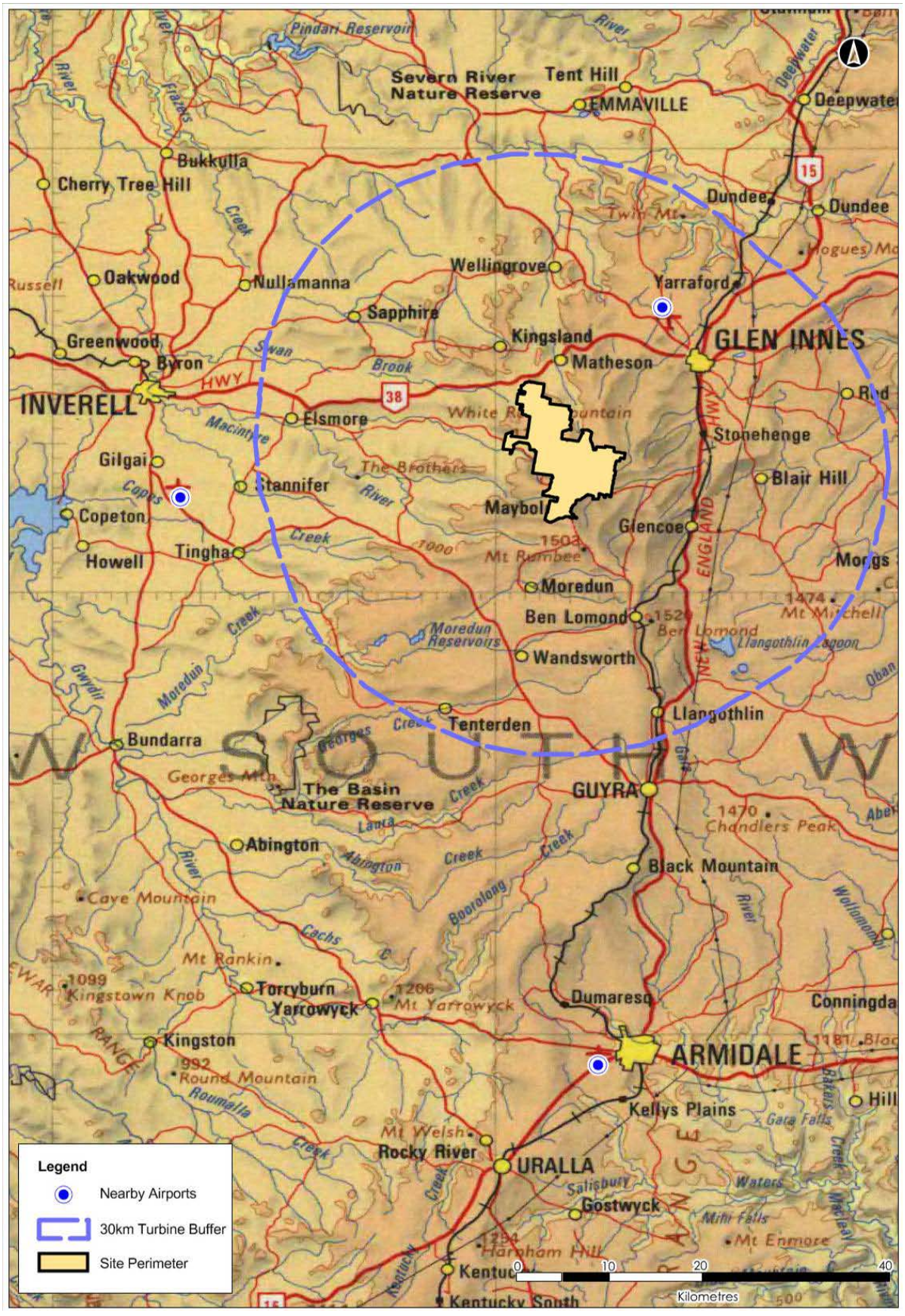

Figure 10-1 Aerodromes within vicinity of the proposed wind farm

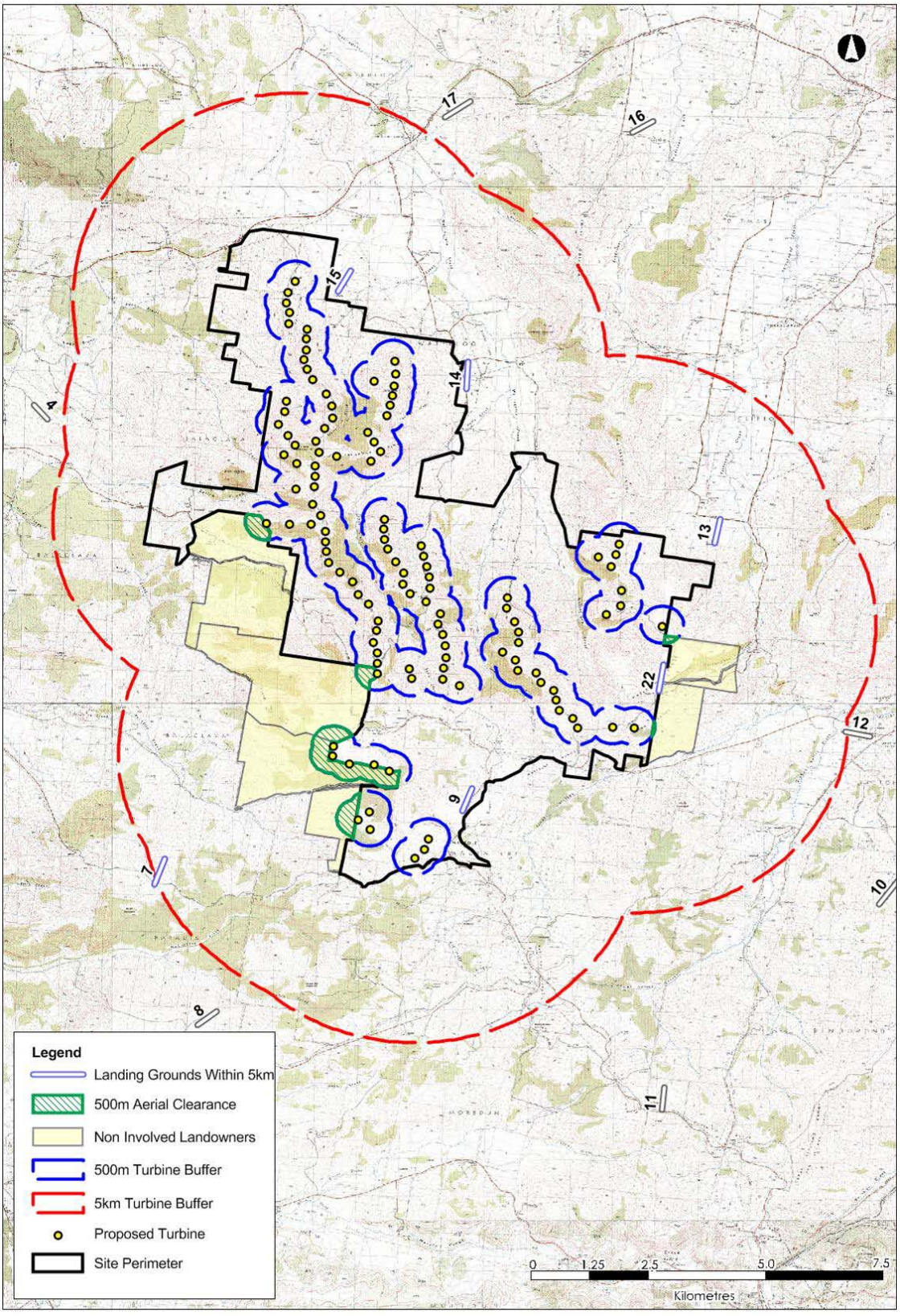

Figure 10-2 Landing strips within 5km of a turbine

10.1.3 Consultation

Epuron has consulted with the Glen Innes Severn Shire Council, Civil Aviation Safety Authority (CASA), Airservices Australia (AA), Aerial Agricultural Association of Australia (AAAA) and the Department of Defence in relation to the project.

On 16 August 2010 Epuron wrote to the operator of Glen Innes airport, Glen Innes Severn Council, in relation to the project. No concerns have been raised by the council in relation to the development of the project in terms of air safety.

On 16 August Epuron wrote to the Department of Defence in relation to the project. The Department of Defence is responsible for ensuring that new developments would not conflict with existing military aircraft operations, radio communications and the operation of navigational aids and radars. No concerns have been raised in relation to the project.

On 16 August 2010 Epuron wrote to CASA in relation to the project. CASA is an independent statutory authority whose primary function is to conduct the safety regulation of civil air operations in Australia.

Due to the height of the proposed turbines (greater than 110m), notification to CASA is required in accordance with the C*ivil Aviation Safety Regulations 1998 (CASR)* Part 139, Subpart 139E Obstacles and hazards.

CASA previously recommended that obstacle lighting be provided as per section 5.5 of *Advisory Circular 139-18(0) - Obstacle Marking and Lighting of Wind Farms*, however this Advisory Circular was withdrawn in September 2008. The withdrawn Circular defined the interval between turbines and obstacle beacons should not exceed 900m.

Since the withdrawal of the Advisory Circular in 2008 there have been no updated recommendations and as such there are currently no CASA guidelines to conform to in relation to obstacle marking of wind farms. CASA has indicated that they are reviewing their position and it appears likely that CASA will align their advice with international guidelines.

Epuron provided Airservices Australia (AA) with details of the project on 13th August 2010. AA is responsible for air traffic management and has the expertise to assess the potential impacts of wind farm proposals on precision / non precision navigational aids, HF/VHF communications, radar and satellite links in the area. AA is also able to provide advice on whether the project would impact Lowest Safe Altitudes (LSALTs). At the time of writing, a response had not been received from AA.

Epuron wrote to and met with a representative from one of the region's largest aerial agriculture operators, Superair Australia, who operate out of Armidale aerodrome. Superair Australia raised concerns that wind farms in general may impact the company's aerial top dressing operations. Superair Australia advised that they are unable to assess and confirm the impact until after the wind farm has been constructed.

The AAAAs formal policy position on all wind farm developments and wind monitoring towers is to automatically oppose such developments, unless the developer is able to clearly demonstrate they have openly and honestly consulted local aerial operators, sought independent expert opinion, ensured no long or short term effect on safety standards and provided a legally binding agreement for compensation for loss of income (AAAA, 2009).

10.1.4 Assessment

Aerodromes

After consultation with CASA regarding regulated aerodromes, the proposed wind farm site is considered to be a sufficient distance away from these airfields (aerodromes) as all proposed turbine locations are outside of the maximum distance (15km) of any existing OLS. Consequently it would not affect their operations and no further assessment is considered necessary in relation to these regulated aerodromes.

Landing Strips

Six landing strips have been identified within 5 kilometres of the proposed development, four of which are within 2km. These strips are classed as "Aeroplane Landing Areas" by CASA in accordance with Civil Aviation Safety Regulations Part 139.

CASA guidelines for these landing strips are contained in their *Civil Aviation Advisory Publication 92-1 (1) - Guidelines for Aeroplane Landing Areas* (CAA, 1992). The publication contains physical characteristics that define the 'surfaces' which should be clear from obstacles around the runway approaches. These characteristics are shown in Figure 10-3 for day operations.

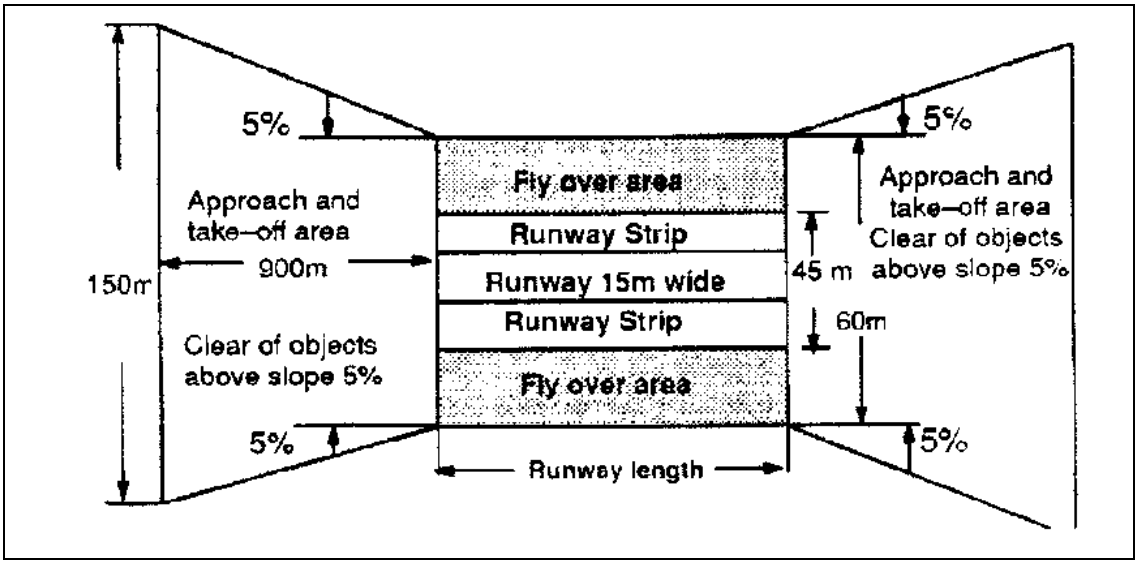

Figure 10-3 CASA's guideline for characteristics of an Aeroplane Landing Area

A zone extending 900 metres from the approach and take off area is required to be free from obstacles at an angle of 5% extending out from the end of the runway.

The project does not encroach on any of the existing landing areas with the closest turbine being 1.1km from landing strip No. 22. Figure 10-4 demonstrates that the clearances are in excess of the CASA guidelines for landing strip No. 22, which is 1.1km from the proposed turbines and is located on land associated with the project.

As these private airstrips rely on visual rather than instrument based landing techniques, and as the turbines being highly visible, it is unlikely that the proposed development would pose any additional hazard to users of these airstrips. It is expected that pilots will continue to use the local landing strips.

Figure 10-4 CASA guidelines for local landing strip No. 22

Aerial Agriculture

The Proponent acknowledges that the wind farm will impact aerial spreading in the area immediately adjacent to the turbine locations. Accordingly, should spreading of fertilisers be required in this vicinity, ground based methods will need to be considered, potentially at a higher cost.

A report conducted by the Ambidji Group Pty Ltd for the Berrybank Wind Farm (Foster, 2010) concluded that a buffer zone of 500m should be applied when planning aerial spreading in the close proximity to an installed wind farm. This would mean that more time would be required in the pre-planning process as the approach may need to be varied to avoid turbines. The report states:

> *A standard agricultural aircraft loaded to maximum capacity takes approximately 500 metres to complete this turn. This would have an impact on the direction at which some of the spraying operations would need to be conducted. A distance of 500 metres from the nearest turbines would be required as a buffer zone for this operation.*

This report therefore assumes that aerial spreading would impact the area within 500m from a constructed turbine.

Figure 10-2 shows a 500m buffer from the currently proposed turbines in relation to non-involved properties surrounding the site. The total affected area, as a result of this buffer zone, is relatively small and in some case covers areas that are heavily vegetated and would not be suitable for aerial agriculture.

Although the project will have some impact on the operations of aerial agriculture on these properties, alternate spreading methods are available.

Lighting

Due to the significant physical separation between the wind farm and the closest airports, the fact that the overall wind turbine height will be below the lowest safe altitude for aviation and consideration of general community views on turbine obstacle lighting at night being visually intrusive, it is not considered appropriate to install obstacle lighting on turbines at the White Rock wind farm site. The use of private landing strips is restricted to daytime operation and hence there would be no reason to install obstacle lighting for private aviation purposes.

Accordingly, the Proponent would only install obstacle lighting if required to do so by CASA, and to the extent required by CASA.

It should also be noted that the night time lighting installed on the Cullerin Wind Farm has been decommissioned by Origin Energy following a risk based aviation assessment. A number of recent wind farm developments in New South Wales have been approved without requirement for night time lighting, including the Gullen Range and Glen Innes wind farms.

10.1.5 Mitigation Measures

- Liaise with all relevant authorities (CASA, Airservices, and Department of Defence) as well as the operators of local airports and airstrips, and local aerial agriculture contractors and the AAAA, and supply location and height details once the final details of the wind turbines have been determined and before construction commences.
- Comply with any requirements of CASA in relation to obstacle marking of wind turbines, and would not otherwise install obstacle beacons on any wind turbine.